OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



EXAM QUESTION PACK

WS1.1 DEVELOPMENT OF SCIENTIFIC THINKING

SCORE	PERCENTAGE
/226	%

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Gateway Physics A (9-1)

Development in scientific thinking

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 **226**.
- The total number of marks may take into account some 'either/or' question choices.

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1

‘Cold fusion’ is fusion at room temperature.

An Italian inventor claims he has achieved ‘cold fusion’.

He has demonstrated his claims but has **not** shared any details or data.

(i) Explain why it is important to share details and data with other scientists.

---

[1]

(ii) Explain why ‘cold fusion’ is **not** accepted as a method of energy production.

---

[1]

2 Which voltage is the maximum voltage made when **four** 1.5 V cells are connected in **series**?

A 0 V

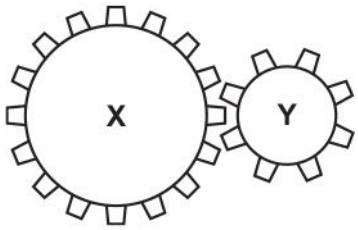
B 1.5 V

C 3.0 V

D 6.0 V

Your answer ☐ **[1]**

3 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

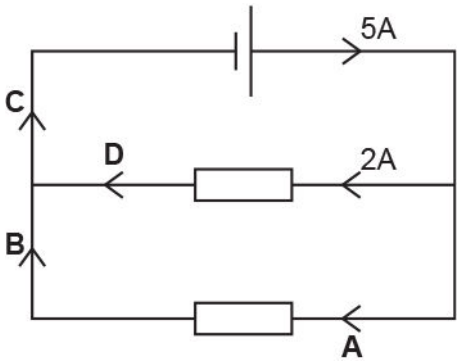
B 2

C 4

D 8

Your answer ☐ **[1]**

4 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]**

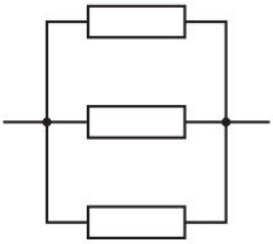
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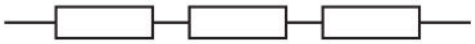
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5 A student has 3 identical resistors. She arranges them in four different ways.

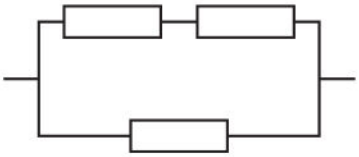
A



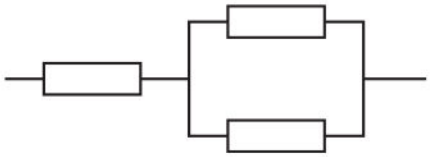
B



C



D



Which arrangement has the **most** resistance?

Your answer ☐ [1]

6 In which situation does the force cause a rotation?

A Bouncing on a trampoline

B Hitting a nail with a hammer

C Pushing a friend on a swing

D Sitting on a chair

Your answer ☐ [1]

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7 Which is a scalar?

A Acceleration

B Displacement

C Force

D Speed

Your answer [1]

8 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]

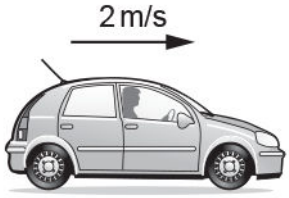
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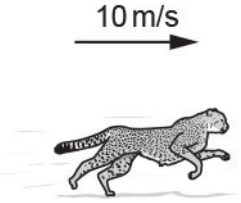
9 Which of the following has the **most** kinetic energy?

A



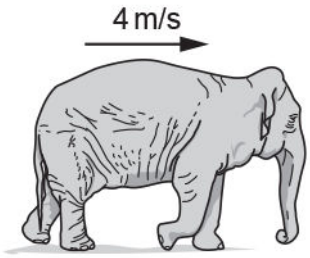
500 kg

B



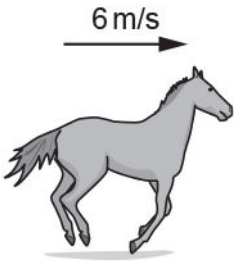
80 kg

C



3000 kg

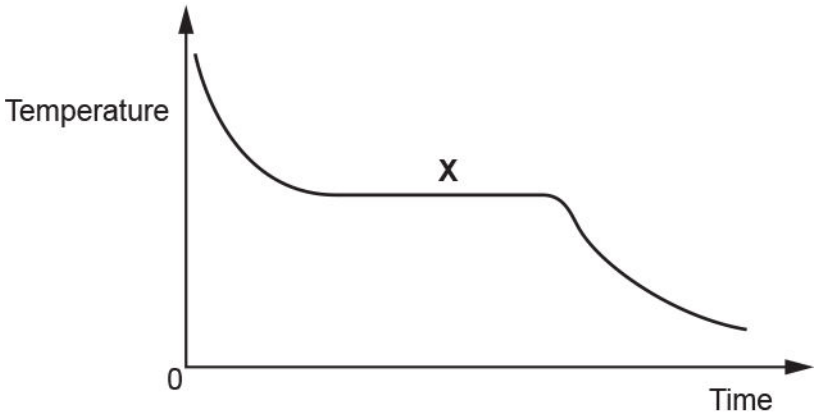
D



750 kg

Your answer ☐ [1]

10 A student studies how the temperature falls when a liquid cools.



What is happening at point **X** on the graph?

A Boiling

B Freezing

C Melting

D Subliming

Your answer ☐ **[1]**

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11(a) 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]

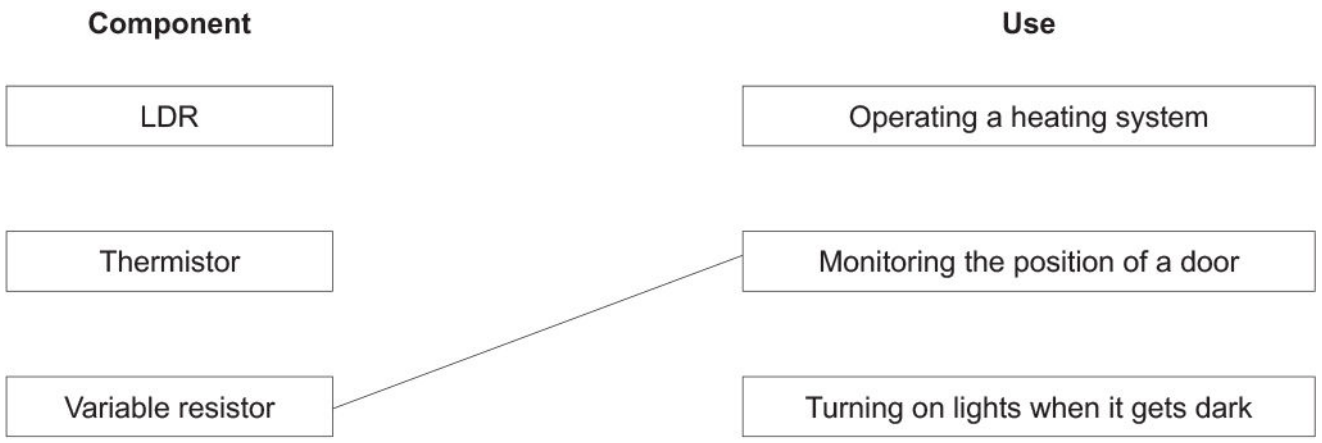
(ii) Which appliance uses the **least** energy?

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

(b) Here are three different components and their use in the home.

Match the component to its correct use.

One has been done for you.



[2]

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(c) A charge of 44 000 C flows through a light bulb. The potential difference is 230 V.

Calculate the energy transferred.

Use the equation: Charge = Energy ÷ Potential difference

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

Answer = ... J **[4]**

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12 Atomic models have changed over time.

Old atomic model – Atoms are a positive mass with negative electrons fixed in it.

Current atomic model – Atoms are made from protons, neutrons and electrons.
Protons and neutrons are in a central nucleus surrounded by a cloud of electrons.

(i) Write down **two** differences between these models.

1 ---

---

2 ---

---[2]

(ii) Why did the atomic model change?

---[2]

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13 * 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]

14(a) A book rests on a table.

Draw a free body force diagram to show the forces acting on the book.

Use arrows to represent the forces.

[4]

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(b) 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]

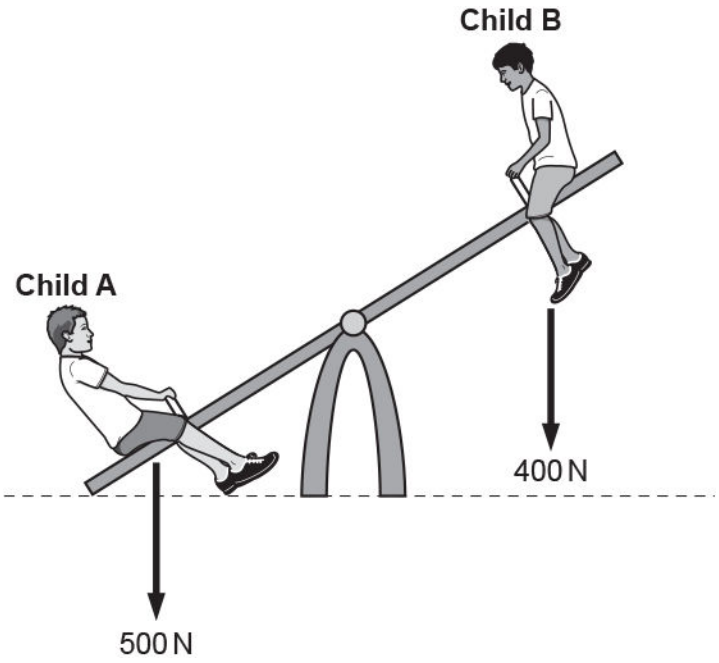
(ii) A car accelerates from 5 m/s to 25 m/s in 4 seconds.

Calculate the acceleration of the car.

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

Answer = ... m/s^2 **[3]**

15 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.

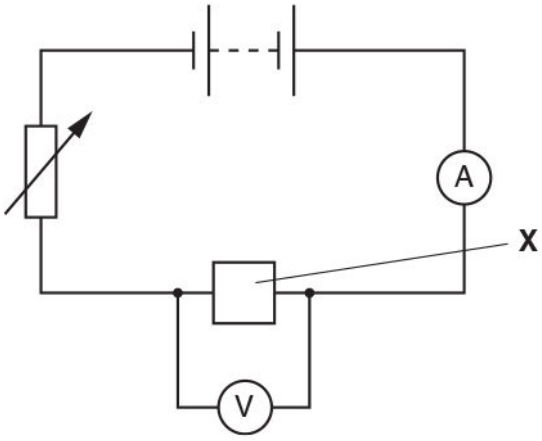
Answer = ... **[3]**

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16 A student builds a circuit to investigate the resistance of component **X**.



Component **X** has a resistance of 16 Ω when a current of 0.25 A flows.

(i) Calculate the potential difference across component **X**.

Use the equation: Potential difference = Current × Resistance

Answer = ... V **[2]**

(ii) Calculate the power of component **X** when a current of 0.25 A flows.

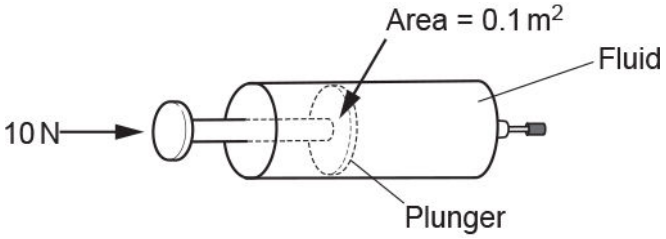
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Answer = ... W **[3]**

17 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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18 The behaviour of a magnetic compass is evidence that the core of the Earth is magnetic. Explain why.

---

[2]

19 The atomic model has changed over time.

Why did the model need to change over time?

A Models only have a finite lifetime

B Computers were invented

C The older models could not explain new evidence

D Peer review

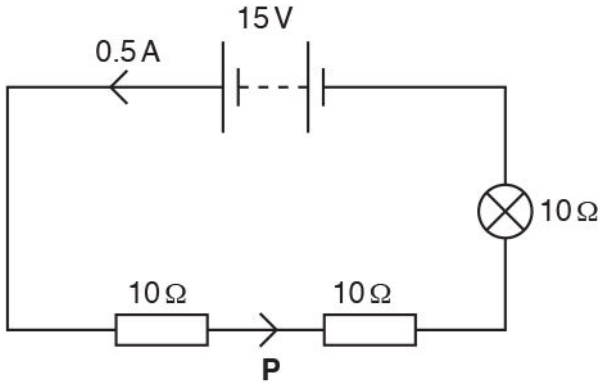
Your answer ☐ [1]

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20 What is the current at point **P** in the circuit?



A 0.5 A

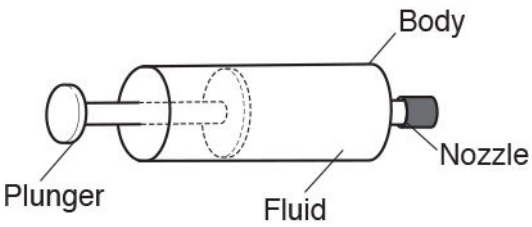
B 7.5 A

C 15.0 A

D 20.5 A

Your answer ☐ **[1]**

21 A fluid is compressed by pushing the plunger into the body of a sealed syringe.



Which of these statements is true?

A There is a net force towards the plunger.

B There is no force towards the nozzle.

C There is a force parallel to all points on the surface of the fluid.

D There is a force at 90° to all points on the surface of the fluid.

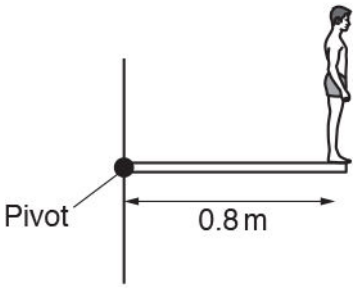
Your answer ☐ **[1]**

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22 A diver stands on a diving board. He weighs 400 N.



What is the moment of the force provided by the diver around the pivot?

A 320 Nm anti-clockwise

B 320 Nm clockwise

C 500 Nm anti-clockwise

D 500 Nm clockwise

Your answer [1]

23 Which factor influences whether an object floats or sinks?

A Size of object

B Depth of water

C Distance from the shore

D Density of object

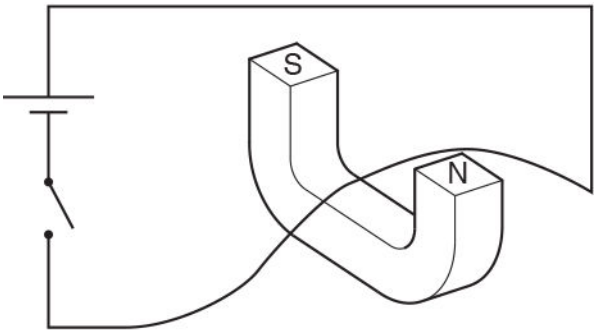
Your answer [1]

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24 A wire is placed inside a horseshoe magnet.



Which direction will the wire move when the switch is closed?

A Downwards

B Left

C Right

D Upwards

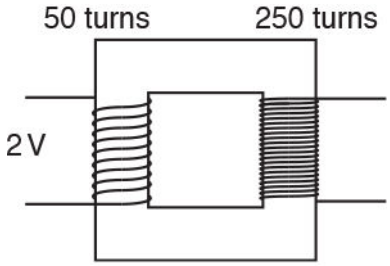
Your answer ☐ **[1]**

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25 What output voltage does the transformer produce?



A 0.2 V

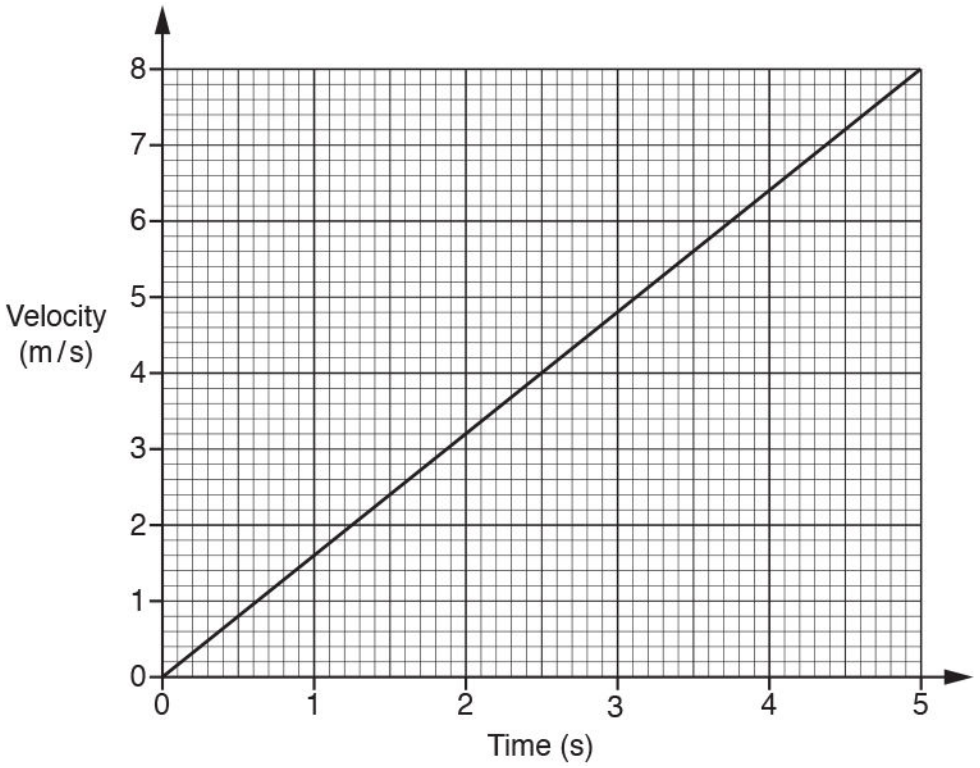
B 0.4 V

C 5 V

D 10 V

Your answer ☐ **[1]**

26 Look at the velocity-time graph of an object.



What is the distance travelled by the object in 5s?

A 0.63 m

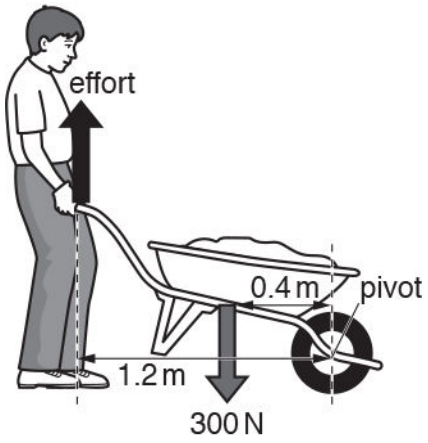
B 1.6 m

C 20 m

D 40 m

Your answer [1]

27 A man lifts a load using a wheelbarrow.



What is the effort needed to lift the load using the wheelbarrow?

A 100 N

B 120 N

C 250 N

D 144 N

Your answer [1]

28 A 0.5 m length of wire is placed inside four different magnetic fields.

Magnetic Field	Force on wire (N)	Current in wire (A)
A	2.0	0.1
B	2.0	0.2
C	4.0	0.1
D	4.0	0.4

Which magnetic field has the **greatest** magnetic flux density?

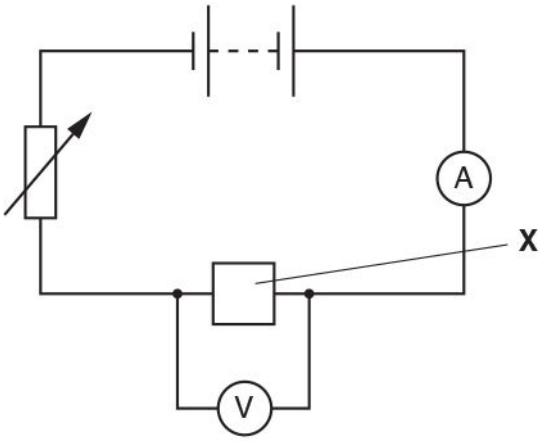
Your answer [1]

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29 A student builds a circuit to investigate the resistance of component **X**.



Component **X** has a resistance of 16 Ω when a current of 0.25 A flows.

(i) Calculate the potential difference across component **X**.

Use the equation: Potential difference = Current × Resistance

Answer = ... V **[2]**

(ii) Calculate the power of component **X** when a current of 0.25 A flows.

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

30 The behaviour of a magnetic compass is evidence that the core of the Earth is magnetic. Explain why.

---**[2]**

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31

(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]**

32(a) A student hangs a length of copper wire from the ceiling.

She adds weights to the bottom of the wire and measures the extension of the wire.

Look at a table of some of her results.

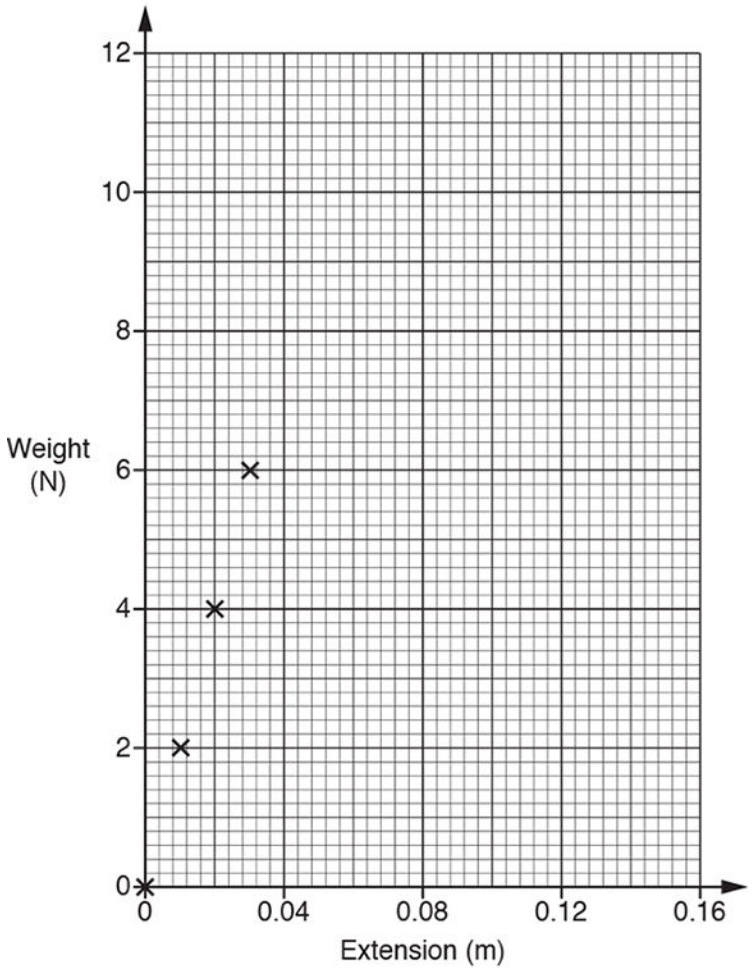
Weight (N)	Extension (m)
0	0
2	0.01
4	0.02
6	0.03
8	0.04
10	0.08
12	0.16

(i) Plot the values on the graph. Some have been done for you.

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[2]

(ii) Draw a line of best-fit on the graph.

[1]

(iii) Describe **and** explain the shape of the graph.

---

[3]

(b) Calculate the spring constant for the 0 – 6 N part of the graph.

Use the equation: Force = Spring constant × Extension

Answer = ... N/m **[3]**

(c) Calculate the work done in stretching the wire to 0.04 m.

Answer = ... J **[2]**

33 A student finds that 250 g of ice takes 95 kJ of energy to change state.

Calculate the specific latent heat.

Answer = ... J/kg **[3]**

34(a) A student investigates collisions of trolleys on a horizontal airtrack.

Write down the **two** quantities involved with motion which are conserved during an elastic collision.

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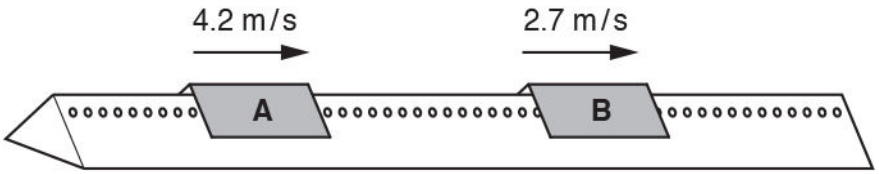
[2]

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(b) Trolley **A** has a mass of 2 kg. Trolley **B** has a mass of 2.5 kg.



(i) Calculate the **momentum** of each trolley.

Trolley **A** = ... kg m/s
Trolley **B** = ... kg m/s
[3]

(ii) The two trolleys collide and stick together after the collision. Use your answers to **(i)** to calculate the **speed** of the combined trolleys after the collision.

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

Answer = ... m/s **[3]**

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35(a) A student wants to find out the depth of a well.

She thinks that she can calculate this by dropping a stone into the well and timing how long it takes to hear the stone splash at the bottom.

(i) Explain how she could use this measurement to find the depth of the well.

--- **[3]**

(ii) It takes 2.2 seconds for the stone to drop from rest and splash into the water at the bottom.

What is the speed of the stone when it hits the water?

Answer = ... m/s **[2]**

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(b) Describe the motion of the stone as it falls.

Assume it does not reach terminal velocity.

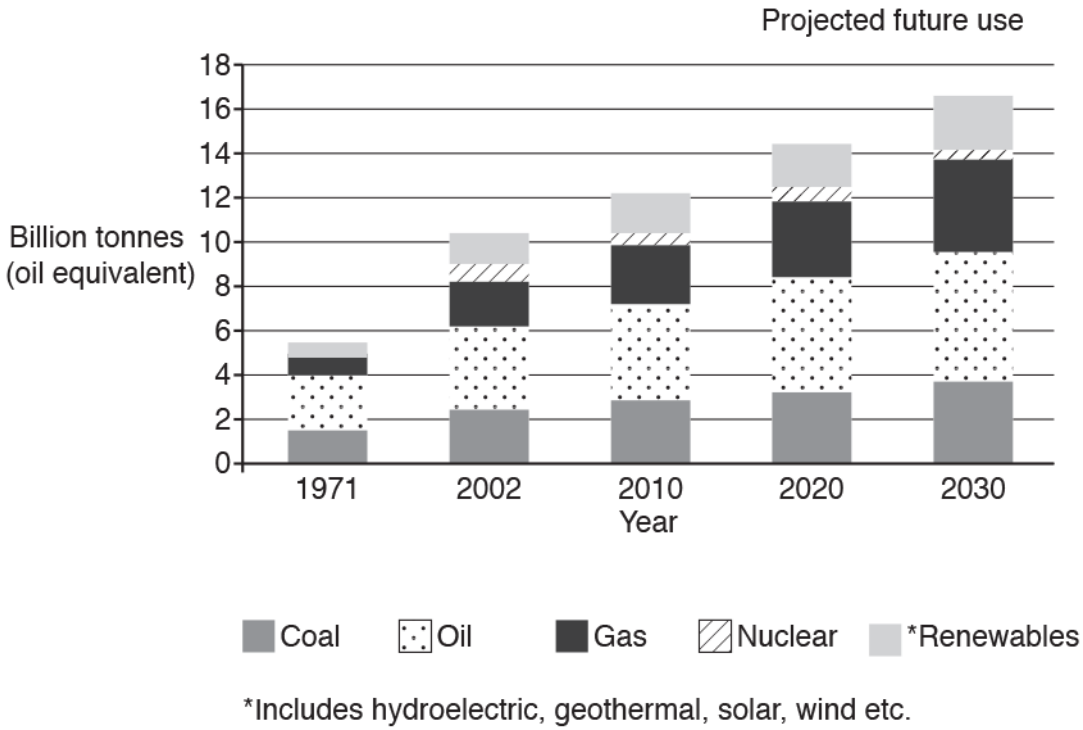
Use a free body diagram to help you.

---

[4]

36(a) 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]

(b) Power stations in the UK generate electricity at 25 kV a.c.

The voltage is then increased to 400 kV a.c. and distributed by power lines.

(i) Write down the full name of the device used to **increase** the voltage.

---

[1]

(ii) Why is it important to increase the voltage in these power lines?

---

[1]

(iii) The high voltages across the power lines are reduced to 230 V a.c. for use in the home.

A phone charger changes the 230 V a.c. to a 5 V d.c.

Explain the difference between d.c. and a.c.

---

[2]

(c) A domestic wind turbine has a power rating which varies from 1.0 kW to 3.0 kW.

(i) The domestic wind turbine has an electrical resistance of 23 Ω.

It generates a current of 11 A on a windy day.

Calculate the power output in kW of the turbine on this day.

Answer = ---------- kW **[4]**

() Suggest why the manufacturer gives a range for the power rating of the wind turbine.

---**[1]**

(i) Using just **one** domestic wind turbine may be an unreliable source of power for a house.

State a reason why.

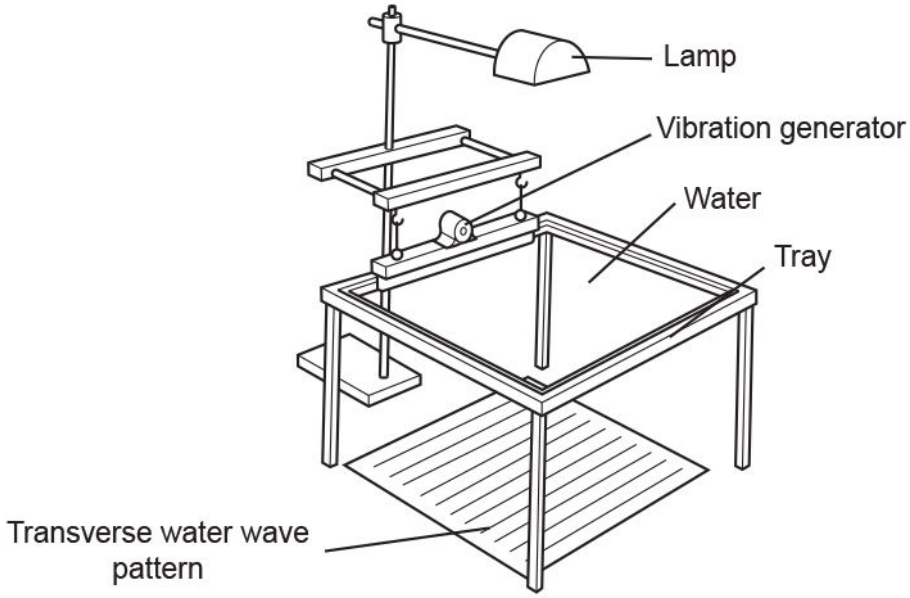
---**[1]**

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37 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.

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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.

[2]

38 * Ultrasound and X-rays are used to scan patients in hospital.

Look at the information about these two different waves.

Name	Frequency	Wavelength	Type	Description
Ultrasound	$\geq$ 2 MHz	$\leq 1.6 \times 10^{-4}$ m	Longitudinal	Pressure sound wave
X-rays	$\geq 3 \times 10^{16}$ Hz	$\leq$ 10 nm	Transverse	Electromagnetic wave

Ultrasound and X-rays are used to scan different parts of the patient.

Explain how ultrasound and X-rays are used and evaluate the risks and benefits of using these two different waves to scan patients in hospital.

Use the information in the table in your answer.

[6]

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39(a) Carbon is a common element. Carbon has two different isotopes called carbon-12 and carbon-14. Both of these isotopes have six protons in the nucleus.

(i) Carbon-14 is radioactive and carbon-12 is **not** radioactive.

Explain why some isotopes are radioactive.

---

[1]

(ii) Describe how the nucleus of carbon-12 is different to the nucleus of carbon-14.

---

[1]

(b) Decay equations are used to show the type of emission from different radioactive elements.

(i) Complete the decay equation for **alpha** emission.

$$^{230}_{92}U \rightarrow ^{4}_{2}He + ^{.....}_{.....}Th$$

[2]

(ii) Complete the decay equation for **beta** emission.

$$^{214}_{83}Bi \rightarrow ^{.....}_{.....}\beta + ^{214}_{84}Po$$

[2]

(iii) Complete the decay equation for **gamma** emission.

$$^{235}_{.....}U \rightarrow ^{0}_{0}\gamma + ^{.....}_{92}U$$

[2]

40 Some electromagnetic waves are used to scan a person in hospital.

Which statement is true about a scan that uses **electromagnetic** waves?

A Micro-waves are used to scan skin.

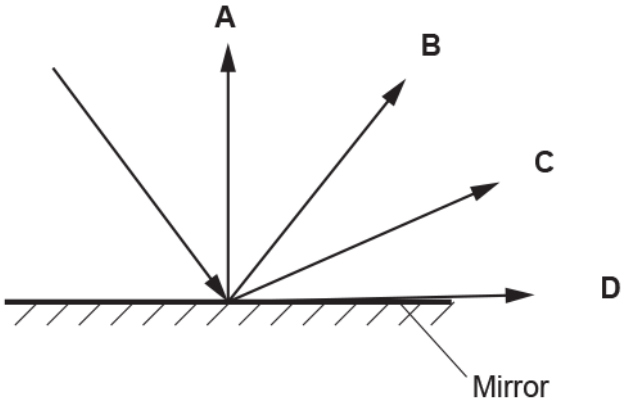
B Ultrasound waves are used to scan an unborn baby.

C Ultra-violet is used to scan for cancer.

D X-rays are used to scan for broken bones.

Your answer ☐ [1]

41 Which light ray shows the correct reflection from the plane (flat) mirror?



Your answer ☐ [1]

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42 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]

43 Water waves are transverse and sound waves are longitudinal.

(i) Describe how water particles move in a **transverse** water wave.

---

[1]

(ii) Describe how air particles move in a **longitudinal** sound wave.

---

[1]

44 A lorry has a mass of 3500 kg. It travels at a speed of 30 m/s.

Use the equation: Kinetic Energy = 0.5 × Mass × Speed^2

Calculate the kinetic energy of this lorry.

A 10 500 J

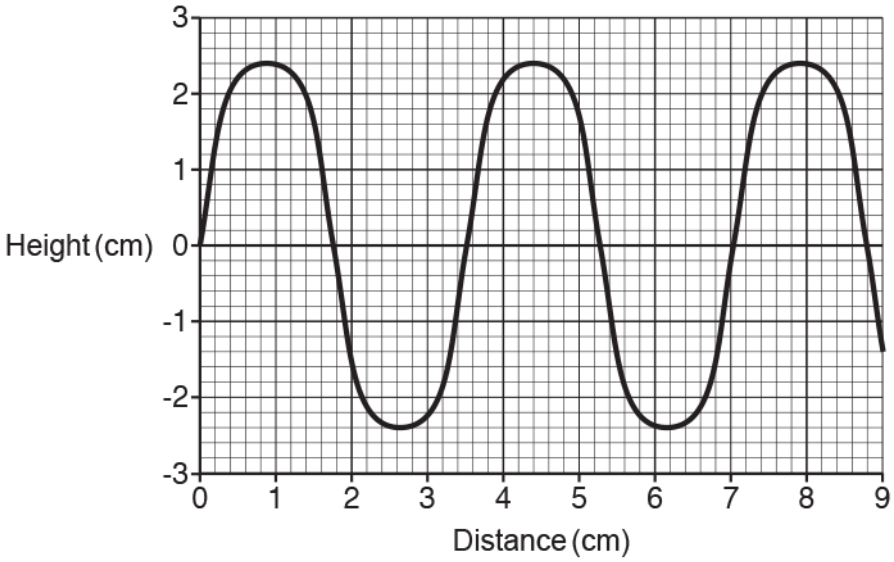
B 52 500 J

C 1 575 000 J

D 3 150 000 J

Your answer ☐ **[1]**

45(a) Look at the diagram of a water wave.



(i) What is the **wavelength** of this wave?

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Answer = _____ cm **[1]**

(ii) What is the **amplitude** of this wave?

Answer = _____ cm **[1]**

(iii) The wavelength of the wave is changed to 25 cm. Two waves are produced each second.

Use the equation: Wave speed = Frequency × Wavelength

Calculate the speed of the wave.

Answer = _____ m/s **[2]**

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(b) Look at the diagram of the electromagnetic spectrum.

Radio	Microwave	Infra-red	Visible light	Ultra-violet	X-rays	Gamma-rays

(i) Name a wave that has a longer wavelength than red light.

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

(ii) Name a wave that has a higher frequency than violet light.

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

(iii) State two **uses** of gamma-rays.

1. ----------

2. ----------

[2]

46(a) Look at the information about different electric motors.

Electric motor	Energy input per hour (J)	Useful energy output per hour (J)	Energy 'wasted' per hour (J)
A	72 000	60 000	
B	54 000	36 000	
C	18 000		3 000
D		48 000	12 000
E	54 000	48 000	

(i) Calculate the energy input per hour in J for electric motor **D**.

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Answer = _____ J [2]

(ii) Which electric motor has the **lowest** 'wasted' energy in one hour?

_____ [1]

(iii) Which electric motor has the **highest** 'wasted' energy in one hour?

_____ [1]

(iv) Describe how energy is 'wasted' in an electric motor.

_____

_____ [1]

(v) Suggest how this 'wasted' energy can be reduced in an electric motor.

_____

_____ [1]

(b) Calculate the % efficiency of electric motor **E**.

Use the equation: Efficiency = Useful output energy transfer / Input energy transfer

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

Answer = _____ % [2]

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47 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

* Explain why the stopping distances are different for each speed in Fig. 20.1.

[6]

48(a)

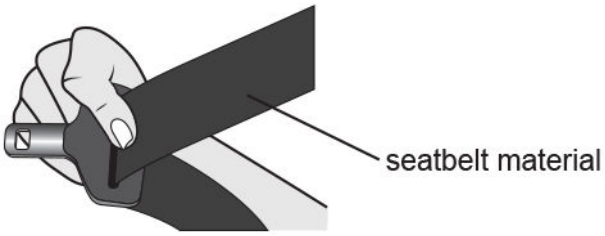
A car has a total weight of 12 000 N. It has four tyres which each have an area of 25 cm^2 in contact with the road.

Calculate the pressure of the car on the road.

Answer = _____ N/cm^2

[3]

(b) Seatbelts in cars are made of a wide material that stretches in a crash.



(i) Explain why it is important that the material is **wide.**

_____

_____ [1]

(ii) Explain why it is important that the material is **stretchy.**

_____

_____ [1]

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49(a) A student watches a ball game on the school field.

The student sees the ball being hit with a bat but he hears the sound a short time after. This is because the speed of light is greater than the speed of sound.

He decides to do an experiment to measure the speed of sound waves in air.

Describe which measurements he needs to measure this speed.

---

[2]

(b) Which equation is used to calculate speed?

---

[1]

50 **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

Calculate the reaction time of the person driving the car.

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

51

Children in cars use special seats with their own seatbelts.



The seatbelts for children are narrower than adult seatbelts.

Why is it safe for children's seatbelts to be **narrower** than adult seatbelts?

---

[2]

52(a) This question is about force, mass and acceleration.

A car starts from rest and accelerates at 3 m/s^2.

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

Calculate the **velocity** of the car after 4 s.

Answer = _____ m/s **[2]**

(b) A roller coaster car moves down a slope with an acceleration of 5 m/s^2.

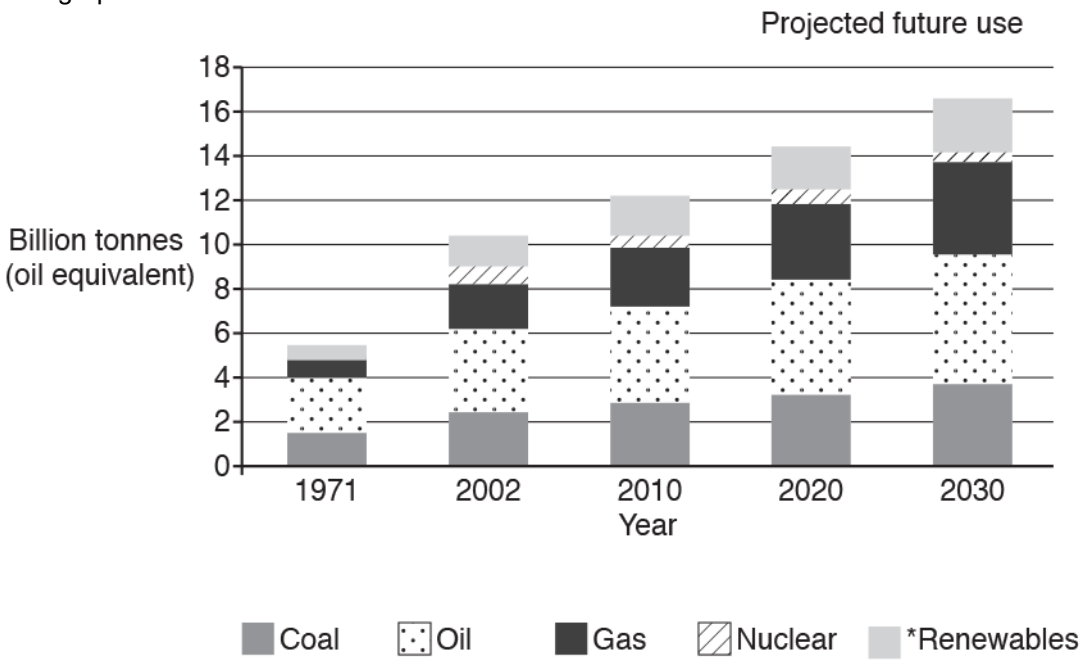
The force on the roller coaster car is 4000 N.

Calculate the **mass** of the roller coaster car.

Answer = _____ kg **[2]**

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

The graph shows some of their research.



*Includes hydroelectric, geothermal, solar, wind etc.

(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.

---

[2]

(b) Power stations in the UK generate electricity at 25 kV a.c.

The voltage is then increased to 400 kV a.c. and distributed by power lines.

(i) Write down the full name of the device used to **increase** the voltage.

---

[1]

(ii) Why is it important to increase the voltage in these power lines?

---

[1]

(iii) The high voltages across the power lines are reduced to 230 V a.c. for use in the home.

A phone charger changes the 230 V a.c. to a 5 V d.c.

Explain the difference between d.c. and a.c.

---

[2]

(c) A domestic wind turbine has a power rating which varies from 1.0 kW to 3.0 kW.

(i) The domestic wind turbine has an electrical resistance of 23 Ω.

It generates a current of 11 A on a windy day.

Calculate the **power** output in kW of the turbine on this day.

Answer = _____ kW **[4]**

(ii) Suggest why the manufacturer gives a range for the power rating of the wind turbine.

_____

_____ **[1]**

(iii) Using just **one** domestic wind turbine may be an unreliable source of power for a house.

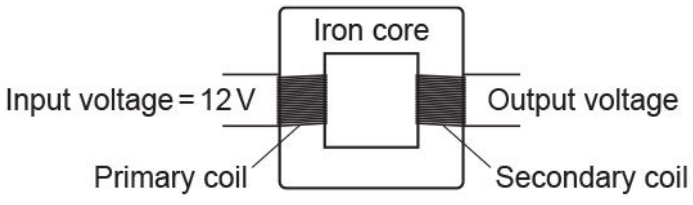
State a reason why.

_____

_____ **[1]**

54(a) A student investigates building model transformers in the laboratory.

Look at the diagram.



The student builds four different transformers, each with different primary and secondary coils.

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Using an input voltage of 12 V the student measures the output voltage.

Look at the results.

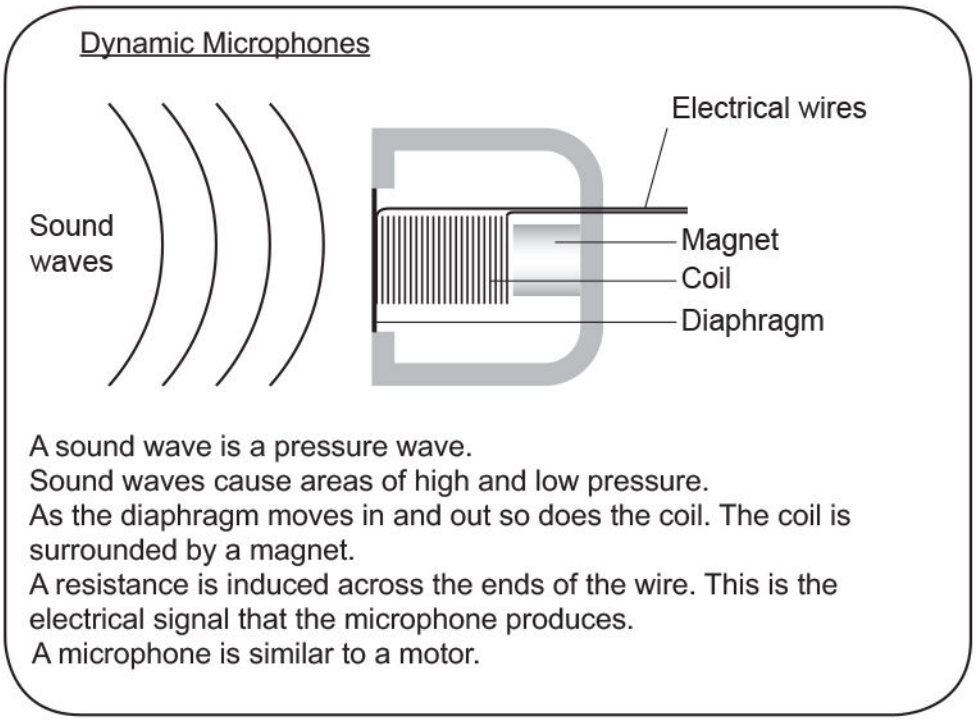
Attempt	Number of turns in primary coil	Number of turns in secondary coil	Output voltage (V)
A	100	200	23
B	200	100	6
C	300	600	23
D	600	300	6

* Explain how a transformer works and if this data supports the expected output voltages.

[6]

(b) A student completes a project on how dynamic microphones work.

Look at her project. The student uses two incorrect words in her work.



(i) Identify **one** of the incorrect words **and** write a correct sentence to replace the mistake.

Incorrect word ----------

Corrected sentence ----------

---

[2]

(ii) Name a device which uses this effect in reverse.

---

[1]

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55 A student investigates a gas at **constant volume.**

Explain, using ideas about particles, how temperature affects gas pressure.

---

[3]

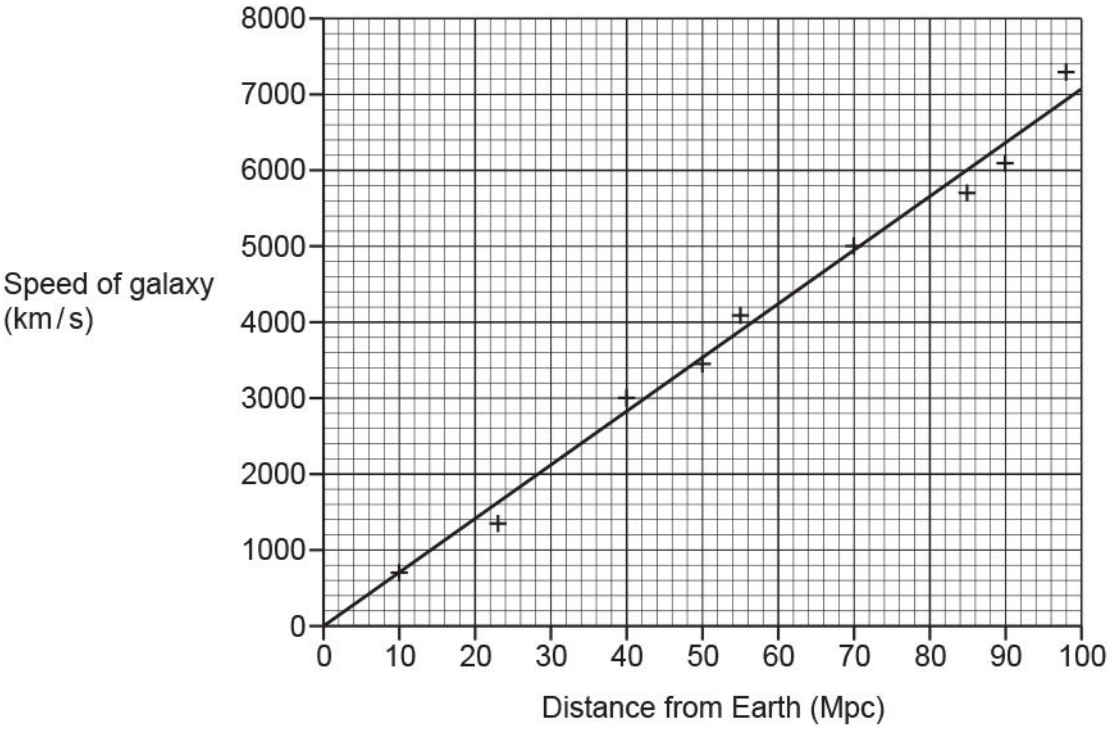
56(a) Edwin Hubble discovered that all distant galaxies were moving away from the Earth.

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]

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(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 2.53×10^{24} m.

Use your answer to **(i)** to help you.

Time = ... s **[3]**

END OF QUESTION PAPER

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