Write your name here

Surname		Other names

Centre Number

Candidate Number

Physics/Additional Science
Unit P2: Physics for Your Future

Higher Tier

Friday 12 June 2015 – Afternoon	Paper Reference
Time: 1 hour	**5PH2H/01**

You must have: Calculator, ruler	Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need*.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question*.
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions*.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

PEARSON

FORMULAE

You may find the following formulae useful.

charge = current × time $\qquad\qquad\qquad\qquad\qquad\qquad$ $Q = I \times t$

potential difference = current × resistance $\qquad\qquad\qquad$ $V = I \times R$

electrical power = current × potential difference $\qquad\qquad$ $P = I \times V$

energy transferred = current × potential difference × time $\qquad$ $E = I \times V \times t$

speed = $\dfrac{\text{distance}}{\text{time}}$

acceleration = $\dfrac{\text{change in velocity}}{\text{time taken}}$ $\qquad\qquad\qquad\qquad$ $a = \dfrac{(v - u)}{t}$

force = mass × acceleration $\qquad\qquad\qquad\qquad\qquad$ $F = m \times a$

weight = mass × gravitational field strength $\qquad\qquad$ $W = m \times g$

momentum = mass × velocity $\qquad\qquad\qquad\qquad\qquad$ $P = m \times v$

force = $\dfrac{\text{change in momentum}}{\text{time}}$ $\qquad\qquad\qquad\qquad$ $F = \dfrac{(mv - mu)}{t}$

work done = force × distance moved in the direction of the force $\qquad$ $E = F \times d$

power = $\dfrac{\text{work done}}{\text{time taken}}$ $\qquad\qquad\qquad\qquad\qquad$ $P = \dfrac{E}{t}$

gravitational potential energy = mass × gravitational field strength × vertical height

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

kinetic energy = ½ × mass × velocity² $\qquad\qquad\qquad$ $KE = \frac{1}{2} \times m \times v^2$

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Answer ALL questions.

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 ☒.

Nuclear power

1   Many countries generate electricity using nuclear fission.

(a) The decay products from nuclear fission emit different types of ionising radiation.

Draw **one** line from each type of radiation to its correct description.

(2)

type of radiation	description
alpha	electromagnetic wave
beta	electron
gamma	helium nucleus

(b) There are both fuel rods and control rods inside each fission reactor.

Explain how pushing control rods between the fuel rods changes the rate of nuclear fission in the reactor.

(2)

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(c) Engineers are trying to generate electricity using the energy from nuclear fusion reactions.

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

High temperatures and pressures are needed in a nuclear fusion reactor. This is to overcome

(1)

☒ **A** the kinetic energy of nuclei

☒ **B** the electrostatic repulsion of protons

☒ **C** the magnetic repulsion of neutrons

☒ **D** nuclear fission

(ii) Describe what happens to nuclei in a nuclear fusion reaction.

(2)

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(Total for Question 1 = 7 marks)

Electrostatic air filters

2 An electrostatic air filter is designed to remove dust particles from the air in a room.

A fan blows dusty air past several metal rods and metal plates.

There is a large potential difference (voltage) between the metal rods and the metal plates.
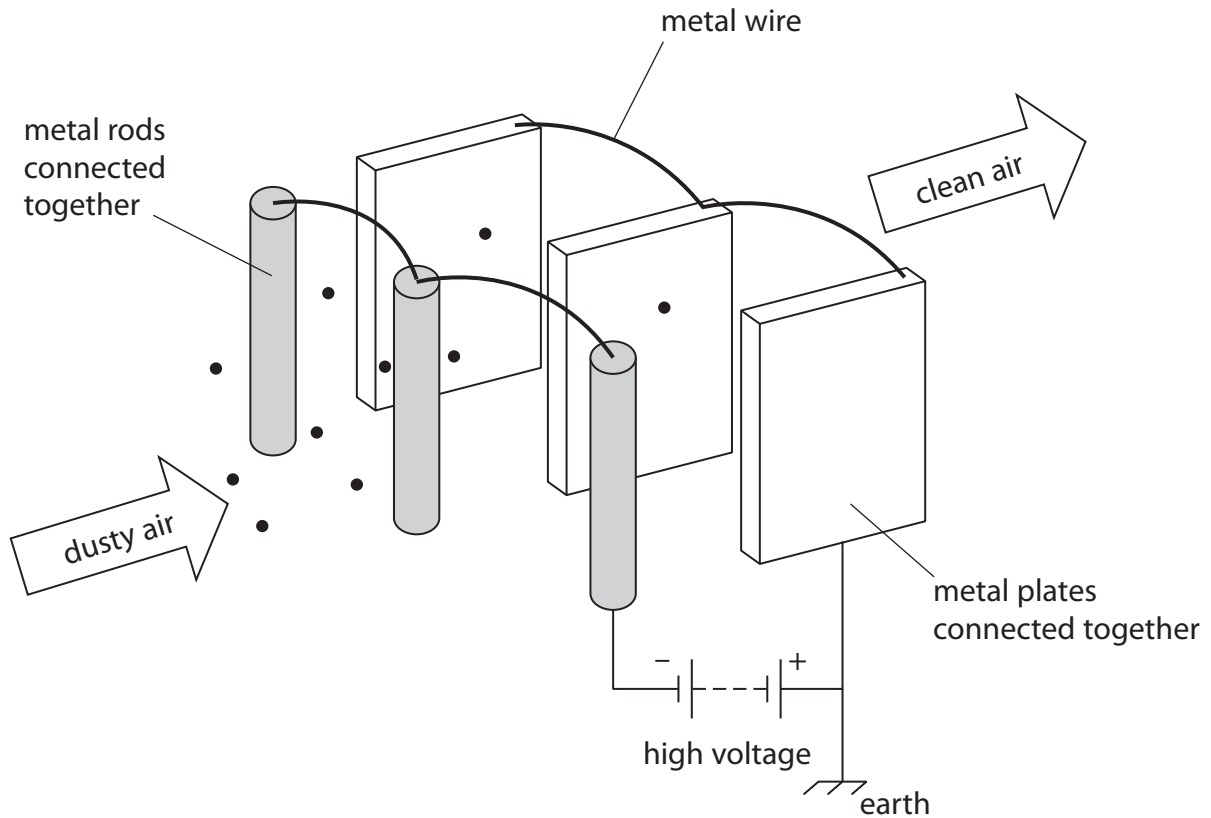
(a) Complete the sentence by putting a cross (⊠) in the box next to your answer.

When dusty air goes past the metal rods, the dust particles become negatively charged.

This is because the dust particles

(1)

⊠ **A** lose electrons

⊠ **B** lose protons

⊠ **C** gain electrons

⊠ **D** gain protons

(b) When the dusty air flows past the metal plates, the dust particles settle on the metal plates.

Explain why the dust particles settle on the metal plates.

(2)

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(c) (i) State what happens to the charge on the dust particles when they settle on the metal plates.

(1)

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(ii) Explain why the charge does not build up on the metal plates.

(2)

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(d) There is a current of 1.2 mA in the circuit.

Calculate the charge transferred by this current in 40 s.

State the unit.

(3)

charge transferred = ... unit: ....

(Total for Question 2 = 9 marks)

Modelling meteorite impacts

3 Some students investigate a model of the craters produced by meteorite impacts.

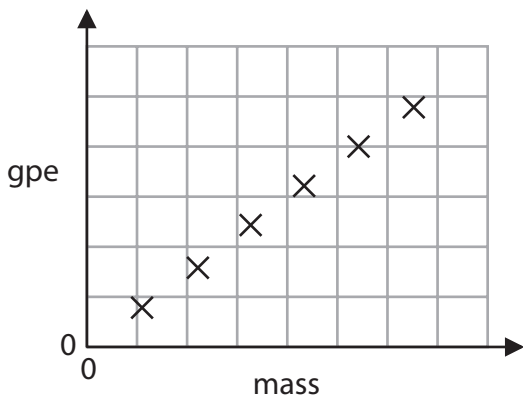They drop balls into a tray filled with sand.

They use six balls with different masses.

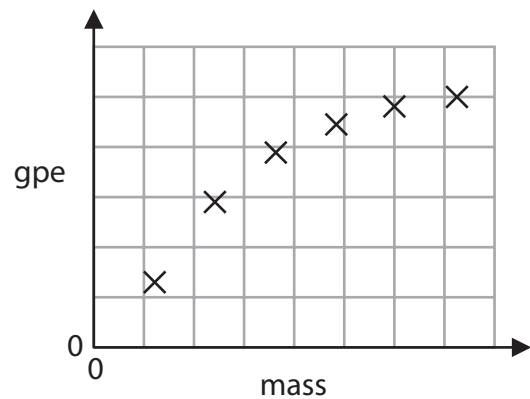They drop each ball from the same height.

(a) (i) Which one of these graphs shows the relationship between the gravitational potential energy (gpe) of the balls and their mass when they are all at the same height?

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

(1)

☒ **A**

☒ **B**
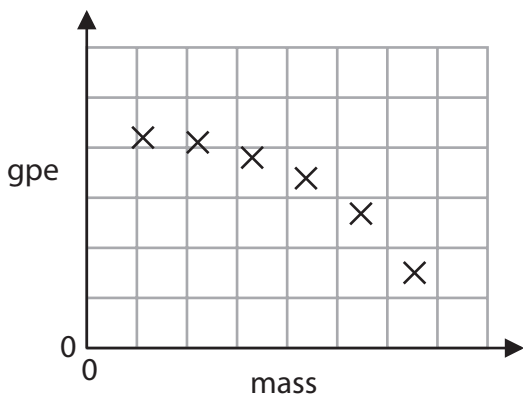
☒ **C**
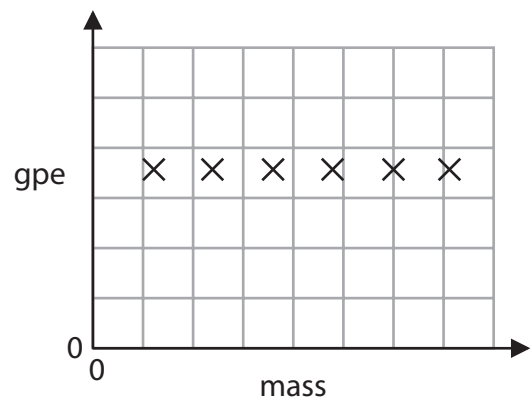
☒ **D**

(ii) Describe how the energy of a ball changes as it drops towards the sand.

(2)

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(b) This photograph shows the sand after several balls have hit it.
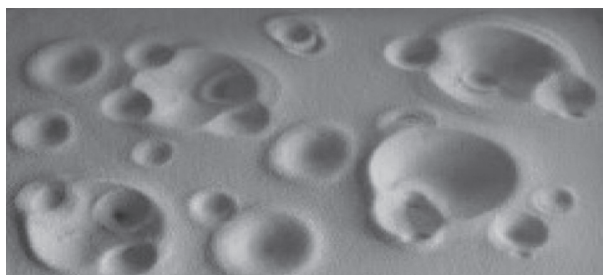
The students read this information in a textbook:

'When work is done, energy is transferred.'

Explain how work is done when the balls impact on the sand.

(2)

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(c) When one ball hits the sand, it has a velocity of 6.2 m/s.

It has a momentum of 0.46 kg m/s.

(i) Calculate the mass of the ball.

(3)

mass of ball = ... kg

(ii) The ball takes 0.17 s to come to rest after it hits the sand.

Calculate the average impact force.

(2)

average impact force = ... N

(Total for Question 3 = 10 marks)

Radiation from rocks

4 (a) One isotope of the element potassium is potassium-40.

A nucleus of potassium-40 is represented by:

$$^{40}_{19}\text{K}$$

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

The number of neutrons in a nucleus of potassium-40 is

(1)

☒ **A** 19

☒ **B** 21

☒ **C** 40

☒ **D** 59

(ii) Which of these symbols is correct for the nucleus of a different isotope of potassium?

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

(1)

$$^{39}_{19}\text{K}$$ $$^{40}_{20}\text{K}$$ $$^{19}_{40}\text{K}$$ $$^{39}_{20}\text{K}$$
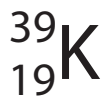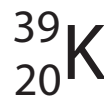
☒ **A**   ☒ **B**   ☒ **C**   ☒ **D**

(iii) A sample of potassium-40 is left for a long time.

Some of the potassium-40 nuclei will emit gamma radiation as they turn into argon-40 nuclei.

Argon-40 nuclei never change.

Describe what information this gives about the isotope potassium-40.

(2)

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(b) Some rocks containing potassium were formed many millions of years ago.

There was no argon-40 in the rocks when they were formed.

When scientists analyse samples of these rocks, they find small amounts of argon-40 trapped inside.

The graph shows how the relative amounts of potassium-40 and argon-40 change over time.
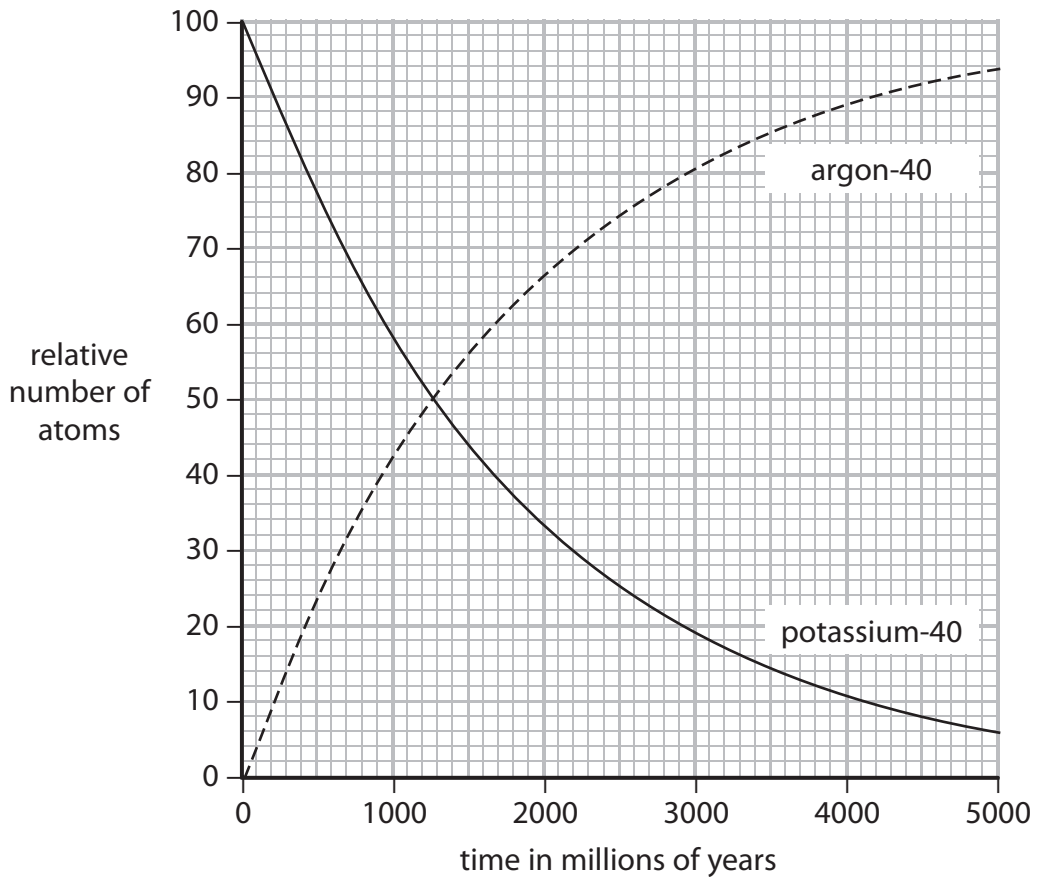
(i) Use the graph to find the half-life of potassium-40.

(1)

half-life = ... million years

(ii) Scientists analyse a sample taken from inside a rock.

They find that there is exactly 3 times as much argon-40 as there is potassium-40.

Use the graph to find the age of the rock.

(2)

age of rock = ... million years

(c) Some other rocks contained uranium when they were formed.

Radioactive decay in these rocks produces radon gas.

Explain why people living near these rocks have an increased health risk from background radiation.

(3)

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(Total for Question 4 = 10 marks)

Forces and rockets

5 (a) A firework rocket contains a solid fuel inside a cardboard tube.

The burning of the fuel creates a thrust to propel the rocket upwards.
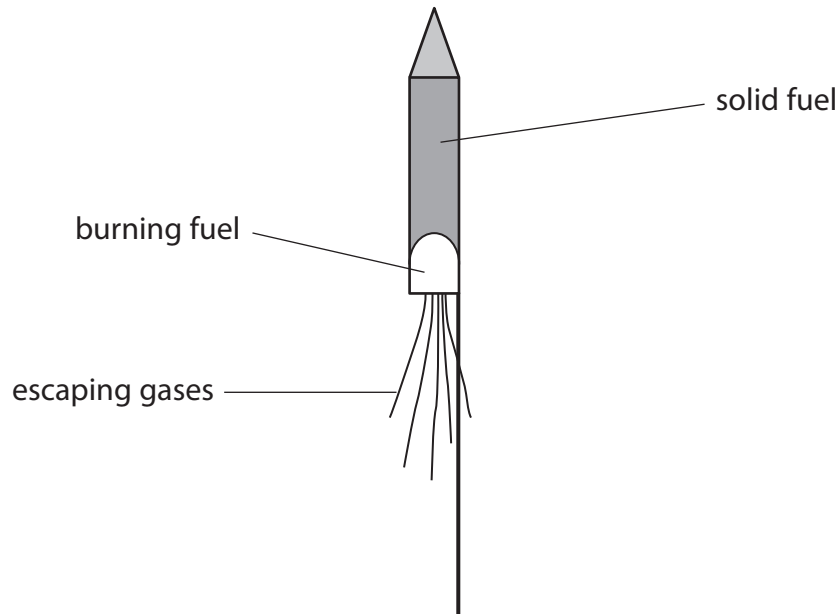
(i) Scientists can refer to several different quantities when describing the motion of the rocket.

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 0.7 N.

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.

0.7 N

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)

Turn over ▶

(b) Another rocket has a total mass of 90 g when it takes off.
The acceleration of the rocket when it takes off is 3.3 m/s^2.

(i) Calculate the resultant force on the rocket when it takes off.

(2)

resultant force = ... N

*(ii) The rocket contains 50 g of fuel when it takes off.
The fuel burns and the rocket rises vertically.
After a while, there is no fuel left.
Eventually the empty rocket falls back to the ground.

The graph is a velocity–time graph for the rocket.

Four stages are labelled on the graph.
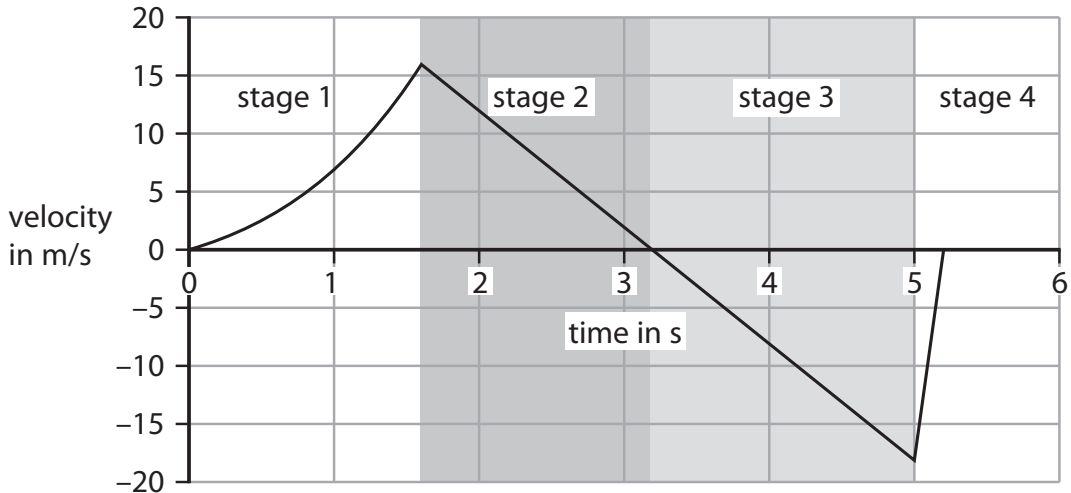
Explain why the velocity of the rocket changes as shown in the graph.

(6)

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(Total for Question 5 = 12 marks)

P 4 4 8 0 4 A 0 1 7 2 4

Light-dependent resistors

6 (a) A technician investigates a light-dependent resistor (LDR) connected in series with a 120 Ω resistor and a voltage source.

The technician measures the voltage across the LDR and also the current in the LDR.

(i) Which **one** of these circuits should the technician use?

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

(1)
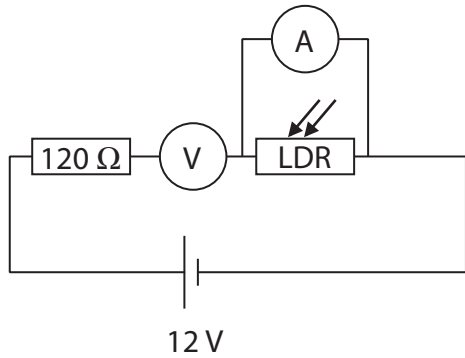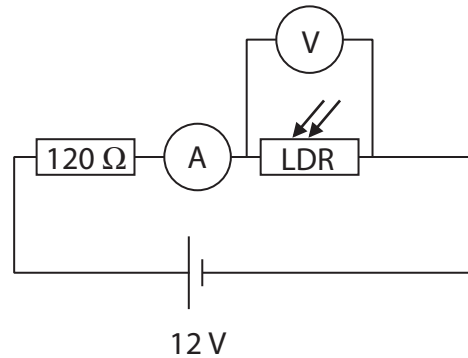
☒ **A**   ☒ **B**
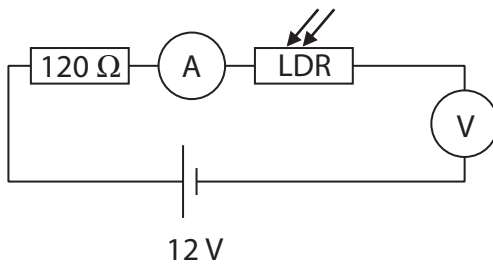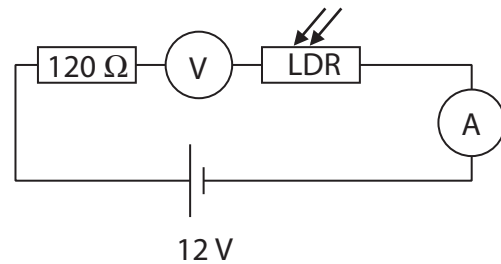
☒ **C**   ☒ **D**

(ii) When the LDR is in bright sunlight, its resistance is 185 Ω. The voltage across the LDR is then 7.2 V.

Show that the current in the LDR is about 0.039 A.

(2)

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

The current in the 120 Ω resistor is

(1)

☒ **A** much more than the current in the LDR

☒ **B** much less than the current in the LDR

☒ **C** the same as the current in the LDR

☒ **D** the opposite of the current in the LDR

(iv) The technician repeats the readings with the LDR in different light conditions.

The table gives two of the readings.

light condition	current in LDR
bright sunlight	0.039 A
cloudy skies	0.028 A

Explain why the two current readings are different.

(2)

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*(b) The photograph shows a temporary traffic sign.

The traffic sign uses many small lights all powered by a rechargeable battery.
These lights need to be very bright during the day so that they can be seen clearly.
They do not need to be as bright at night.

Explain how using a light-dependent resistor can make the energy stored in the
battery last longer.

(6)

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(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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