OCR GCSE GATEWAY PHYSICS A · J249

# PHYSICS



EXAM QUESTION PACK

## M1 ARITHMETIC AND NUMERICAL COMPUTATION

| SCORE | PERCENTAGE |
| --- | --- |
| /139 | % |

STEMUP

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# 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 forename | | Candidate 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

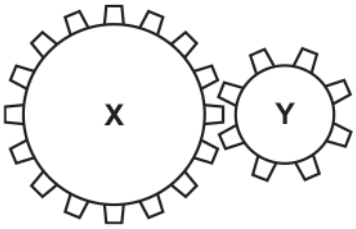
- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist 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.

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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

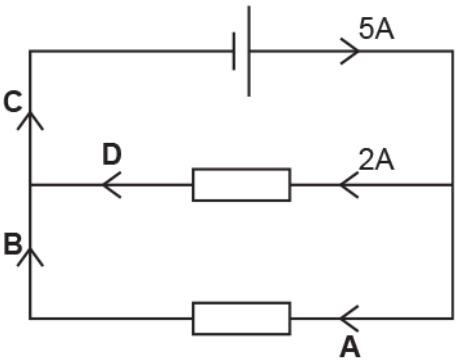
**B** 2

**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]

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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]

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4 * Four students run in different races.

| 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 μm

**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]

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

Use the equation: work done = force × 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.

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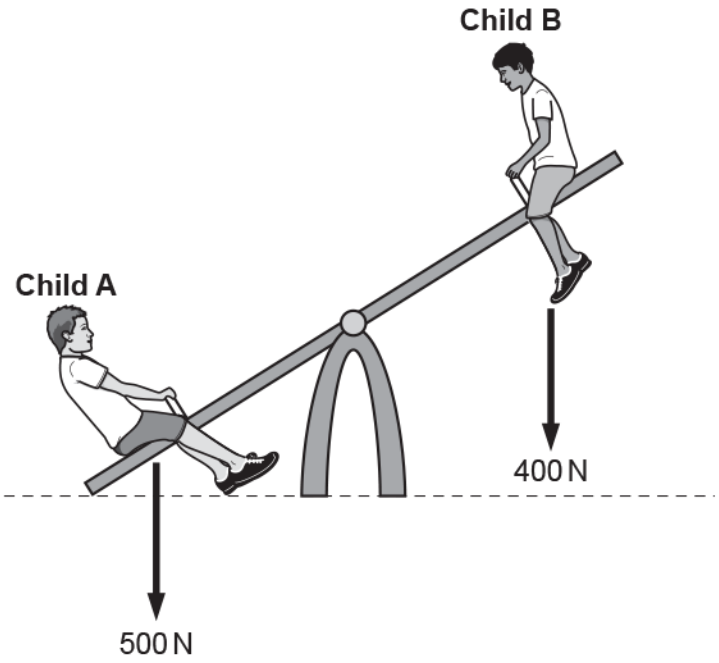
(ii) A car accelerates from 5 m/s to 25 m/s in 4 seconds.

Calculate the acceleration of the car.

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

Answer = ..... $m/s^2$ **[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.

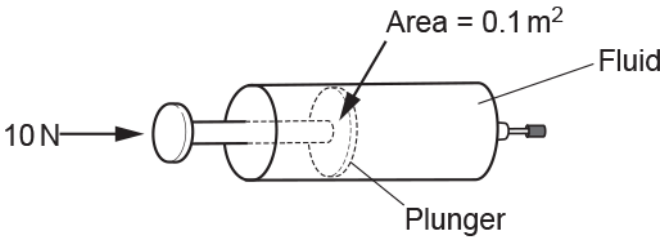
Answer = ..... **[3]**

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(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 $m^2$.

(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.

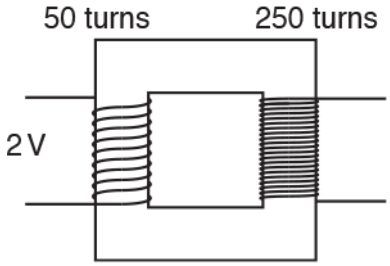
---------- **[1]**

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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]**



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11

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

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[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

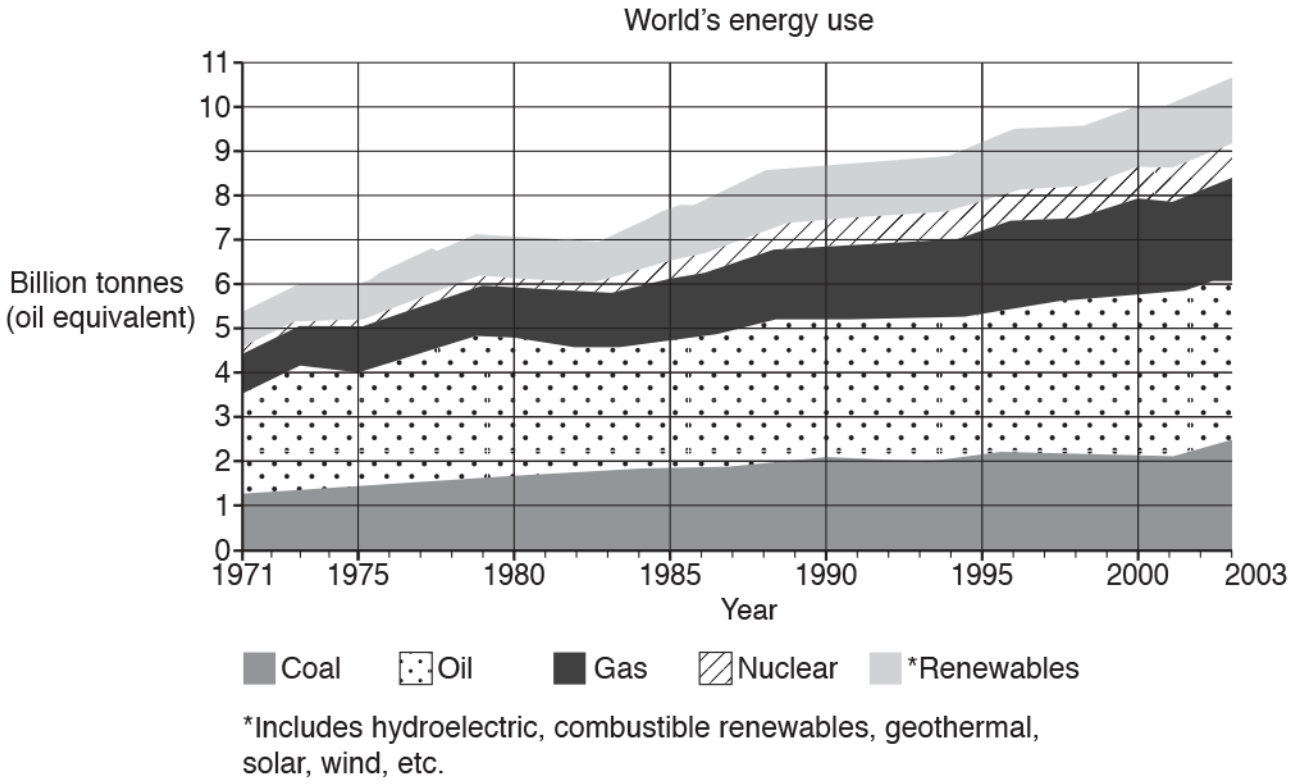
Your answer [1]



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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]**

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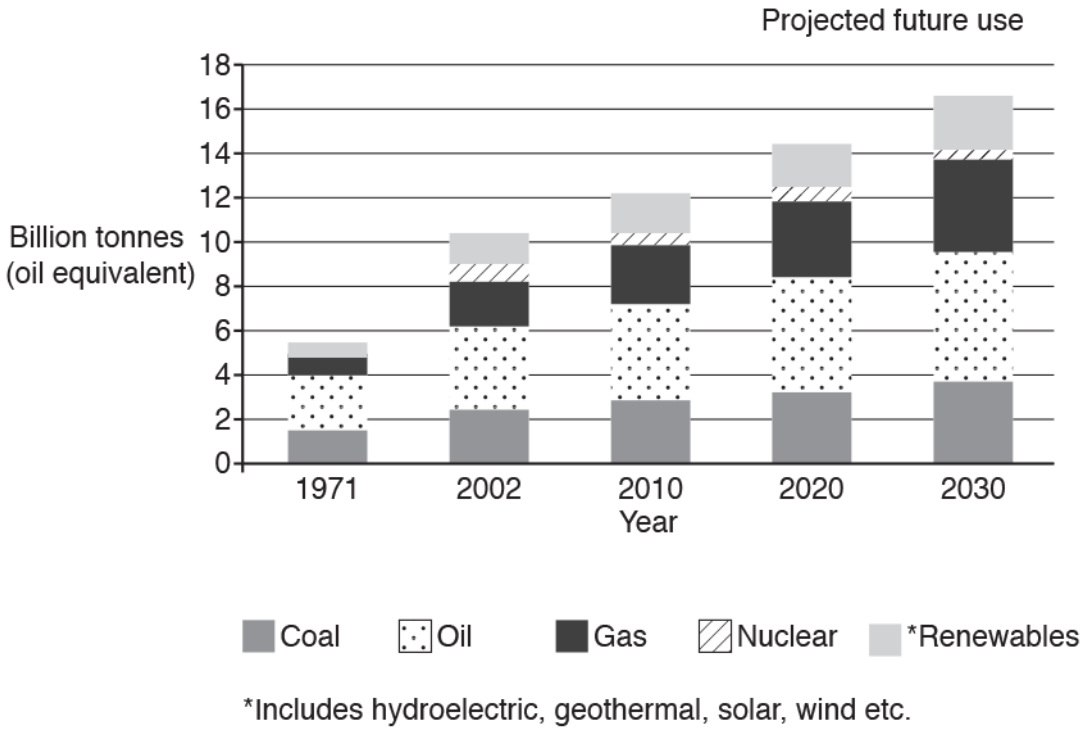
(iii) The total energy use in the year 2003 was 10.6 billion tonnes (oil equivalent).

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 ----------

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2 ----------

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[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.

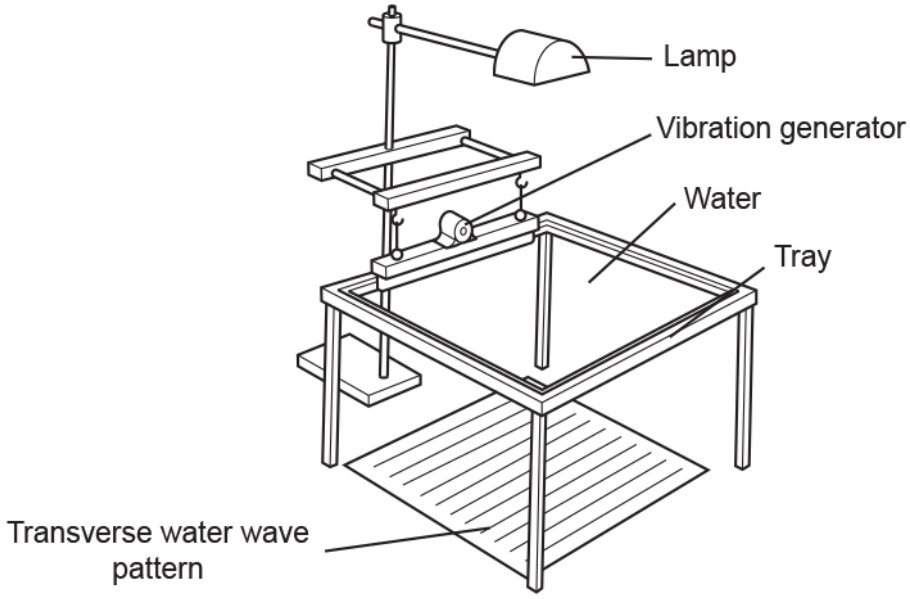
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[2]

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




She makes measurements of the water waves.



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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.

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---[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.

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---[2]

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

Look at the results.

| Driver | Speed (m/s) | Thinking distance (m) | Braking distance (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]**

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

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

Explain your answer.

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[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 (m/s) | Thinking distance (m) | Braking distance (m) | Stopping distance (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.

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--- **[1]**

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

Answer = ---------- s **[3]**

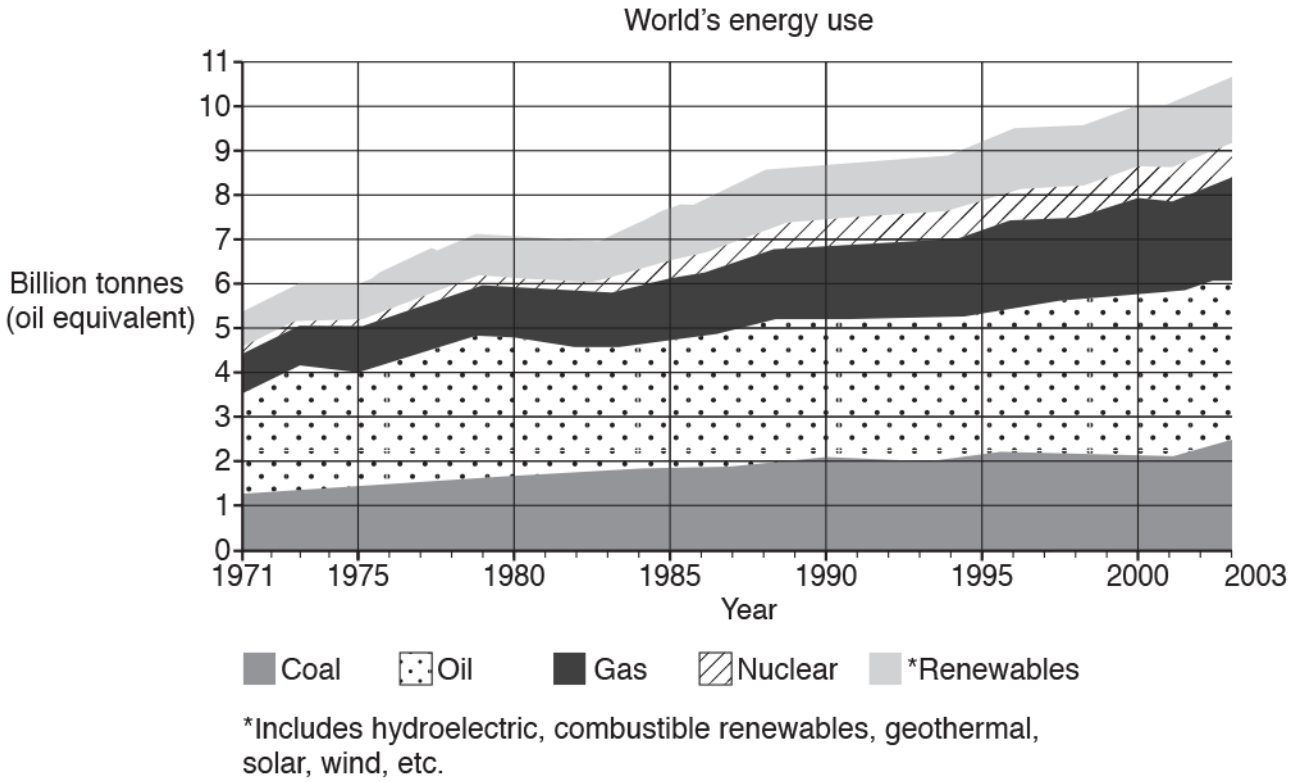
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18(a) The graph shows how the World's energy use has changed from the year 1971 to the year 2003.

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]**

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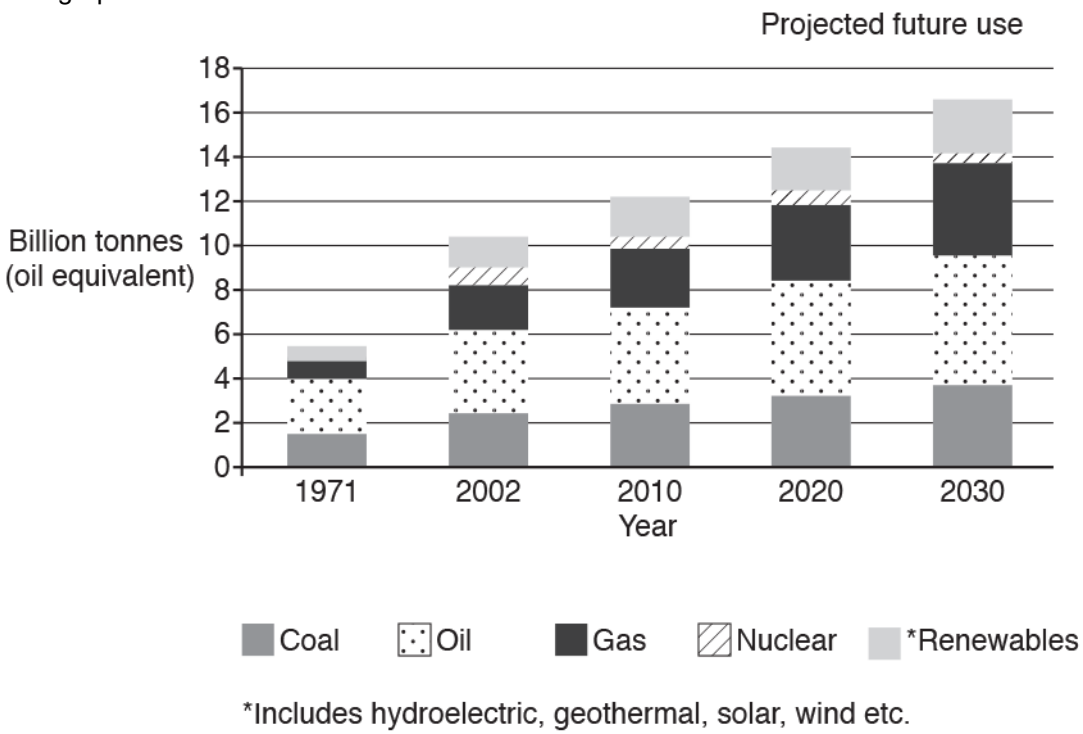
(iii) The total energy use in the year 2003 was 10.6 billion tonnes (oil equivalent).

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. ----------

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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.

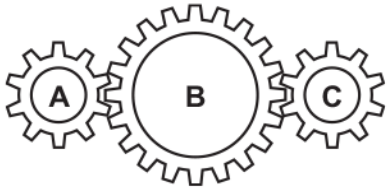
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---------- [2]

19 A student investigates cogs and gears.

Cogs **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]

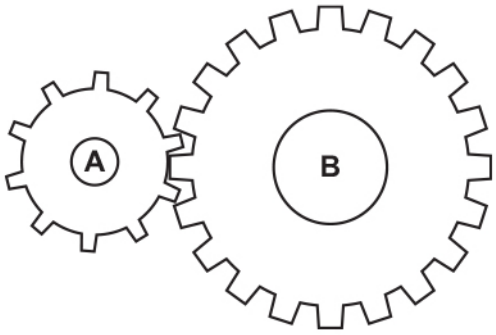
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20 A student sets up two cogs.

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]

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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 × 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 × mass × $(\text{speed})^2$

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

Your answer ☐ [1]

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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 / $m^3$.

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]**

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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.

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[2]

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

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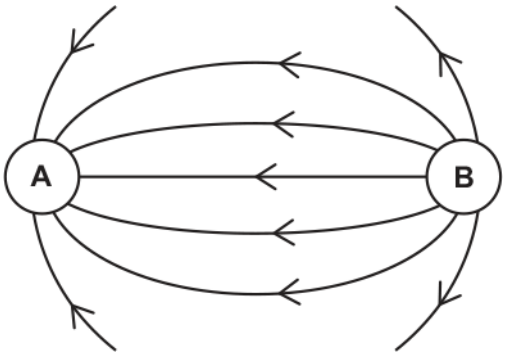
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(b) The diagram shows the electric field between two charges, **A** and **B**.




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

Use the diagram to explain your answer.

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**[3]**

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

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**[1]**

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

Use the equation: energy transferred = charge × potential difference

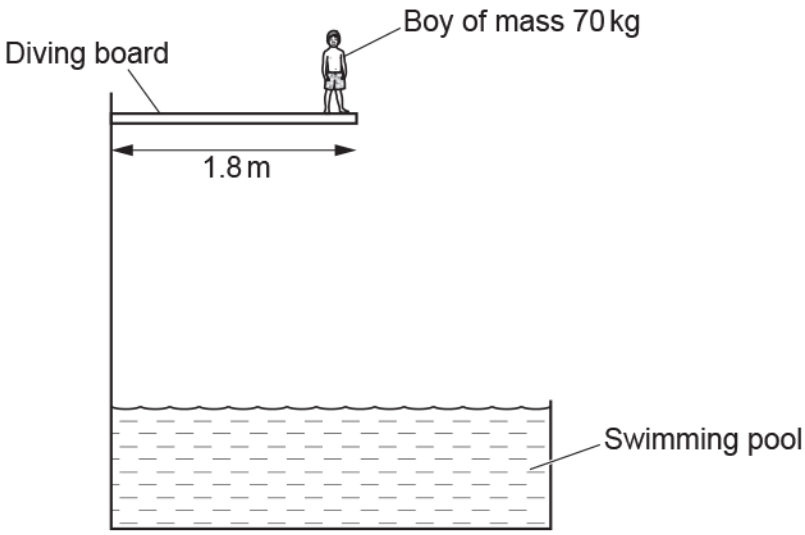
Charge = ..... C **[3]**

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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.



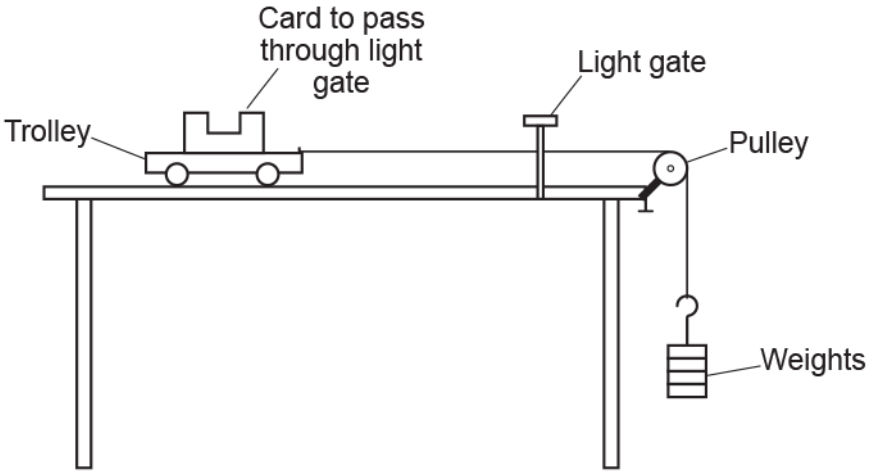

Calculate the moment of the boy standing on the diving board.
Gravitational field strength on Earth = 10 N / kg.

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



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29 A student investigates the acceleration of a trolley.




The trolley is released from a fixed position and accelerates.

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

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**[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 × distance

Give your answer to **2** significant figures.

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

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30 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.

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[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.

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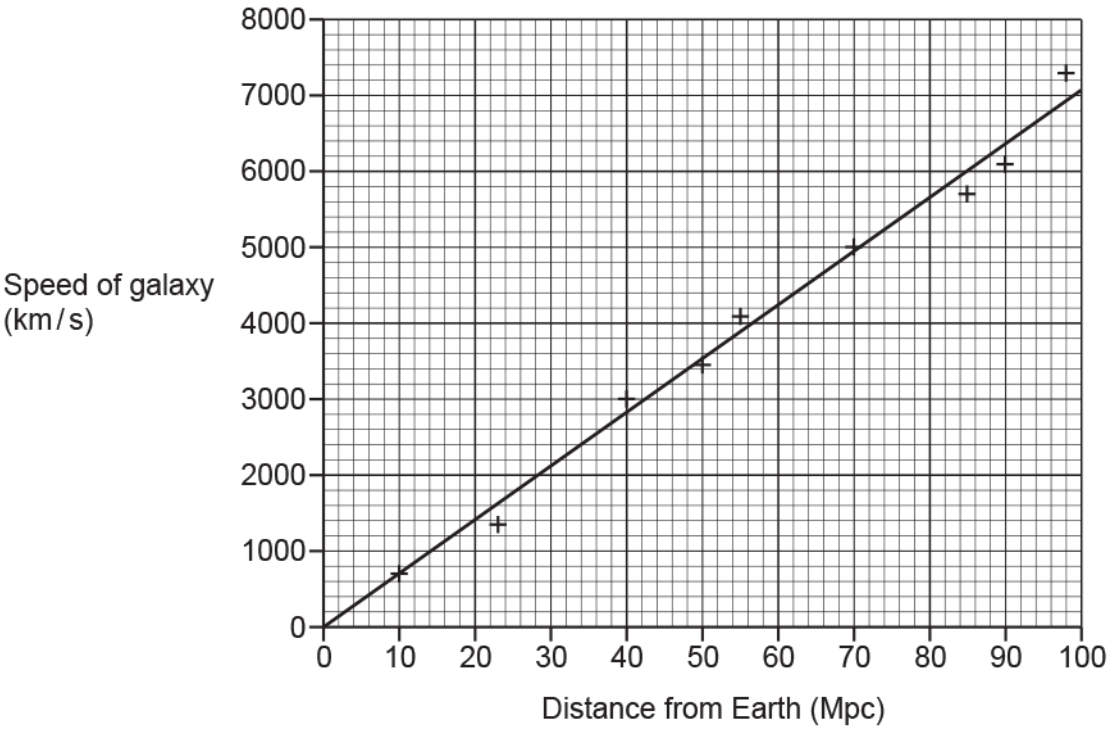
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(b) This graph shows how the speed of a galaxy changes with distance from the Earth.




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

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[2]

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

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[1]

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

Suggest why peer review is important.

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**[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]**

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32 A cyclist travels 750 m in 50 seconds.

Calculate the speed of the cyclist.

Use the equation: speed = distance / 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: gravity force = mass × 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: charge flow = current × time

**A** 40 C
**B** 100 C
**C** 40 000 C
**D** 100 000 C

Your answer ☐ [1]

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

| Box | Weight (N) | Area ($cm^2$) |
|---|---|---|
| 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]



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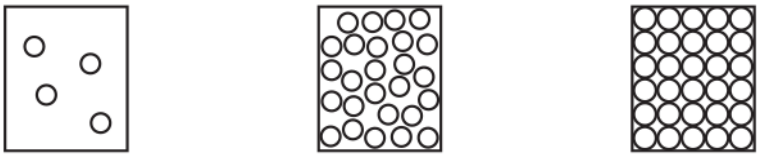
(i) A swimming pool contains 9970 kg of water in 10 $m^3$.

Calculate the density of water.

Use the equation: density = mass ÷ volume

Density = ..... kg / $m^3$ **[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)**.

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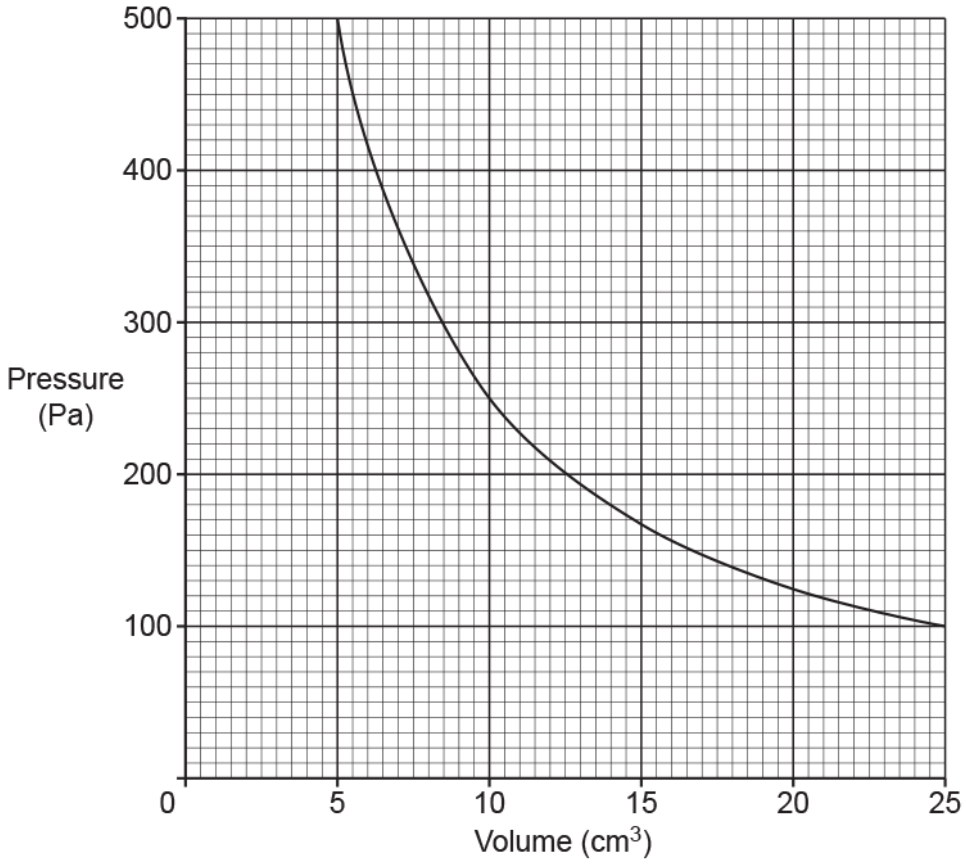
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**[1]**



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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]



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

(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 × 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 |

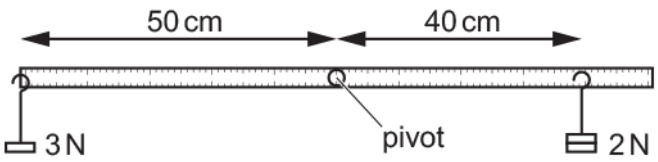
The spring constant of a different spring is 40 N / m.

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: moment = force × 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: energy transferred = charge × potential difference

Charge = ..... C **[3]**

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