

FOR OFFICIAL USE

--	--	--	--	--	--

C

**3220/402**

K & U	PS
Total Marks	

NATIONAL  
QUALIFICATIONS  
2008

FRIDAY, 23 MAY  
10.50 AM – 12.35 PM

PHYSICS  
STANDARD GRADE  
Credit Level

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth

Day Month Year

--	--	--	--	--	--	--	--

Scottish candidate number

--	--	--	--	--	--	--	--	--	--

Number of seat

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 Write your answer where indicated by the question or in the space provided after the question.
- 4 If you change your mind about your answer you may score it out and rewrite it in the space provided at the end of the answer book.
- 5 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.
- 6 Any necessary data will be found in the **data sheet** on page three.
- 7 Care should be taken to give an appropriate number of significant figures in the final answers to questions.



**[BLANK PAGE]**

## DATA SHEET

### *Speed of light in materials*

<i>Material</i>	<i>Speed in m/s</i>
Air	$3.0 \times 10^8$
Carbon dioxide	$3.0 \times 10^8$
Diamond	$1.2 \times 10^8$
Glass	$2.0 \times 10^8$
Glycerol	$2.1 \times 10^8$
Water	$2.3 \times 10^8$

### *Speed of sound in materials*

<i>Material</i>	<i>Speed in m/s</i>
Aluminium	5200
Air	340
Bone	4100
Carbon dioxide	270
Glycerol	1900
Muscle	1600
Steel	5200
Tissue	1500
Water	1500

### *Gravitational field strengths*

	<i>Gravitational field strength on the surface in N/kg</i>
Earth	10
Jupiter	26
Mars	4
Mercury	4
Moon	1.6
Neptune	12
Saturn	11
Sun	270
Venus	9

### *Specific heat capacity of materials*

<i>Material</i>	<i>Specific heat capacity in J/kg °C</i>
Alcohol	2350
Aluminium	902
Copper	386
Glass	500
Glycerol	2400
Ice	2100
Lead	128
Silica	1033
Water	4180

### *Specific latent heat of fusion of materials*

<i>Material</i>	<i>Specific latent heat of fusion in J/kg</i>
Alcohol	$0.99 \times 10^5$
Aluminium	$3.95 \times 10^5$
Carbon dioxide	$1.80 \times 10^5$
Copper	$2.05 \times 10^5$
Glycerol	$1.81 \times 10^5$
Lead	$0.25 \times 10^5$
Water	$3.34 \times 10^5$

### *Melting and boiling points of materials*

<i>Material</i>	<i>Melting point in °C</i>	<i>Boiling point in °C</i>
Alcohol	-98	65
Aluminium	660	2470
Copper	1077	2567
Glycerol	18	290
Lead	328	1737
Turpentine	-10	156

### *Specific latent heat of vaporisation of materials*

<i>Material</i>	<i>Specific latent heat of vaporisation in J/kg</i>
Alcohol	$11.2 \times 10^5$
Carbon dioxide	$3.77 \times 10^5$
Glycerol	$8.30 \times 10^5$
Turpentine	$2.90 \times 10^5$
Water	$22.6 \times 10^5$

### *SI Prefixes and Multiplication Factors*

<i>Prefix</i>	<i>Symbol</i>	<i>Factor</i>
giga	G	$1\ 000\ 000\ 000 = 10^9$
mega	M	$1\ 000\ 000 = 10^6$
kilo	k	$1000 = 10^3$
milli	m	$0.001 = 10^{-3}$
micro	μ	$0.000\ 001 = 10^{-6}$
nano	n	$0.000\ 000\ 001 = 10^{-9}$



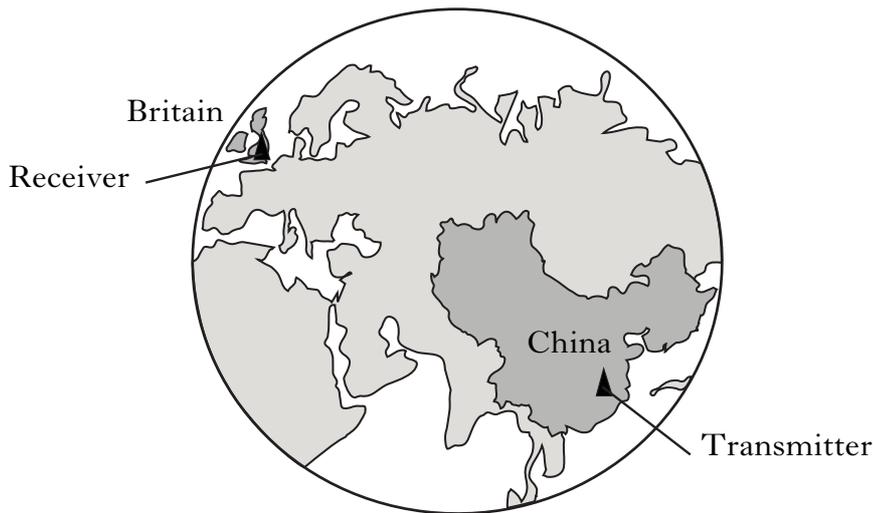
Marks

2. A television company is making a programme in China. Britain receives television pictures live from China. The television signals are transmitted using microwaves. The microwave signals travel from China **via** a satellite, which is in a geostationary orbit.

(a) State what is meant by a geostationary orbit.

..... **1**

(b) The diagram shows the position of the transmitter and receiver. Complete the diagram to show the path of the microwave signals **from** China **to** Britain.



**2**

(c) The frequency of the microwave signals being used for transmission is 8 GHz.

(i) What is the speed of the microwaves?

..... **1**

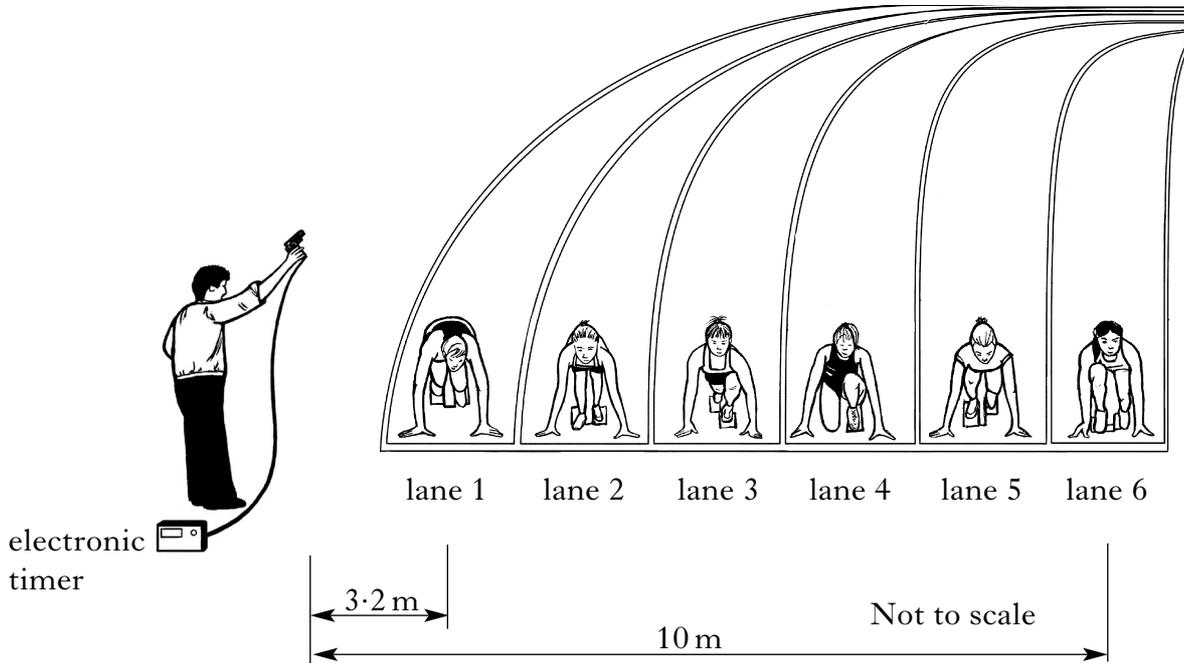
(ii) Calculate the wavelength of these microwaves.

*Space for working and answer*

**2**

Marks

3. In a sprint race at a school sports day, the runners start when they hear the sound of the starting pistol. An electronic timer is also started when the pistol is fired into the air.



The runner in lane 1 is 3.2 m from the starting pistol. The runner in lane 6 is 10 m from the starting pistol.

- (a) The runner in lane 1 hears the starting pistol first.

Calculate how much later the runner in lane 6 hears this sound after the runner in lane 1.

*Space for working and answer*

3

K&U	PS

Marks

3. (continued)

- (b) A sensor detects each runner crossing the finishing line to record their time.

The table gives information about the race.

<i>Place</i>	<i>Lane</i>	<i>Time (s)</i>
1st	1	13.11
2nd	6	13.12
3rd	3	13.21

Using your answer to part (a), explain why the runner in lane 6 should have been awarded first place.

*Space for working and answer*

2

- (c) One runner of mass 60kg has a speed of 9 m/s when crossing the finishing line.

Calculate the kinetic energy of the runner at this point.

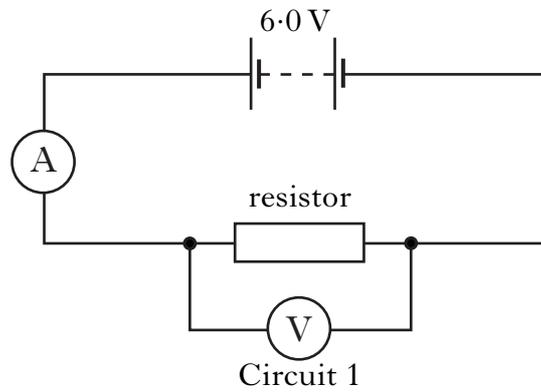
*Space for working and answer*

2

[Turn over

Marks

4. A student has four resistors labelled A, B, C and D. The student sets up Circuit 1 to identify the value of each resistor.



Each resistor is placed in the circuit in turn and the following results are obtained.

<i>Resistor</i>	<i>Voltage across resistor (V)</i>	<i>Current (A)</i>
A	6.0	0.017
B	6.0	0.027
C	6.0	0.050
D	6.0	0.033

- (a) (i) Show, **by calculation**, which of the resistors has a value of  $120\ \Omega$ .

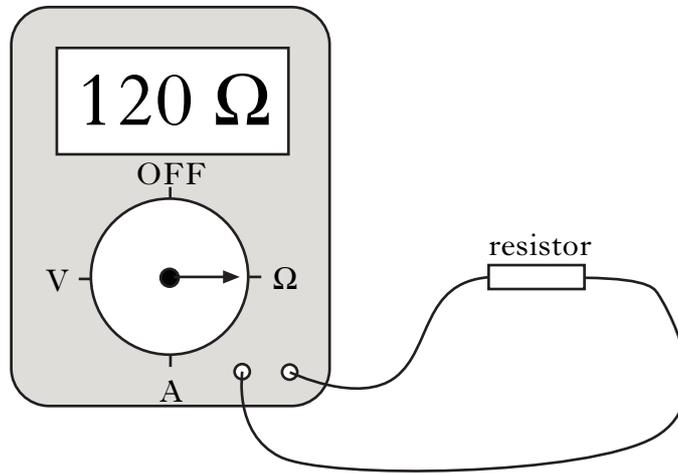
*Space for working and answer*

3

Marks

4. (a) (continued)

- (ii) The student then sets up Circuit 2 to measure the resistance of each resistor.



Circuit 2

State **one** advantage of using Circuit 2 to measure the resistance compared to using Circuit 1.

..... 1

- (b) The resistances of the other three resistors are  $180 \Omega$ ,  $220 \Omega$  and  $360 \Omega$ . The student connects all four resistors in series. Calculate the total resistance.

*Space for working and answer*

2

[Turn over





Marks

6. A short-sighted person has difficulty seeing the picture on a cinema screen. Figure 1 shows rays of light from the screen entering an eye of the person until the rays reach the retina.

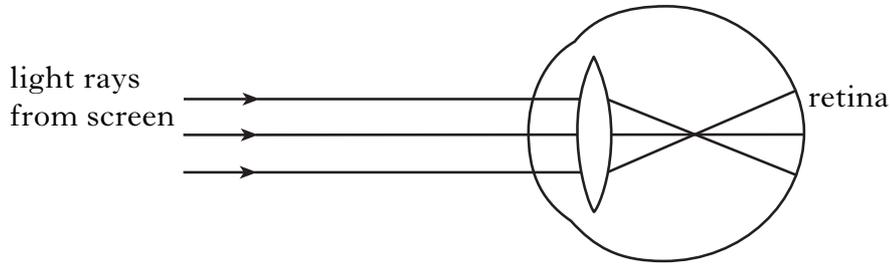


Figure 1

- (a) (i) In the dotted box in Figure 2, draw the shape of lens that would correct this eye defect.

1

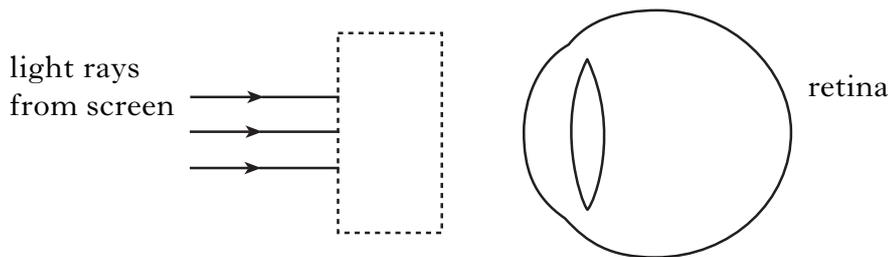


Figure 2

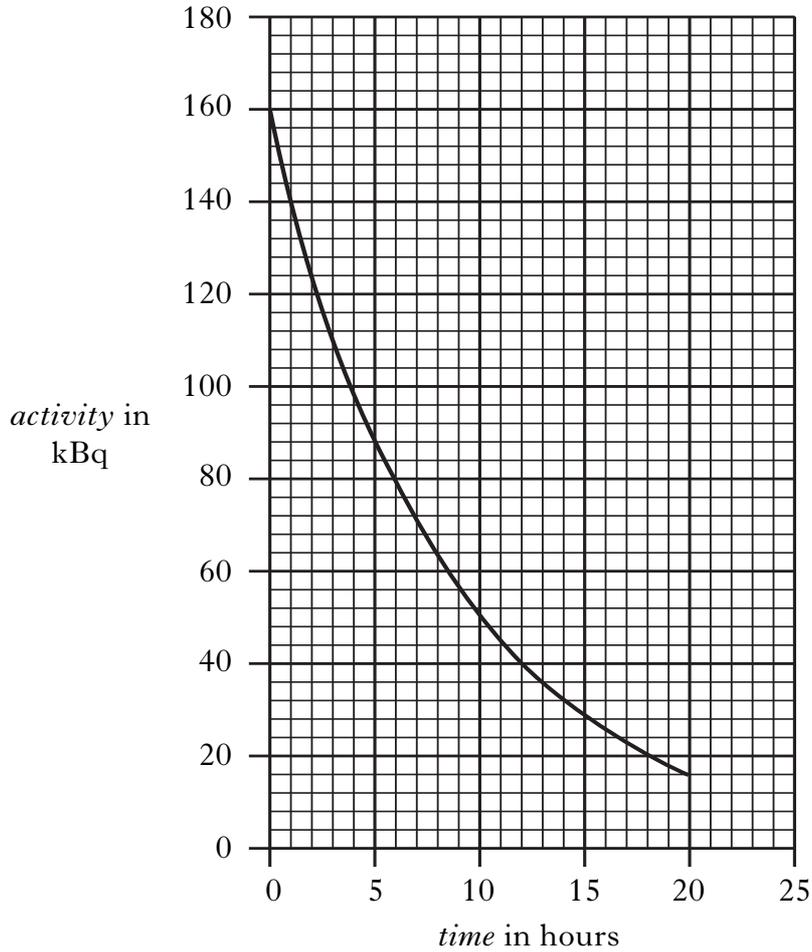
- (ii) In Figure 2, complete the path of the rays of light from this lens until they reach the retina.

2



Marks

7. A hospital technician is working with a radioactive source. The graph shows the activity of the source over a period of time.



- (a) (i) State what is meant by the term *half-life*.

..... **1**

- (ii) Use information from the graph to calculate the half-life of the radioactive source.

*Space for working and answer*

**1**





Marks

8. (b) (continued)

(iii) Calculate the power supplied by the battery when all five LEDs are lit.

<i>Space for working and answer</i>
-------------------------------------

2

(c) State **one** advantage of using five LEDs rather than a single filament lamp in the torch.

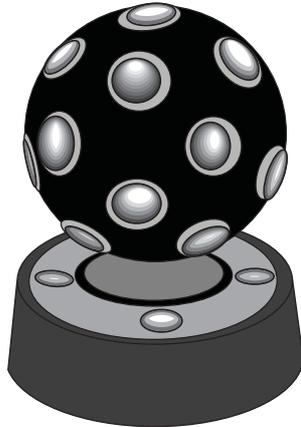
.....

1

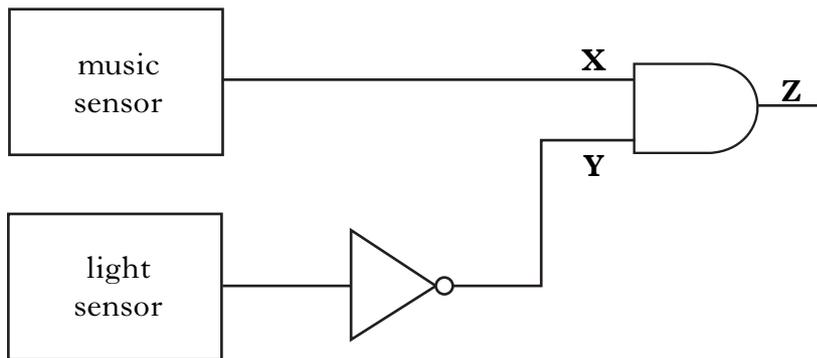
[Turn over

Marks

9. An electronic device produces a changing light pattern when it detects music, but only when it is in the dark.



The device contains the logic circuit shown.



The music sensor produces logic 1 when the music is on and logic 0 when the music is off.

The light sensor produces logic 1 when it detects light and logic 0 when it is dark.

- (a) (i) Suggest a suitable input device for the light sensor.

.....

1

- (ii) Complete the truth table for the logic levels at points **X**, **Y** and **Z** in the circuit.

<i>Music</i>	<i>Light level</i>	<b>X</b>	<b>Y</b>	<b>Z</b>
off	dark			
off	light			
on	dark			
on	light			

3



Marks

10. A railway train travels uphill between two stations.



Information about the train and its journey is given below.

average speed of train	5 m/s
time for journey	150 s
power of train	120 kW
mass of train plus passengers	20 000 kg

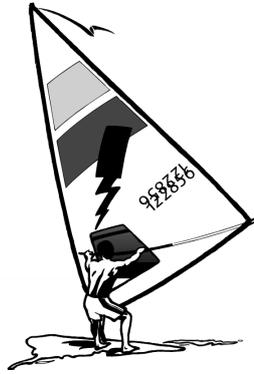
- (a) Calculate the energy used by the train during the journey.

*Space for working and answer*

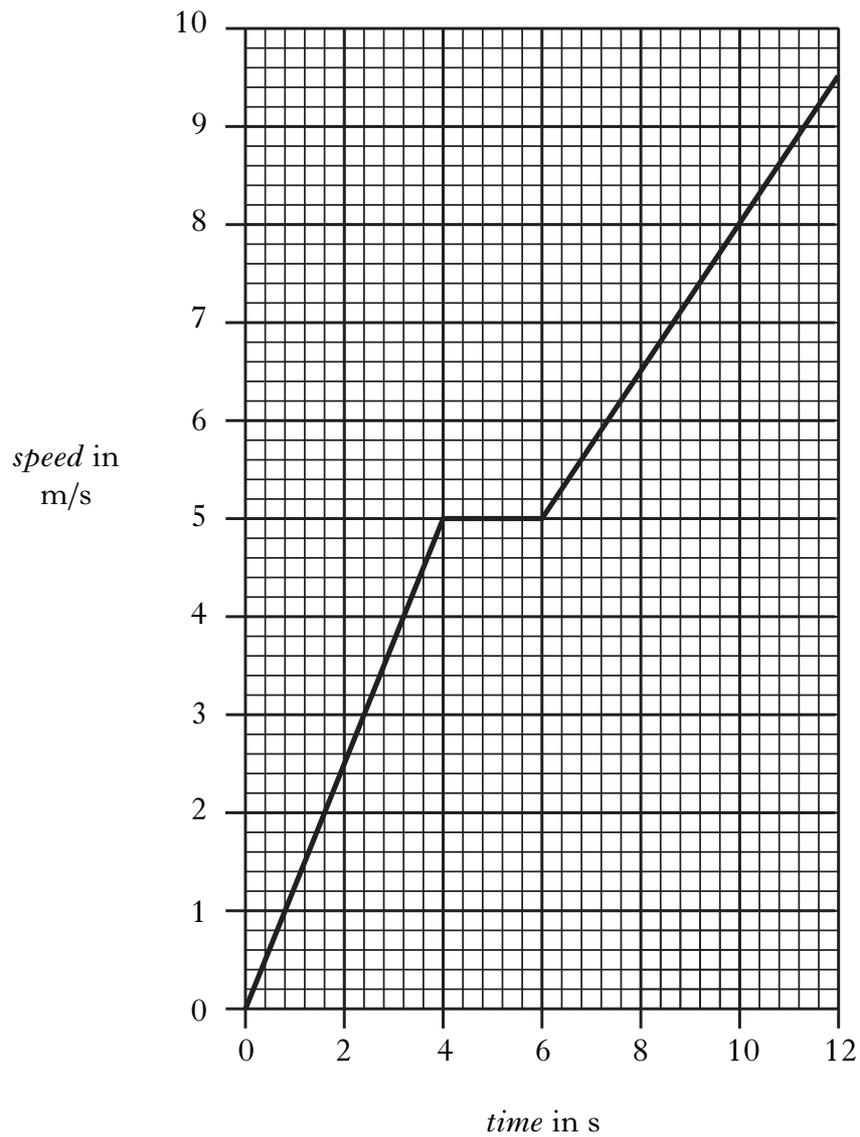
2



11. A windsurfer takes part in a race. The windsurfer takes 120 seconds to complete the race. The total mass of the windsurfer and the board is 90 kg.

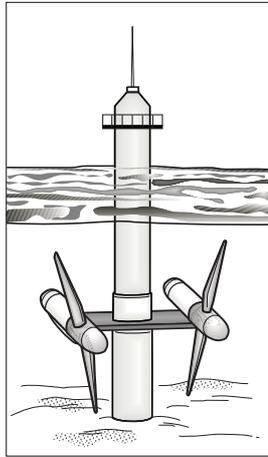


The graph shows how the speed of the windsurfer and board changes with time during part of the race.



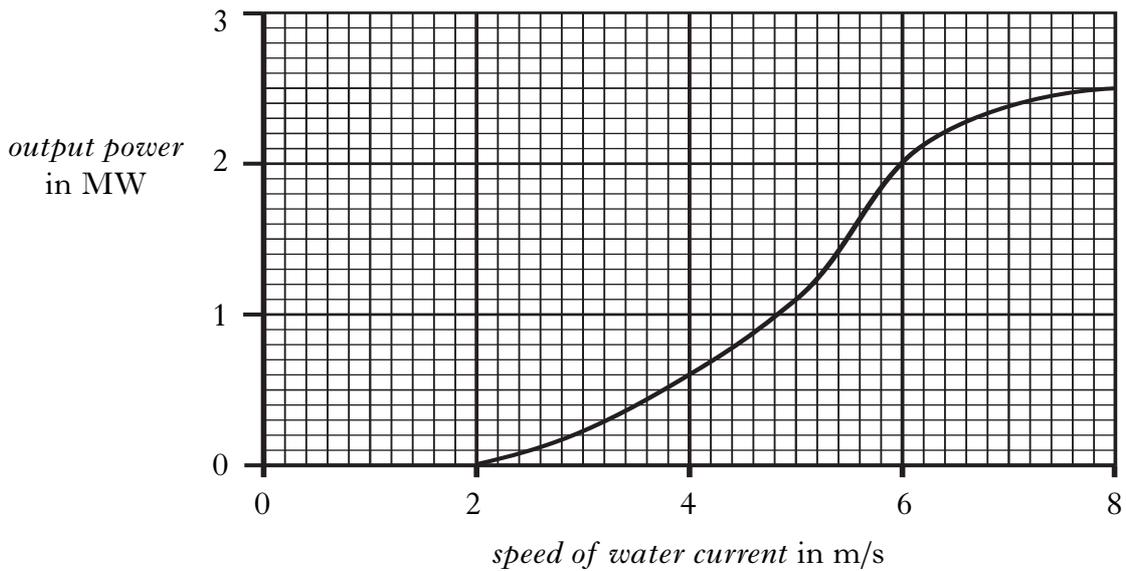


12. An underwater generator is designed to produce electricity from water currents in the sea.



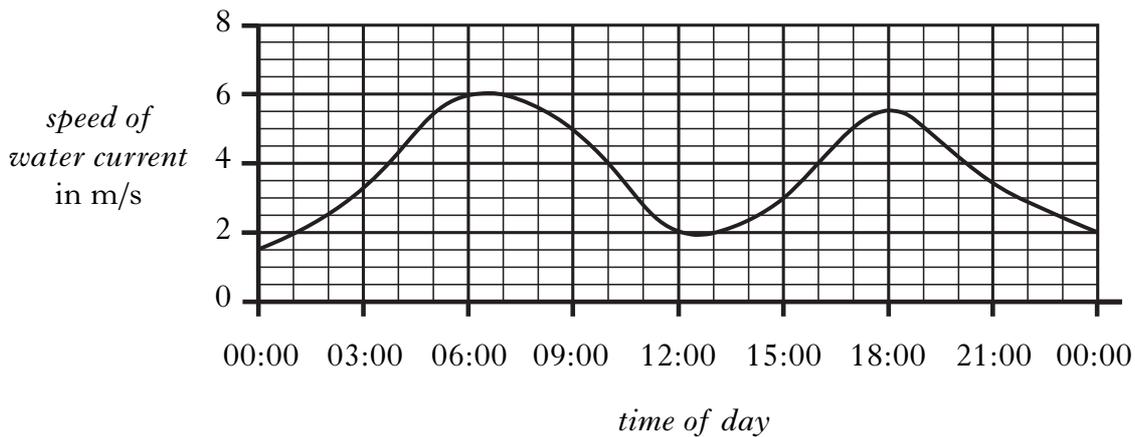
The output power of the generator depends on the speed of the water current as shown in Graph 1.

Graph 1



The speed of the water current is recorded at different times of the day shown in Graph 2.

Graph 2

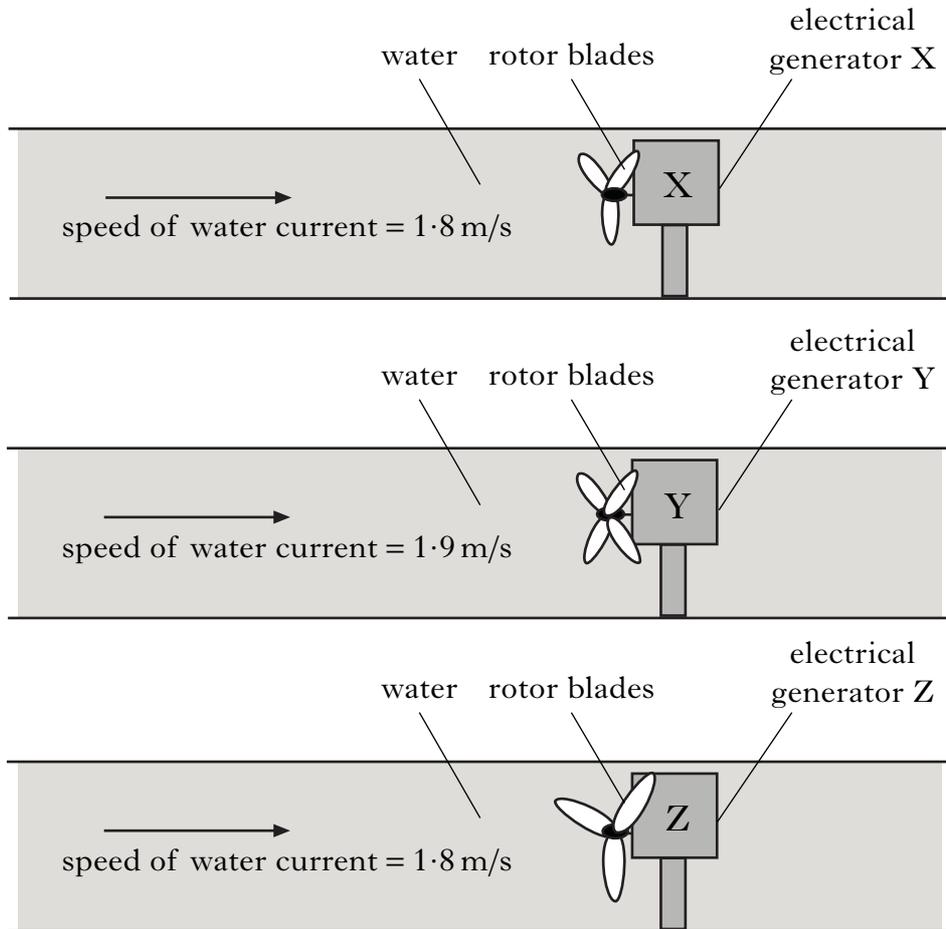




Marks

12. (continued)

- (c) Three different types of electrical generator, X, Y and Z are tested in a special tank with a current of water as shown to find out the efficiency of each generator.



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

.....

.....

1







Marks

15. (a) A spacecraft is used to transport astronauts and equipment to a space station. On its return from space the spacecraft must re-enter the Earth's atmosphere. The spacecraft has a heat shield made from special silica tiles to prevent the inside from becoming too hot.



- (i) Why does the spacecraft increase in temperature when it re-enters the atmosphere?

.....

1

- (ii) The mass of the heat shield is  $3.5 \times 10^3$  kg and the gain in heat energy of the silica tiles is 4.7 GJ.

Calculate the increase in temperature of the silica tiles.

*Space for working and answer*

3

- (iii) Explain why the actual temperature rise of the silica tiles is less than the value calculated in (a)(ii).

.....

.....

1

- (b) When a piece of equipment was loaded on to the spacecraft on Earth, two people were required to lift it.

One person was able to lift the same piece of equipment in the Space Station.

Explain why one person was able to lift the equipment in the Space Station.

.....

1

[END OF QUESTION PAPER]

Marks	
K&U	PS

K&U	PS

**YOU MAY USE THE SPACE ON THIS PAGE TO REWRITE ANY ANSWER YOU HAVE DECIDED TO CHANGE IN THE MAIN PART OF THE ANSWER BOOKLET. TAKE CARE TO WRITE IN CAREFULLY THE APPROPRIATE QUESTION NUMBER.**

**[BLANK PAGE]**