

OCR GCSE GATEWAY PHYSICS A • J249

# PHYSICS



**EXAM QUESTION PACK**

**M1 ARITHMETIC AND NUMERICAL COMPUTATION**

**SCORE**

**/139**

**PERCENTAGE**

**%**

**STEMUP**

# These questions belong to OCR, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by OCR. They are past assessment materials, reproduced here so that students can revise from them.

## What we do not own

STEMUP is not affiliated with OCR and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. OCR has not endorsed, approved or been involved in the production of it. OCR and the qualification titles used here belong to their respective owners and appear for identification only.

## Where to find the originals

OCR publishes its past papers, mark schemes and examiner reports. Always check the current specification at [ocr.org.uk](http://ocr.org.uk) before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact [admin@stemup.co.uk](mailto:admin@stemup.co.uk) and we will act on it.

# Gateway Physics A (9-1)

## Maths 1: Arithmetic and numerical computation

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

**OCR supplied materials:**

Additional resources may be supplied with this paper.

**Other materials required:**

- Pencil
- Ruler (cm/mm)

**Duration:** Not set

|                       |  |                      |  |  |  |                  |  |  |  |  |
|-----------------------|--|----------------------|--|--|--|------------------|--|--|--|--|
| Candidate<br>forename |  | Candidate<br>surname |  |  |  |                  |  |  |  |  |
| Centre number         |  |                      |  |  |  | Candidate number |  |  |  |  |

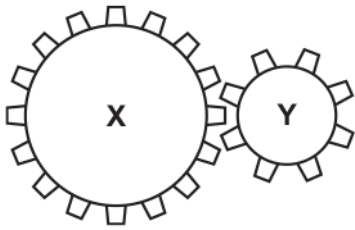
## INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

## INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **139**.
- The total number of marks may take into account some 'either/or' question choices.

- 1 Cog X has 16 teeth and cog Y has 8 teeth.



Cog X is turned around **two** times.

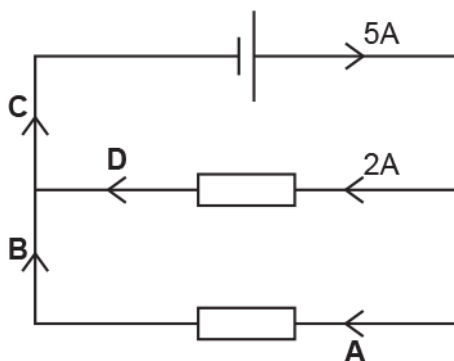
How many times does cog Y turn around?

- A 1
- B 2
- C 4
- D 8

Your answer

[1]

- 2 This is a circuit.



Which letter A, B, C or D shows the part of the circuit that carries a current of 2 A?

Your answer

[1]

3 These statements are about pressure and volume of a gas.

Which statement is correct?

- A Volume doubles, pressure doubles
- B Volume doubles, pressure halves
- C Volume halves, pressure halves
- D Volume halves, pressure stays constant

Your answer

[1]

4

| Student | Race distance (m) | Time (s) |
|---------|-------------------|----------|
| A       | 50                | 6        |
| B       | 100               | 15       |
| C       | 100               | 14       |
| D       | 200               | 31       |

Use the information in the table to **describe** and **compare** the motion of the four students.

Use the data in your answer.

[6]

5 Which distances are the **same**?

A  $1 \times 10^{-3}$  m and 1  $\mu$ m

B  $1 \times 10^{-6}$  m and 1 mm

C  $1 \times 10^{-9}$  m and 1 nm

D  $1 \times 10^{-12}$  m and 1 Gm

Your answer

[1]

6 A student uses four electrical appliances for different lengths of time.

Look at the table.

| Appliance  | Power (W) | Time used (hours) |
|------------|-----------|-------------------|
| Hair dryer | 1500      | 0.3               |
| TV         | 100       | 5                 |
| Toaster    | 2000      | 0.2               |
| Light bulb | 10        | 12                |

(i) Which appliance uses the **most** energy?

-----[1]

(ii) Which appliance uses the **least** energy?

-----[1]

7 An object moved 20 cm with a force of 20 N.

Use the equation: work done = force  $\times$  distance

Which is the correct calculation of work done?

A 0.4 J

B 4.0 J

C 40 J

D 400 J

Your answer

[1]

8 A presenter on a car TV programme says:

“The car maker has reduced the mass of this car and it now has better acceleration.”

(i) Explain why the presenter is correct.

-----

-----

----- [2]

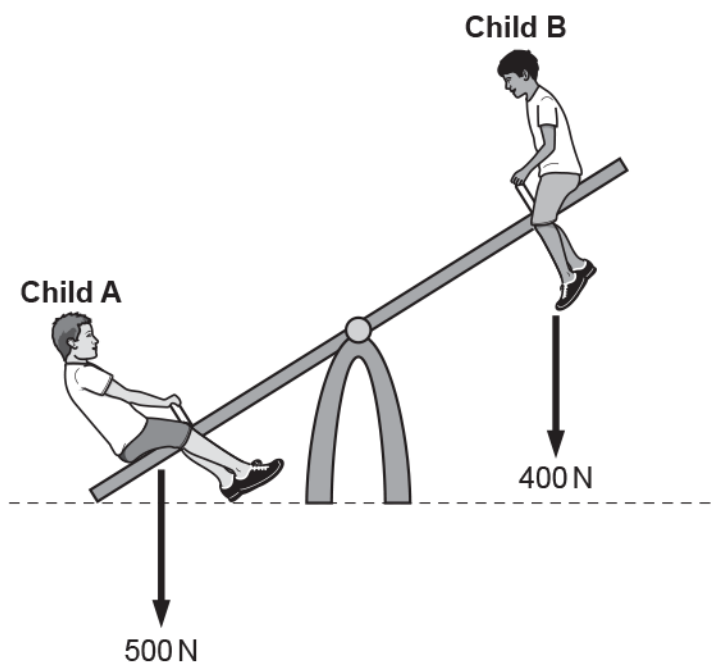
(ii) A car accelerates from 5 m/s to 25 m/s in 4 seconds.

Calculate the acceleration of the car.

Use the equation: Acceleration = Change in speed ÷ Time taken

Answer = ..... m/s<sup>2</sup> [3]

9(a) Two children play on a seesaw.



Both children sit 2 m from the pivot.

Calculate the clockwise and anti-clockwise moments around the pivot when the seesaw is horizontal.

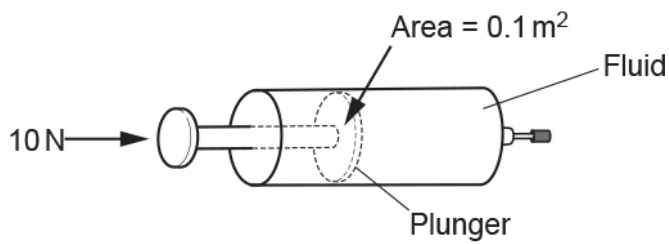
Clockwise moment = ..... Nm

Anti-clockwise moment = ..... Nm  
[3]

Calculate where **Child A** should sit to balance the seesaw.

Answer = ..... [3]

(b) A student tries to compress the fluid in a sealed syringe with a force of 10 N.



The area of the end of the syringe is  $0.1 \text{ m}^2$ .

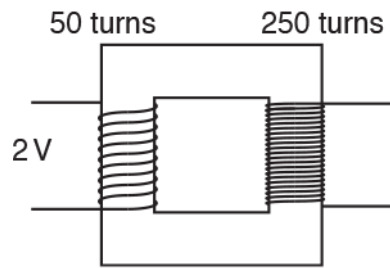
(i) Calculate the pressure in the fluid.

Answer = ..... Pa [3]

(ii) Write down the direction of the force produced by the fluid on the plunger.

----- [1]

10 What output voltage does the transformer produce?



A 0.2 V

B 0.4 V

C 5 V

D 10 V

Your answer

[1]

- (i) Write down the conditions needed for charge to flow through a conductor.

-----

----- [2]

- (ii) Calculate the charge that flows past a point in a circuit with a 5.0 A current for five minutes.

Answer = ..... C [4]

- 12 An adult on a bicycle travels at 8 m/s on a level road. She sees a hazard and applies her brakes using full force.

Estimate the force of the brakes.

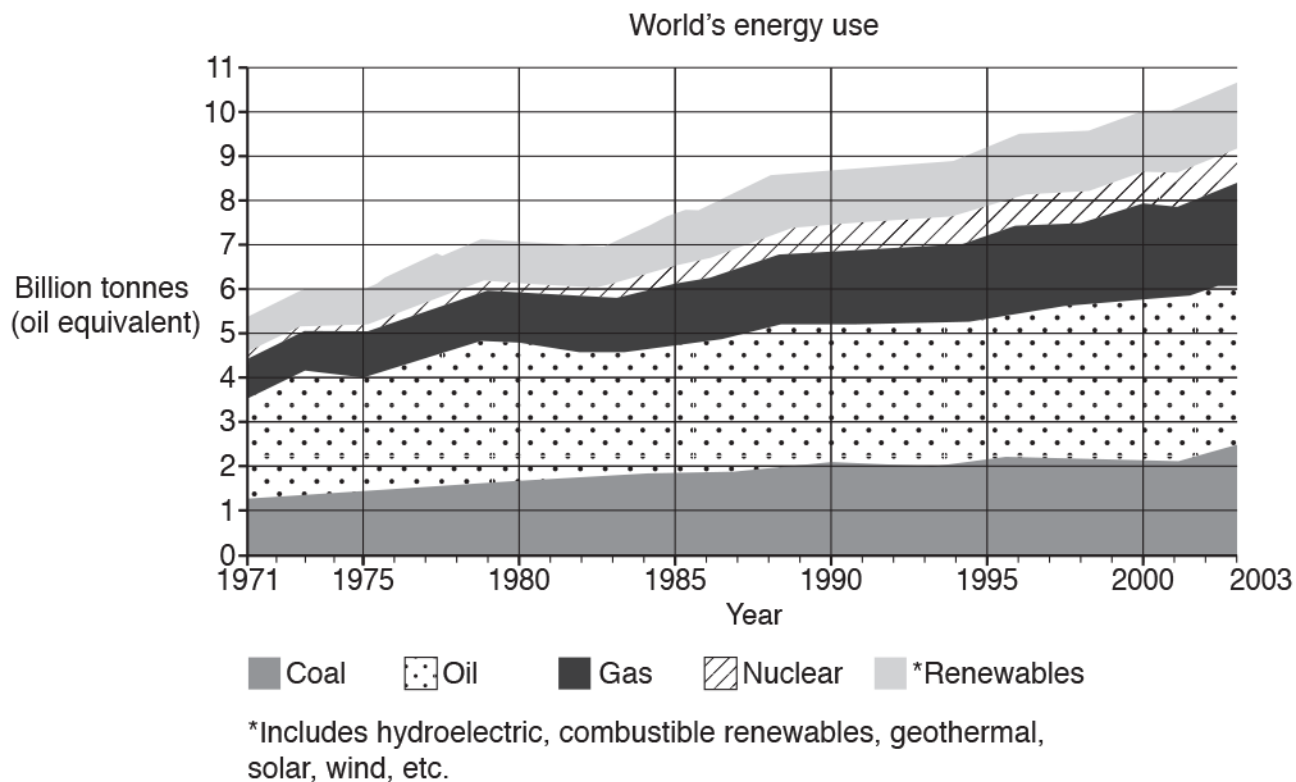
- A 5 N
- B 50 N
- C 500 N
- D 5000 N

Your answer

[1]

13(a) The graph shows how the World's energy use has changed from the year 1971 to the year 2003.

It also shows the amount of different energy sources used.



(i) Approximately how much did the total World's energy use increase from the year 1971 to the year 2003?

Answer = ..... billion tonnes (oil equivalent) [1]

(ii) Which energy source had the **greatest** use in the year 2003?

..... [1]

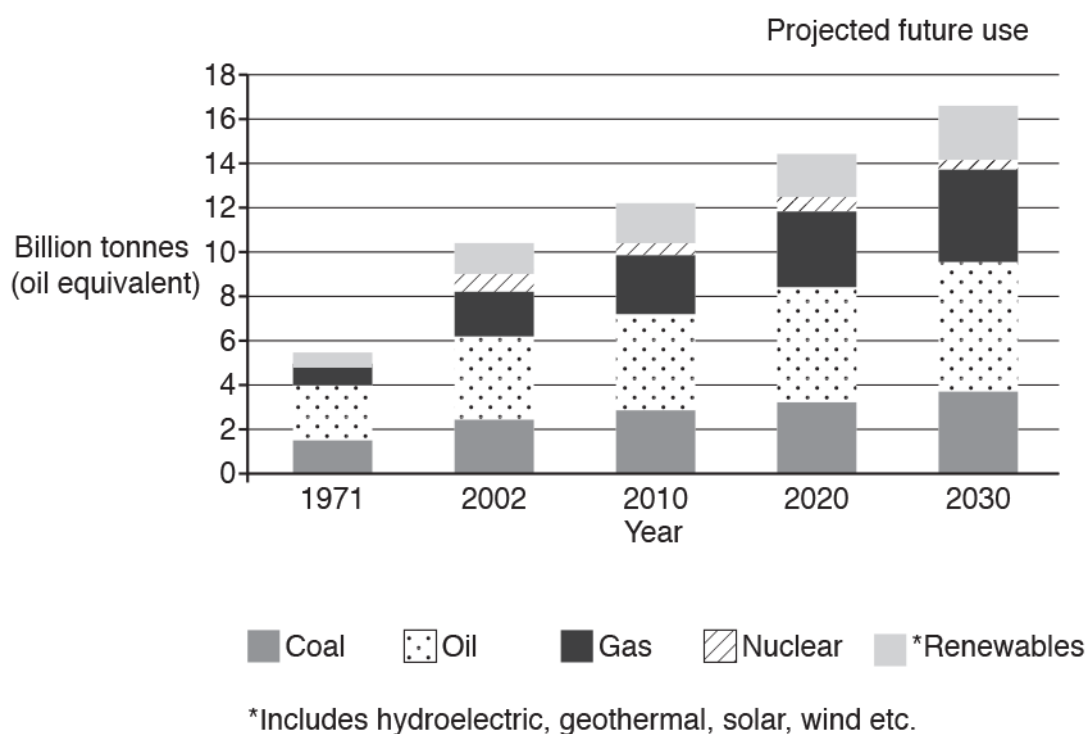
(iii) The total energy use in the year 2003 was 10.6 billion tonnes (oil equivalent).

Approximately what percentage of this amount was due to fossil fuel use?

Answer = ..... % [2]

(b) Scientists are researching the World's energy use for the future.

The graph shows some of their research.



(i) The future demand for fossil fuels is expected to increase.

Give two reasons why scientists are worried about this increase in demand.

1 .....

.....

2 -----  
-----

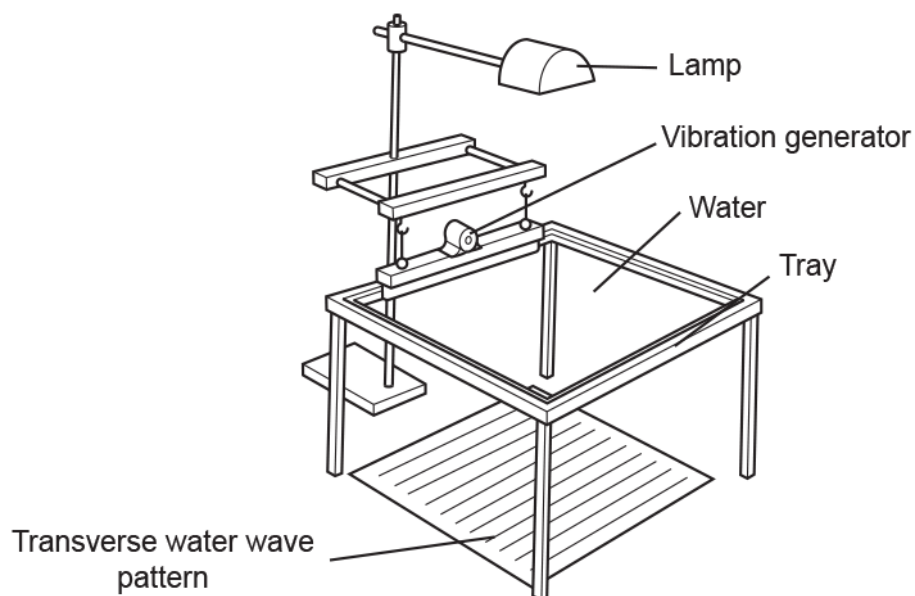
[2]

- (ii) In the UK the government is closing coal fired power stations and planning for new nuclear power stations to be built.

Suggest why the government wants more nuclear power stations.

-----  
-----  
----- [2]

- 14 A teacher uses water waves in a ripple tank to demonstrate **transverse** waves.



She makes measurements of the water waves.

The frequency of the water waves is 0.5 Hz.

- (i) Calculate the number of water waves produced in 5 seconds.

Answer = ..... [1]

- (ii) The teacher **increases** the frequency of the water waves.

Describe what happens to the speed **and** the wavelength of the water waves.

.....

.....

..... [2]

- (iii) A student tries to describe water waves in the sea.

'The water waves move up and down. The water particles move all the way across the surface of the sea. This means that water moves in the direction of the waves.'

Part of his explanation is **incorrect**.

Write an improved and correct description about water waves in the sea.

.....

.....

..... [2]

15(a) A scientist uses different drivers to test the stopping distances of the same car.

Look at the results.

| Driver | Speed<br>(m/s) | Thinking distance<br>(m) | Braking distance<br>(m) |
|--------|----------------|--------------------------|-------------------------|
| A      | 8              | 6                        | 6                       |
| B      | 16             | 13                       | 24                      |
| C      | 32             | 24                       | 96                      |
| D      | 16             | 12                       | 22                      |
| E      | 8              | 5                        | 6                       |
| F      | 32             | 30                       | 120                     |

Driver **B** travels at 16 m/s on the road. The thinking distance is 13 m and the braking distance is 24 m.

Driver **B** now drives the car **uphill** at the same speed on the same road.

How will driving the car **uphill** affect thinking, braking and stopping distances?

The reaction time will stay the same.

Complete the sentences.

The **thinking distance** will -----

The **braking distance** will -----

The **stopping distance** will -----

[2]

(b) Give two drivers that have the **same** reaction time.

Drivers ..... have the **same** reaction time.

Explain your answer.

-----

-----

----- [2]

16 A wooden block has a mass of 2 kg and a specific heat capacity of 2000 J/kg °C.

Calculate the energy needed to raise its temperature by 6 °C.

Use the equation:

Change in thermal energy = Mass × Specific Heat Capacity × Change in Temperature

A 1 200 J

B 2 400 J

C 12 000 J

D 24 000 J

Your answer

[1]

17(a) Fig. 20.1 shows thinking, braking and stopping distances for the same car travelling at different speeds.

| Speed<br>(m/s) | Thinking distance<br>(m) | Braking distance<br>(m) | Stopping distance<br>(m) |
|----------------|--------------------------|-------------------------|--------------------------|
| 8              | 6                        | 6                       | 12                       |
| 16             | 12                       | 24                      | 36                       |
| 32             | 24                       | 96                      | 120                      |

Fig. 20.1

Describe how the **thinking distance** changes when the speed doubles.

Use data from the table in your answer.

-----

-----

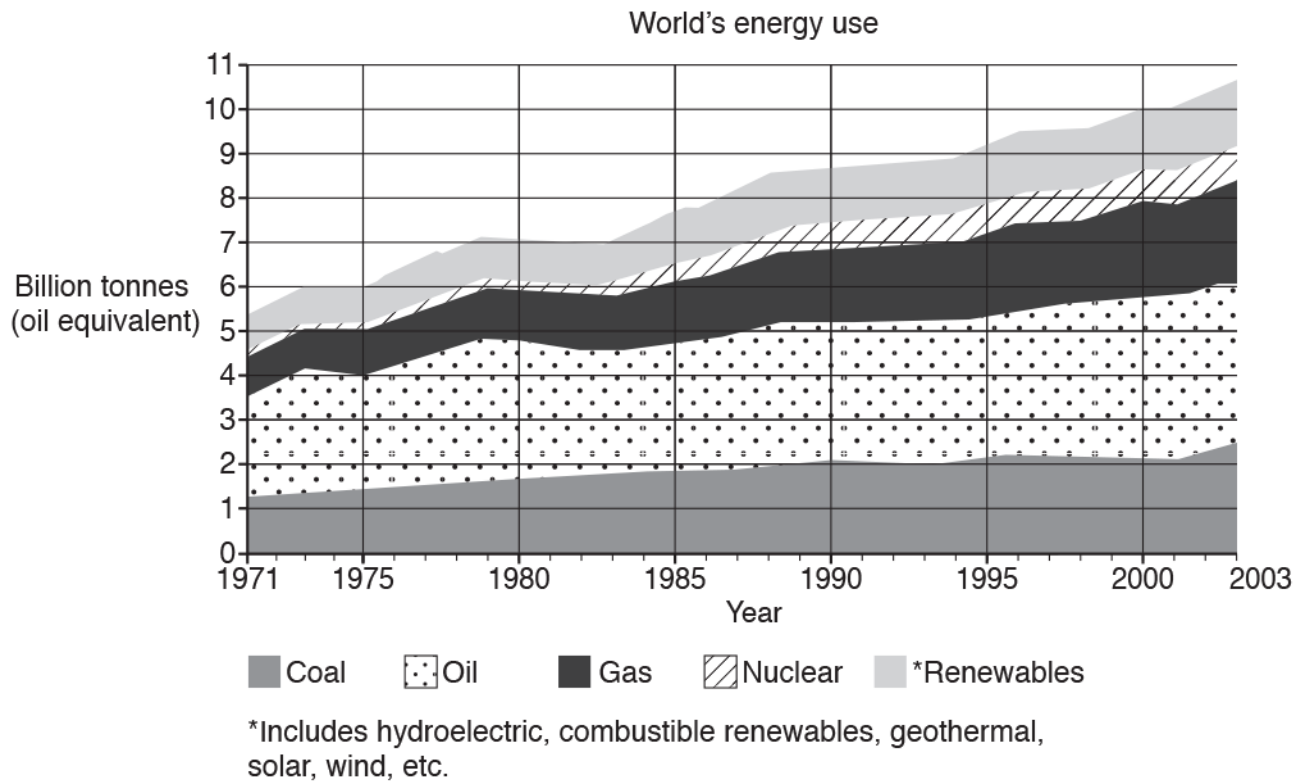
-----[1]

(b) Calculate the reaction time of the person driving the car.

Answer = ----- s [3]

18(a) The graph shows how the World's energy use has changed from the year 1971 to the year 2003.

It also shows the amount of different energy sources used.



(i) Approximately how much did the total World's energy use increase from the year 1971 to the year 2003?

Answer = ..... billion tonnes (oil equivalent) [1]

(ii) Which energy source had the **greatest** use in the year 2003?

..... [1]

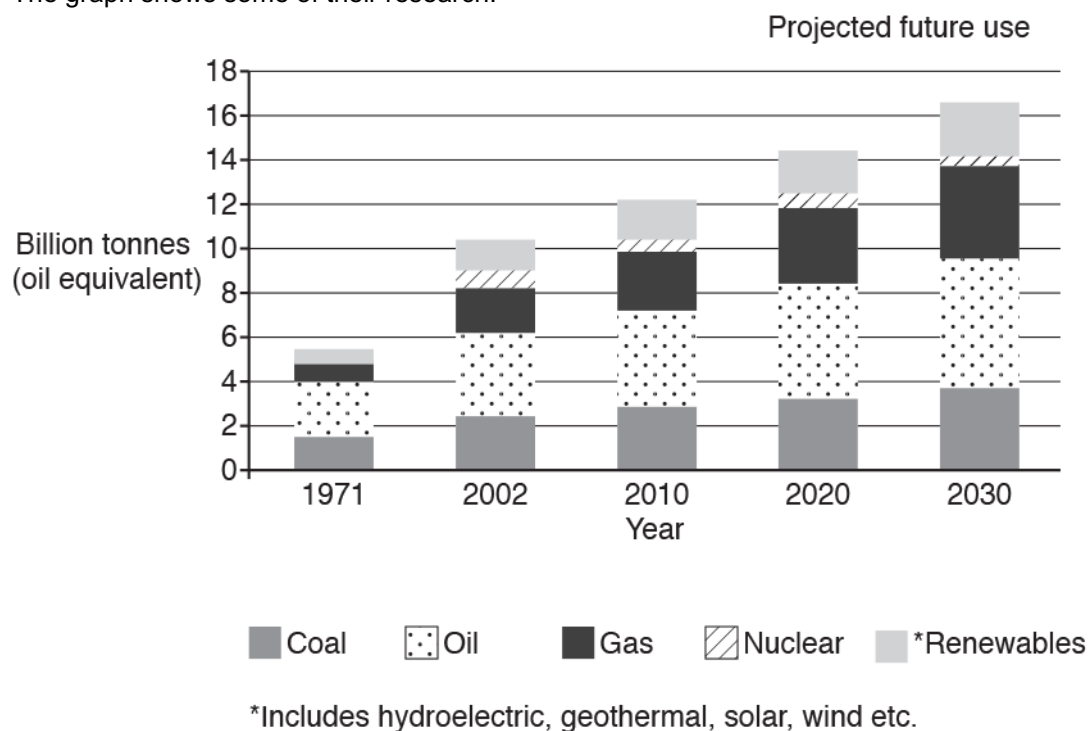
(iii) The total energy use in the year 2003 was 10.6 billion tonnes (oil equivalent).

Approximately what percentage of this amount was due to fossil fuel use?

Answer = ..... % [2]

(b) Scientists are researching the World's energy use for the future.

The graph shows some of their research.



(i) The future demand for fossil fuels is expected to increase.

Give two reasons why scientists are worried about this increase in demand.

1. ....

.....

2.

[2]

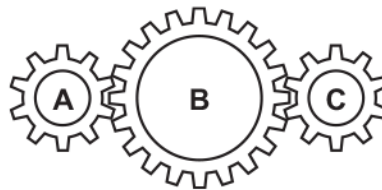
- (ii) In the UK the government is closing coal fired power stations and planning for new nuclear power stations to be built.

Suggest why the government wants more nuclear power stations.

[2]

- 19 A student investigates cogs and gears.

Cog A and C have 10 teeth. Cog B has 20 teeth.



Cog A is turned 5 times.

How many times does cog C turn?

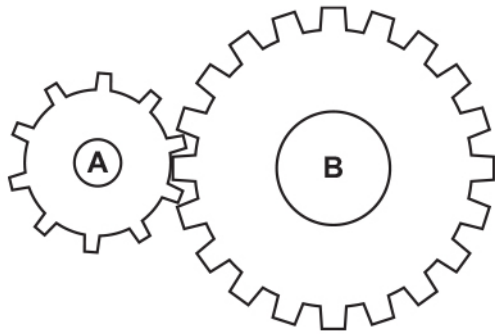
- A 5 times
- B 10 times
- C 20 times
- D 50 times

Your answer

[1]

20 A student sets up two cogs.

Cog A has 10 teeth and cog B has 20 teeth.



Cog A is turned 2 times.

How many times does cog B turn?

A 0.5 times

B 1 time

C 2 times

D 20 times

Your answer

[1]

21 A car travels at a speed of 60 mph (miles per hour).

1 mph = 0.45 m / s.

Convert 60 mph into m / s (metres per second).

A 0.45 m / s

B 7.5 m / s

C 27 m / s

D 130 m / s

Your answer

[1]

22 The table shows the current and potential difference for four different lamps.

Which lamp has the highest **power**?

Use the equation: power = potential difference  $\times$  current

|   | Current (A) | Potential difference (V) |
|---|-------------|--------------------------|
| A | 2           | 5                        |
| B | 3           | 4                        |
| C | 4           | 2                        |
| D | 5           | 1                        |

Your answer

[1]

23 The kinetic energy of motorbike X is 10 kJ.

Motorbike Y has the same speed but double the mass.

What is the kinetic energy of motorbike Y?

Use the equation: kinetic energy =  $0.5 \times \text{mass} \times (\text{speed})^2$

- A 5 kJ
- B 10 kJ
- C 20 kJ
- D 40 kJ

Your answer

[1]

24 What is the change in pressure when a diver moves from a depth of 3.0 m to a depth of 8.0 m?

Assume gravitational field strength on Earth = 10 N / kg and water density = 1000 kg / m<sup>3</sup>.

Use an equation from the data sheet to help you.

- A 30 000 Pa
- B 50 000 Pa
- C 80 000 Pa
- D 110 000 Pa

Your answer

[1]

25 A student uses 2250 J of energy climbing up steps. It takes the student 15 seconds to climb the steps.

Calculate the power of the student.

Use the equation: power = work done ÷ time taken

- A 15 W
- B 150 W
- C 9000 W
- D 33750 W

Your answer

[1]

26 An astronaut on the Moon lifts a 5.5 kg object a vertical distance of 50 cm.

Calculate the potential energy gained by the object.

Gravitational field strength on the Moon = 1.6 N / kg.

- A 4.4 J
- B 8.8 J
- C 17.6 J
- D 440 J

Your answer

[1]

27(a) A student investigates static electricity using a plastic ruler.

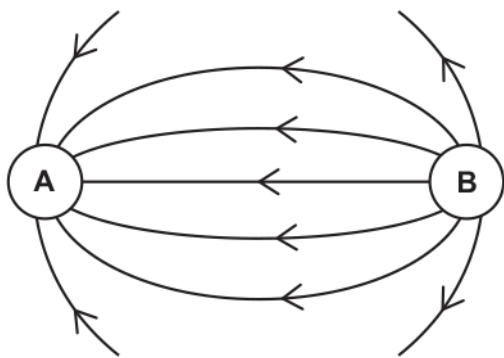
(i) Explain in terms of electrons why the plastic ruler is not normally charged.

[2]

(ii) Explain in terms of electrons why the ruler becomes charged when the student rubs it with a cloth.

[2]

(b) The diagram shows the electric field between two charges, **A** and **B**.



(i) State the charges of **A** and **B**.

Use the diagram to explain your answer.

-----

-----

-----

----- [3]

(ii) Describe **one** similarity between the electric field line diagram and a magnetic field line diagram.

-----

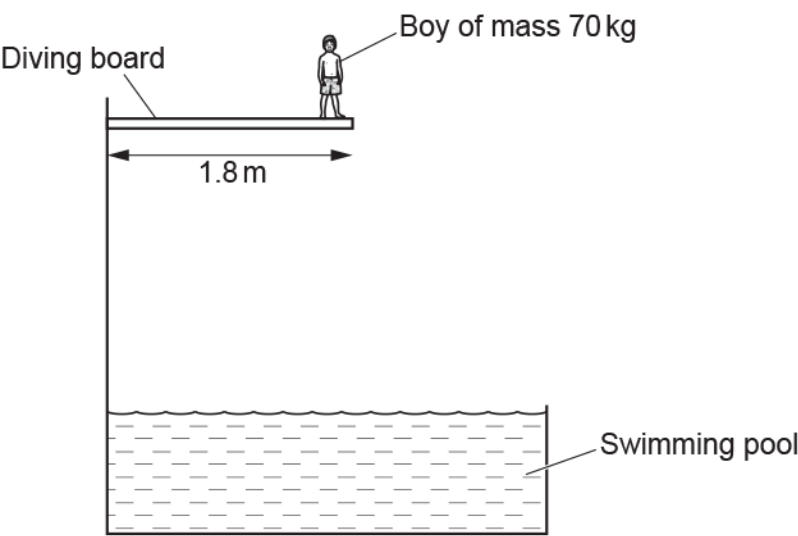
----- [1]

(c) Calculate the charge when 200 J of energy is transferred with a potential difference of 40 V.

Use the equation: energy transferred = charge  $\times$  potential difference

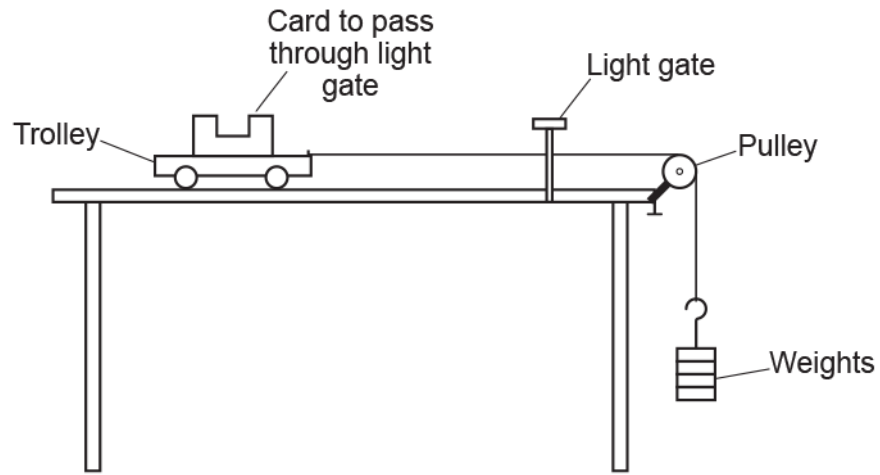
Charge = ..... C [3]

28 A boy of mass 70 kg stands on the end of a diving board at a distance of 1.8 m from the wall.



Calculate the moment of the boy standing on the diving board.  
Gravitational field strength on Earth = 10 N / kg.

Moment = ..... N m [4]



The trolley is released from a fixed position and accelerates.

- (i) Describe the energy transfer as the trolley accelerates on the desk.

-----

----- [1]

- (ii) The trolley moves a distance of 86 cm along the desk.

Calculate the work done when a force of 3.0 N is applied.

Use the equation: work done = force  $\times$  distance

Give your answer to 2 significant figures.

Work done = ..... J [4]

This question is about an electric kettle.

- (i) An electric kettle is filled with water, connected to the mains and switched on. The electricity for the kettle is generated in a coal-fired power station. Describe the energy transfer that occurs when the kettle is switched on. Include ideas about energy stores in your answer.

-----

-----

----- [2]

- (ii) The mains supply has a potential difference of 230 V.

The kettle has a current of 5.0 A. The kettle is switched on for 2.0 minutes.

Calculate the total energy transferred to the kettle in 2.0 minutes.

Total energy transferred = ..... J [4]

- 31(a) Edwin Hubble discovered that all distant galaxies were moving away from the Earth.

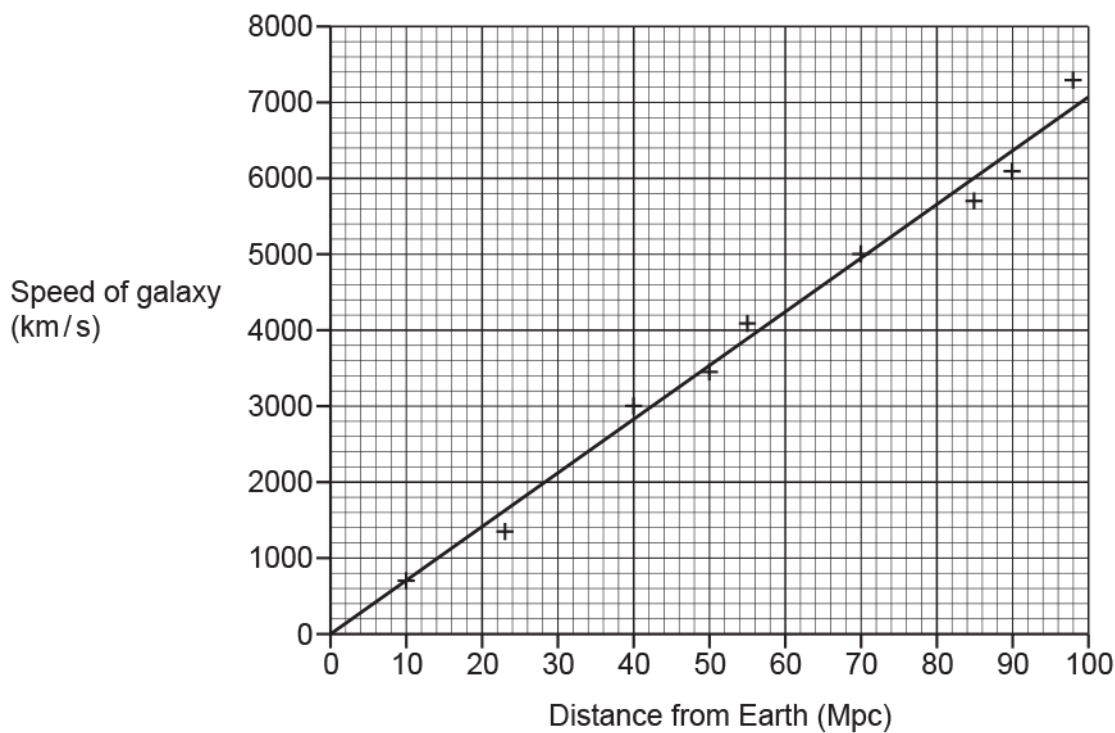
Explain how he could tell that all distant galaxies were moving away from the Earth.

-----

-----

----- [2]

(b) This graph shows how the speed of a galaxy changes with distance from the Earth.



(i) Use data from the graph to show that the speed of the galaxy is proportional to the distance from the Earth.

-----

-----

-----

-----

[2]

(ii) Explain how data from the graph provides evidence for the Big-Bang.

-----

-----

-----

[1]

(c) Before Edwin Hubble could publish his results, his work was peer reviewed.

Suggest why peer review is important.

-----

----- [1]

(d) The parsec (pc) is a unit used for measuring large distances in the Universe.

(i) A galaxy is at a distance of 82 Mpc from the Earth.

Use the graph to determine the speed of this galaxy.

Give your answer in metres per second (m / s).

Speed = ..... m / s [2]

(ii) Calculate the time it takes for the galaxy to travel  $2.53 \times 10^{24}$  m.

Use your answer to (i) to help you.

Time = ..... s [3]

- 32 A cyclist travels 750 m in 50 seconds.

Calculate the speed of the cyclist.

Use the equation:  $\text{speed} = \text{distance} / \text{time}$

- A 0.015 m / s
- B 15 m / s
- C 37.5 m / s
- D 375 m / s

Your answer

[1]

- 33 On the Moon the gravitational field strength is 1.6 N / kg.

Calculate the gravity force for an 80 kg astronaut.

Use the equation:  $\text{gravity force} = \text{mass} \times \text{gravitational field strength}$

- A 50 N
- B 128 N
- C 800 N
- D 1280 N

Your answer

[1]

- 34 Calculate the charge flow when a current of 20 mA flows for 2000 s.

Use the equation:  $\text{charge flow} = \text{current} \times \text{time}$

- A 40 C
- B 100 C
- C 40 000 C
- D 100 000 C

Your answer

[1]

- 35 A student measures the weight of four boxes and the area in contact with the ground.

| Box | Weight (N) | Area (cm <sup>2</sup> ) |
|-----|------------|-------------------------|
| A   | 50         | 100                     |
| B   | 75         | 250                     |
| C   | 90         | 400                     |
| D   | 100        | 500                     |

Which box exerts the greatest pressure on the ground?

Your answer

[1]

- 36 Which item uses the most power?

Use the equation: power = potential difference × current

|   | Item         | Current (A) | Potential difference (V) |
|---|--------------|-------------|--------------------------|
| A | Calculator   | 0.1         | 3                        |
| B | Mobile Phone | 1.0         | 5                        |
| C | Radio        | 0.5         | 12                       |
| D | Torch        | 1.2         | 6                        |

Your answer

[1]

- 37 Energy is needed to change ice into water.

Calculate the energy needed to change 5 kg of ice into water.

Use an equation from the data sheet to help you.

Specific latent heat of melting =  $3.34 \times 10^5$  J / kg.

- A 16.7 J
- B 1670 J
- C 1 670 000 J
- D 1 670 000 000 J

Your answer

[1]

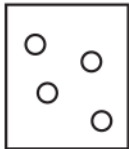
- (i) A swimming pool contains 9970 kg of water in  $10 \text{ m}^3$ .

Calculate the density of water.

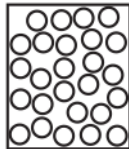
Use the equation: density = mass  $\div$  volume

Density = ..... kg /  $\text{m}^3$  [1]

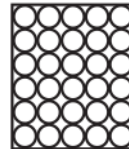
- (ii) The diagrams, A, B and C, show the particles in three states of matter.



**A**



**B**



**C**

Write the letters in the boxes to give the correct order of density, from **most** to **least** dense.

**Most dense** —————→ **Least dense**



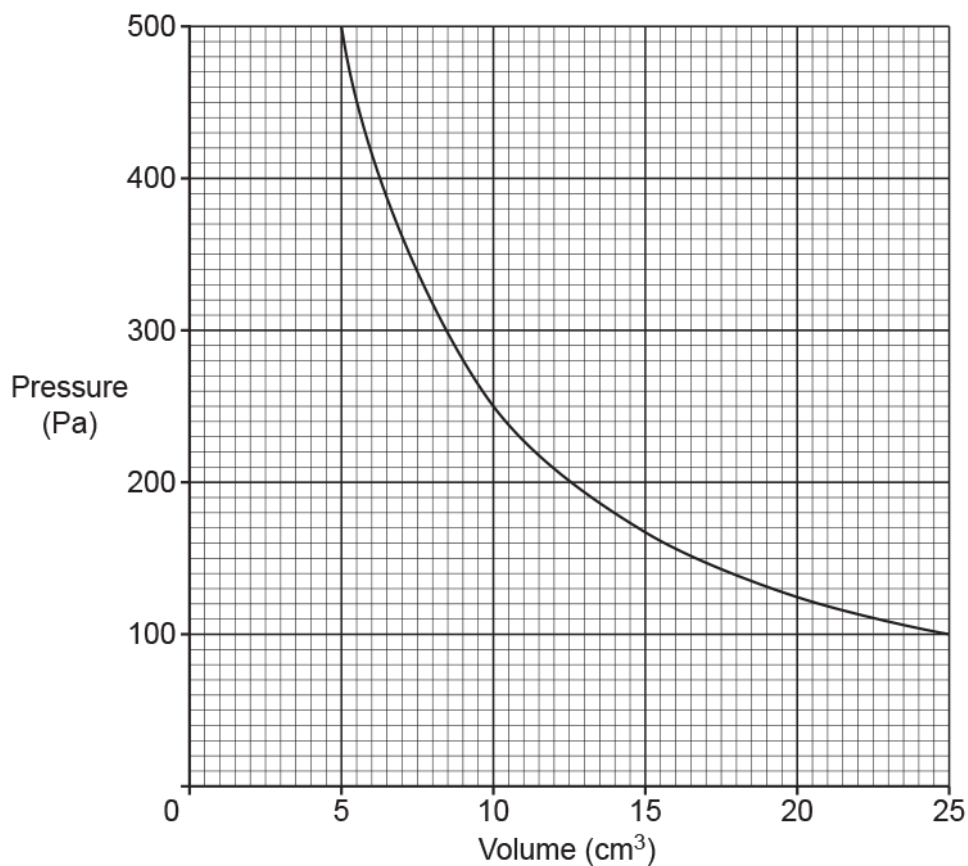
[1]

- (iii) Explain why you chose the order in (ii).

-----

----- [1]

- 39 A student investigates the link between the volume and pressure of a gas. The student uses a fixed mass of gas in a closed container. The student plots a graph of the results.



The student thinks that pressure multiplied by volume is always equal to the same number.

Explain why the student is correct.

Use data from the graph to support your answer.

---

---

---

[2]

40(a) The mass of a toy car is 5 kg and it has an acceleration of 4 m / s<sup>2</sup>.

(i) Calculate the force needed to accelerate the toy car.

Use the equation: force = mass × acceleration

Force = ..... N [2]

(ii) Suggest why the actual force needed would be more than in part (i).

----- [1]

(b)

- (i) A toy car requires a constant force of 30 N to move it along a surface.

Calculate the work done on the car when it moves a distance of 50 m.

Use the equation: work done = force  $\times$  distance

Work done = ..... J [2]

- (ii) Calculate the power output of this toy car if the work is done over 75 seconds.

Use your answer from (i).

Power = ..... W [3]

41(a) A student investigates how a spring stretches.

She measures the original length of the spring, adds a 2.0 N weight, and then measures the extended length of the spring.

Look at her data in the table.

|                 |        |
|-----------------|--------|
| Force used      | 2.0 N  |
| Original length | 3.0 cm |
| Extended length | 7.0 cm |
| Extension       | 4.0 cm |

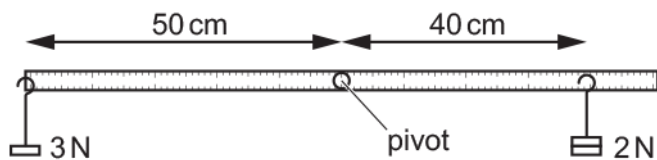
The spring constant of a different spring is 40 N / m.

Calculate the energy stored in the spring when it is stretched 0.20 m.

Use an equation from the data sheet to help you.

Energy stored = ..... J [4]

(b) The diagram shows an experiment a student set up to study moments.



The student:

- holds the metre rule so that it is horizontal
- adds weights to the metre rule at different distances from the pivot.

(i) Calculate the moments of the 2 N weight and the 3 N weight about the pivot.

Use the equation:  $\text{moment} = \text{force} \times \text{distance from pivot}$

Moment of 2 N weight = ..... N cm

Moment of 3 N weight = ..... N cm  
[2]

(ii) Which way will the metre rule rotate when it is released by the student?

..... [1]

42 Calculate the charge when 200 J of energy is transferred with a potential difference of 40 V.

Use the equation:  $\text{energy transferred} = \text{charge} \times \text{potential difference}$

Charge = ..... C [3]

END OF QUESTION PAPER

### Mark Scheme

| Question |  |  | Answer/Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Marks                                                           | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        |  |  | C ✓                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1<br>(AO2.2)                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|          |  |  | Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 2        |  |  | D ✓                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1<br>(AO2.1)                                                    | <b>Examiner's Comments</b><br><br>About two-thirds of the candidates got this question correct: the commonest wrong answer here was A, presumably looking at the symmetry in the bottom part of the diagram.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|          |  |  | Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 3        |  |  | B ✓                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1<br>(AO1.2)                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|          |  |  | Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 4        |  |  | <p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b><br/>Detailed description and comparison of the motion of all four students in terms of distance and time relating speed to distance run<br/><b>AND</b><br/>Calculates the speed of all four students.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b><br/>Description and comparison of the motion of three students of distance and time<br/><b>OR</b><br/>Calculates the speed of at least three students.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b><br/>Brief description of the motion of at least</p> | 6<br>(AO2 × 1.1)<br>(AO2 × 2.2)<br>(AO1 × 3.1a)<br>(AO1 × 3.2b) | <p><b>AO1.1 Demonstrate knowledge and understanding of the correct formulae</b></p> <ul style="list-style-type: none"> <li>• speed = distance ÷ time</li> <li>• <math>v = s \div t</math></li> <li>• evidence of calculation</li> </ul> <p><b>AO2.2 Apply knowledge and understanding of the motion of the four students</b></p> <ul style="list-style-type: none"> <li>• Race B is a longer distance than race A</li> <li>• Race B and C are the same distance</li> <li>• Students B &amp; C take different amounts of time</li> <li>• Student D takes the longest time</li> <li>• Race D is the longest distance</li> <li>• Race A is the shortest distance</li> <li>• Student A speed = <math>15 \div 6 = 8.3\text{m/s}</math></li> <li>• Student B speed = <math>100 \div 15 = 6.7\text{m/s}</math></li> <li>• Student C speed = <math>100 \div 14 = 7.1\text{m/s}</math></li> <li>• Student D speed = <math>200 \div 31 = 6.5\text{m/s}</math></li> </ul> <p><b>AO3.1a &amp; AO3.2b Analyse information to interpret and draw conclusions about the motion of the four students</b></p> <ul style="list-style-type: none"> <li>• Race B is twice the length of race A,</li> </ul> |

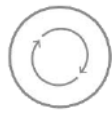
## Mark Scheme

| Question | Answer/Indicative content                                                                                                                                                                                                                                                                      | Marks | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | <p>three students.<br/>OR<br/>Calculates the speed of at least one student.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p><b>0 marks</b><br/><i>No response or no response worthy of credit.</i></p> |       | <p>but time is more than twice that of race A</p> <ul style="list-style-type: none"> <li>• C is faster than B as the time is shorter (for the same distance)</li> <li>• As race length increases, average speed decreases</li> </ul> <p><b><u>Examiner's Comments</u></b></p> <p></p> <p>There were many excellent answers, with the mean speeds of all four runners calculated with comments about how they had run different races (apart from B and C). Many candidates helped themselves by annotating the calculated speeds next to the table). The most able candidates discussed the effect of running a longer race on the mean speed of the runner (see Exemplar 7 below). Less able candidates compared the times of each runner but did not calculate speeds (see Exemplar 5 below).</p> <p> <b>OCR support</b></p> <p>About one in ten candidate did not attempt to answer this question. Level of Response (LoR) questions are designed to open up the potential answers so that candidates at all levels of ability have an opportunity to show their scientific understanding. Every candidate should be encouraged to answer LoR questions as even a weak but relevant answer will be credited. The 'How to answer 6 mark LoR questions' resource can be used to help candidates prepare for this style of question<br/> <a href="http://www.ocr.org.uk/Images/374902-how-to-answer-6-mark-lor-activity.doc">http://www.ocr.org.uk/Images/374902-how-to-answer-6-mark-lor-activity.doc</a></p> <p>Exemplar 5</p> |

# Mark Scheme

| Question | Answer/Indicative content | Marks | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|---------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                           |       | <p>Use the information in the table to describe and compare the motion of the four students.<br/>Use the data in your answer.</p> <p>The less motion the student had completed the race quicker as to student A the race distance is 50m then did the race in 6s about student B the race distance was 200 and did the race in 31s. However student B and C race distance was the same and student B did the race in 15s and C did the race in 14s. [10]</p> <p>A Level 1 candidate response. They describe the data in the table with no attempt to process data and calculate the speed of each runner. The information is relevant to the question but there is no real attempt to compare the motion of the four students.</p> <p><b>Exemplar 6</b></p> <p>Use the information in the table to describe and compare the motion of the four students.<br/>Use the data in your answer.</p> <p>Student A raced 50 m in 6s which means they were racing at roughly <math>8.3\frac{m}{s}</math> or <math>\frac{50}{6}</math>. This shows that their motion of their student is very fast. Students B and C ran 100m. However, student B ran 100m in 15 seconds while student C ran 100m in 14 seconds. This shows that student B has a slower motion than student C. Student D races 200m in 31 seconds, which is around <math>6.5\frac{m}{s}</math>. This shows that the motion of student A is slower than the motion of student D. [10]</p> <p>A Level 2 candidate response. They have calculated and compared the speeds of A and D, but only compared the relative motions of B and C. There is a structured line of reasoning and the reporting of data is linked by sentences that offer some interpretation of the facts.</p> <p><b>Exemplar 7</b></p> |

# Mark Scheme

| Question |                   |          | Answer/Indicative content | Marks        | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |         |                   |          |   |    |   |   |     |    |   |     |    |   |     |    |
|----------|-------------------|----------|---------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------|----------|---|----|---|---|-----|----|---|-----|----|---|-----|----|
|          |                   |          |                           |              | <table border="1"><thead><tr><th>Student</th><th>Race distance (m)</th><th>Time (s)</th></tr></thead><tbody><tr><td>A</td><td>50</td><td>8</td></tr><tr><td>B</td><td>100</td><td>15</td></tr><tr><td>C</td><td>100</td><td>14</td></tr><tr><td>D</td><td>200</td><td>31</td></tr></tbody></table> <p>Speed = <math>\frac{\text{distance}}{\text{time}}</math></p> <p>3.3 m/s<br/>6.6 m/s<br/>7.1 m/s<br/>6.4 m/s</p> <p>Use the information in the table to describe and compare the motion of the four students.<br/>Use the data in your answer.</p> <p>From looking at the table Student A covered the smallest distance of 50m in the smallest time of 8s but at the greatest speed of 3.3 m/s. Students B and C both covered 100m during the race but Student C was one second quicker than Student B (15s - 14s). Therefore Student C had a greater speed of 7.1 m/s compared to Student B at 6.6 m/s. Even though Student D covered the largest overall distance of 200m they moved at the smallest speed of 6.4 m/s. This could be due to the fact Student D took the largest amount of time of 31s.</p> <p>A Level 3 candidate response. They first calculated the speed of each student and then annotated the data table. This allowed them to be more focused and precise in their response. They have offered some explanation of the relative motions of the students. This answer is logical and all the content is relevant. The word counts for all three exemplars are similar and demonstrating that a well thought out answer is better than a very long answer.</p> | Student | Race distance (m) | Time (s) | A | 50 | 8 | B | 100 | 15 | C | 100 | 14 | D | 200 | 31 |
| Student  | Race distance (m) | Time (s) |                           |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |                   |          |   |    |   |   |     |    |   |     |    |   |     |    |
| A        | 50                | 8        |                           |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |                   |          |   |    |   |   |     |    |   |     |    |   |     |    |
| B        | 100               | 15       |                           |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |                   |          |   |    |   |   |     |    |   |     |    |   |     |    |
| C        | 100               | 14       |                           |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |                   |          |   |    |   |   |     |    |   |     |    |   |     |    |
| D        | 200               | 31       |                           |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |                   |          |   |    |   |   |     |    |   |     |    |   |     |    |
|          |                   |          | Total                     | 6            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |                   |          |   |    |   |   |     |    |   |     |    |   |     |    |
| 5        |                   |          | C ✓                       | 1<br>(AO1.2) | <p><b>Examiner's Comments</b></p> <p>Nearly half of the candidates did get the right answer. However most of the other candidates appeared to have been just guessed which response was correct.</p> <p> <b>AfL</b></p> <p>Standard form is tricky for Foundation Tier candidates. Try using low stakes pop quizzes and starter exercises to embed concepts of standard form and the metric prefixes. See also the Mathematical Skills Handbook <a href="http://www.ocr.org.uk/Images/310651-mathematicalskills-handbook.pdf">http://www.ocr.org.uk/Images/310651-mathematicalskills-handbook.pdf</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |         |                   |          |   |    |   |   |     |    |   |     |    |   |     |    |

## Mark Scheme

| Question |  |  | Answer/Indicative content | Marks | Guidance |
|----------|--|--|---------------------------|-------|----------|
|          |  |  | Total                     | 1     |          |

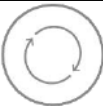
## Mark Scheme

| Question |  |    | Answer/Indicative content | Marks         | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|--|----|---------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6        |  | i  | TV ✓                      | 1<br>(AO3.2b) | <p><b><u>Examiner's Comments</u></b></p> <p>Most candidates multiplied the relevant variables (power and time used) in the data table, and used the units Wh or kWh. This was a good approach for questions of this type.</p>                                                                                                                                                                                                                                                                                                                                                                                                  |
|          |  | ii | Light bulb ✓              | 1<br>(AO3.2b) | <p><b><u>Examiner's Comments</u></b></p> <p>Here the appliance with the lowest power rating (light bulb) was the right answer</p> <p> <b>Misconception</b></p> <p>The most common misconception was just to compare the power ratings of the appliances and chose the toaster as the answer. Doing some quick calculations of work done and jotting vales next to the table helps answering these types of question. If the power and time for the TV and light bulb had been slightly different it would have given a different answer.</p> |
|          |  |    | <b>Total</b>              | <b>2</b>      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 7        |  |    | B ✓                       | 1<br>(AO2.1)  | <p><b><u>Examiner's Comments</u></b></p> <p>This was the hardest multiple-choice question, with one in six candidates getting it right. Most candidates did not convert cm into m.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|          |  |    | <b>Total</b>              | <b>1</b>      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

# Mark Scheme

| Question | Answer/Indicative content                                                                                                                               | Marks                         | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8        | <p><math>F = ma</math> / force equals mass times acceleration ✓<br/> so reducing mass means the same engine force will cause greater acceleration ✓</p> | <p>2 (AO1.2)<br/> (AO2.2)</p> | <p>Must start with Newton II<br/> NOT less force for same acceleration</p> <p><b>Examiner's Comments</b></p> <p>Few candidates identified that this question was about the implications of the equation <math>F = ma</math>. Candidates did not recognise that the force would be the same for both the heavier and the lighter model of car. Most candidates discussed the effects of friction on the car. For the order of magnitude for changes in mass between different models of a car frictional forces would have no measurable effect on acceleration.</p> <p><b>Exemplar 12</b></p> <p>(i) Explain why the presenter is correct.</p> <p>...if the car is heavier the weight on the wheels<br/> ...can affect the acceleration if the mass is less<br/> ...there will be less weight on the wheels so the acceleration will be better</p> <p>This answer only considers the marginal changes in friction caused by a very small increase in the contact area of the tyres but ignores the more significant effect that the same force applied to a smaller mass will have on acceleration.</p> <p><b>Exemplar 13</b></p> <p>(i) Explain why the presenter is correct.</p> <p>As force = mass x acceleration and force is more so acceleration is greater. Mass is less so acceleration is greater. So the acceleration will be better.</p> <p>This candidate's answer shows very clearly why using a more mathematical approach in physics saves time and increases understanding. They have identified the appropriate equation (<math>F=ma</math>), changed the subject to acceleration and then drawn the correct conclusion. Using this approach their answer was shorter, clearer and more relevant than exemplar 12.</p> <p><b>AfL</b></p> |

## Mark Scheme

| Question |  |    | Answer/Indicative content                                                                                                                                                                                                                                                               | Marks                                                                         | Guidance                                                                                                                                                                                                                                                                                                                                                |
|----------|--|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |  |    |                                                                                                                                                                                                                                                                                         |                                                                               |  <p>As a starter exercise show students the question and ask them to select the equation that will answer the question. Helping students to be more comfortable using equations will help them overcome their reluctance to answer physics questions using maths.</p> |
|          |  | ii | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/> <b>If answer = 5 (m/s<sup>2</sup>) award 3 marks</b></p> <p>change in speed = <math>25 - 5 = 20</math> (m/s) ✓<br/>           acceleration = <math>20 \div 4</math> (m/s<sup>2</sup>) ✓<br/>           = 5 (m/s<sup>2</sup>) ✓</p> | <p>3<br/>           (AO2.1)<br/>           (AO2.1)<br/>           (AO2.1)</p> | <p>e.c.f. incorrect change in speed if subtraction attempted</p> <p><b><u>Examiner's Comments</u></b></p> <p>This calculation was well done with most candidates being credited with all three marks.</p>                                                                                                                                               |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                                                            | <b>5</b>                                                                      |                                                                                                                                                                                                                                                                                                                                                         |

# Mark Scheme

| Question |   |    | Answer/Indicative content                                                                                                                                                                                                                            | Marks                                                 | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|---|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9        | a | i  | <p>moment = force <math>\times</math> distance ✓</p> <p>clockwise moment = 800 (Nm) ✓</p> <p>anti-clockwise moment = 1000 (Nm) ✓</p>                                                                                                                 | <p>3</p> <p>(AO1.2)</p> <p>(AO2.1)</p> <p>(AO2.1)</p> | <p><b>ALLOW 2 marks (total) if clockwise and anti-clockwise moments are reversed</b></p> <p>Correct calculation of either moment implies correct equation so gets m.p.1 also</p> <p><b><u>Examiner's Comments</u></b></p> <p>Some candidates were confused as to the direction of rotation of 'clockwise' and 'anticlockwise', so credit was allowed to those who reversed their sense. Many candidates did not know how to calculate a moment, although this could be deduced from the units provided in the answer line (telling them to multiply the two). The unit Nm is the product of the force (N) and the distance (m) of each child from the pivot point of the seesaw.</p> |
|          |   | ii | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b></p> <p><b>If answer = 1.6 (m) award 3 marks</b></p> <p>(anti-clockwise moment) 500 (N)<math>\times</math>distance = 800 (N m) ✓</p> <p>distance = 800 <math>\div</math> 500 ✓</p> <p>= 1.6 (m) ✓</p> | <p>3</p> <p>(AO1.2)</p> <p>(AO2.2)</p> <p>(AO2.2)</p> | <p>E.c.f. clockwise moment from (a)(i) for 800 (N m)</p> <p>If child B chosen, giving 1000 <math>\div</math> 400 = 2.5 (m), award 2 marks (loses m.p.1)</p> <p><b><u>Examiner's Comments</u></b></p> <p>Many candidates did not identify that the command word "calculate" was asking them to provide a mathematical solution rather than a qualitative descriptive of where child A should sit. Several candidates did calculate the correct answer and showed their workings in the space provided.</p>                                                                                                                                                                            |
|          | b | i  | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b></p> <p><b>If answer = 100 (Pa) award 3 marks</b></p> <p>pressure = force <math>\div</math> area ✓</p> <p>= 10 <math>\div</math> 0.1 ✓</p> <p>= 100 (Pa)✓</p>                                         | <p>3</p> <p>(AO1.2)</p> <p>(AO2.1)</p> <p>(AO2.1)</p> | <p><b><u>Examiner's Comments</u></b></p> <p>Many candidates were not able to recall the equation <math>P = F/A</math>. Some candidates did recall the equation and correctly calculated the pressure in the fluid as 100 Pa. A common misconception was using the equation <math>P = F \times A</math> to calculate the pressure as 1 Pa.</p>                                                                                                                                                                                                                                                                                                                                        |

### Mark Scheme

| Question |  |    | Answer/Indicative content                          | Marks        | Guidance                                                                                                                                                                                                                                                                                                                                                                                   |
|----------|--|----|----------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |  | ii | at right angles/perpendicular/90° (to the plunger) | 1<br>(AO1.1) | <p><b>ALLOW</b> to the left opposite to the force from the plunger</p> <p><u><b>Examiner's Comments</b></u></p> <p>Many answers here bore no relationship to the diagram: Any clear indication of direction including 'left' or 'at right angles' or 'perpendicular/90° to the plunger' were accepted. Ambiguous and inappropriate directions such as 'to the east' were not credited.</p> |
|          |  |    | <b>Total</b>                                       | <b>10</b>    |                                                                                                                                                                                                                                                                                                                                                                                            |
| 10       |  |    | D ✓                                                | 1<br>(AO2.2) | <p><u><b>Examiner's Comments</b></u></p> <p>This calculation was answered successfully by about three quarters of the candidates stating D.</p>                                                                                                                                                                                                                                            |
|          |  |    | <b>Total</b>                                       | <b>1</b>     |                                                                                                                                                                                                                                                                                                                                                                                            |

### Mark Scheme

| Question |  |    | Answer/Indicative content                                                                                                                                                                                                                                                   | Marks                                                                | Guidance                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------|--|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11       |  | i  | <p>potential difference ✓</p> <p>closed or complete circuit ✓</p>                                                                                                                                                                                                           | <p>2<br/>(AO2 × 1.1)</p>                                             | <p><b>IGNORE</b> ions / charge<br/><b>ALLOW</b> voltage</p> <p><b>ALLOW</b> higher level answers<br/>eg. must have delocalised electrons / electrons that are free to move</p> <p><u><b>Examiner's Comments</b></u></p> <p>Only about 10% here gained both marks. Delocalised electrons was a common correct answer for 1 mark. Less often seen were a potential difference [1] and a complete circuit [1].</p> |
|          |  | ii | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b></p> <p><b>If answer = 1500 (C) award 4 marks</b></p> <p><math>Q = It</math> ✓</p> <p><math>t = 5 \times 60 = 300 \text{ (s)}</math> ✓</p> <p><math>Q = 5 \times 300</math> ✓</p> <p><math>Q = 1500 \text{ (C)}</math> ✓</p> | <p>4</p> <p>(AO1.1)</p> <p>(AO2.1)</p> <p>(AO2.1)</p> <p>(AO2.1)</p> | <p><u><b>Examiner's Comments</b></u></p> <p>This was reasonably well answered and about two thirds of candidates gained 3 marks for 1500. Some forgot to convert minutes to seconds but were credited some reward for their working.</p>                                                                                                                                                                        |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                                                | <b>6</b>                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                 |

# Mark Scheme

| Question |  |  | Answer/Indicative content | Marks     | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------|--|--|---------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12       |  |  | C ✓                       | 1 (AO2.2) | <p><b>Examiner's Comments</b></p>  <p>Many candidates struggled to estimate the force of the brakes, often incorrectly choosing distractor B. Those candidates who correctly choose distractor C were often seen to write down their estimated values of the mass and acceleration.</p>  <p><b>AfL</b> Candidates would benefit from being provided with opportunities to estimate, the speed, accelerations and forces involved for everyday road transport.</p> |
|          |  |  | Total                     | 1         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

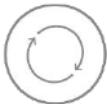
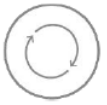
### Mark Scheme

| Question |   |     | Answer/Indicative content                                                                                                            | Marks           | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------|---|-----|--------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13       | a | i   | 5.2 (billion tonnes oil equivalent) ✓                                                                                                | 1<br>(AO3.1a)   | ALLOW answers between 5.0 and 5.5<br>IGNORE wrong units                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|          |   | ii  | Oil ✓                                                                                                                                | 1<br>(AO3.1a)   | <b><u>Examiner's Comments</u></b><br><br>Part (a)(i) and (ii) assessed AO3 and required candidates to use estimated values from the graph. The majority of candidates were able to do this successfully.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|          |   | iii | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = 78 (%) award 2 marks</b><br><br>8.3 / 10.6 (x 100) ✓<br><br>=78 (%) ✓ | 2 (AO 2 × 3.1a) | ALLOW answers that round between 77(%) and 80(%) ✓✓<br><br>ALLOW 8.2 / 10.6 (x 100) OR 8.4 / 10.6 (x 100) OR 8.5 / 10.6 (x 100) OR answers that round between 0.77 and 0.80<br><br><b><u>Examiner's Comments</u></b><br><br>This question required candidates to use estimated values from the graph to work out the amount of energy use due to fossil fuels and then convert their answer into a percentage of the total energy use.<br><br>The question discriminated well as the lower ability candidates struggled to identify the proportion due to fossil fuel use. Many did not take into account all three of the fossil fuels which resulted in percentages that were much smaller than the expected answer.<br><br>The higher ability candidates, who did identify the amount of energy use due to fossil fuels, were able to calculate the percentage correctly. |

# Mark Scheme

| Question |   |   | Answer/Indicative content                                                                                                                                                                                                                                       | Marks                                        | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------|---|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | b | i | <p>Fossil fuel may run out / is non-renewable / be in short supply / become very costly ✓</p> <p><b>Named</b> damage to environment:<br/>Eg (increased) greenhouse gases / global warming / sea levels rise / carbon dioxide / climate change / acid rain ✓</p> | <p><b>2</b><br/>(AO3.1b)</p> <p>(AO3.1b)</p> | <p><b>ALLOW</b> being used faster than being produced / finite resource</p> <p><b>ALLOW</b> ice caps melting / droughts and storms / more polluting gases / other named polluting gases e.g. SO<sub>2</sub> / carbon emissions</p> <p><b>IGNORE</b> just pollution or bad for the environment / more CFCs</p> <p><u><b>Examiner's Comments</b></u></p> <p>This question assessed AO3 and the majority of candidates gained at least 1 mark, usually for the idea that fossil fuels are not renewable. A significant number of candidates did not gain the second mark as their responses included statements about pollution that were too vague e.g. 'harmful emissions' or 'bad for the environment'.</p> <p><b>Exemplar 2</b></p> <p>1. Fossil fuels are non-renewable and will eventually run out ✓</p> <p>2. Fossil fuels release lots of pollution, which causes damage to people and the planet [2]</p> <p>This response was credited with 1 mark for stating that fossil fuels are renewable. The second mark was not achieved as the candidate's statement that 'fossil fuels release lots of pollution' is not specific enough. To gain the second mark, the candidate should have referred to an appropriate scientific reason, for example more CO<sub>2</sub> or more greenhouse gases.</p> |

# Mark Scheme

| Question |  |    | Answer/Indicative content                                                                                                                                                                                                                                               | Marks                           | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------|--|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |  | ii | <p>To meet demand for electricity / not enough energy from renewable resources ✓</p> <p>Less <b>named</b> damage to environment: (decreased) greenhouse gases / global warming / sea levels may fall / carbon dioxide / climate change / acid rain / ORA for coal ✓</p> | <p>2 (AO1.2)</p> <p>(AO1.2)</p> | <p><b>ALLOW</b> will not run out as fast (as coal) / to preserve fossil fuels / produces more energy (per kg than coal)</p> <p><b>ALLOW</b> less polluting gases / carbon emissions / ice caps melting / droughts and storms</p> <p><b>IGNORE</b> just less pollution or just better for the environment / less CFCs</p> <p><u><b>Examiner's Comments</b></u></p> <p> Although many candidates achieved 1 or 2 marks, a significant proportion did not gain any credit. Some candidates had the misconception that nuclear power is renewable. Others gave vague suggestions about 'damage to the environment'. Only the highest ability candidates usually gained full credit.</p> <p></p> <p> <b>AfL</b> Candidates should be aware that in a Physics exam what they write will be assessed as a specific scientific response. Where candidates use unnamed, vague statements about 'pollution' or 'damage to the environment' these are unlikely to gain credit. For example graffiti, fly tipping and loud music are examples of pollution that are unlikely to be caused a power station.</p> |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                                            | <b>8</b>                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

# Mark Scheme

| Question |  |     | Answer/Indicative content                                                                                                                                                                                                                          | Marks                           | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|--|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14       |  | i   | 2 ½ or 2.5 ✓                                                                                                                                                                                                                                       | 1 (AO1.2)                       | <p><b>Examiner's Comments</b></p> <p>Most candidates were able to calculate the number of waves produced. The most common error made was to divide the time by the frequency instead of multiplying the time by the frequency.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|          |  | ii  | <p>Speed is unchanged / stays the same ✓</p> <p>Wavelength reduces ✓</p>                                                                                                                                                                           | <p>2 (AO2.1)</p> <p>(AO2.1)</p> | <p>Answer <b>must</b> indicate idea of speed</p> <p>Answer <b>must</b> indicate idea of wavelength<br/><b>IGNORE</b> answers that merely state 'no change and reduces'</p> <p><b>Examiner's Comments</b></p> <p>Most candidates correctly stated that the wavelength would decrease. The majority of candidates stating that wave speed would also increase while only the highest ability candidates knew that that wave speed would be unchanged.</p>                                                                                                                                                                                                                                                 |
|          |  | iii | <p>Any two from:</p> <p>Water / particles move up and down / oscillate vertically ✓</p> <p>Water / particles move at 90° / perpendicular to the direction of wave (travel) / AW ✓</p> <p>Energy moves in direction of the wave (travel) / AW ✓</p> | 2 (AO2 × 2.1)                   | <p><b>IGNORE</b> any statements that are just repeated from the question.</p> <p><b>IGNORE</b> water waves move up and down</p> <p><b>ALLOW</b> energy moves at 90° to wave vibrations / movement ✓✓</p> <p><b>Examiner's Comments</b></p> <p>Candidates found this question very challenging and many misinterpreted what they were being asked to do. Most candidates did not identify that the second and third statements about water wave were incorrect and many merely rewrote the student's original statement. The most common mark gained was for the idea of the water moving perpendicular to the direction of the wave motion. Only the highest ability candidates gained full credit.</p> |

### Mark Scheme

| Question |  |  | Answer/Indicative content | Marks | Guidance |
|----------|--|--|---------------------------|-------|----------|
|          |  |  | Total                     | 5     |          |

# Mark Scheme

| Question |   |  | Answer/Indicative content                                                                                                                                                                                                                           | Marks                                           | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|---|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15       | a |  | <p>(The <b>thinking</b> distance will) <b>stay the same</b></p> <p>(The <b>braking</b> distance will) <b>decrease</b></p> <p>(The <b>stopping</b> distance will) <b>decrease</b></p> <p><b>All three</b> correct ✓✓</p> <p><b>Two</b> correct ✓</p> | <p><b>2</b></p> <p>(AO3.2b)</p> <p>(AO3.2b)</p> | <p><u><b>Examiner's Comments</b></u></p> <p>Higher ability candidates generally were credited with full marks for this question. However a third of the candidates did not provide any creditable response. .</p> <div> </div> <p>These 'thought experiment' type questions can be used as short starter activities to help students develop the habit of thinking about science. Candidates can also be encouraged to quickly sketch out the question. This can help candidates to visualise how the forces acting on the car have changed from moving along the flat road to moving uphill at a constant speed.</p>                                                   |
|          | b |  | <p>Any two from: A, C or D ✓</p> <p>Thinking distance / reaction time is proportional to speed / AW ✓</p>                                                                                                                                           | <p><b>2</b></p> <p>(AO3.2b)</p> <p>(AO3.2b)</p> | <p><b>ALLOW</b> as speed doubles, thinking distance doubles / ratio of speed:distance or distance:speed is the same / both have reaction time of 0.75 (s)</p> <p><u><b>Examiner's Comments</b></u></p> <p>This question required candidates to identify two drivers from A, C and D and explain why their reaction times are the same. Over half of the candidates correctly identified two of the drivers. Most of these candidates proceeded to explain why, usually by calculating the reaction time of 0.75 s.</p> <p>A significant number of candidates did not gain any credit. A common error candidates made was to choose drivers A and E or B and D due to their braking distances being almost the same.</p> |

### Mark Scheme

| Question |  |  | Answer/Indicative content | Marks      | Guidance                                                                                                                                      |
|----------|--|--|---------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
|          |  |  | Total                     | 4          |                                                                                                                                               |
| 16       |  |  | D ✓                       | 1 (AO 2.1) | <u>Examiner's Comments</u><br>Candidates were required to carry out a simple substitution into a given equation were generally answered well. |
|          |  |  | Total                     | 1          |                                                                                                                                               |

# Mark Scheme

| Question |   |  | Answer/Indicative content   | Marks     | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------|---|--|-----------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17       | a |  | Thinking distance doubles ✓ | 1 (AO1.1) | <p><b>ALLOW</b> higher level answer: thinking distance is (directly) proportional to speed</p> <p><b>Examiner's Comments</b><br/>           Around half the candidates stated that thinking distance also doubled and used data from the table to demonstrate their answer. Many of the candidates who did not gain credit stated that the thinking distance increases but without using the information from the question of the speed doubling. Other candidates did not answer the question set but explained factors that could affect thinking distance. A few candidates referred to the 'thinking time' doubling.</p>  <p><b>AfL</b></p> <p>When investigating stopping distances, candidates should be encouraged to understand fully the terms thinking distance, braking distance, thinking time, braking time. Encourage candidates to underline the important parts of the question – in this case thinking distance (which was already emboldened) and speed doubles.</p> |

### Mark Scheme

| Question |   |  | Answer/Indicative content                                                                                                                                                                                | Marks                                                    | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|---|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | b |  | <p>FIRST CHECK THE ANSWER ON ANSWER LINE</p> <p>If answer = 0.75 (s) award 3 marks</p> <p>Recall: (Reaction) time = (Thinking) distance ÷ Speed ✓</p> <p>6÷8 or 12÷16 or 24÷32 ✓</p> <p>= 0.75 (s) ✓</p> | <p>3</p> <p>(AO 1.2)</p> <p>(AO 2.1)</p> <p>(AO 2.1)</p> | <p>IGNORE correct substitutions if NOT rearranged</p> <p><b>Examiner's Comments</b></p> <p>10% of candidates recalled the speed equation and rearrange it as <i>reaction time</i> = <i>thinking distance</i> ÷ <i>speed</i>. The majority of the candidates were unable to interpret the data from the table and very few realised that the reaction time depended on the thinking distance before calculating the answer.</p> |
|          |   |  | Total                                                                                                                                                                                                    | 4                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                |

### Mark Scheme

| Question |   |     | Answer/Indicative content                                                                                                             | Marks           | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|---|-----|---------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18       | a | i   | 5.2 (billion tonnes oil equivalent) ✓                                                                                                 | 1 (AO 3.1a)     | <p>ALLOW answers between 5.0 and 5.5<br/>IGNORE wrong units</p> <p><b>Examiner's Comments</b><br/>Many candidates found it difficult to interrogate the stacked line graph and many candidates stated the total energy use in 1971 rather than the increase from 1971 to 2003. As the vertical scale on the graph was only marked at 1 billion tonne increments candidates were allowed to give an answer between 5.0 and 5.5 billion tonnes (oil equivalent).</p>                                                                                   |
|          |   | ii  | Oil ✓                                                                                                                                 | 1 (AO 3.1a)     | <p><b>Examiner's Comments</b><br/>Most candidates correctly identified oil as the greatest use. Other candidates suggested coal or renewables.</p>                                                                                                                                                                                                                                                                                                                                                                                                   |
|          |   | iii | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br/>If answer = 78 (%) award 2 marks</p> <p>8.3 / 10.6 (× 100) ✓</p> <p>=78 (%) ✓</p> | 2 (AO 2 x 3.1a) | <p>ALLOW answers that round between 77(%) and 80(%) ✓✓</p> <p>ALLOW 8.2 / 10.6 (× 100) OR 8.4 / 10.6 (× 100) OR 8.5 / 10.6 (× 100) OR answers that round between 0.77 and 0.80</p> <p><b>Examiner's Comments</b><br/>Only around 10% of candidates were able to answer this question fully and most other candidates were not credited with any marks. Many candidates struggled to identify coal, oil and gas as fossil fuels. Those less able candidates that attempted to show their working were could be credited with a compensatory mark.</p> |

### Mark Scheme

| Question |   |    | Answer/Indicative content                                                                                                                                                                                                                                                   | Marks                               | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------|---|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | b | i  | <p>Fossil fuel may run out / is non-renewable / be in short supply / become very costly ✓</p> <p><b>Named</b> damage to environment:<br/>Eg (increased) greenhouse gases / global warming / sea levels rise / carbon dioxide / climate change / acid rain ✓</p>             | <p>2 (AO 3.1b)</p> <p>(AO 3.1b)</p> | <p><b>ALLOW</b> being used faster than being produced / finite resource</p> <p><b>ALLOW</b> ice caps melting / droughts and storms / more polluting gases / other named polluting gases e.g. SO<sub>2</sub> / carbon emissions</p> <p><b>IGNORE</b> just pollution or bad for the environment / more CFCs</p> <p><u><b>Examiner's Comments</b></u><br/>Most candidates recognised that fossil fuels may run out or be in short supply or stating that they are non-renewable. However, fewer candidates went on to give specific scientific reasons for scientists concerns that were creditable. Most candidates gave generalised responses about fossil fuels damaging the environment or causing 'pollution'.</p>                                                                          |
|          |   | ii | <p>To meet demand for electricity / not enough energy from renewable resources ✓</p> <p>Less <b>named</b> damage to environment:<br/>(decreased) greenhouse gases / global warming / sea levels may fall / carbon dioxide / climate change / acid rain / ORA for coal ✓</p> | <p>2 (AO 1.2)</p> <p>(AO 1.2)</p>   | <p><b>ALLOW</b> will not run out as fast (as coal) / to preserve fossil fuels / produces more energy (per kg than coal)</p> <p><b>ALLOW</b> less polluting gases / carbon emissions / ice caps melting / droughts and storms</p> <p><b>IGNORE</b> just less pollution or just better for the environment / less CFCs</p> <p><u><b>Examiner's Comments</b></u><br/>Higher ability candidates said that there were not enough renewable energy resources and nuclear power stations would assist in meeting the demand for electricity, or help in preserving fossil fuels. Answers which gave detail about less damage to the environment were also credited, although a number of candidates thought that nuclear power stations would not cause any potential damage to the environment.</p> |
|          |   |    | <b>Total</b>                                                                                                                                                                                                                                                                | <b>8</b>                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

### Mark Scheme

| Question |  |  | Answer/Indicative content | Marks     | Guidance                                                                                                                                                                                                                                                |
|----------|--|--|---------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19       |  |  | A ✓                       | 1 (AO1.1) | <p><b><u>Examiner's Comments</u></b></p> <p>This question was generally answered well. For the cogs shown since the reverse must also be true, response A was straightforward.</p> <p>Candidates who did not gain this mark often chose response B.</p> |
|          |  |  | Total                     | 1         |                                                                                                                                                                                                                                                         |
| 20       |  |  | B ✓                       | 1 (AO1.1) |                                                                                                                                                                                                                                                         |
|          |  |  | Total                     | 1         |                                                                                                                                                                                                                                                         |
| 21       |  |  | C ✓                       | 1 (AO1.2) |                                                                                                                                                                                                                                                         |
|          |  |  | Total                     | 1         |                                                                                                                                                                                                                                                         |
| 22       |  |  | B ✓                       | 1 (AO2.1) |                                                                                                                                                                                                                                                         |
|          |  |  | Total                     | 1         |                                                                                                                                                                                                                                                         |
| 23       |  |  | C ✓                       | 1 (AO2.1) |                                                                                                                                                                                                                                                         |
|          |  |  | Total                     | 1         |                                                                                                                                                                                                                                                         |
| 24       |  |  | B                         | 1 (AO2.1) |                                                                                                                                                                                                                                                         |
|          |  |  | Total                     | 1         |                                                                                                                                                                                                                                                         |
| 25       |  |  | B                         | 1 (AO2.1) |                                                                                                                                                                                                                                                         |
|          |  |  | Total                     | 1         |                                                                                                                                                                                                                                                         |
| 26       |  |  | A                         | 1 (AO2.1) |                                                                                                                                                                                                                                                         |
|          |  |  | Total                     | 1         |                                                                                                                                                                                                                                                         |

### Mark Scheme

| Question |   |    | Answer/Indicative content                                                                                                                                                                                                                                                                                                                                                               | Marks            | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|---|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27       | a | i  | <p>(Ruler has) equal numbers of protons and electrons / ORA ✓</p> <p>So (effects of positive charges and negative charges) cancel out / AW / ORA ✓</p>                                                                                                                                                                                                                                  | 2<br>(AO2 x 1.1) | <p><b>ALLOW</b> equal numbers of positive and negative charges/opposite charges / ORA<br/> <b>ALLOW</b> ruler has not lost/gained electrons / ORA<br/> <b>ALLOW</b> ruler is/atoms are neutral unless there is a loss/gain of electrons / ORA<br/> <b>ALLOW</b> if the ruler had been charged, movement of electrons (to/from the air) would discharge it</p> <p><b>ALLOW</b> overall/net charge is zero/neutral / ORA<br/> <b>IGNORE</b> just charge is neutral</p> |
|          |   | ii | <p>Electrons are transferred (from/to the ruler or from/to the cloth) / ORA ✓</p> <p><b>And any one from:</b><br/> Charges are no longer equal / AW ✓</p> <p>Different numbers of protons and electrons / AW ✓</p> <p>Effects no longer cancel out / AW ✓</p>                                                                                                                           | 2<br>(AO2 x 1.1) | <p><b>ALLOW</b> electrons are lost/gained<br/> <b>DO NOT ALLOW</b> protons/positive charges move</p> <p><b>ALLOW</b> ruler becomes negative/positive with correct movement of electrons ✓✓</p>                                                                                                                                                                                                                                                                       |
|          | b | i  | <p>They must be opposite/unlike charges / one is positive and one is negative / one is a proton and one is an electron ✓</p> <p><b>And any two from:</b><br/> They are being attracted ✓</p> <p>The arrows show a force on the positive (charge)/(charge) B ✓</p> <p>Forces/field (lines) go from positive to negative ✓</p> <p>(Charge) A is negative AND (charge) B is positive ✓</p> | 3<br>(AO3 x 1.2) | <p><b>ALLOW</b> A is positive and B is negative for this mark only</p> <p><b>ALLOW</b> forces/field (lines) go from B to A</p> <p><b>ALLOW</b> maximum of 1 mark if described as opposite poles / positive and negative poles</p>                                                                                                                                                                                                                                    |

### Mark Scheme

| Question |   |    | Answer/Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                           | Marks                                             | Guidance                                                                                                                                                                                                                                                                       |
|----------|---|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |   | ii | <p><b>Any one from:</b></p> <p>North and South (poles) (replace positive and negative charges) ✓</p> <p>The arrows/field lines go from North to South (as opposed to positive to negative) ✓</p> <p>They have similar shape field (patterns) ✓</p> <p>Closeness of field lines represents strength of field (in each case) ✓</p> <p>Opposite <u>poles</u> (and opposite charges) attract ✓</p> <p>Both show direction of field (lines)/forces ✓</p> | 1<br>(AO1.1)                                      |                                                                                                                                                                                                                                                                                |
|          | c |    | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b></p> <p>If answer = 5(.00) (C) award 3 marks</p> <p>(Rearrange equation) (charge =) energy transferred / potential difference ✓</p> <p>(charge =) <math>200 / 40</math> ✓</p> <p>(charge =) 5 (C) ✓</p>                                                                                                                                                                                              | 3<br><br>(AO1.2)<br><br>(AO2.1)<br><br>(AO2.1)    |                                                                                                                                                                                                                                                                                |
|          |   |    | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>11</b>                                         |                                                                                                                                                                                                                                                                                |
| 28       |   |    | <p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b></p> <p>If answer = 1260 or 1300 (Nm) award 4 marks</p> <p>(Force = <math>70 \times 10</math> =) 700 (N) ✓</p> <p>(Moment =) force x distance ✓</p> <p>(Moment =) <math>700 \times 1.8</math> ✓</p> <p>(Moment =) 1260 (Nm) ✓</p>                                                                                                                                                                    | 4<br><br>(AO2.1)<br>(AO1.2)<br>(AO2.1)<br>(AO2.1) | <p><b>ALLOW</b> ecf for using mass not weight e.g. 3 marks for an answer of 126 (Nm), 2 marks for <math>70 \times 1.8</math></p> <p><b>ALLOW</b> ecf for incorrect calculation of force</p> <p><b>ALLOW</b> ecf for converting 1.8m to 180cm e.g. 3 marks for 126 000 (Nm)</p> |
|          |   |    | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>4</b>                                          |                                                                                                                                                                                                                                                                                |

### Mark Scheme

| Question |  |    | Answer/Indicative content                                                                                                                                                                                                                                                                  | Marks                                             | Guidance                                                                                                                                                                                                                                                                              |
|----------|--|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29       |  | i  | Gravitational (potential energy store) to kinetic (energy store) ✓                                                                                                                                                                                                                         | 1<br>(AO2.1)                                      | ALLOW kinetic (energy store) to thermal (energy store) / gravitational (potential energy) to thermal (energy)<br>ALLOW KE for kinetic energy / GPE for gravitational (potential) energy / heat for thermal<br>IGNORE just potential energy / PE                                       |
|          |  | ii | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br>If answer = 2.6 (J) award 4 marks<br><br>86cm = 0.86 m ✓<br>(Work done =) $3(.0) \times 0.86$ ✓<br>(Work done =) 2.58 (J) ✓<br>(Work done =) 2.6 (J) ✓                                                                                     | 4<br><br>(AO1.2)<br>(AO2.1)<br>(AO2.1)<br>(AO1.2) | ALLOW ecf for missing or incorrect unit conversion e.g. 260 (J) for 3 marks, 258 (J) for 2 marks                                                                                                                                                                                      |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                                                               | <b>5</b>                                          |                                                                                                                                                                                                                                                                                       |
| 30       |  | i  | (From) <u>Chemical</u> energy (store) ✓<br><br>(To) <u>Thermal</u> energy (store of the water in the kettle) ✓                                                                                                                                                                             | 2<br>(AO2 × 2.1)                                  | ALLOW chemical energy store decreases<br><br>ALLOW thermal energy store increases<br>ALLOW heat / internal energy for thermal<br><br>IGNORE sound/electrical energy<br>IGNORE intermediate energy transfers/stores and any energy transfers/stores after thermal (store of the water) |
|          |  | ii | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br>If answer = 138 000 (J) award 4 marks<br><br>(Recall: energy transferred =) power x time ✓<br><br>(Power = $5.0 \times 230$ =) 1150✓<br><br>(Time = $2 \times 60$ =) 120✓<br><br>(Energy transferred =) $1150 \times 120 = 138\,000$ (J) ✓ | 4<br><br>(AO1.2)<br>(AO2.1)<br>(AO2.1)<br>(AO2.1) | ALLOW equation in any form<br><br><br><br><br><br><br>ALLOW ecf for incorrect power calculated<br>ALLOW ecf for incorrect/no conversion of time                                                                                                                                       |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                                                               | <b>6</b>                                          |                                                                                                                                                                                                                                                                                       |

### Mark Scheme

| Question |   |    | Answer/Indicative content                                                                                                                                                                                    | Marks                           | Guidance                                                                                                                                                                                                                                                                                                                                                                                 |
|----------|---|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31       | a |    | (All galaxies) showed <u>red-shift</u> ✓<br><br>(Hubble measured the) wavelength/frequency of <u>light</u> (from the galaxy) ✓                                                                               | 2<br>(AO2 × 1.1)                | <b>ALLOW</b> (all galaxies) showed <u>light</u> with a longer wavelength/lower frequency for 2 marks                                                                                                                                                                                                                                                                                     |
|          | b | i  | Readings of speed taken for two different values of distance ✓<br><br>Working to show that the factor increase in speed is the same as distance ✓                                                            | 2<br>(AO2 × 3.1a)               | <b>ALLOW</b> +/- ½ a small square<br><br><b>ALLOW</b> a statement for the second mark e.g. as the distance doubles so does the speed.<br><br><u>Example:</u><br>At 20 Mpc, speed = 1400 km/s<br>At 40 Mpc, speed = 2800 km/s<br><br>$40/20 = 2 = 2800/1400$<br><br><b>ALLOW</b> 1 mark maximum for it is a (straight) line of best fit through the origin (therefore it is proportional) |
|          |   | ii | <b>Any one from:</b><br>The more distant galaxies are travelling faster ✓<br><br>The evidence suggests the universe is expanding ✓<br>The universe was smaller in the past ✓                                 | 1<br>(AO1.1)                    | <b>ALLOW</b> galaxies are moving away from each other                                                                                                                                                                                                                                                                                                                                    |
|          | c |    | To ensure results are reproducible / check the work is of high enough quality / claims are not false / for new theories to be accepted / to develop theories / AW ✓                                          | 1<br>(AO1.1)                    | <b>ALLOW</b> check validity / for mistakes/anomalies / AW<br><b>ALLOW</b> check that it's not biased / AW                                                                                                                                                                                                                                                                                |
|          | d | i  | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = 5 800 000 (m/s) award 2 marks</b><br><br>(Reads off speed from graph =) 5800 (km/s) ✓<br><br>Speed = $5800 \times 1000 = 5\,800\,000$ (m/s) ✓ | 2<br><br>(AO2.2)<br><br>(AO1.2) | <b>ALLOW</b> $5.8 \times 10^6$ (m/s)<br><br><b>ALLOW</b> ecf for their speed from graph x 1000                                                                                                                                                                                                                                                                                           |

### Mark Scheme

| Question |  |    | Answer/Indicative content                                                                                                                                                                                                                        | Marks                                          | Guidance                                                                               |
|----------|--|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------|
|          |  | ii | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br><b>If answer = <math>4.36 \times 10^{17}</math> (s) award 3 marks</b><br><br>time = distance / speed ✓<br>(time =) $2.53 \times 10^{24} / 5\,800\,000$ ✓<br>(time =) $4.36 \times 10^{17}$ (s) ✓ | 3<br><br>(AO1.2)<br><br>(AO2.1)<br><br>(AO2.1) | ALLOW ecf from (i)<br>ALLOW $4.4 \times 10^{17}$ (s)<br><br>ALLOW equation in any form |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                     | <b>11</b>                                      |                                                                                        |
| 32       |  |    | B                                                                                                                                                                                                                                                | 1<br>(AO2.1)                                   |                                                                                        |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                     | <b>1</b>                                       |                                                                                        |
| 33       |  |    | B                                                                                                                                                                                                                                                | 1<br>(AO2.1)                                   |                                                                                        |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                     | <b>1</b>                                       |                                                                                        |
| 34       |  |    | A                                                                                                                                                                                                                                                | 1<br>(AO2.1)                                   |                                                                                        |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                     | <b>1</b>                                       |                                                                                        |
| 35       |  |    | A                                                                                                                                                                                                                                                | 1<br>(AO2.1)                                   |                                                                                        |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                     | <b>1</b>                                       |                                                                                        |
| 36       |  |    | D                                                                                                                                                                                                                                                | 1<br>(AO1.1)                                   |                                                                                        |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                     | <b>1</b>                                       |                                                                                        |
| 37       |  |    | C                                                                                                                                                                                                                                                | 1<br>(AO2.1)                                   |                                                                                        |
|          |  |    | <b>Total</b>                                                                                                                                                                                                                                     | <b>1</b>                                       |                                                                                        |

### Mark Scheme

| Question |  |     | Answer/Indicative content                                                                                                                                                              | Marks                         | Guidance                                                                                                                                                                                                                                                  |
|----------|--|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 38       |  | i   | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br>If answer = 997 (kg/m <sup>3</sup> ) award 2 marks<br><br>9970 ÷ 10 ✓<br>= 997 (kg/m <sup>3</sup> ) ✓                                  | 2<br><br>(AO 2.1)<br>(AO 2.1) |                                                                                                                                                                                                                                                           |
|          |  | ii  | C B A                                                                                                                                                                                  | 1<br>(AO1.1)                  | Correct order only                                                                                                                                                                                                                                        |
|          |  | iii | <b>Any one from:</b><br>C has more/the most particles (for the same volume) ✓<br><br>A has fewer/the least particles (for the same volume) ✓                                           | 1<br>(AO 1.1)                 | <b>ALLOW</b> C has particles closest together/least spread out/most tightly packed<br><br><b>ALLOW</b> A has particles furthest apart/most spread out/least tightly packed<br><br><b>ALLOW</b> correct identification of C = solid, (B = liquid,) A = gas |
|          |  |     | <b>Total</b>                                                                                                                                                                           | <b>4</b>                      |                                                                                                                                                                                                                                                           |
| 39       |  |     | Any one set of readings from the graph multiplied together to give a correct number ✓<br><br>Any second set of readings from the graph multiplied together to give the same constant ✓ | 2<br>(AO3.1b x 2)             | e.g. 5×500 = 10×250 = 20×125 = 25× 100 = 2500                                                                                                                                                                                                             |
|          |  |     | <b>Total</b>                                                                                                                                                                           | <b>2</b>                      |                                                                                                                                                                                                                                                           |

### Mark Scheme

| Question |   |    | Answer/Indicative content                                                                                                                                                                    | Marks                                  | Guidance                                        |
|----------|---|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-------------------------------------------------|
| 40       | a | i  | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br>If answer = 20 (N) award 2 marks<br><br>$5 \times 4 \checkmark$<br>$= 20 \text{ (N)} \checkmark$                                             | 2<br><br>(AO2.1)<br>(AO2.1)            |                                                 |
|          |   | ii | <b>Any one from:</b><br>Not all energy is transferred to motion $\checkmark$<br><br>(Air) resistance $\checkmark$<br><br>Drag $\checkmark$<br><br>Friction $\checkmark$                      | 1<br>(AO3.2a)                          | ALLOW Energy losses                             |
|          | b | i  | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br>If answer = 1500 (J) award 2 marks<br><br>$30 \times 50 \checkmark$<br>$= 1500 \text{ (J)} \checkmark$                                       | 2<br><br>(AO2.1)<br>(AO2.1)            |                                                 |
|          |   | ii | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br>If answer = 20 (W) award 3 marks<br><br>work done $\div$ time $\checkmark$<br><br>$1500 \div 75 \checkmark$<br>$= 20 \text{ (W)} \checkmark$ | 3<br><br>(AO1.2)<br>(AO2.1)<br>(AO2.1) | ALLOW ecf from (i)<br><br>ALLOW $P = WD \div t$ |
|          |   |    | <b>Total</b>                                                                                                                                                                                 | <b>8</b>                               |                                                 |

### Mark Scheme

| Question |   |    | Answer/Indicative content                                                                                                                                                                                                                            | Marks                                          | Guidance                                                |
|----------|---|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---------------------------------------------------------|
| 41       | a |    | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br>If answer = 0.8 (J) award 2 marks<br><br>$\frac{1}{2} \times 40 \times 0.2^2 \checkmark$<br><br>= 0.8 (J) $\checkmark$                                                                               | 2<br><br>(AO2.1)<br><br>(AO2.1)                | ALLOW 3.8 (J)                                           |
|          | b | i  | (moment of 2N weight) = 80 (N cm) $\checkmark$<br><br>(moment of 3N weight) = 150 (N cm) $\checkmark$                                                                                                                                                | 2<br>(AO2.1)<br>(AO2.1)                        | ALLOW 1 mark if answers are reversed                    |
|          |   | ii | Anti-clockwise (as anti-clockwise moment is larger than the clockwise moment) / left hand side goes down / AW $\checkmark$                                                                                                                           | 1<br>(AO3.1b)                                  | ALLOW indication of rotation by an arrow on the diagram |
|          |   |    | <b>Total</b>                                                                                                                                                                                                                                         | <b>5</b>                                       |                                                         |
| 42       |   |    | <b>FIRST CHECK THE ANSWER ON ANSWER LINE</b><br>If answer = 5(.00) (C) award 3 marks<br><br>(Rearrange equation) Charge = energy transferred / potential difference $\checkmark$<br><br>(charge =) $200 / 40 \checkmark$<br><br>= 5 (C) $\checkmark$ | 3<br><br>(AO1.2)<br><br>(AO2.1)<br><br>(AO2.1) |                                                         |
|          |   |    | <b>Total</b>                                                                                                                                                                                                                                         | <b>3</b>                                       |                                                         |