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K&U PS

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NATIONAL QUALIFICATIONS 2011

MONDAY, 23 MAY 9.00 AM – 10.30 AM

PHYSICS
STANDARD GRADE
General 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 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 6–19, 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.

DO NOT WRITE IN THIS MARGIN

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1. The purpose of the curved reflector on a satellite television aerial is to

A make the transmitted signal stronger

B make the received signal stronger

C reflect light onto the receiver

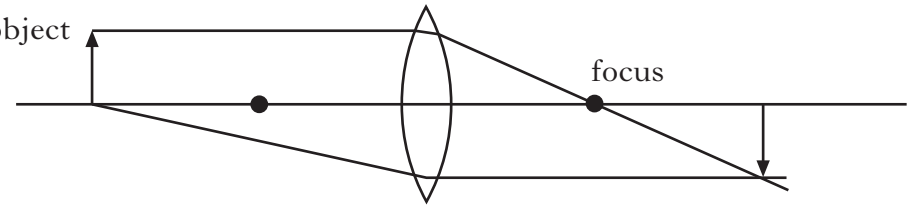
D absorb transmitted signals

E absorb received signals.

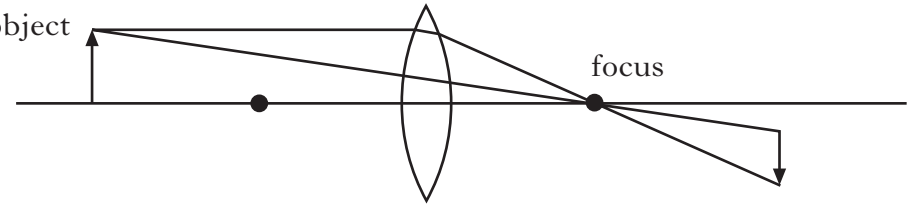
Answer ☐ **1**

2. Which diagram shows the correct paths for the rays forming an inverted image?

A



B



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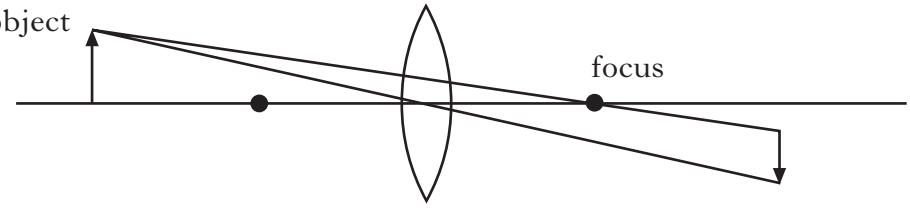
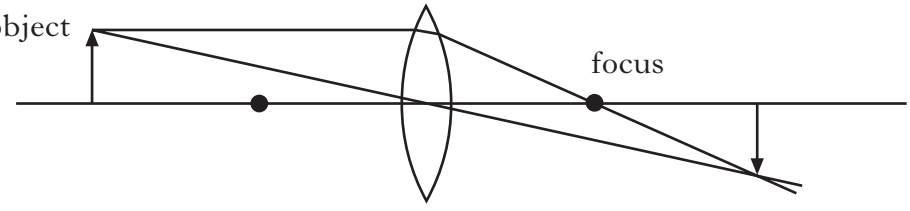
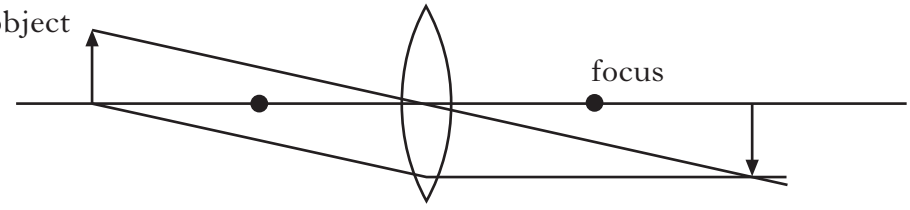


D



E



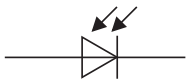
Answer ☐ **1**

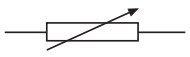
DO NOT WRITE IN THIS MARGIN

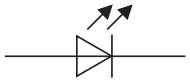
Marks | K&U | PS

3. Which of the following is the correct symbol for a light emitting diode (LED)?

A 

B 

C 

D 

E 

Answer ☐ **1**

4. A substance is changing state from a liquid to a solid.

Which row in the table gives the correct description of the effect on the temperature and the heat energy of the substance?

	Temperature	*Heat Energy*
A	stays the same	no effect
B	stays the same	given out by substance
C	increases	taken in by substance
D	decreases	given out by substance
E	decreases	taken in by substance

Answer ☐ **1**

5. Far out in space the rocket motor of a space probe is fired for a short time.

When the motor is switched off, the probe will

A decelerate until it stops

B follow a curved path

C continue to accelerate forwards

D move at a constant speed

E change direction.

Answer ☐ **1**

DO NOT WRITE IN THIS MARGIN

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6. The River Severn in England is a tidal river. At certain times the tide does not rise gradually, but instead tidal waves travel along the river. Surfing these waves is a popular activity.

(*a*) One tidal wave travels 34 km along the river in a time of two and a half hours.

Calculate the average speed of the tidal wave in km/h.

Space for working and answer

2

DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

6. (continued)

(*b*) A surfer is gathering data about these tidal waves.

(i) The surfer stands beside the river and counts 8 waves passing a point in a time of 10 seconds.

Calculate the frequency of these waves.

Space for working and answer

2

(ii) As the waves move from the sea to the river, their wavelength decreases and their amplitude increases.

The drawing shows waves in the sea.

Sketch the waves as they would appear in the river.

You must show clearly differences in wavelength and amplitude in your sketch.

Space for drawing

2

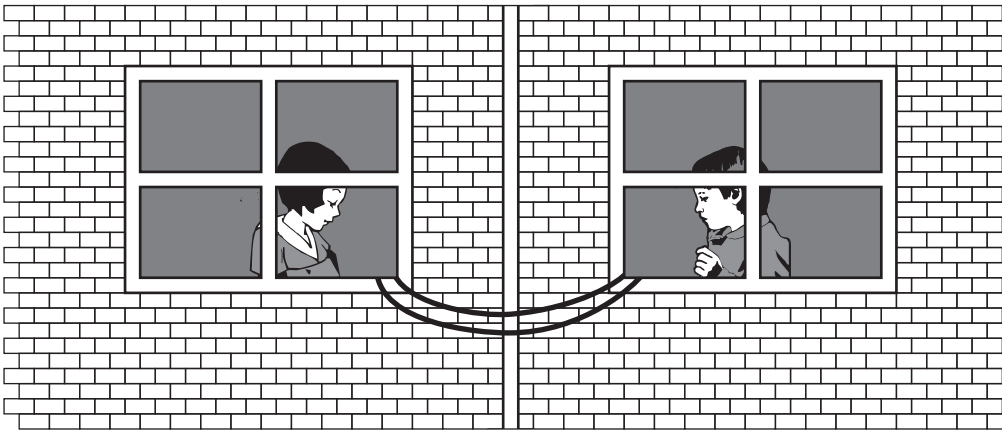
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

7. Messages can be sent using codes.

(*a*) Two friends, living in neighbouring houses, set up a communication system using wires. They can send and receive simple coded messages using this system.



The diagram shows one of the electrical circuits that the friends use.

(i) State which part of the circuit acts as the receiver.

..... **1**

(ii) Describe how the friends could use this system.

.....

..... **2**

DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

7. (continued)

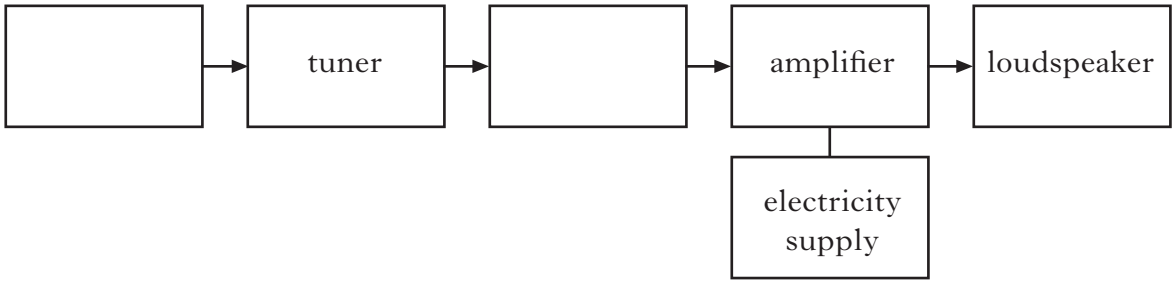
(*b*) The pilot of a light aircraft can use a code to navigate between ground stations.

Each station transmits a different coded radio signal which the pilot can hear.

(i) The block diagram shows the main parts of a radio receiver.

The labels in two of the blocks are missing.

Complete the block diagram by filling in the two missing labels.



1

(ii) State the function of:

(A) the electricity supply;

..... **1**

(B) the tuner.

..... **1**

[Turn over

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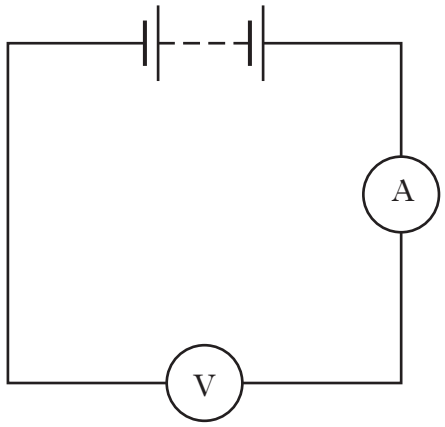
8. A student sets up an experiment to investigate the current in and the voltage across two different resistors.

The student uses a battery, an ammeter, a voltmeter and some wires to obtain measurements for each resistor.

(*a*) Complete the diagram shown below, by inserting a resistor, to show how the measurements could be obtained.



1

(*b*) The measurements obtained for each resistor are shown in the table.

Resistor	*Current* (amperes)	*Voltage* (volts)
X	0·6	1·5
Y	7·5	1·5

(i) Use the information in the table to calculate the resistance of resistor Y.

Space for working and answer

2

DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

8. (*b*) (continued)

(ii) Complete the sentence below by circling the correct phrase.

An increase in the resistance of a circuit leads to { an increase / no change / a decrease } in the current in that circuit. **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

9. The diagram shows a hair straightener and its rating plate.

Hair straightener

Type	Code
G46	UK–11
230 V ~	50 Hz
115 W	

Rating plate

(*a*) (i) State the names of the wires in the flex of the hair straightener.

..... **1**

(ii) State the colours of the insulation on the wires in this flex.

You must indicate clearly which colour applies to each wire.

..... **1**

(*b*) Calculate the current in the hair straightener when it is operating at its stated power rating.

Space for working and answer

2

(*c*) (i) State the correct fuse value which should be in the plug of the hair straightener.

..... **1**

(ii) State the purpose of the fuse in the plug.

..... **1**

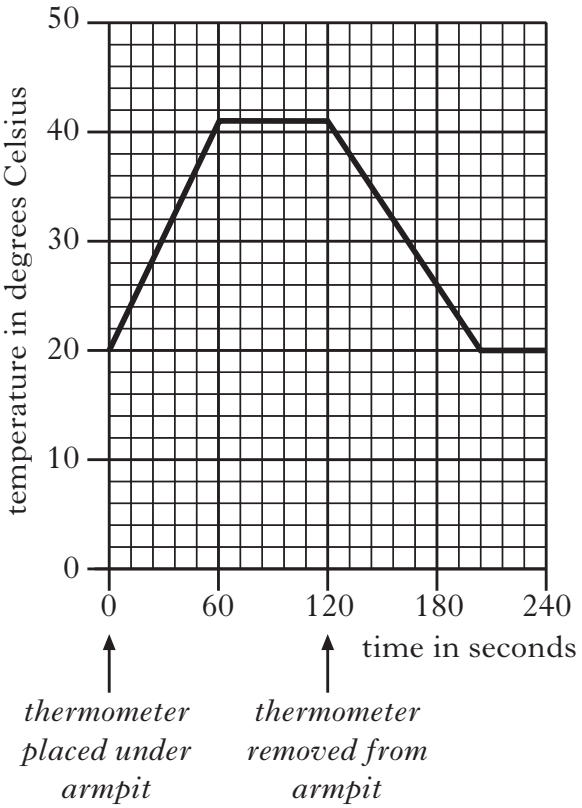
DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

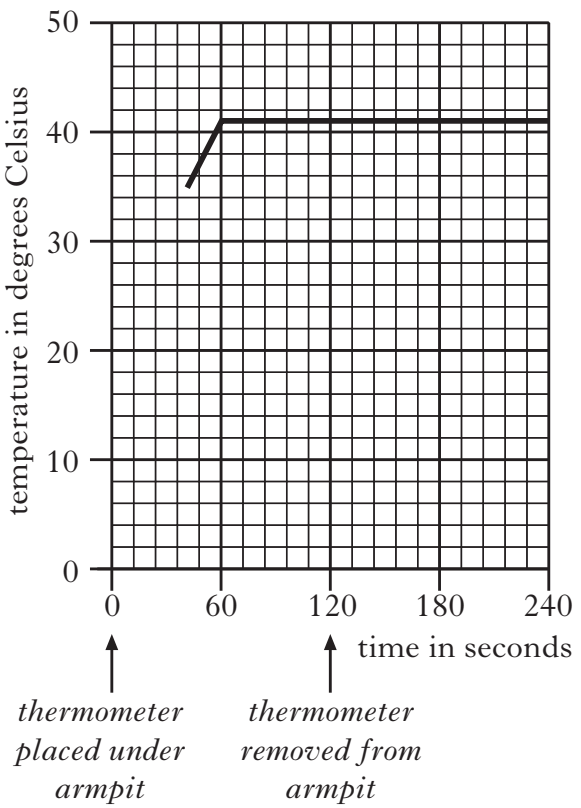
10. A student investigates the properties of two thermometers. This student places the sterilised thermometers under the armpits of a second student for two minutes. Temperature readings are recorded at 15 second intervals for four minutes.

The graphs show the recorded readings.

Thermometer A



Thermometer B



(*a*) Both thermometers are made of glass and contain a column of liquid.

Explain how a liquid in glass thermometer works.

.....

..... **1**

(*b*) (i) State which thermometer is a clinical thermometer.

..... **1**

(ii) Referring to the graphs, give **two** reasons for your choice.

.....

..... **2**

(*c*) Explain why these results suggest that the student may be ill.

.....

..... **1**

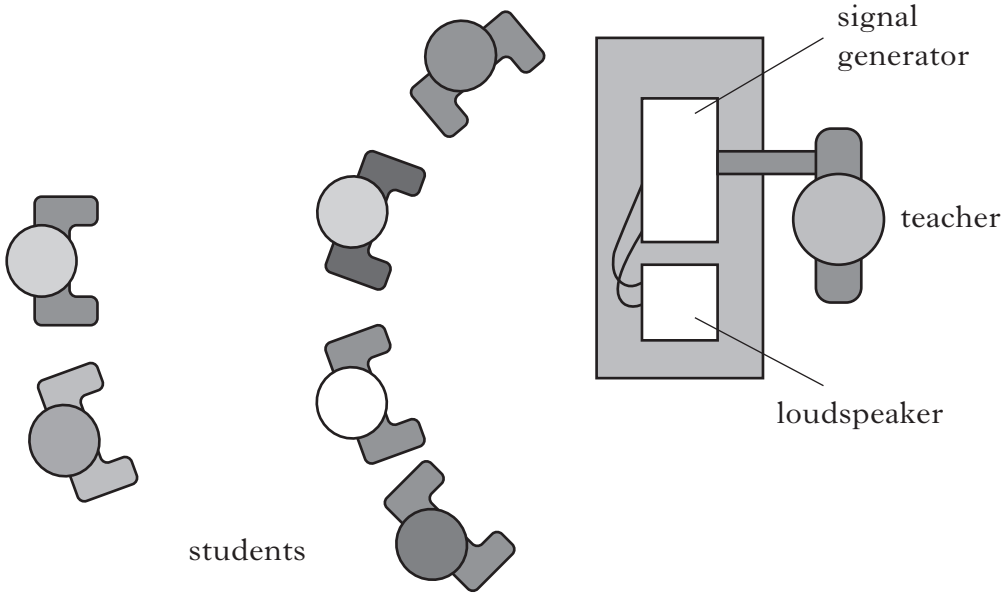
DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

11. In a class experiment, some students investigate their range of hearing.

A signal generator is connected to a loudspeaker and the teacher checks that all students can hear the sound. The frequency of the sound signal is then gradually increased.

The volume is kept constant.



(*a*) (i) State why this test is not a fair one.

..... **1**

(ii) The frequency of the sound signal reaches 20 000 Hz.

No students can hear this signal.

What name is given to high frequency vibrations that are above the range of human hearing?

..... **1**

(*b*) One student repeats the experiment using a stethoscope. The earpieces of the stethoscope are in the student's ears. The student places the open bell of the stethoscope on the table next to the loudspeaker.

Explain how the stethoscope makes the sound heard by the student louder.

.....

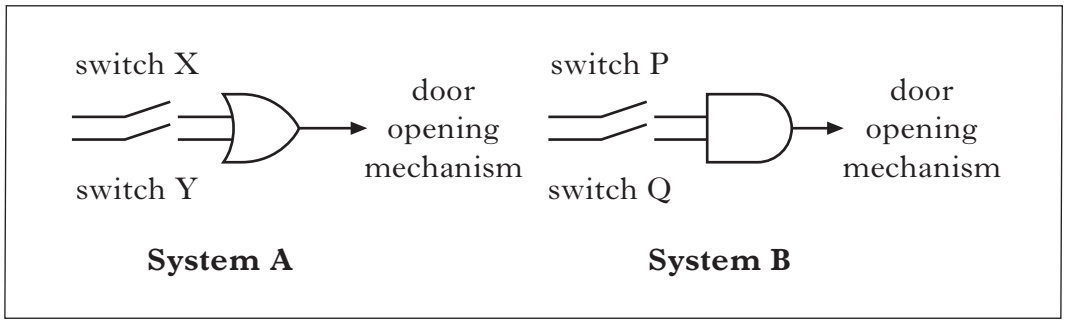
.....

.....

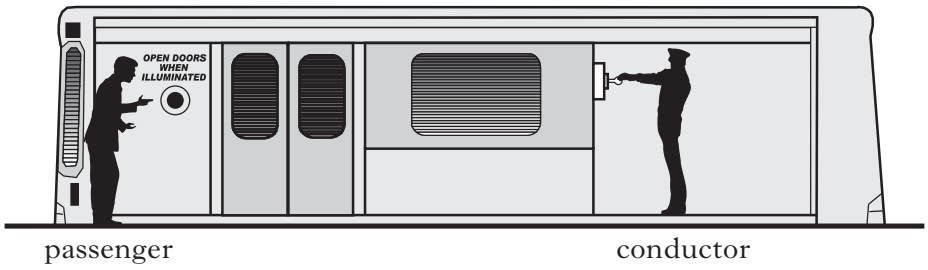
..... **2**

Marks | K&U | PS

12. Two logic systems, A and B, for controlling door opening mechanisms are shown.



To open the passenger doors on a train, the button marked "Open Doors When Illuminated" must be pressed. To illuminate the button the conductor closes a master switch using a key.

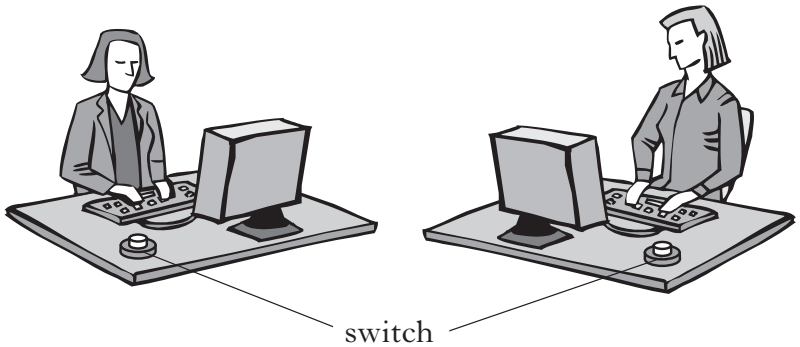


(*a*) Explain which system, A or B, should be used in this situation.

.....

..... **2**

(*b*) The main entrance doors in a school can be opened by either of two office staff using a switch on their desk.



Explain which system, A or B, should be used in this situation.

.....

..... **2**

DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

13. A supermarket uses an open display cabinet which keeps fresh food cold.

The temperature of the cabinet is monitored and displayed using a digital thermometer.

The digital thermometer is an electronic system.

(*a*) This system can be represented by a block diagram as shown.

Complete the block diagram by filling in the missing label.

1

(*b*) The list below shows the names of some input devices.

light dependent resistor (LDR)
switch
capacitor
thermistor
microphone

(i) Choose an appropriate input device from the list that could be used to monitor the temperature.

..... **1**

(ii) Suggest an output device that could be used to display the temperature.

..... **1**

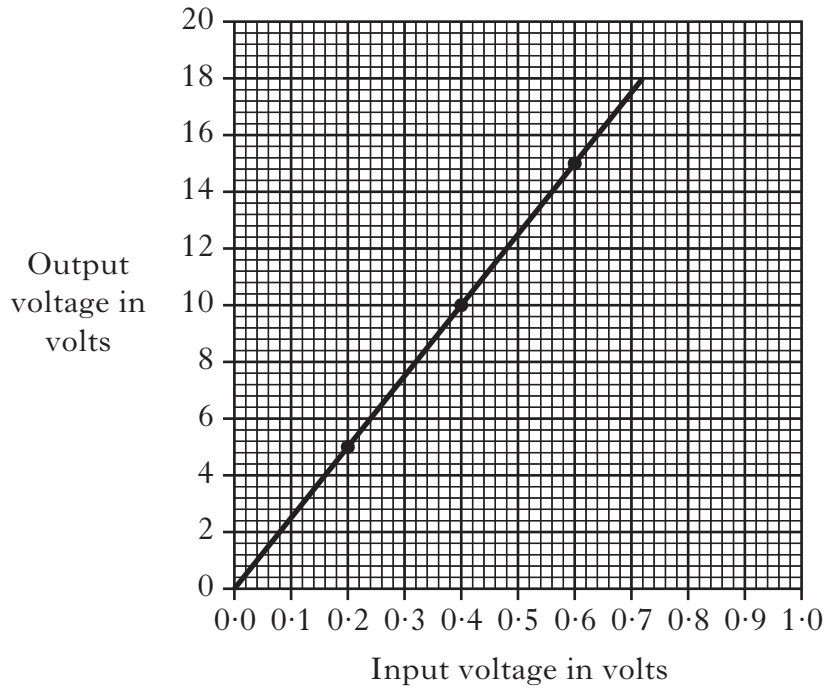
Marks | K&U | PS

13. (continued)

(*c*) A public address system is used in the supermarket to make announcements.

The public address system uses an amplifier. An engineer is testing the amplifier by applying different input voltages.

The output voltages are measured and the data is shown on the graph.



Using values from the graph, calculate the voltage gain of the amplifier.

Space for working and answer

2

(*d*) The test signal applied to the input of the amplifier has a frequency of 1000 Hz.

State the frequency of the test signal at the output of the amplifier.

.....

1

DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

14. A motoring journalist tests the grip on two new designs of tyre.

One set of tyres is placed on car A, the other set of tyres is placed on car B.

Car A

Car B

Each car is driven at a speed of 28 metres per second on a dry surface then the brakes are applied until the car stops. The distance travelled by each car during braking is measured.

The table gives information about the cars.

Car	*Mass of car in* kilograms	*Braking distance in* metres
A	1500	70
B	800	50

(*a*) Car B decelerates at 8 metres per second per second during braking.

(i) Calculate the force required during braking.

Space for working and answer

2

(ii) Calculate the work done on Car B during braking.

Space for working and answer

2

DO NOT WRITE IN THIS MARGIN

14. (continued)

Marks | K&U | PS

(*b*) The journalist concludes that the tyres on Car B have better grip than those on Car A.

Explain why the journalist's conclusion may not be correct.

..... **1**

[Turn over

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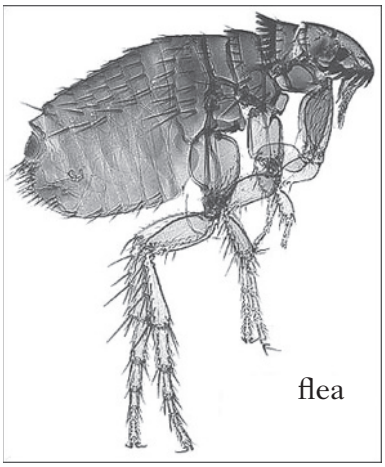
Marks | K&U | PS

15. A scientist studies a flea while it jumps.



flea

Starting from rest, the flea accelerates to 1·2 metres per second in a time of 0·001 seconds.

The flea has a mass of 0·0001 kilograms.

(*a*) State the meaning of the term "acceleration".

..... **1**

(*b*) Calculate the acceleration of the flea.

Space for working and answer

2

(*c*) Calculate the weight of the flea.

Space for working and answer

2

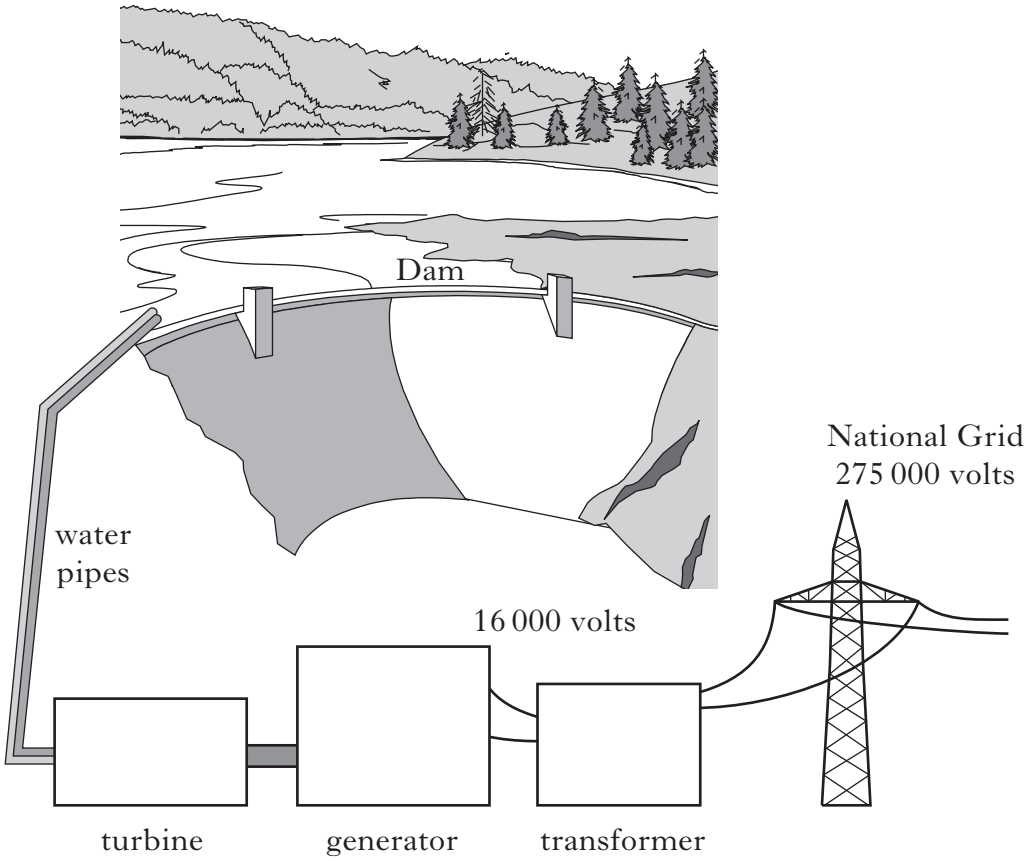
[Turn over for Question 16 on *Page twenty*

DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

16. A hydroelectric power station uses water stored in a dam to generate electricity.

The power station generates electricity at 16 000 volts. Electricity is then transmitted across the country at 275 000 volts using the National Grid.



(*a*) State the energy transformation:

(i) in the water pipes;

..... **1**

(ii) at the generator.

..... **1**

DO NOT WRITE IN THIS MARGIN

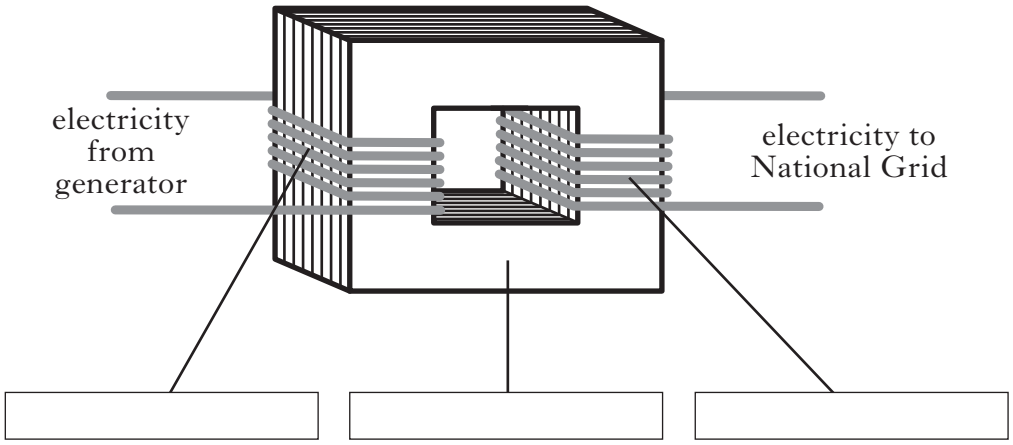
Marks | K&U | PS

16. (continued)

(*b*) (i) A transformer consists of three parts.

Label each of these three parts on the diagram, using the names below.

core **secondary coil** **primary coil**



2

(ii) The transformer has 18 000 turns on the primary coil.

Calculate the number of turns on the secondary coil.

Space for working and answer

2

(iii) Why is electrical power transmitted at a very high voltage across the National Grid?

.....

1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

17. A scientific research station near the South Pole uses a vertical axis windmill to generate electrical power.

(*a*) During a 24 hour period the average power output of the wind-powered generator is 25 kilowatts.

Calculate the electrical energy generated in kilowatt-hours during this time.

Space for working and answer

2

DO NOT WRITE IN THIS MARGIN

17. (continued)

Marks | K&U | PS

(*b*) The research station uses 200 kilowatt-hours of energy in a 24 hour period.

The remaining energy is sold at 9 pence per kilowatt-hour to another station.

Calculate the income from the sale of this remaining energy.

Space for working and answer

3

(*c*) Wind is a renewable source of energy.

Name **one** other renewable source of energy.

..... **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	K&U	PS

18. A spacecraft is orbiting the Earth. Scientists prepare to bring it back to the Earth's surface.

(*a*) To safely enter the Earth's atmosphere, the speed of the spacecraft must be decreased. This is achieved by thruster rockets.

The spacecraft has a mass of 6000 kilograms and the thruster rockets create a combined thrust of 4800 newtons.

Calculate the deceleration of the spacecraft when the thruster rockets fire.

Space for working and answer

2

(*b*) The thruster rockets are now switched off. A heat resistant tile breaks off the spacecraft. The force of gravity near the Earth causes both the spacecraft and the tile to accelerate towards the Earth.

(i) Complete the sentence by circling the correct phrase.

If there is no air resistance the tile will accelerate

at { a lower rate than / the same rate as / a faster rate than } the spacecraft. **1**

(ii) When the objects enter the Earth's atmosphere some of their kinetic energy is transformed into heat.

Name the force that causes this energy transformation.

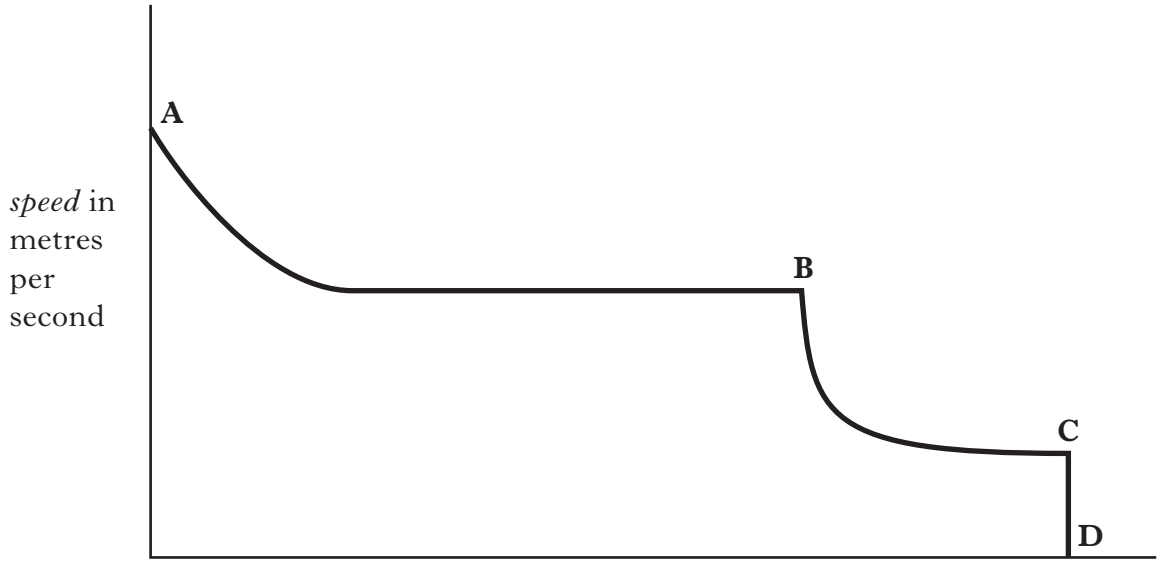
..... **1**

Marks | K&U | PS

18. (continued)

(*c*) Not all of the spacecraft's kinetic energy is lost at re-entry. It still needs to be slowed down before impact with the Earth. This is achieved using a parachute.

The graph shows how the speed of a spacecraft changes from re-entry to impact.



Which point on the graph corresponds to the parachute opening?

..... **1**

[Turn over for Question 19 on *Page twenty-six*

DO NOT WRITE IN THIS MARGIN

Marks | K&U | PS

19. Read the following passage about comets.

Halley's Comet is famous because it is visible to the naked eye, orbiting from beyond the planet Neptune and returning to the solar system on average once every 76 years.

Halley's Comet last visited the inner solar system in 1986. It will return again in 2061.

Comets are made of ice mixed with frozen methane; substances very similar to those found on a moon called Miranda.

Comets can only survive very far away from the Sun. Most comets reside in the Oort Cloud which contains many billions of comets. The Oort Cloud reaches a quarter of the distance from the Sun to the next nearest star called Proxima Centauri.

The Oort Cloud is easily affected by the gravitational pull of the Milky Way galaxy which causes comets to move into new orbits that carry them closer to the Sun.

(*a*) Use information **given in the passage** to answer the following questions.

(i) State the name of **one** object that orbits a planet.

..... **1**

(ii) State the name of **one** object that generates light.

..... **1**

(iii) State the name of the object furthest away from the Earth.

..... **1**

(iv) State the name of **one** object that orbits the Sun.

..... **1**

(*b*) State what is meant by the term galaxy.

..... **1**

(*c*) State what is meant by the term solar system.

..... **1**

[*END OF QUESTION PAPER*]

DO NOT WRITE IN THIS MARGIN

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ADDITIONAL SPACE FOR ANSWERS

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

DO NOT WRITE IN THIS MARGIN

K&U	PS

ADDITIONAL SPACE FOR ANSWERS

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

ACKNOWLEDGEMENTS

General Level Question 14—Two photographs of Citroën cars are reproduced by kind permission of Citroën UK Ltd.