

PEARSON EDEXCEL GCSE PHYSICS (HIGHER) • 1PH0

PHYSICS



EXAM QUESTION PACK

TOPIC 10: ELECTRICITY AND CIRCUITS (PACK 2)

SCORE

/89

PERCENTAGE

%

STEMUP

These questions belong to Pearson Edexcel, not to us.

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

What we do not own

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

Where to find the originals

Pearson Edexcel publishes its past papers, mark schemes and examiner reports. Always check the current specification at [qualifications.pearson.com](https://www.pearson.com/qualifications) 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 and we will act on it.

Q1.

Figure 11 shows the three-pin plug used to connect the kettle to the mains.

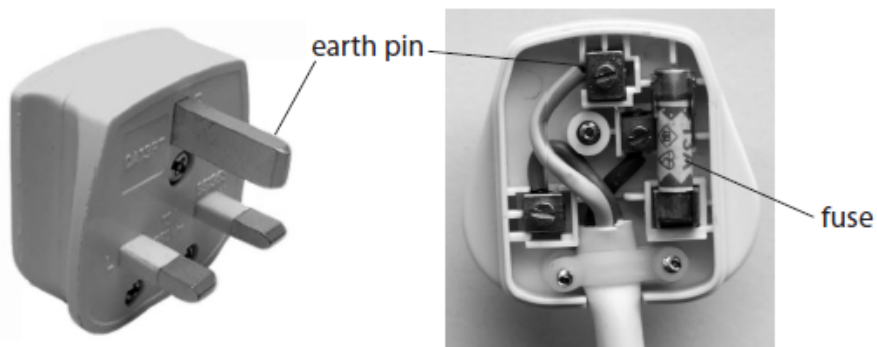


Figure 11

A fault occurs in the kettle causing the live wire to touch the metal case of the kettle.

Explain how the safety features of the plug operate when this fault occurs.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q2.

Figure 23 shows an electric car connected to a battery charger.



(Source: © Danil Roudenko/123RF)

Figure 23

* The battery charger shown in Figure 23 is connected to the 230 V a.c. domestic mains supply.

The output voltage of the charger is 335 V and it provides a d.c. charging current. Charging stops if the charging current exceeds 15 A.

Explain how electrical components in the charger can be connected together to give this type of output.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q3.

A student investigates how the resistance of a thermistor varies with temperature.

Figure 8 shows the apparatus used for this investigation.

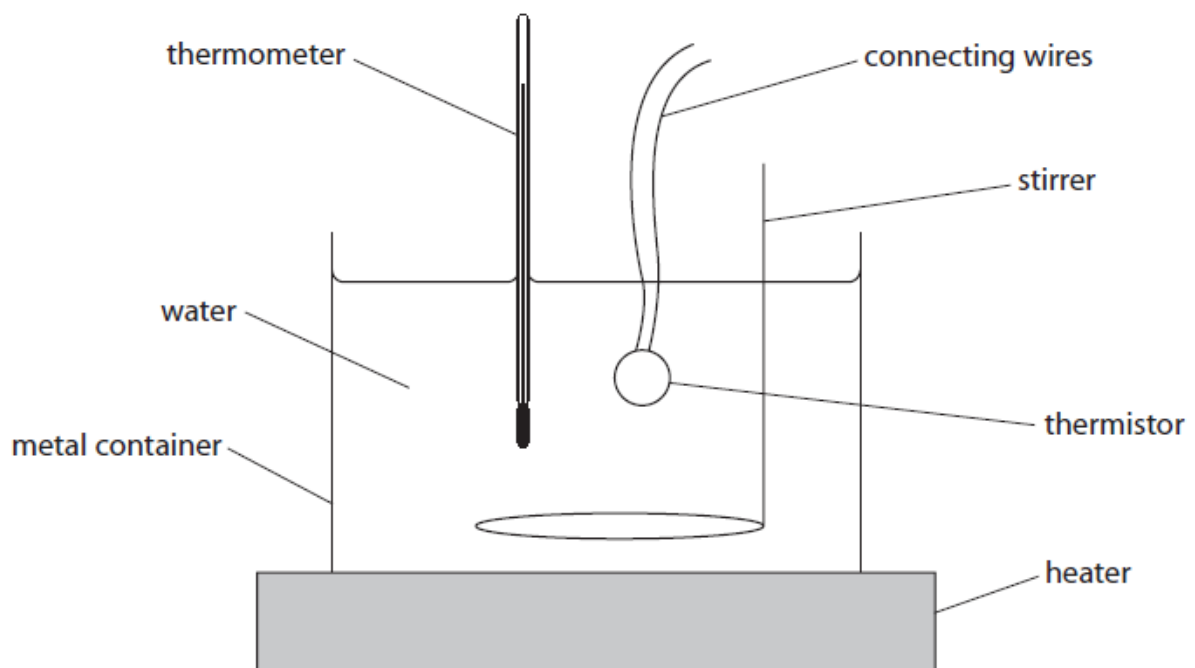


Figure 8

(i) Explain **one** improvement in measurement that the student could make in the investigation.

(2)

.....

.....

.....

.....

In this investigation, the resistance can be measured in two ways.

Method 1 - use an ohmmeter.

Method 2 - use an ammeter and a voltmeter.

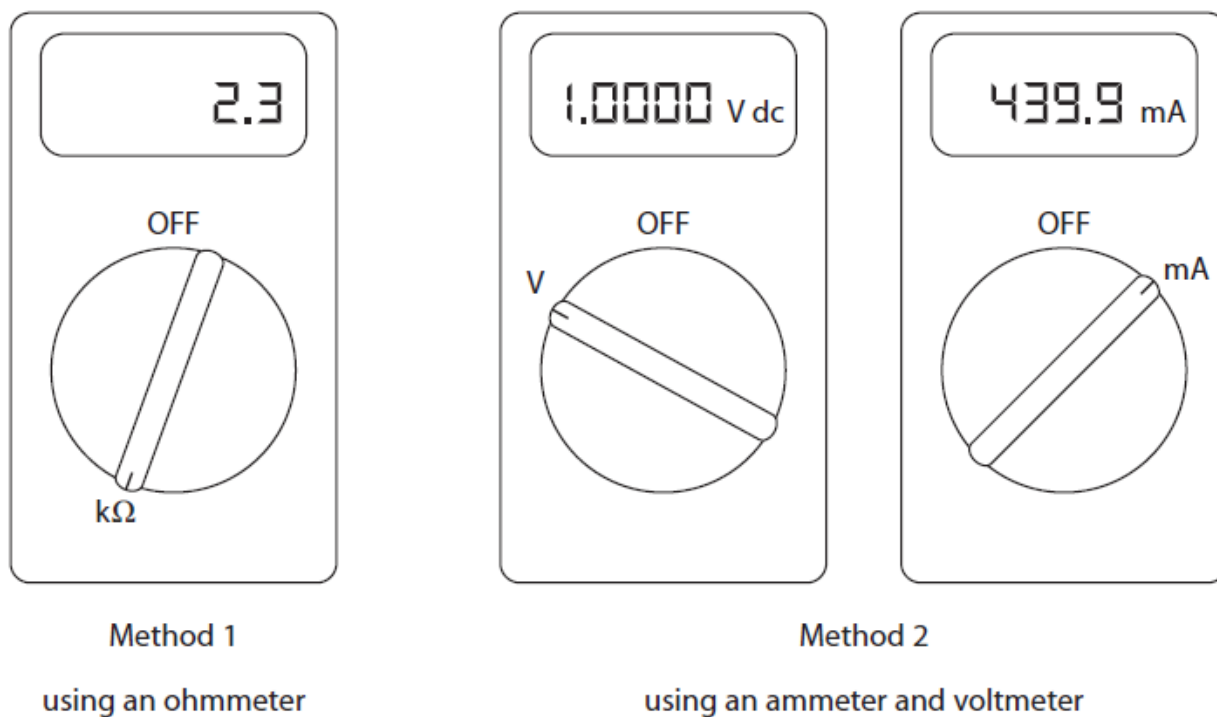


Figure 9

(ii) Explain why method 2 gives more precise results than method 1.

(2)

.....

.....

.....

.....

(Total for question = 4 marks)

Q4.

Figure 2 shows an open door.

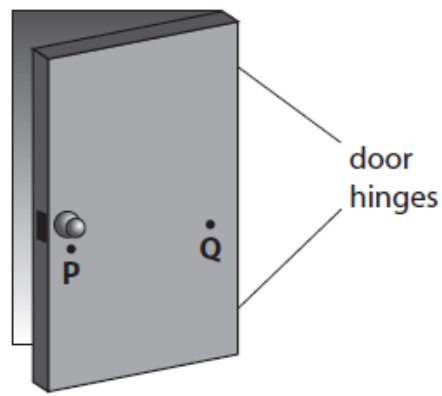


Figure 2

Explain why it is easier to close the door by pushing at point **P** rather than pushing at point **Q**.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q5.

Figure 7 shows a person trying to lift a large rock using a metal bar.

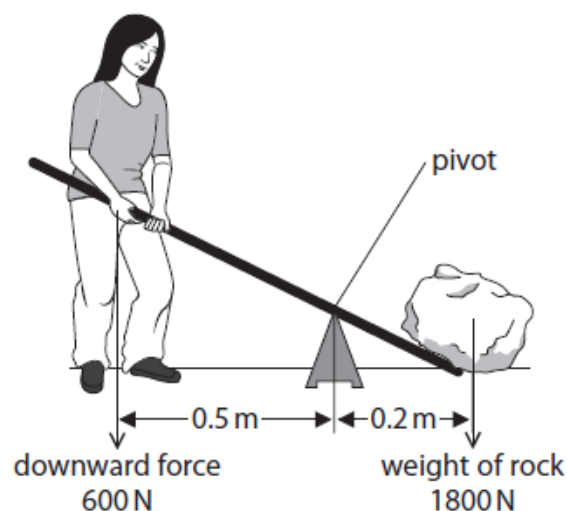


Figure 7

The rock weighs 1800 N.

The person can only produce a downwards force of 600 N.

The person cannot lift the rock.

(i) Explain, using calculations, why the person cannot lift the rock.

(3)

.....

.....

.....

.....

.....

.....

(ii) Explain **one** change to the arrangement that will make it possible for this person to lift the rock.

(2)

.....

.....

.....

.....

(Total for question = 5 marks)

Q6.

A resistor is connected to a power supply.

The resistor becomes warm while there is a current in it.

Explain why the resistor becomes warm.

(2)

.....

.....

.....

.....

.....

(Total for question = 2 marks)

Q7.

(i) Figure 14 shows the vertical forces on an aeroplane.

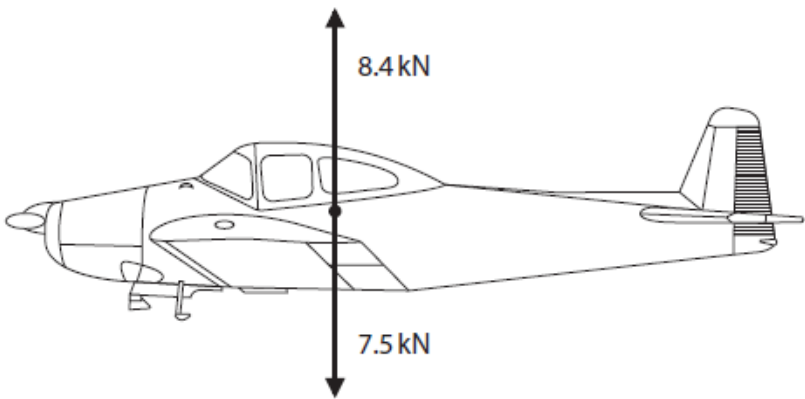


Figure 14

Use information from the diagram to determine the size and direction of the resultant vertical force on the aeroplane.

(2)

size = ... kN, direction is

(ii) The aeroplane is descending.

Figure 15 shows a diagram of the resultant vertical and horizontal forces on the aeroplane as it is descending.

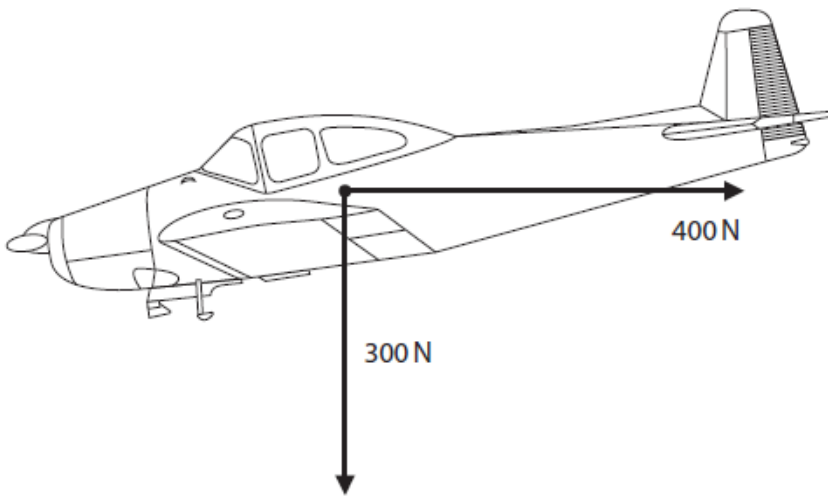


Figure 15

Complete the diagram to show the resultant of these two forces.

(1)

(iii) The mass of the aeroplane is 750 kg.

Calculate the change in gravitational potential energy of the aeroplane as it descends from 1300 m to the ground.

Gravitational field strength (g) = 10 N/kg

(2)

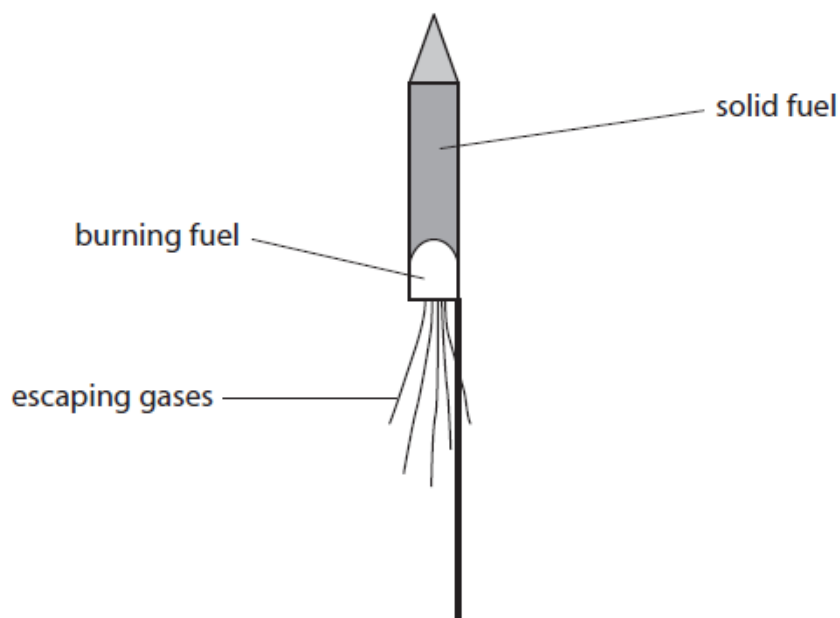
energy = ... J

(Total for question = 5 marks)

Q8.

A firework rocket contains a solid fuel inside a cardboard tube.

The burning of the fuel creates a thrust to propel the rocket upwards.



(i) Scientists can refer to several different quantities when describing the motion of the rocket.

mass	energy	speed	force
------	--------	-------	-------

Only one of these quantities is a vector.

Complete this sentence using **one** of the words from the box.

(1)

The vector quantity is

(ii) Before the fuse is lit, the total weight of a rocket including fuel is 0.7N.

The gravitational field strength is 10 N/kg.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The total mass of the rocket including fuel is

(1)

☐ **A** 0.007 kg

☐ **B** 0.07 kg

☐ **C** 0.7 kg

☐ **D** 7 kg

(iii) There is a resultant force on the rocket of 0.5 N upwards when it takes off.

The arrow on the diagram shows the size and direction of the force of gravity acting on the rocket when it takes off.



Add another arrow to the diagram to show the thrust produced by the burning fuel at the time the rocket takes off.

You should label the arrow with the size of the thrust.

(2)

Q9.

Answer the question with a cross in the box you think is correct ☐ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐ .

Two cyclists ride on a hilly road and go through points P, Q, R and S.

The diagram in Figure 16 shows how the vertical height of the road changes during the journey from P to S.

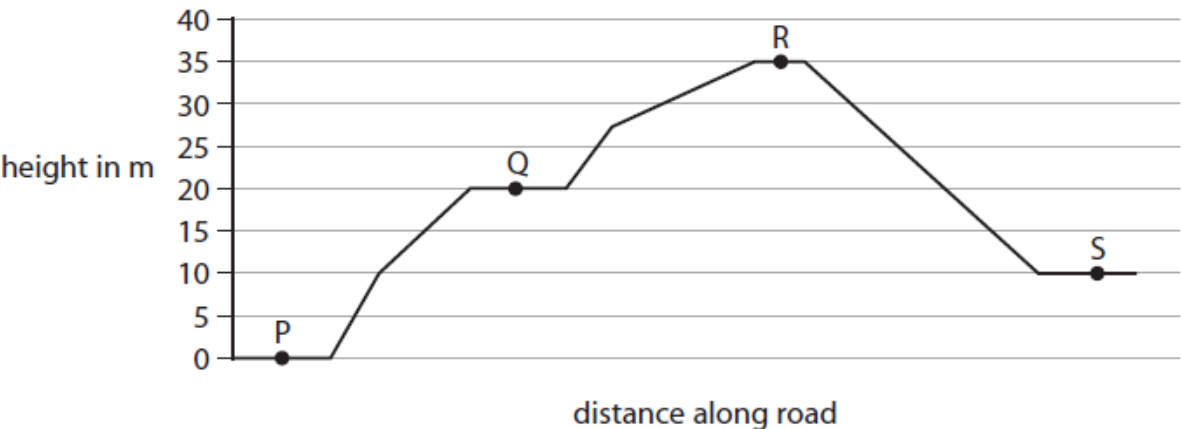


Figure 16

(i) The greatest overall change in gravitational potential energy for each cyclist is between which two points on the journey?

(1)

- ☐ **A** P and Q
- ☐ **B** Q and R
- ☐ **C** P and S
- ☐ **D** R and S

(ii) The total weight of one cyclist and bicycle is 700 N.

Calculate the total amount of work done against gravity when the cyclist travels from point P to point Q in the journey.

(2)

work done = ... J

(iii) The gravitational potential energy of the other cyclist changes by 11 250 J when travelling from point Q to point R.

Calculate the mass of this cyclist.

Gravitational field strength = 10 N / kg

Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

(2)

mass = ... kg

(iv) Explain why the total amount of work done by a cyclist between points Q and R is different from the change in gravitational potential energy of the cyclist between points Q and R.

(2)

.....

.....

.....

.....

(v) The cyclists lubricated the chains and the wheel bearings of their bicycles before setting off.

Lubricating the chains and wheel bearings helps to

(1)

- ☐ **A** decrease the amount of work done against gravity
- ☐ **B** decrease the efficiency of the cyclist and bicycle

- ☐ **C** increase the efficiency of the cyclist and bicycle
- ☐ **D** increase the overall amount of energy transferred by the cyclist

(Total for question = 8 marks)

Q10.

Explain how current varies with potential difference for the component that matches graph R.
Refer to the resistance of the component in your answer.

(3)

.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q11.

The graphs P, Q and R in Figure 7 each show how the current in a component varies with the potential difference (voltage) across that component.

In each box, state the name of the component that matches the graph.

(3)

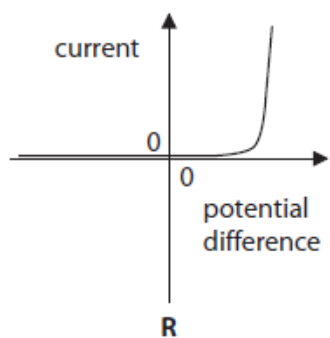
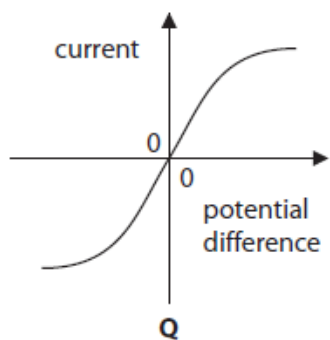
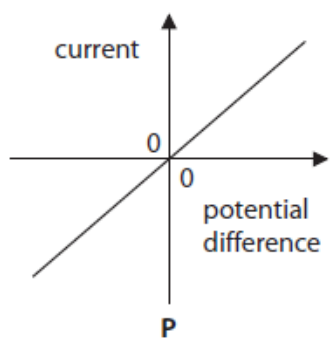


Figure 7

(Total for question = 3 marks)

Q12.

Explain how unwanted energy transfers may be reduced in mechanical systems.

(2)

(Total for question = 2 marks)

Q13.

Figure 6 shows a book resting on a table with some forces involved.

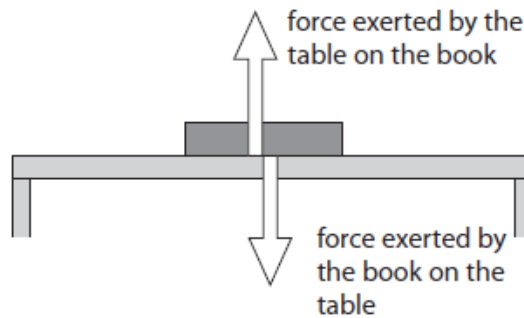


Figure 6

State why this diagram is **NOT** a free body force diagram.

(1)

.....

.....

(Total for question = 1 mark)

Q14.

In which of the following situations is a non-zero resultant force acting?

(1)

- ☐ **A** a book rests on a table
- ☐ **B** a car travels along a road at a constant speed
- ☐ **C** a javelin moves through the air after leaving an athlete's hand
- ☐ **D** a steel ball bearing descends through some car oil at a constant velocity

(Total for question = 1 mark)

Q15.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

The magnitude and direction of a force can be represented by a vector.

Figure 22 shows the forces acting on four identical trolleys. The arrows show the magnitude and direction of the forces.

Which diagram shows a pair of forces that will produce zero acceleration?

(1)

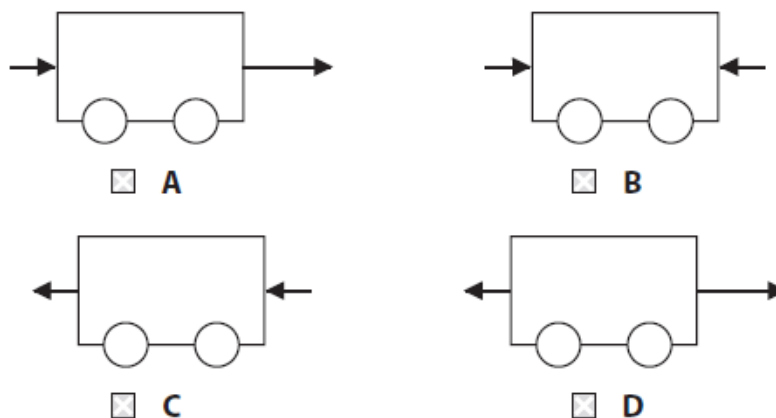


Figure 22

(Total for question = 1 mark)

Q16.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

Figure 6 shows four forces, P, Q, R and S, acting on a rod.

The rod can rotate around an axle.

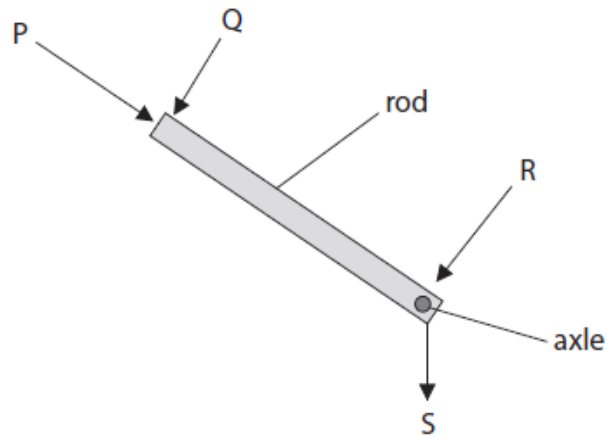


Figure 6

Which force will make the rod rotate about the axle?

(1)

- ☐ **A** P
- ☐ **B** Q
- ☐ **C** R
- ☐ **D** S

(Total for question = 1 mark)

Q17.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ~~☒~~ and then mark your new answer with a cross ☒.

Which of these symbols is used to represent a thermistor in an electrical circuit?

(1)

- ☒ A 
- ☒ B 
- ☒ C 
- ☒ D 

(Total for question = 1 mark)

Q18.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Figure 1 shows some forces acting on a seesaw.

The forces shown have the same magnitude but act in different directions.

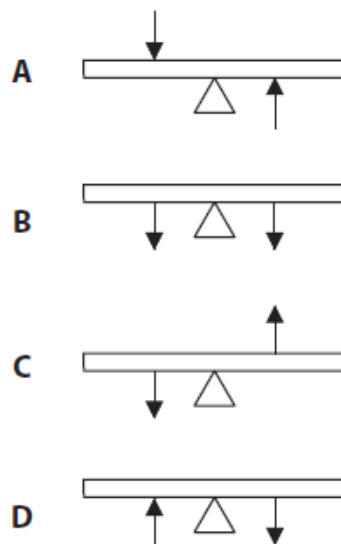


Figure 1

In which of these could the forces acting on a seesaw be in equilibrium?

(1)

- ☒ A
- ☒ B
- ☒ C

(Total for question = 1 mark)

Q19.

A student investigates the relationship between the magnetic flux density and the electromagnetic force on a current-carrying wire.

The student has the equipment shown in Figure 19.

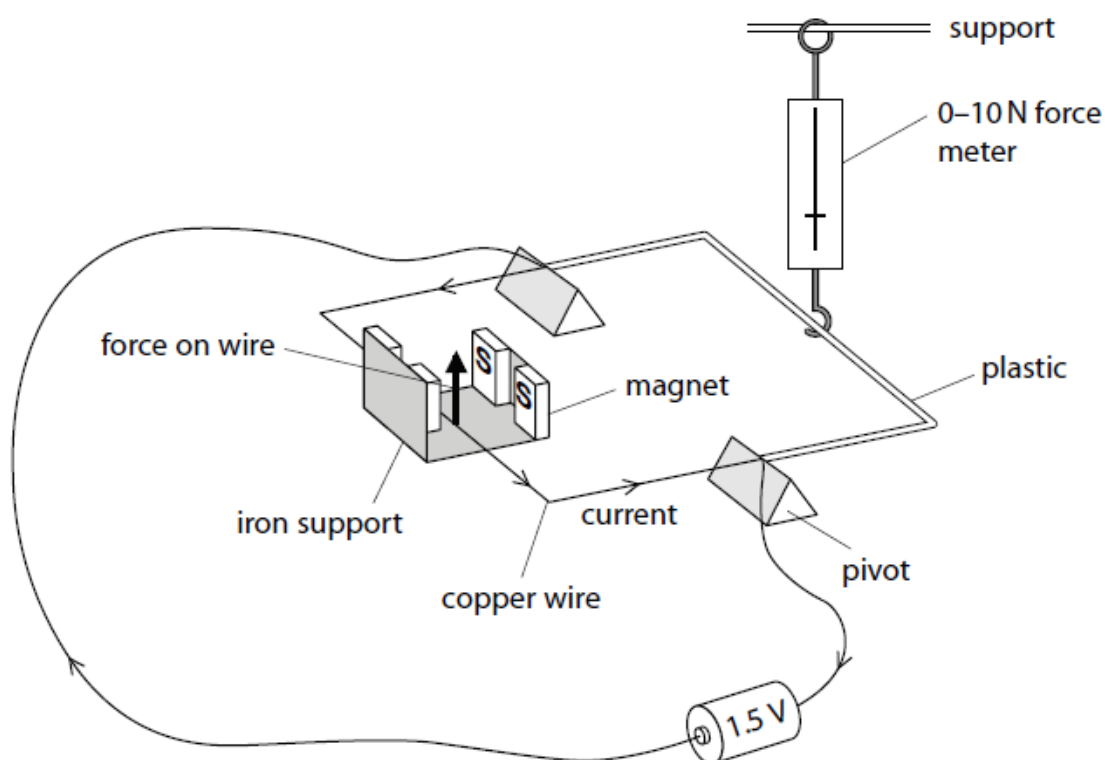


Figure 19

The student varies the number of magnets and measures the force on the wire using the force meter.

The results are shown in Figure 20.

number of pairs of magnets	reading on force meter (N)
1	0.0
2	0.0
3	0.1

Figure 20

The student decides that his equipment is not sufficiently sensitive.

Give **three** ways the student should develop his investigation to improve the quality of his results.

(3)

- 1
- 2
- 3

(Total for question = 3 marks)

Q20.

A student investigates how the resistance of a thermistor varies with temperature.

(a) The student sets up the circuit shown in Figure 5 to measure current and voltage.

He finds that it does not work.

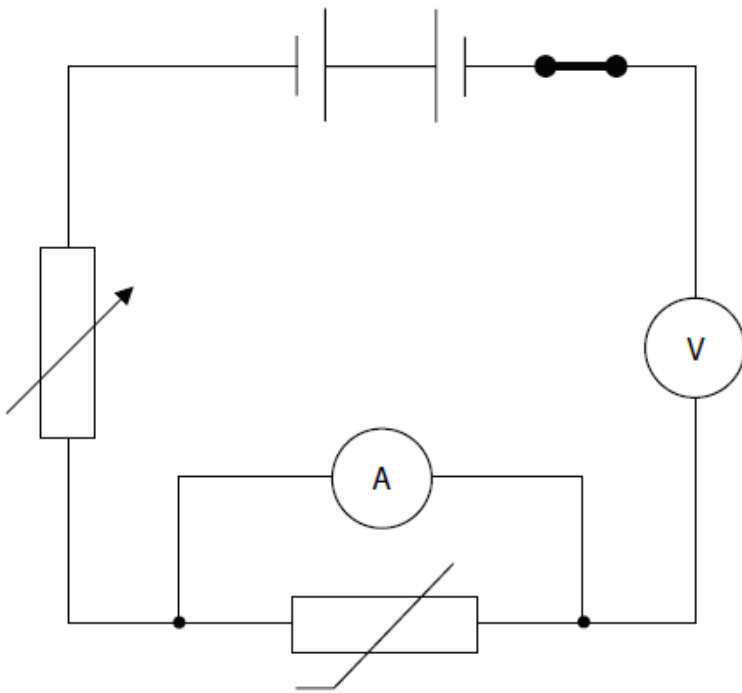


Figure 5

Give **three** modifications the student should make to the circuit so that the circuit works correctly.

(3)

1

.....

2

.....

3

.....

(b) The student uses the equipment shown in Figure 6 to measure the temperature of the thermistor.

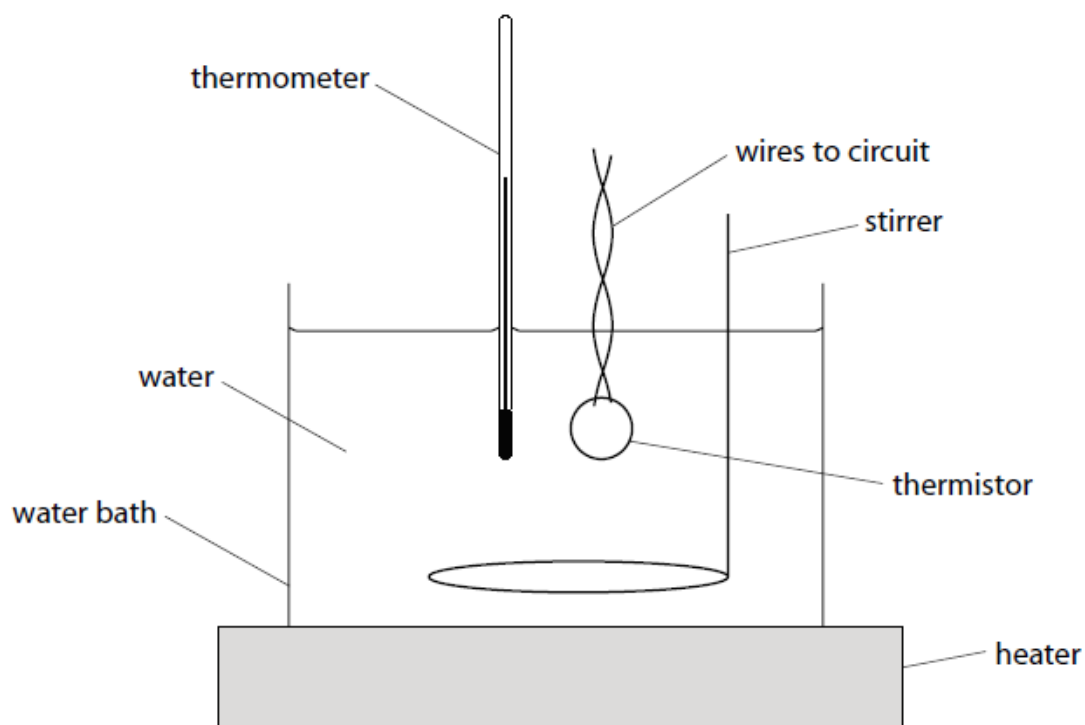


Figure 6

(i) Give **one** reason for using the water bath.

(1)

.....

.....

(ii) The equipment shown in Figure 6 is for investigations in the temperature range from 20°C to 100°C.

State **one** way the student could develop this experimental procedure to investigate temperatures outside this range.

(1)

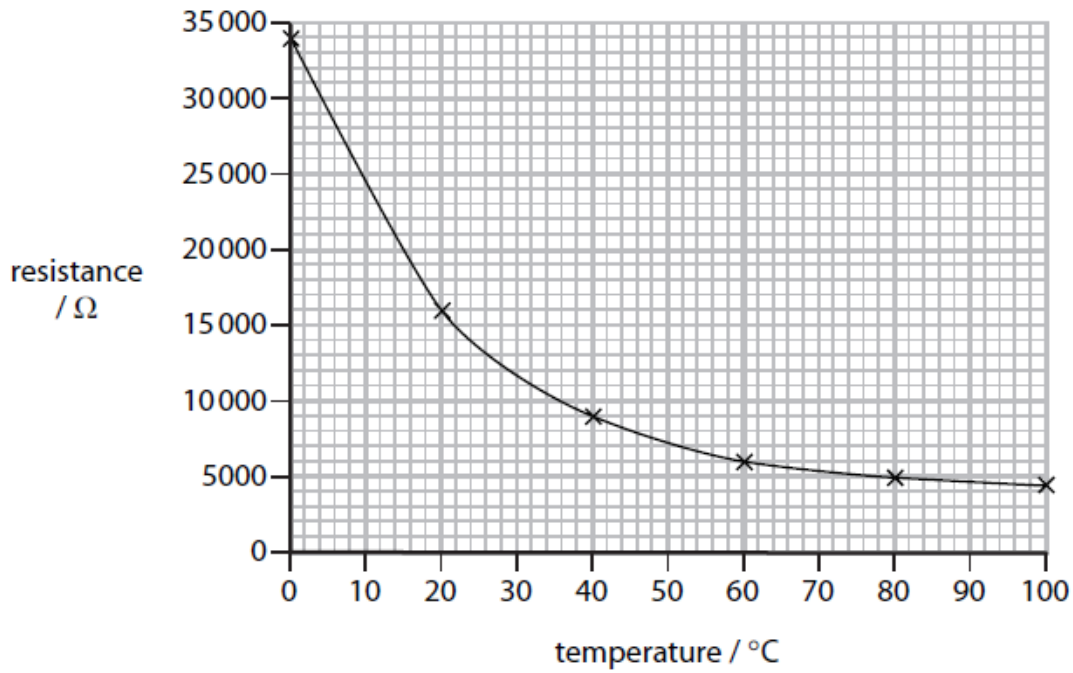
.....

.....

(c) The student takes measurements for two other components, **A** and **B**.

The results for both these components are shown in Figure 7.

Component A



Component B

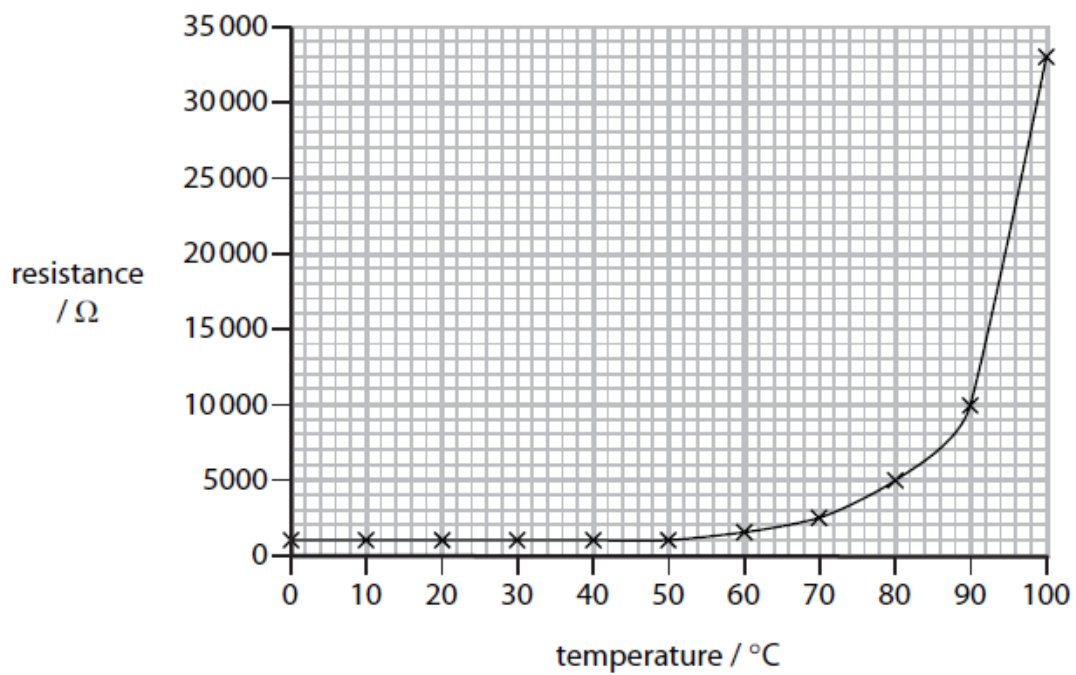


Figure 7

(i) Compare and contrast how the resistances of component **A** and component **B** vary with temperature.

(3)

.....

.....

.....

.....

.....

.....

(ii) Component **A** is connected to a 12 V supply.

Which of these is the current in component **A** when the temperature is 80°C?

(1)

☐ **A** $I = 12 \times 5000$

☐ **B** $I = \frac{12}{5000}$

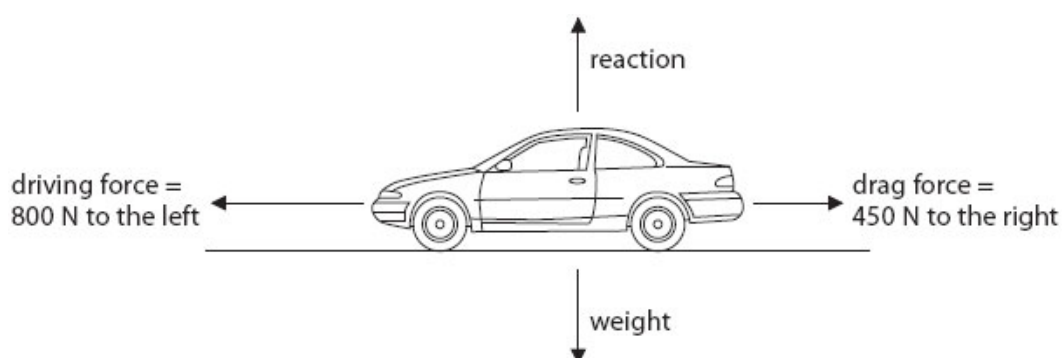
☐ **C** $I = \frac{12^2}{5000}$

☐ **D** $I = \sqrt{\left(\frac{12}{5000}\right)}$

(Total for question = 3 marks)

Q21.

The diagram shows the forces acting on a car which is travelling along a flat straight road.



(a) (i) The size of the resultant force on the car is 350 N.

In which direction is the resultant force acting?

Put a cross (☐) in the box next to your answer.

(1)

☐ **A** down ↓

- ☐ **B** to the left ←
- ☐ **C** to the right →
- ☐ **D** up ↑

(ii) Complete the sentence by putting a cross (☐) in the box next to your answer.

The car is

(1)

- ☐ **A** accelerating
- ☐ **B** decelerating
- ☐ **C** moving at a constant speed
- ☐ **D** not moving

(2)

(iii) The mass of the car is 625 kg.

Calculate the weight of the car.

gravitational field strength = 10N/kg

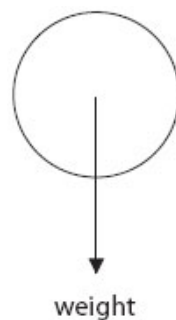
(2)

weight of car = ...N

(b) Forces also act on objects when they fall through the air.

There are two forces acting on this ball as it falls through the air.

The weight is shown on the diagram.



(i) Draw and label an arrow on the diagram to show the other force acting on the ball.

(2)

(ii) Use words from the box to complete the sentences.

(2)

balanced	changing	greater	smaller	zero
----------	----------	---------	---------	------

After a short time the ball falls at a steady speed.

The forces acting on the ball are now

The acceleration of the ball is now

(Total for Question is 8 marks)

Q22.

Figure 8 shows a box sliding down a slope in the direction shown.

(3)

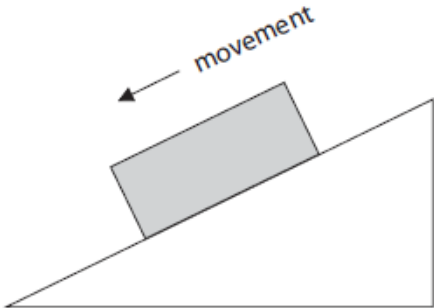


Figure 8

Draw two vector arrows on this diagram showing the 'normal contact force' and 'friction' acting on the box.
Label these two forces.

(Total for question = 3 marks)

Q23.

Figure 18 shows identical filament lamps connected together to a 12 V power supply.

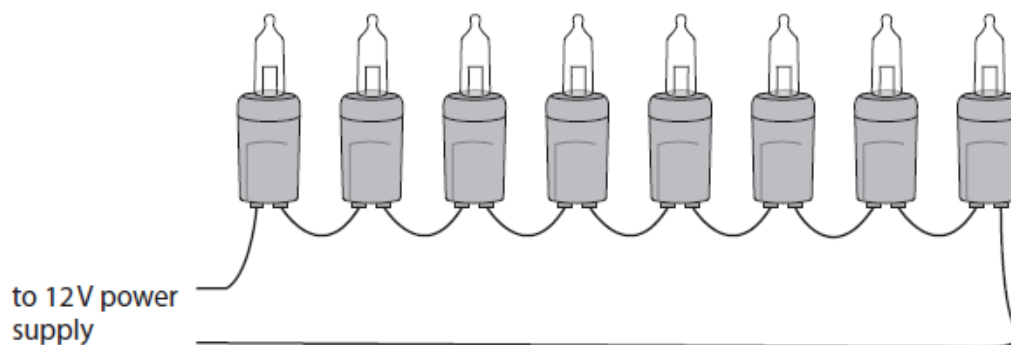


Figure 18

(i) Calculate the potential difference across each lamp.

(1)

potential difference = ... V

(ii) The power output of each lamp is 0.75 W

Calculate the resistance of each lamp.

(4)

resistance = ... Ω

(Total for question = 5 marks)

Q24.

A technician investigates different electrical devices that are used in a car.

The technician connects a device to the 12 V car battery.

The technician measures the current in the circuit and the potential difference (voltage) across the device.

Figure 8 shows the car battery and the device that is being tested.



Figure 8

(i) Draw on Figure 8 to show how the circuit should be completed so that the current in the circuit and voltage across the device can be measured.

(2)

(ii) The technician tests a headlamp.

The current in the headlamp is 4.8 A when connected to the 12 V battery.

Calculate the power supplied to the headlamp.

(2)

power = ... W

(iii) The technician tests an interior light.

The current in the interior light is 600 mA when connected to the 12 V battery.

Calculate the energy transferred to the interior light in 7 minutes.

Use an equation selected from the list of equations at the end of the paper.

(2)

energy transferred = ... J

(Total for question = 6 marks)

Q25.

Figure 1 shows a lamp connected to a d.c. power supply.

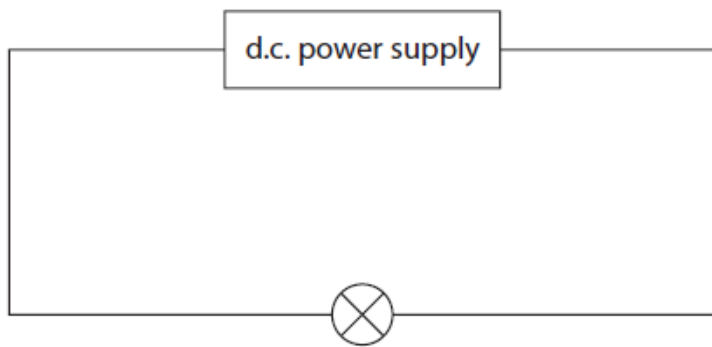


Figure 1

The power supply provides a potential difference (voltage) of 4.5 V.

The current in the lamp is 0.30 A.

Another **identical** lamp is added to the circuit, as shown in Figure 2.

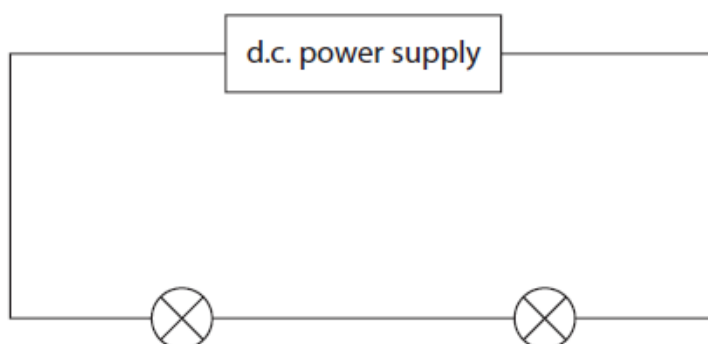


Figure 2

The power supply provides the same potential difference as it provided in the circuit in Figure 1.

State and explain the difference between the brightness of the lamp in Figure 1 and the brightness of a lamp in Figure 2.

(3)

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q26.

A car headlamp has a power rating of 55 W when the current in the headlamp is 4.4 A.

(i) State the equation relating power, current and resistance.

(1)

(ii) Calculate the resistance of the headlamp.

(3)

resistance = ... Ω

(Total for question = 4 marks)

Q27.

A student investigates moments of forces.

Figure 14 shows the apparatus used.

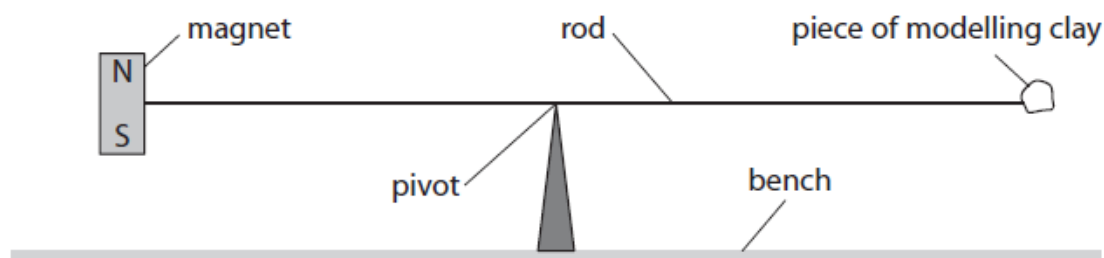


Figure 14

The pivot is under the centre of the rod.

A magnet is fixed to one end of the rod.

A piece of modelling clay is fixed to the other end of the rod.

The system is in equilibrium.

State the relationship between the moment of the weight of the magnet and the moment of the weight of the piece of modelling clay about the pivot.

(1)

.....

(Total for question = 1 mark)

Q28.

Figure 16 shows a cardboard tube with a wire coming out from each end.



Figure 16

There are two 10 ohm resistors inside the cardboard tube.

A potential difference of 6.0 V is connected between P and Q.

There is a current of 1.2 A in the wires.

Deduce how the resistors have been arranged inside the cardboard tube.

(3)

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q29.

Figure 10 shows an arrangement of gears.

Each gear turns around a fixed axle.

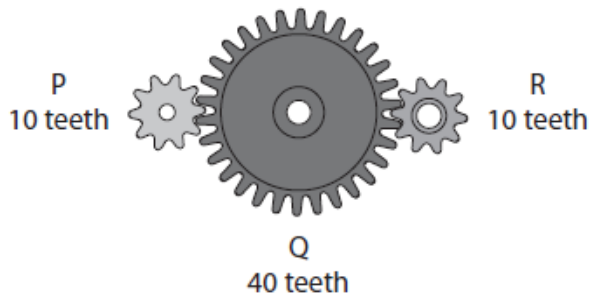


Figure 10

Gear P is turned through one complete revolution per second.

(i) Which of the following describes the motion of gear R?

(1)

	speed (revolutions per second)	direction of rotation
☐ A	4	same as P
☐ B	1	same as P
☐ C	4	opposite to P
☐ D	1	opposite to P

(ii) Figure 11 shows the same arrangement with gear R replaced by a rack.

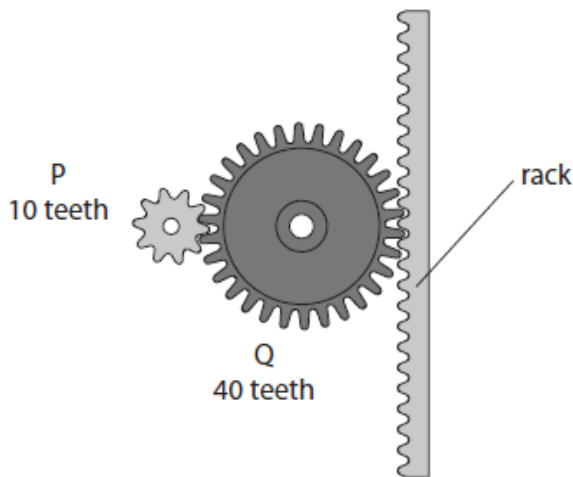


Figure 11

The rack can move up or down when the gears turn.

The teeth on the rack are 2 mm apart.

Calculate how far the rack moves when P turns through to one complete revolution.

(2)

distance = ... mm

(Total for question = 3 marks)

Q30.

Figure 24 shows a submarine underwater.

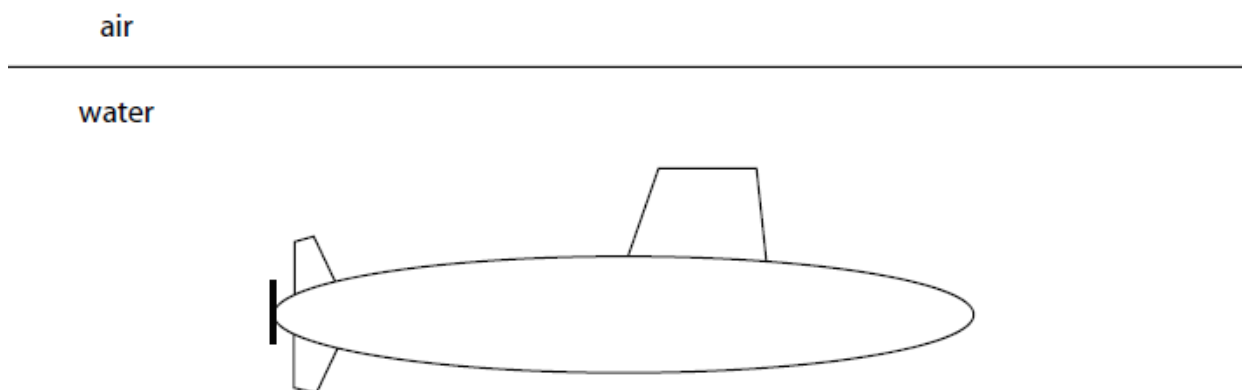


Figure 24

The motor in the submarine turns the gear wheels shown in Figure 25.

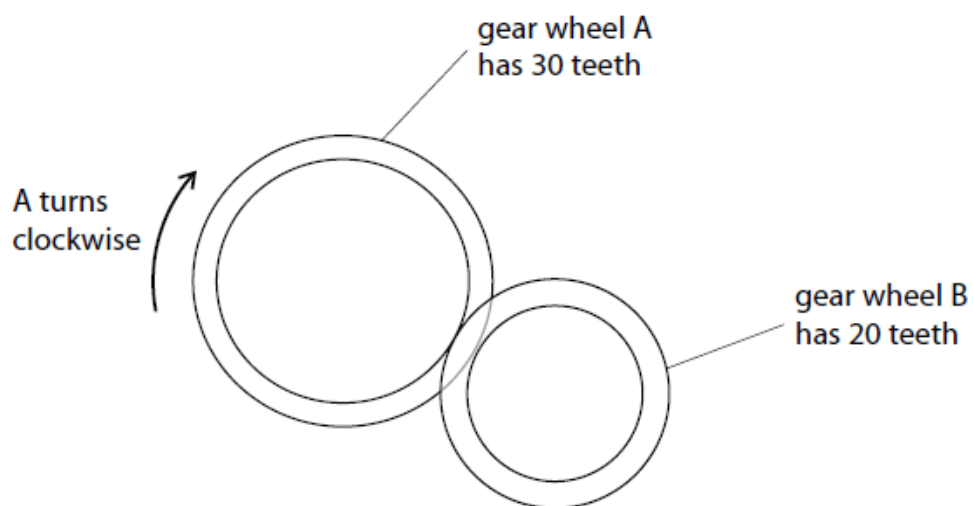


Figure 25

Gear wheel A rotates clockwise through one complete turn.

Which of these is correct for gear wheel B?

(1)

	amount that gear wheel B rotates	direction gear wheel B rotates
☐ A	1½ turns	clockwise
☐ B	1½ turns	anticlockwise
☐ C	⅔ of a turn	clockwise
☐ D	⅔ of a turn	anticlockwise

(Total for question = 1 mark)

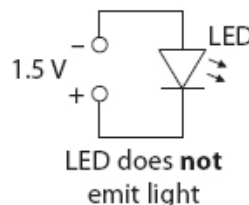
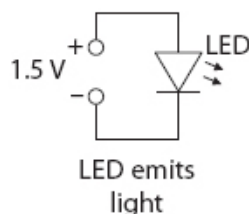
Q31.

(a) What is the name of the device used to change the size of an alternating voltage?

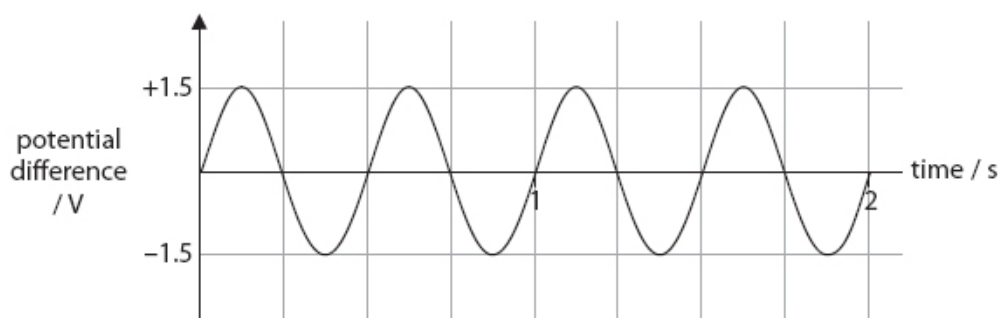
(1)

.....

(b) A light emitting diode (LED) can only emit light when connected correctly to a potential difference.



Use this information to suggest what happens when this alternating voltage is connected across the LED.



.....

.....

.....

-
- (c) A LED lamp has a power rating of 3 W.
The voltage across the lamp is 12 V.
Calculate the current in the lamp.

(3)

current in the lamp =.....A

- *(d) Some research has been carried out into replacing fluorescent lamp fittings with LED fittings.



photo of stairwell
with fluorescent fitting



photo of stairwell
with LED fitting

The data in the table is taken from the report of a trial using LEDs to light stairwells and corridors in a large building.

total energy saved each year by using LEDs	3 000 kW h
LED fitting cost	£2 000
CO ₂ saving each year by using LEDs	1.6 tonnes
change in lighting levels by using LEDs	200%
average price of electrical energy	14 p / kW h
average lifetime of LED fittings	50 000 hours
average lifetime of fluorescent fittings	10 000 hours

Use the information to discuss the benefits of replacing fluorescent fittings with LED fittings.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question = 12 marks)

Q32.

Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

Which of these is a vector quantity?

(1)

- ☐ **A** acceleration
- ☐ **B** speed
- ☐ **C** time
- ☐ **D** distance

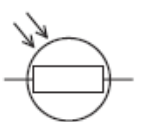
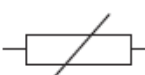
(Total for question = 1 mark)

Q33.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

Which of these shows the correct circuit symbol for a thermistor?

(1)

- ☐ **A** 
- ☐ **B** 
- ☐ **C** 
- ☐ **D** 

(Total for question = 1 mark)

Q34.

The photograph shows the security check-in at an airport.



metal detector

X-ray scanner

An X-ray machine is used to scan luggage for dangerous items.
A metal detector is used to check people for dangerous items.

(a) (i) Suggest why people are not scanned with X-rays in an airport but have X-rays in a hospital.

(2)

.....

.....

.....

.....

(ii) The security people work near the X-ray machine.

Explain how they are protected from the X-rays.

(2)

.....

.....

.....

.....

(b) X-rays are produced when fast moving electrons collide with a metal anode in a vacuum tube.

(i) The electrons come from the cathode by the process of thermionic emission.

Explain what is meant by thermionic emission.

(2)

.....

.....

.....

.....

(ii) The current in the vacuum tube is 7.0 mA.
charge on an electron is 1.6×10^{-19} C.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The number of electrons colliding with the metal anode in one second is

(1)

☐ **A** 2.3×10^{-20}

☐ **B** 2.3×10^{-17}

☐ **C** 4.4×10^{16}

☐ **D** 4.4×10^{19}

(iii) In order to produce X-rays which can penetrate the luggage, each electron must have at least an energy of 1.4×10^{-14} J.
The charge on an electron is 1.6×10^{-19} C.

Calculate the accelerating potential difference which will produce electrons of this energy.

(3)

accelerating potential difference = ... V

(Total for Question = 10 marks)

Mark Scheme

Q1.

Question Number	Answer	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1(6 marks) AO1 Earth • earth wire connected to metal case • metal case is a conductor • (when live touches case) resistance between live and earth is very low • (very) large current to earth through (low resistance) earth wire • case is kept at same potential as earth • so cannot get a shock if (earthed) person touches metal case Fuse • made of thin wire • fuse connected between live pin and wire to kettle • temperature of wire depends on current in it • when the current is (very) large, the temperature of the wire increases beyond melting point of wire • fuse (wire) breaks • disconnects mains supply to kettle • prevents damage to house wiring • (now) there is no possibility of live wire in kettle being at mains voltage	(6)

Mark	Descriptor
0	No rewardable material.
1–2	- Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) - Presents an explanation with some structure and coherence. (AO1)
3–4	- Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) - Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
5–6	- Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) - Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Summary for guidance			
Level	Mark	Additional Guidance	General additional guidance e.g. At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> isolated facts about either fuse or earth	<u>Possible candidate responses</u> The fuse blows when there is a fault. The earth stops you from getting shock
Level 2	3–4	<u>Additional guidance</u> facts about fuse and earth that are linked to provide an explanation of the operation of either the fuse or the earth. OR a well-developed explanation of the operation of fuse or earth	<u>Possible candidate responses</u> The earth wire is connected to the (metal) case of the kettle. The wire in fuse melts when current becomes too big. OR A large current flows through the wires in the kettle. The wire in the fuse heats up and melts. This disconnects the kettle from the mains supply.

Level 3	5–6	<u>Additional guidance</u> explanation of the operation of both the fuse and the earth one explanation may be more developed than the other but both fuse and earth must be explained.	<u>Possible candidate responses</u> A large current flows through the wires in the kettle. The wire in the fuse heats up and melts. The earth wire keeps (exposed) metal parts at earth potential and prevents shocks
---------	-----	--	---

Q2.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 (6 marks) - the sequence of events is voltage change, conversion to direct current, followed by current limiting - the battery is the load in the secondary circuit, not a store of energy for the primary circuit - a transformer is needed to increase (or step up) the voltage - so a diode is needed to change a.c. to d.c. - the charging current can be limited to 15 A using a fuse (or circuit breaker) - a circuit breaker may be preferable to a fuse, since a fuse would need to be replaced after use - the transformer primary coil is connected between the live and neutral in the primary circuit - the diode is connected in the secondary circuit of the transformer - the battery(which is to be charged), diode, fuse and secondary coil should be connected in series in the secondary circuit	(6)

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	- Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) - Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	- Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) - Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	- Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) - Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Q3.

Question number	Answer	Additional guidance	Mark
(i)	explanation linking a suitable improvement (1) with a matching reason (1)	for example place thermometer close(r) to the thermistor stirring digital thermometer thermometer measures same temperature as thermistor to get uniform temperature (for stirring) thermometer with better resolution or scale	(2) A03.3

Question number	Answer	Additional guidance	Mark
(ii)	an explanation including: method 2 has measurements to more significant figures / more decimal places (than method 1) (1) so the calculated answer can have more s.f.'s / d.p.'s (1)	may be shown via a calculation accept an alternative argument in terms of consistency in final calculated answer ignore restating stem of question – e.g. so more precise ignore more accurate	(2) A02.2

Q4.

Question number	Answer	Additional guidance	Mark
	an explanation linking distance from hinge/pivot increased (1) (therefore) smaller force needed (to close door)	P further from hinge than Q accept the greater distance gives greater moment for 2 marks	(2)

Q5.

Question Number	Answer	Additional guidance	Mark
(i)	recall of moment = force x distance (1) (moment of force from person =) 600×0.5 and (moment of weight of rock =) 1800×0.2 (1) moment of force from person is less than moment of weight of rock. (1)	may be implied in a calculation 300 (Nm) and 360 (Nm) independent mark accept reverse argument	(3)

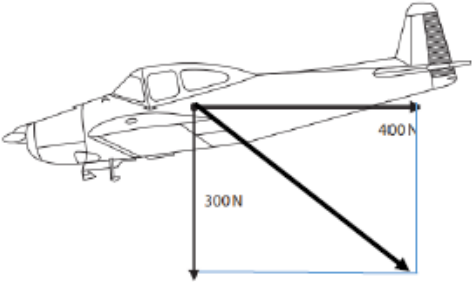
Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that links increase distance between person and pivot/ reduce distance between rock and pivot / increase force from person (1) increase the moment of the force from the person / decrease the moment of the weight of the rock (1)	use longer lever / hold lever nearer the end / move pivot nearer to rock / get someone to help to push value of new distance and calculation of new moment	(2)

Q6.

Question Number:	Answer	Additional Guidance	Mark
	an explanation linking: collisions between electrons and lattice (1) lattice {vibrates / moves} more (1)	throughout accept atoms / ions for lattice accept charges / charged particles for electrons allow collision between electrons in this context KE of lattice increases KE of electrons decreases	(2) AO 1 1

Q7.

Question Number:	Answer	Additional guidance	Mark
(i)	0.9 (k N) (1) up / upwards / ascending (1)	accept .9 or 0.90 north N ↑	(2) AO 3 2a AO 3 2b

Question Number:	Answer	Additional guidance	Mark
(ii)		judge length and direction by eye construction lines need not be shown magnitude need not be stated allow missing arrowhead if direction and length are correct reject answers which have any additional vectors drawn	(1) AO 3 2b

Question Number:	Answer	Additional Guidance	Mark
(iii)	recall and substitution (1) $GPE = 750 \times 10 \times 1300$ evaluation (1) (energy =) 9 800 000 (J)	no POT error (could have missed out g) allow answers in standard form 9.8×10^6 allow answers that round to 9 800 000 e.g. 9 750 000 J allow 9800 kJ or 9.8MJ allow 9 555 000 J allow negative values award full marks for correct answer without working	(2) AO 2 1

Q8.

Question Number	Answer	Acceptable answers	Mark
(i)	force (1)	If than one word given then 0 marks.	(1)

Question Number	Answer	Acceptable answers	Mark
(ii)	B 0.07kg		(1)

Question Number	Answer	Acceptable answers	Mark
(iii)	Arrow pointing (vertically) upwards (1) Value of 1.2 (N) (written near to arrow) (1)	Marks are independent of each other	(2)

Q9.

Question number	Answer	Additional guidance	Mark
(i)	D R and S A, B and C are incorrect because the difference in vertical positions are all less than that shown by R and S		(1) AO1

Question number	Answer	Additional guidance	Mark
(ii)	recall (1) work done = force x distance substitution and evaluation (1) (work done =) 14,000 (J)	(work done) = 700 x 20 award full marks for the correct answer without working	(2) AO1

Question number	Answer	Additional guidance	Mark
(iii)	substitution (1) $11250 = m \times 10 \times 15$ rearrangement and evaluation (1) (mass=) 75 (kg)	award full marks for the correct answer without working. if no other marks scored then award 1 mark for answers of 0.013 (substitution mark using $h = 15$)	(2) AO2

Question number	Answer	Additional guidance	Mark
(iv)	An explanation linking some work is done to overcome friction/air resistance (1) energy is dissipated /transferred to the environment (1)	allow energy is lost thermal energy	(2) AO1

Question number	Answer	Additional guidance	Mark
(v)	C increase the efficiency of the cyclist and bicycle A is incorrect because lubrication has no effect on work done against gravity B is incorrect because lubrication will increase efficiency D is incorrect because the overall energy transfer will not increase		(1) AO1

Q10.

Question number	Answer	Mark
	An answer that makes reference to: Identification – knowledge (1 mark) and reasoning / justification – knowledge (2 marks) - to begin with (there is) no current as V increases, then, after a certain voltage, the current rises - sharply / with an increasing gradient - associated with a decreasing resistance	(3)

Q11.

Question number	Answer	Mark
	P (ohmic) resistor/wire (1) Q (filament) lamp (1) R (semiconducting) diode (1)	(3)

Q12.

Question number	Answer	Mark
	An answer that combines points of interpretation/evaluation to provide a logical description: Use of lubrication / oil (1) To reduce friction (between parts) (1)	(2)

Q13.

Question number	Answer	Mark
	An explanation identifying the fact that the forces shown are acting on two different bodies / they are not acting on the same body (1)	(1)

Q14.

Question number	Answer	Mark
	C a javelin moves through the air after leaving an athlete's hand	(1)

Q15.

Question number	Answer	Mark
	B  A, C and D are incorrect because they all show a resultant force which would cause the trolley to accelerate	(1)

Q16.

Question Number	Answer	Mark
	The only correct answer is B: force Q A is incorrect because the moment of force P about the axle is zero. C is incorrect because moment of force R about the axle is zero. D is incorrect because moment of force S about the axle is zero.	(1)

Q17.

Question Number	Answer	Mark
	The only correct answer is D  A is incorrect because that is the symbol for a diode B is incorrect because that is the symbol for a light dependent resistor C is incorrect because that is a symbol for a motor	(1)

Q18.

Question number	Answer	Mark
	B  A,C and D are incorrect as the forces would cause the seesaw to turn	(1)

Q19.

Question number	Answer	Additional guidance	Mark
	Any three from: • use a higher current as the force depends on the current (1) • use more/stronger/larger range of magnets (1) • use a force meter with smaller range, e.g. 0.00 to 0.01 (1) • use a longer distance from pivot to increase the moment of the force on the wire (1)	accept voltage for current add variable resistor (in series) with power supply accept use more sensitive force meter	(3)

Q20.

Question number	Answer	Additional guidance	Mark
(a)	- connect ammeter in series (with thermistor) (1) - connect voltmeter in parallel (with thermistor) (1) - reverse (connections for) one of the cells (1)	allow idea that meters should be swapped for two marks (equivalent to first two points)	(3)

Question number	Answer	Additional guidance	Mark
(b)(i)	Any one of the following reasons: - the thermistor and the water are at the same temperature (1) - large volume of water gives a steady temperature rise (1)	accept idea that only small part of thermometer would be in contact with a thermistor in air accept difficult to control change in temperature of thermistor when heated in air	(1)

Question number	Answer	Additional guidance	Mark
(b)(ii)	Any one of the following developments to the procedure: - add ice to increase lower limit of temperature range (1) - use liquid with higher boiling point to increase upper limit of temperature range (1)	accept named liquid with higher boiling point, e.g. oil	(1)

Question number	Answer	Additional guidance	Mark
(c) (i)	A comparison and contrast that must include at least one similarity and one difference from the following points to a maximum of three marks: Similarities - resistance of both changes with temperature (1) - both graphs show a non-linear relationship (1) - data comparison, e.g. both have the same resistance at 80°C (1)		(3)

	Differences - resistance of A decreases with temperature but resistance of B increases with temperature (1) - for A, (largest slope/rate of change) is at lower temperature but for B, (largest slope/rate of change) is at higher temperature(s) (1) - for B, resistance is constant below 50°C but for A resistance is roughly constant above 60°C (1)	accept (smallest slope/rate of change) for A is at higher temperature but (smallest slope/rate of change) for B is at lower temperature	
--	---	---	--

Question number	Answer	Mark
(c) (ii)	B	(1)

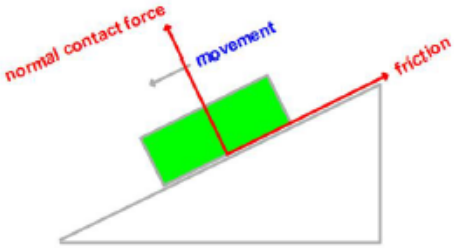
Q21.

	Answer	Acceptable answers	Mark
(a)(i)	B to the left ←		(1)
(a)(ii)	A accelerating		(1)
(a)(iii)	substitution 625x 10 (1) Evaluation 6250 (N) (1)	625 x 9.8 6125 (N) give full marks for correct answer, no working	(2)
(b)(i)		upward arrow on any part of line vertical line from any point on the diagram (1)	(2)

	air resistance (1)	air friction, upthrust, drag Ignore any downward arrow labelled weight or gravity	
(b)(ii)	Balanced (1) Zero (1)		(2)

Total for marks for question = 8

Q22.

Question number	Answer	Additional guidance	Mark
	- An arrow showing the 'normal contact force' - from between the two surfaces, acting upwards (1) - An arrow showing the 'friction' force - from between the two surfaces (1) - Both forces in the correct directions, as shown (1) 	generally upwards / away from the surface can be to the left or to the right they do not need to start from the same point	(3)

Q23.

Question Number:	Answer	Additional Guidance	Mark
(i)	1.5 (V)	accept $\frac{12}{8}$ or $\frac{3}{2}$ or $1\frac{1}{2}$	(1) AO 3 1b

Question Number:	Answer	Additional Guidance	Mark
(ii)	recall and substitution (1) $0.75 = I \times 1.5$ rearrangement (1) $(I =) \frac{0.75}{1.5} (= 0.5)$ recall, substitution and rearrangement (1) $R = \frac{1.5}{0.5}$ evaluation (1) $(R =) 3.0 (\Omega)$	allow ecf from a(i) for all marking points substitution and rearrangement in either order allow ecf of current from MP2 for this mark point only allow other approaches such as $P = \frac{V^2}{R}$ scores 1 mark $0.75 = \frac{1.5^2}{R}$ scores 2 marks $R = \frac{(1.5)^2}{0.75}$ scores 3 marks award full marks for correct answer without working	(4) AO 2 1

Q24.

Question number	Answer	Additional guidance	Mark
(i)	voltmeter connected in parallel with device (1) ammeter connected in series with device (1)	voltmeter connected in parallel with battery may be in top or bottom of circuit and could be inside or outside the voltmeter connections	(2) AO1

Question number	Answer	Additional guidance	Mark
(ii)	recall and substitution (1) (power =) 12×4.8 evaluation (1) (power =) 58 (W)	voltmeter connected in parallel with battery allow values that round to 58 e.g. 57.6 award full marks for the correct answer without working	(2) AO2

Question number	Answer	Additional guidance	Mark
(iii)	substitution (1) (power =) $12 \times 600(/1000) \times 7 (x60)$ evaluation (1) (energy =) 3000 (J)	allow values that round to 3000 e.g. 3024 allow 1 mark for any other values of 3(.024) to any power of ten. if no other marks scored then award 1 mark for answers of 50,400 or 50.4 (substitution mark) award full marks for the correct answer without working.	(2) AO2

Q25.

Question number	Answer	Additional guidance	Mark
	an explanation linking any three from: lamp in second circuit is dimmer (than lamp in first circuit) (1) current in second circuit is less (than in first circuit) (1) potential difference / voltage across each lamp (in second circuit is) less / shared (1) idea that power of each lamp (in second circuit) is less / shared (1) the (total) resistance of the second circuit is more (than in first circuit) (1)	accept reverse arguments throughout	(3) AO1.1

Q26.

Question number	Answer	Mark
(i)	either power = (current)² × resistance OR $P = I^2 \times R$	(1)

Question number	Answer	Additional guidance	Mark
(ii)	substitution into $P = I^2 \times R$ (1) $55 = 4.4^2 \times R$ rearrangement (1) $R = P \div I^2$ evaluation (1) 2.8 (Ω)	Substitution and re-arrangement in either order $R = 55 \div 4.4^2$ for 2 marks allow answers that round to 2.8 award full marks for correct answer without working allow alternative route $V = P \div I = 55 \div 4.4$ then $R = V \div I = 12.5 \div 4.4$	(3)

Q27.

Question number	Answer	Additional guidance	Mark
	(sum of) the clockwise moments = (sum of) the anticlockwise moments	moment of magnet = moment of modelling clay moments are equal (size)	(1) AO1

Q28.

Question Number:	Answer	Additional Guidance	Mark
	an explanation linking: relevant calculation (1) $R \text{ (between P and Q)} = \frac{6}{1.2} = 5\Omega$ reasoning / interpretation of result (1) this is less than {a single resistor / two resistors in series} conclusion (1) resistors must be connected <u>in parallel</u>	allow alternative arguments such as if resistors had been in series, then... $I = \frac{6}{20} = 0.3A$ V (between P and Q) $= 1.2 \times 10 = 12V$ current is more (than 0.3A) total p.d. is less than 12 V	(3) AO 3 2a AO 3 2b

Q29.

Question number	Answer			Mark
(i)	B	1	same as P	(1) AO 1 1
The only correct answer is B <i>A is incorrect because the number of teeth on P and R are equal</i> <i>C is incorrect because Q reverses the rotation of P and then R reverses the rotation of Q</i> <i>D is incorrect because Q reverses the rotation of P and then R reverses the rotation of Q</i>				

Question Number:	Answer	Additional Guidance	Mark
(ii)	use of distance = pitch x number of teeth (moved) (1) evaluation (1) (distance =) 20 (mm)	allow first mark if 2 x 4 (=8) or 2 x 40 (=80) seen award full marks for correct answer without working	(2) AO 1 1

Q30.

Question number	Answer	Mark
	B	(1)

Q31.

	Answer	Acceptable answers	Mark
(a)	transformer	Step-up transformer	(1)
		Step-down transformer	
(b)	A suggestion to include any 2 of		(2)

	the following • (LED) turns on and off • as voltage/current {changes direction/from +ve to -ve/ twice each second } (1) • (LED) on for (+ve) part of cycle (1) • (LED) off for (-ve) part of cycle (1)	Flash(es) / flicker(s) (on and off) current changes every 0.25 s /4 times each second Turns on twice each second = 2 marks Only on when voltage/current is +ve gains both marks	
(c)	substitute (1) $3 = I \times 12$ transformation (1) $I = 3 \div 12$ evaluation (1) 0.25 (A) Ignore any unit given by candidate	Subst. and transform. either order 1 mark only can be scored for correct substitution after incorrect transposition. Accept any number of sig. figs. that rounds to 0.25 (A) 250 <u>m</u>A gains 3 marks give full marks for correct answer, no working $2.5 \times$ any other power of ten = 2 marks eg 25 (A) gains 2 marks	(3)

			Indicative Content	
QWC		*(d)	A discussion including some of the following points • improved lighting levels for LEDs • energy savings per year for LEDs or calculation time • calculation of energy savings over lifetime of LEDs • calculation of monetary savings by using LEDs • link to savings in fossil fuels for LEDs or link to LEDs and reduced global warming • comparison of lifetimes and maintenance cost	
Level	0	No rewardable content		
1	1 - 2	• a limited discussion of benefits using some pieces of the information provided, e.g. LEDs last 40 000 hours longer and the lighting levels are 200% brighter. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy		
2	3 - 4	• a simple discussion of benefits using some pieces of the information and processing one of them OR 2 processed pieces of information. e.g. LEDs save 3000 kW h of energy each year and are much brighter. The money they save each year compared to fluorescents is £420. OR The payback time for the LEDs is about 5 years and in that time they		

		would have to pay for the fluorescent lights to be replaced 5 times. - the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately - spelling, punctuation and grammar are used with some accuracy
3	5 - 6	- a detailed discussion of benefits using processed information covering more than half of the data points in the table e.g. LEDs use less energy each year and this means that fossil fuel reserves are not used up as quickly. The LEDs save £420 each year and have a payback time of about 5 years. - the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately - spelling, punctuation and grammar are used with few errors

Q32.

Question number	Answer	Mark
	☒ A acceleration This is the only vector quantity from the options given	(1) A01.1

Q33.

Question number	Answer	Mark
	☒ C  Only this is the correct symbol for a thermistor	(1) A01.1

Q34.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	A suggestion linking two of: • (X-rays/they) are harmful to health (1) • airport use non-essential/ hospital use essential (1) • idea that benefits outweigh risk in hospitals (1)	Dangerous to health/damage cells/ can cause cancer/mutate cells/ionising ORA Ignore references to risks of frequent flyers	(2)

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	A suggestion linking: lead casing / shielding (1) <u>absorbs</u> X-rays (1)	metal casing/shielding (security workers) out of range Ignore references to lead suits/aprons etc.	(2)

Question Number	Answer	Acceptable answers	Mark
(b)(i)	Explanation linking two of the following:- • cathode is heated (1) • (electrons) given enough energy (1) • (electrons) escape (from the surface) (1)	filament/wire is heated boiled off / released / emitted Ignore emission	(2)

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	C 4.4×10^{16} (1)		(1)

Question Number	Answer	Acceptable answers	Mark
(b)(iii)	substitution: (1) $1.4 \times 10^{-14} = 1.6 \times 10^{-19} \times V$ Transposition (1) $(V) = 1.4 \times 10^{-14} / 1.6 \times 10^{-19}$ evaluation: (1) $88\,000\text{ (V)} / 88 \times 10^3\text{ (V)} / 8.8 \times 10^4\text{ (V)}$	substitution and transposition in any order ignore powers of 10 until evaluation $87\,500\text{ (V)}, 9 \times 10^4\text{ (V)}$ $88\text{ kV}, 87.5\text{ kV}, 90\text{ kV}$ full marks for the correct numerical answer without working	(3)

(Total marks for question = 10 marks)