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K&U PS

G

NATIONAL QUALIFICATIONS 2013

PHYSICS
STANDARD GRADE
General Level

MONDAY, 27 MAY
9.00 AM – 10.30 AM

3220290 1

3220/29/01

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth
Day Month Year

Scottish candidate number

Reference may be made to the Physics Data Booklet.

1 All questions should be answered.

2 The questions may be answered in any order but all answers must be written clearly and legibly in this book.

3 For questions 1–5, write down, in the space provided, the letter corresponding to the answer you think is correct. There is only **one** correct answer.

4 For questions 6–18, write your answer where indicated by the question or in the space provided after the question.

5 If you change your mind about your answer you may score it out and replace it in the space provided at the end of the answer book.

6 If you use the additional space at the end of the answer book for answering any questions, you **must** write the correct question number beside each answer.

7 Before leaving the examination room you must give this book to the Invigilator. If you do not, you may lose all the marks for this paper.

Use **blue** or **black ink**. Pencil may be used for graphs and diagrams only.

SQA ©

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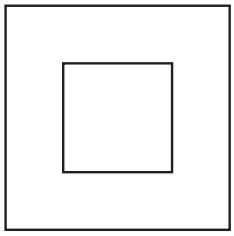
1. The symbol below is sometimes seen on the rating plate of electrical appliances.



This indicates that the appliance

A operates at 230 volts

B has a metal casing

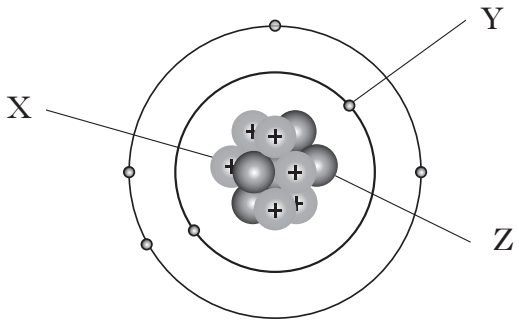
C does not require an earth wire

D requires an earth wire

E does not require a fuse.

Answer ☐ **1**

2. A simple model of an atom is shown.



Which row in the table identifies particles X, Y and Z?

	X	*Y*	*Z*
A	proton	electron	neutron
B	electron	neutron	proton
C	neutron	electron	proton
D	neutron	proton	electron
E	proton	neutron	electron

Answer ☐ **1**

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3. When a force of 4 newtons is applied to a newton balance, the spring extends in length from 2 centimetres to 5 centimetres.

When a force of 8 newtons is applied to the balance, the length of the spring is

A 3·0 centimetres

B 5·0 centimetres

C 6·0 centimetres

D 8·0 centimetres

E 10·0 centimetres.

Answer ☐ **1**

4. Which of the following contains only non-renewable sources of energy?

A	coal	biomass	water
B	wind	wave	solar
C	tidal	oil	gas
D	oil	gas	coal
E	coal	wind	wave

Answer ☐ **1**

5. Which of the following lists the colours red, blue and green in order of increasing wavelength?

A red, green, blue

B blue, red, green

C green, red, blue

D blue, green, red

E red, blue, green

Answer ☐ **1**

[Turn over

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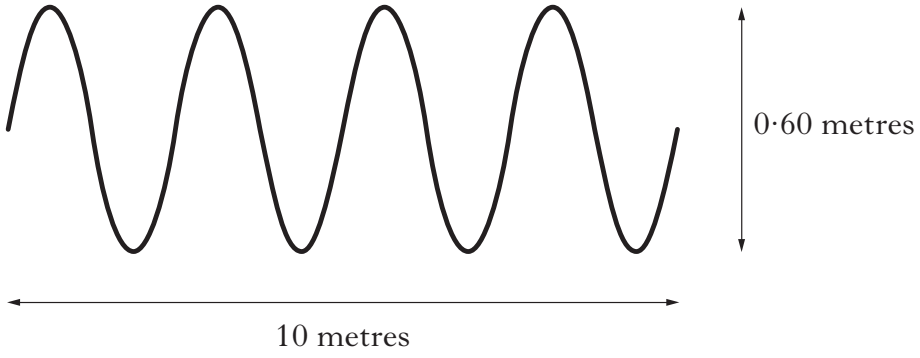
6. A teacher is carrying out a demonstration using a slinky spring to show some properties of waves.

A simplified diagram of the wave produced is shown below.



(*a*) Determine the amplitude of the wave.

Space for working and answer

2

(*b*) The diagram shows the number of waves produced in 2 seconds.

Calculate the frequency of the waves.

Space for working and answer

2

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6. (continued)

(*c*) Calculate the wavelength of the waves.

Space for working and answer

2

(*d*) Calculate the speed of the waves.

Space for working and answer

2

[Turn over

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* 3 2 2 0 2 9 0 1 0 5 *

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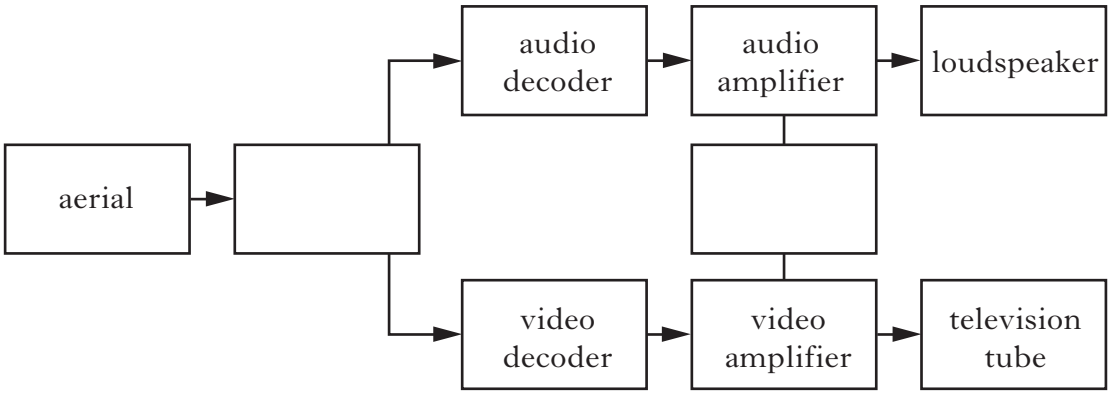
7. The block diagram shows the main parts of a television receiver.



(*a*) Complete the block diagram by filling in the missing labels. **1**

(*b*) What is the energy change in the TV tube?

.....

1

(*c*) The table gives information about different wavebands for broadcasting.

Waveband	*Frequency Range in* megahertz
high frequency (HF)	3 – 30
very high frequency (VHF)	30 – 300
ultra high frequency (UHF)	300 – 3000
super high frequency (SHF)	3000 – 30000

(i) The television channel BBC1 Scotland broadcasts on a frequency of 674 megahertz.

In which waveband does this station broadcast?

.....

1

(ii) Radio stations broadcast at lower frequencies than television channels.

Suggest a possible frequency for a radio station which broadcasts on VHF.

.....

1

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[Turn over for Question 8 on *Page eight*

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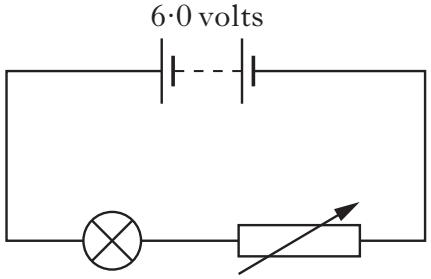
8. A student is investigating the operation of a filament lamp using the following circuit.



When the voltage across the lamp is 2 volts the current through the lamp is 0·2 ampere.

(*a*) Calculate the power dissipated in the lamp.

Space for working and answer

2

(*b*) (i) Calculate the resistance of the lamp.

Space for working and answer

2

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8. (*b*) (continued)

(ii) Calculate the voltage across the variable resistor.

Space for working and answer

1

(*c*) The resistance of the variable resistor is increased.

(i) What happens to the brightness of the lamp?

.....

1

(ii) Explain your answer.

.....

1

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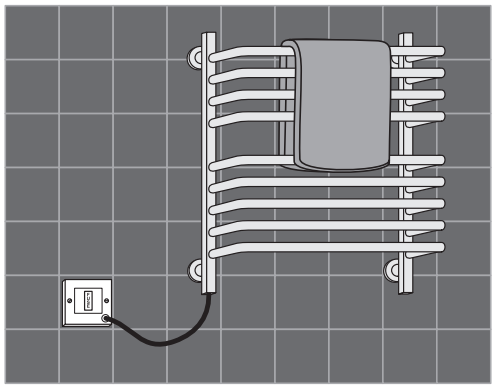
9. A bathroom is fitted with an electrically heated towel rail. The towel rail is filled with water which is heated by a 300 watt electric heating element connected to the mains supply.



(*a*) (i) State the declared value of the mains voltage.

.....

1

(ii) The flex connected to the heating element has three wires in it. The table shows the name and colour of insulation for some of the wires.

Complete the table.

Name of wire	*Colour of insulation*
Live	Brown
Neutral	
	Green/yellow

1

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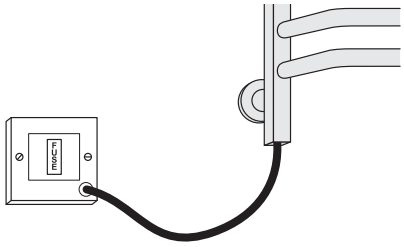
9. (*a*) (continued)

(iii) The heating element is protected by a fuse.



Select the appropriate fuse from the following list.

Circle your answer.

3 ampere 13 ampere 30 ampere **1**

(*b*) The towel rail contains 2·5 kilograms of water.

Calculate the minimum energy required to raise the temperature of the water by 50 degrees celsius.

(Specific heat capacity of water = 4180 joules per kilogram degrees celsius.)

Space for working and answer

2

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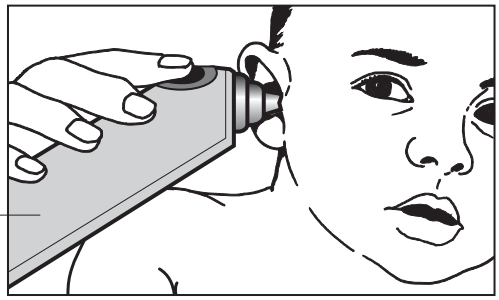
10. The temperature of a baby who appears to be unwell is taken using a thermometer.



The temperature produces a reading using the invisible radiation given out by the human body. The reading is displayed on a small screen.

(*a*) State the radiation used by this thermometer.

.....

1

(*b*) The reading displayed on the thermometer is 39 degrees celsius.

Explain how this reading shows that the baby is unwell.

.....

.....

1

(*c*) Other radiations are used in hospitals.

laser light **ultraviolet** **x-rays** **gamma rays**

Use words from the above list to identify the following:

(i) radiation used to detect broken bones;

.....

1

(ii) radiation used to sterilise medical equipment.

.....

1

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10. (continued)

(*d*) Why is exposure to too much ultraviolet radiation dangerous?

.....

.....

1

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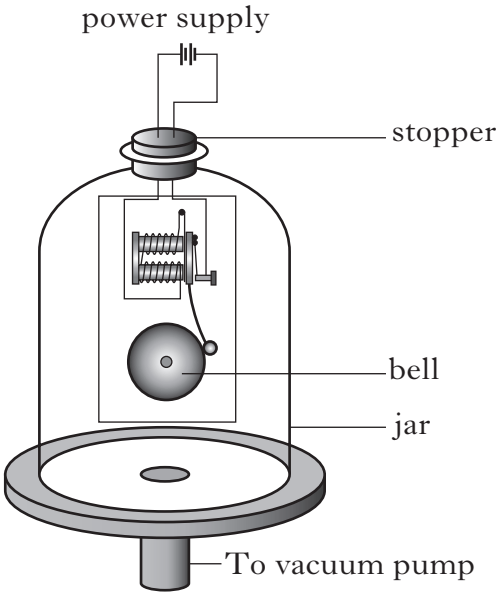
11. An experiment involving sound is demonstrated to a group of students. The diagram shows the equipment used for the experiment.



The bell is connected to a power supply and hung inside the jar from a stopper. The bell is switched on and the students hear the bell ringing. The vacuum pump is switched on until all of the air has been removed from the jar.

(*a*) (i) State what happens to the sound from the bell when all of the air has been removed from the jar.

.....

1

(ii) Explain your answer.

.....

.....

1

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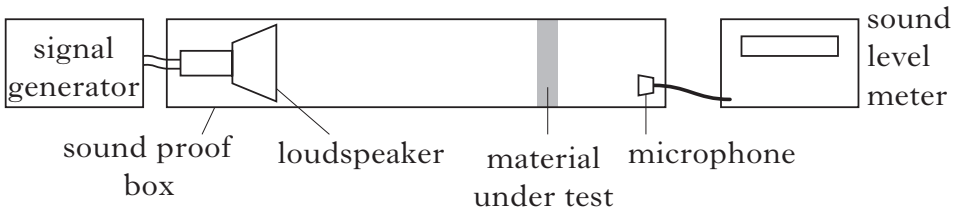
11. (continued)

(*b*) The students set up a second experiment to test how well different materials compare at absorbing sound. The diagram shows the equipment used for this experiment.



The results obtained from the experiment are shown in the table below.

Material	*Thickness of material* (millimetres)	*Sound level* (decibels)	
		without material	*with material*
Polystyrene	30	100	80
Bubble wrap	40	100	85
Foam	40	100	72
Egg carton	20	80	79

Give **two** reasons why this is not a fair test.

Reason 1 .....

Reason 2 ..... **2**

(*c*) The students then use the sound level meter to measure the sound level from a set of earphones connected to a smart phone.

The reading on the meter is 92 decibels.

Explain why this sound level is dangerous.

.....

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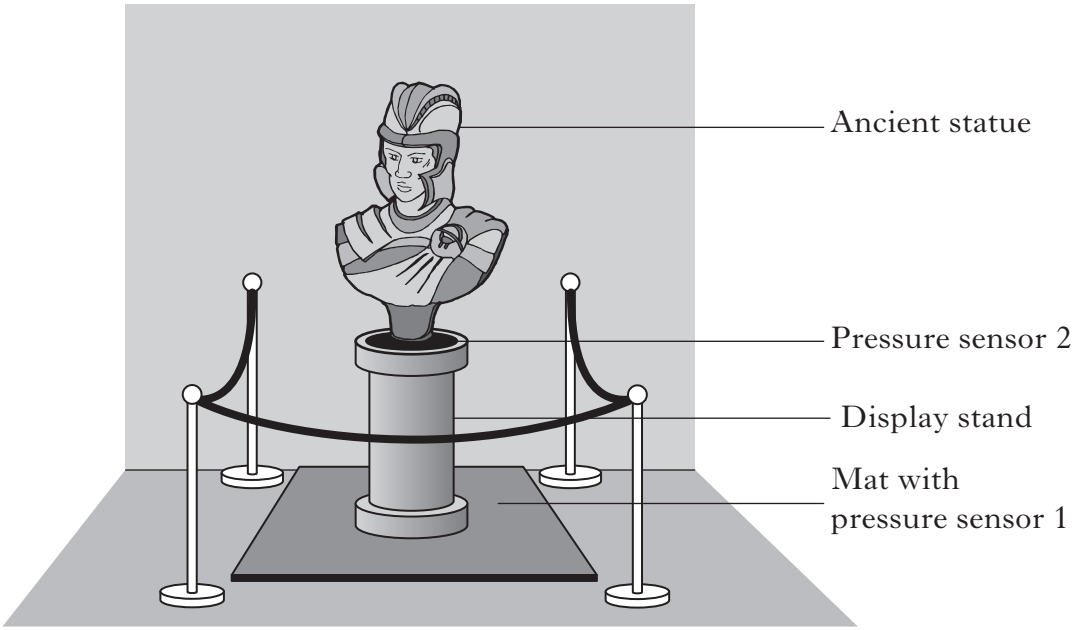
12. A statue in a museum is protected by an alarm system.

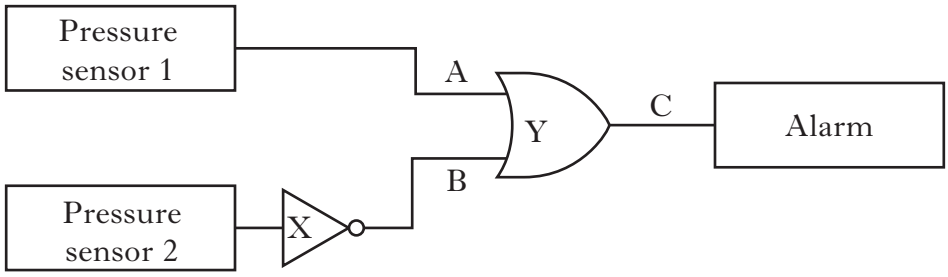


An electronic system which contains two pressure sensors is used.

Pressure sensor 1 is contained in a mat which surrounds the display stand and activates the alarm if someone steps onto it.

Pressure sensor 2 is placed between the statue and the top of the display stand and activates the alarm if the statue is removed.

A diagram of the logic circuit is shown.



The pressure sensor gives a logic 1 when pressure is applied.
The pressure sensor gives a logic 0 when no pressure is applied.

(*a*) (i) Name logic gate Y.

.....

1

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12. (*a*) (continued)

(ii) Complete the truth table for the logic gate Y.

A	B	C
0	0	
0	1	
1	0	
1	1	

1

(*b*) Explain why the NOT gate X is required.

.....

.....

1

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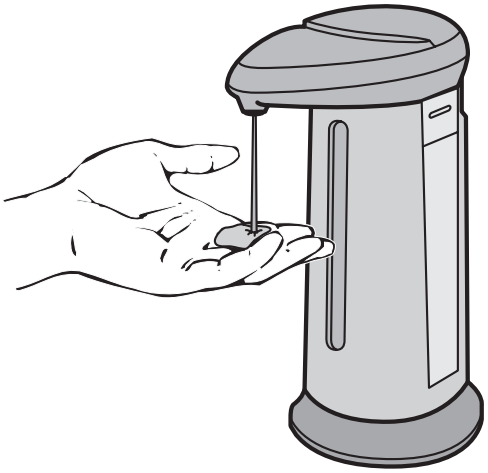
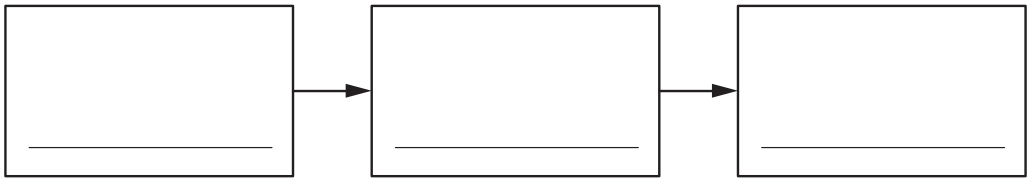
13. A student is investigating the operation of an electronic soap dispenser. A set volume of liquid soap is dispensed when a sensor detects a hand underneath the nozzle.



(*a*) The dispenser can be described as a simple electronic system. Complete the block diagram by filling in the missing labels.



1

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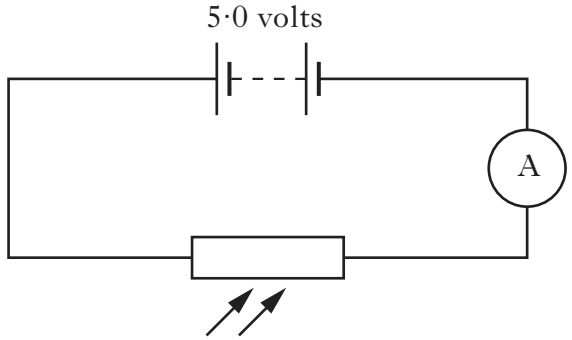
13. (continued)

(*b*) The student suggests that a light dependent resistor (LDR) could be used as the sensor in the soap dispenser and investigates the operation of an LDR.

The LDR is connected in the circuit shown.



When the LDR is uncovered the reading on the ammeter is 0·002 ampere.

(i) Calculate the resistance of the LDR.

Space for working and answer

2

(ii) State what happens to the resistance of the LDR when it is covered.

.....

1

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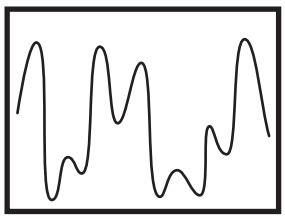
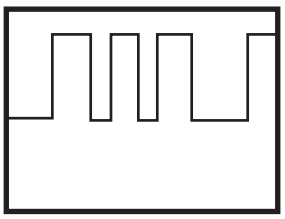
13. (continued)

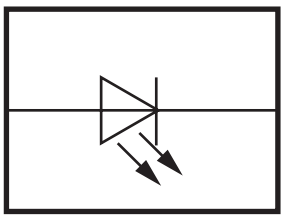
(*c*) Electronic signals can be analogue or digital. The diagrams below are associated with electronic systems.



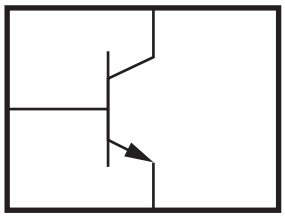
A



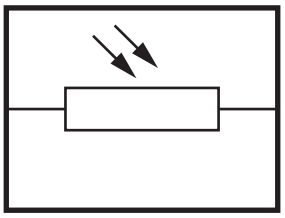
B



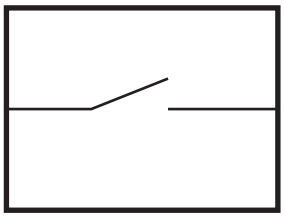
C



D



E



F

Match the appropriate diagram to the following labels.

Label	*Letter*
Analogue signal	
Analogue input device	
Digital input device	
Digital output device	

2

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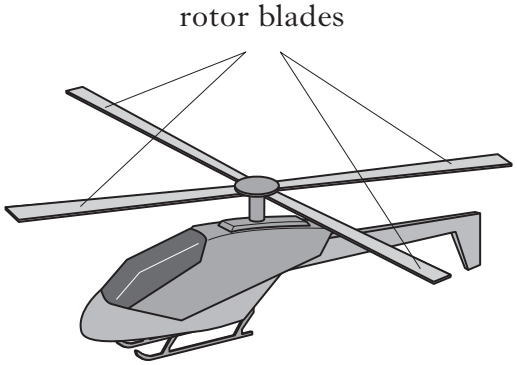
14. A child is playing with a remote control helicopter of mass 1·4 kilograms.



(*a*) Calculate the weight of the helicopter.

Space for working and answer

2

(*b*) (i) The child adjusts the controls so that the helicopter rises vertically through a height of 2·5 metres at a constant speed.

What upward force must be supplied by the rotor blades for this to happen?

.....

1

(ii) Calculate the work done by the helicopter.

Space for working and answer

2

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15. A motoring television programme shows a test where different cars are driven around a racetrack and the lap times compared. The length of the track is 2820 metres. The best lap time for each car is shown in the table along with the time taken for each car to accelerate from 0–100 kilometres per hour.

Car	*Lap time in* seconds	*Time to accelerate uniformly from 0–100 kilometres per hour in* seconds
Ariel Atom	75·0	2·8
McLaren MP4	76·2	3·2
Lamborghini Aventador	76·5	2·9
Bugatti Veyron	76·8	2·5
Gumpert Apollo	77·1	3·0

(*a*) Calculate the average speed of the Ariel Atom around the track.

Space for working and answer

2

(*b*) Describe how the instantaneous speed of a car could be measured as it crosses the finishing line.

You must state the measurements that are made and how they are used.

.....

.....

.....

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15. (continued)

(*c*) Which car in the table has the greatest acceleration?

.....

1

(*d*) Use information from the table to complete a speed-time graph for the Gumpert Apollo as it accelerates uniformly from 0–100 kilometres per hour.

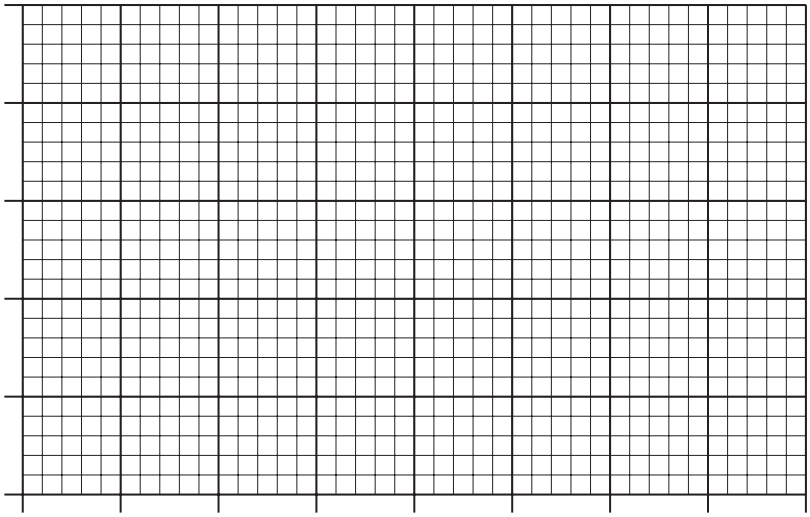
Units and numerical values must be shown on each axis.

speed in

.....

.....

.....



time in .....

3

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16. A farm in a remote location has a wind turbine to generate electricity.

(*a*) In one year the wind turbine produces 18 250 kilowatt-hours of energy.

Calculate the average number of kilowatt-hours produced per day.

Space for working and answer

1

(*b*) On average, the wind turbine operates for 8 hours per day.

Calculate the average power of the wind turbine.

Space for working and answer

2

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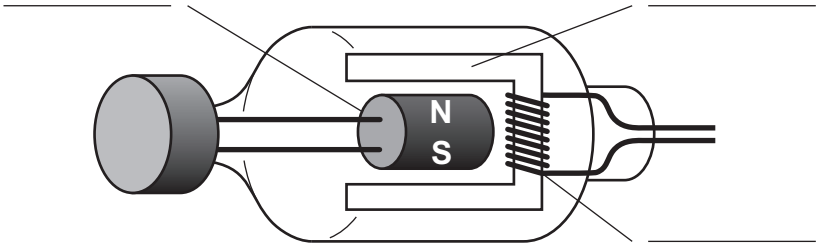
16. (continued)

(*c*) The wind turbine uses an a.c. generator.

A diagram of a simple a.c. generator is shown.

Label the diagram using the following words.

Rotor **Stator coil** **Iron core**



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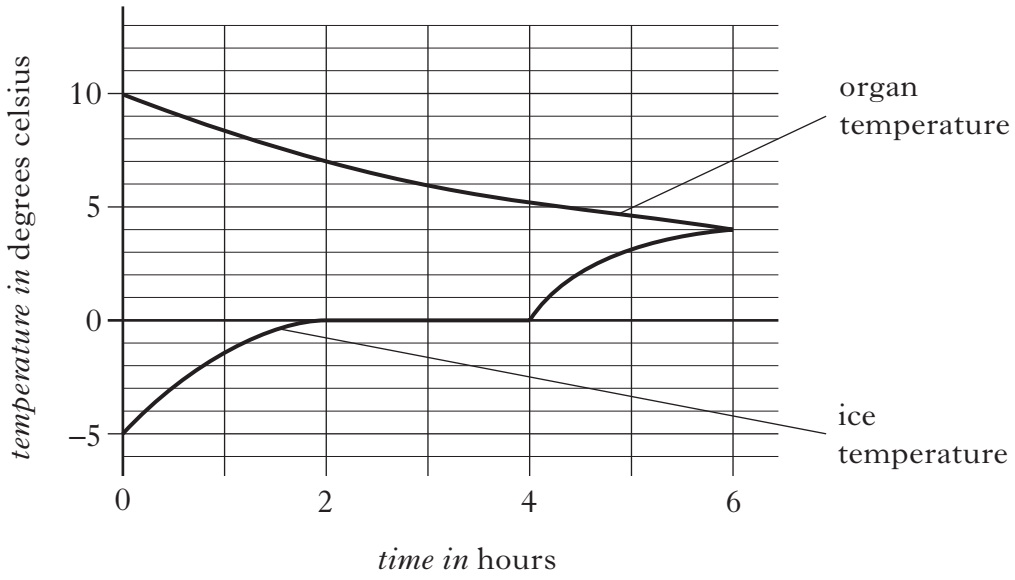
17. Human organs which are available for transplant need to be transferred from one hospital to another. These organs need to be kept cool and are surrounded by ice in insulated containers for transportation. The temperatures of an organ and ice during transportation are shown in the graph.



(*a*) (i) (A) State the temperature of the ice between 2 and 4 hours.

.....

1

(B) State what is happening to the ice during this time.

.....

1

(ii) Explain why the temperature of the organ falls during this time.

.....

.....

1

(*b*) Explain why the container is insulated.

.....

.....

1

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18. (*a*) The table gives information about some of the planets in our solar system.

Planet	*Mercury*	*Venus*	*Earth*	*Mars*	*Jupiter*	*Saturn*	*Neptune*
Distance from the sun (million kilometres)	58	110	150	228	780	1430	4500
Time to go around the sun once (years)	0·25	0·6	1	1·9	12	30	165
Time for one complete spin (in Earth days or hours)	59 days	243 days	24 hours	25 hours	10 hours	10 hours	16 hours
Acceleration due to gravity (metres per second per second)	4	9	10	4	26	11	12

(i) Which **two** planets have the same length of day?

.....

1

(ii) On which planet will a 5 kilogram mass have the greatest weight?

.....

1

(iii) Which planet has the shortest orbit time?

.....

1

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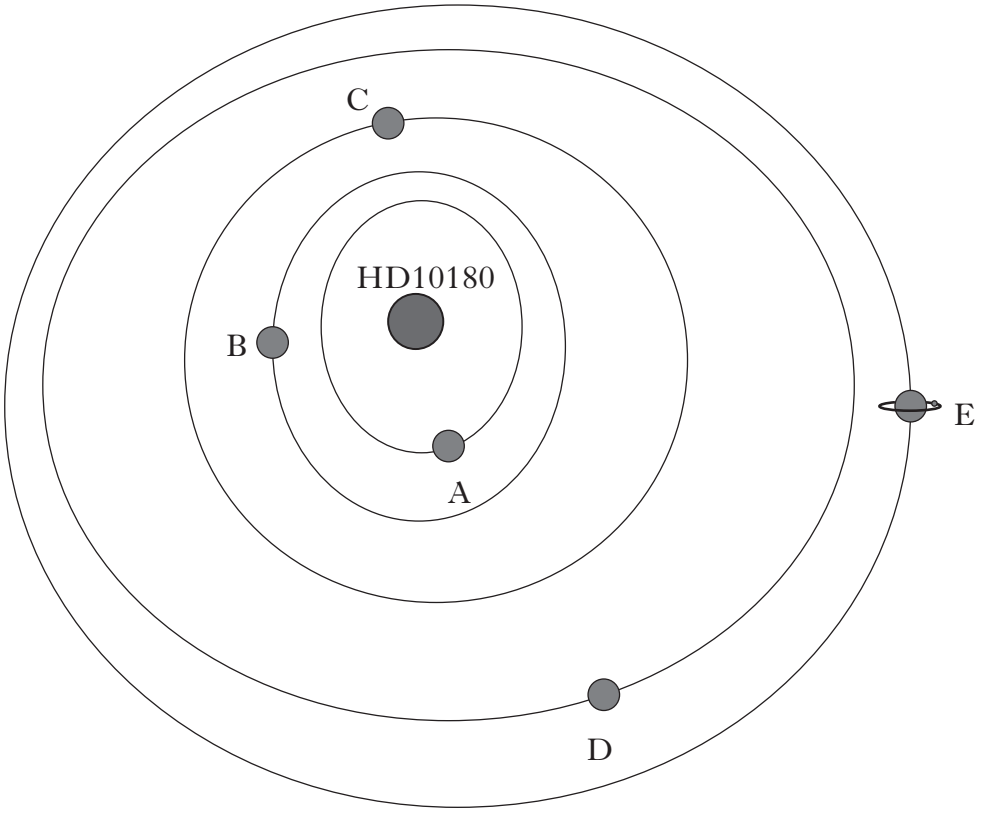
18. (continued)

(*b*) Astronomers have discovered a new solar system.

A diagram of the solar system is shown.



Complete the passage by using some of the words from the following list.

moon	**closer**	**galaxy**	**planet**
star	**universe**	**Milky Way**	

At its centre is the _____ HD10180.

D is in orbit around HD10180. D is a _____.

E has a natural satellite called a _____ .

The name given to all space is the _____ . **2**

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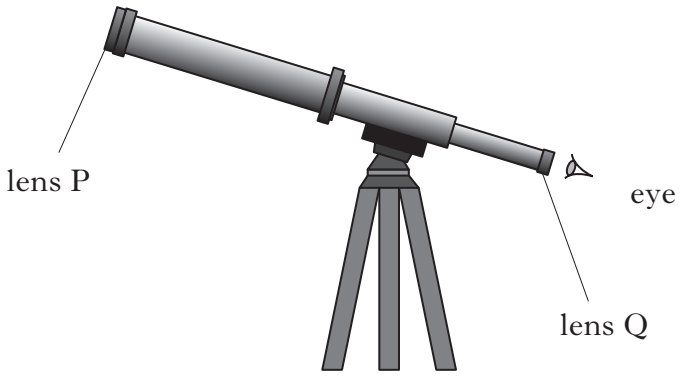
18. (continued)

(*c*) An astronomer uses a refracting telescope to study objects in outer space.



(i) The telescope uses two convex lenses.

Name each lens.

Lens P .....

Lens Q **2**

(ii) State the purpose of lens P.

.....

..... **1**

(*d*) A research satellite of mass 76 kilograms is in orbit around the Earth. A rocket on the satellite applies a decelerating thrust of 1900 newtons.

Calculate the deceleration of the satellite.

Space for working and answer

2

[*END OF QUESTION PAPER*]

ADDITIONAL SPACE FOR ANSWERS

Make sure you write the correct question number beside each answer.

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ADDITIONAL SPACE FOR ANSWERS

Make sure you write the correct question number beside each answer.

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