FOR OFFICIAL USE

Presenting Centre No.	Candidate No.	Subject No.	Level	Paper No.	Group No.	Marker's No.	
		3220					

K&U PS

Total Marks

G

[3220/144] 1994

SCOTTISH CERTIFICATE OF EDUCATION

PHYSICS

Standard Grade—GENERAL LEVEL

Friday, 13th May—9.30 a.m. to 11.00 a.m.

Fill in these boxes and read what is printed below.

Full Name of school or college

Town

Christian Name/First Name, Initial(s) (of other/middle name(s))

Surname

Date of Birth
Day *Month* *Year*

Number of seat occupied at examination

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 1–9, 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 10–22, 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. **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.**

ES 3220/144 6/3/30110

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

This tells you that the appliance

A operates from 440 volts

B does not require a live wire

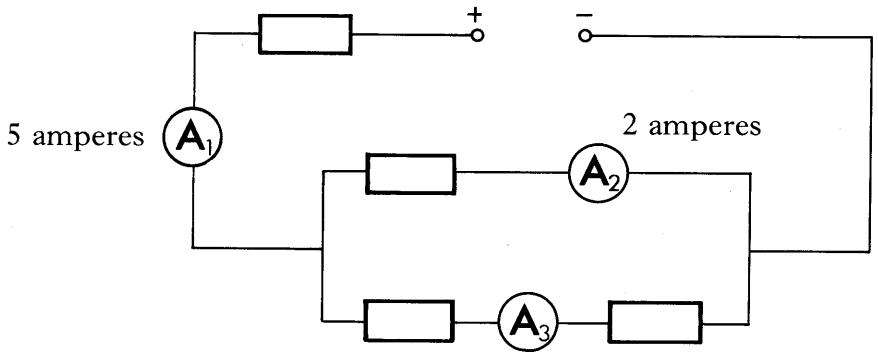
C does not require an earth wire

D has a poisonous casing

E does not need a fuse.

Answer ☐ 1

2. In the circuit shown below, the reading on ammeter A_1 is 5 amperes and on ammeter A_2 is 2 amperes.



The reading on ammeter A_3 is

A 1·5 amperes

B 2 amperes

C 3 amperes

D 5 amperes

E 7 amperes.

Answer ☐ 1

3. Which of the following correctly lists the units of current and resistance?

	Current	*Resistance*
A	watt	ohm
B	ampere	ohm
C	ohm	ampere
D	ohm	watt
E	ampere	watt

Answer ☐ 1

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4. The kilowatt-hour is a unit of

A voltage
B current
C power
D energy
E charge.

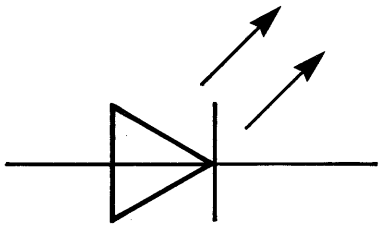
Answer ☐ **1**

5. Which of the following is an input device?

A Relay
B Buzzer
C Solenoid
D Loudspeaker
E Microphone

Answer ☐ **1**

6. The diagram shows a symbol used to represent a component in an electronic circuit.



Which of the following does the symbol represent?

A A NOT gate
B An AND gate
C A light dependent resistor (LDR)
D A light emitting diode (LED)
E An OR gate

Answer ☐ **1**

[Turn over

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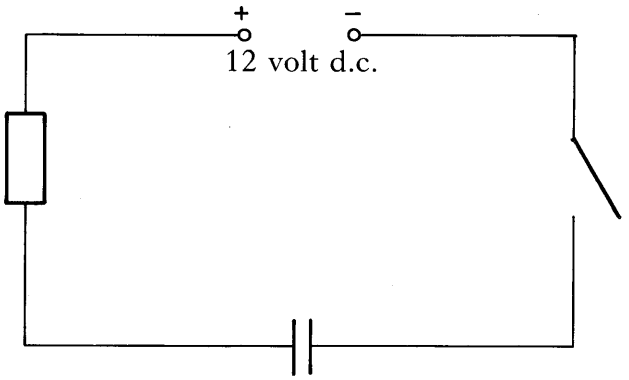
7. The circuit below shows an uncharged capacitor connected in series with a resistor, a switch and a 12 volt d.c. supply.



When the switch is closed, the voltage across the capacitor

A is immediately at 12 volts

B gradually increases to 12 volts

C gradually drops from 12 volts to 0 volt

D drops from 12 volts to 0 volt and then goes back to 12 volts

E remains at 0 volt.

Answer ☐ **1**

8. Our Sun is a

A planet

B moon

C star

D galaxy

E meteorite.

Answer ☐ **1**

9. Which of the following is the source of energy in a portable radio?

A Tuner

B Decoder

C Amplifier

D Battery

E Loudspeaker

Answer ☐ **1**

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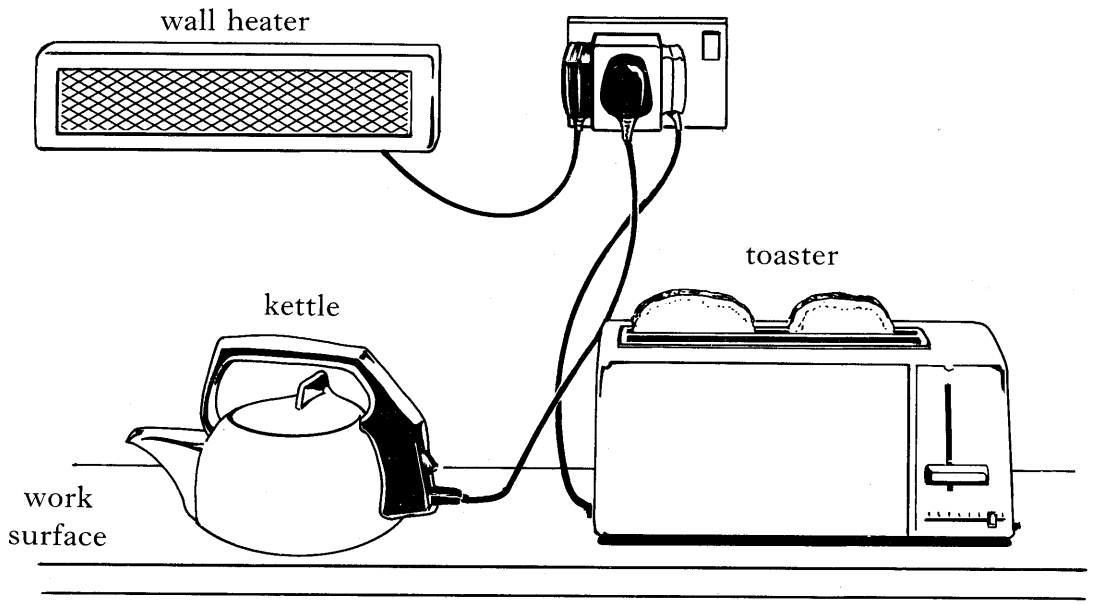
10. The diagram shows some electrical appliances connected in an unsafe manner.



Explain why the appliances connected in this way could result in an accident.

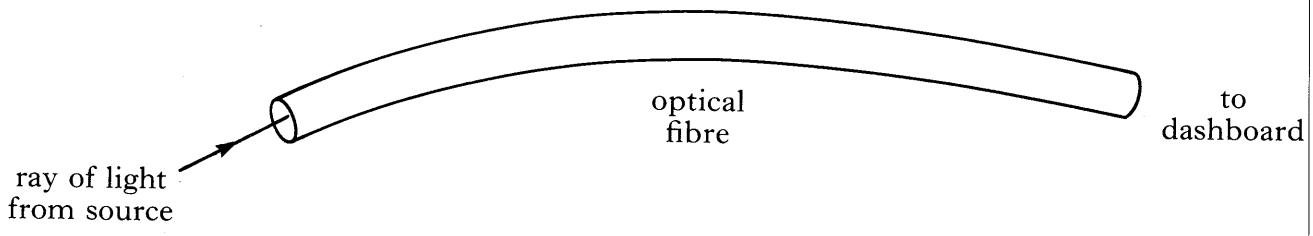
.....

.....

.....

..... **2**

11. Optical fibres are used to illuminate the instrument panel on the dashboard of some cars. The diagram below shows part of an optical fibre between the light source and the dashboard.



Complete the diagram to show the passage of the ray of light along the fibre. **2**

[Turn over

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12. A reporter from the local radio station is present at the opening of a new factory.

The reporter has to get her report back to the radio station in time for the next news bulletin. She telephones in her report.

(*a*) Give **one** advantage of using a telephone in everyday life.

..... **1**

(*b*) A girl, listening to her radio, hears the broadcast of the report on the opening of the factory. The table below shows the frequency range of the different wavebands on her radio receiver.

Waveband	*Frequency range*
long wave	30 kilohertz – 300 kilohertz
medium wave	300 kilohertz – 3 megahertz
high frequency	3 megahertz – 30 megahertz
F.M.	30 megahertz – 300 megahertz

(i) The radio station she is listening to has a frequency of 570 kilohertz.

State the waveband of this radio station.

..... **1**

(ii) Give a possible frequency of a radio station which transmits in the F.M. waveband.

..... **1**

(iii) The main parts of a radio receiver are listed below.

Aerial Tuner Decoder Amplifier Loudspeaker Electricity supply

Which part is used to select a particular radio station?

..... **1**

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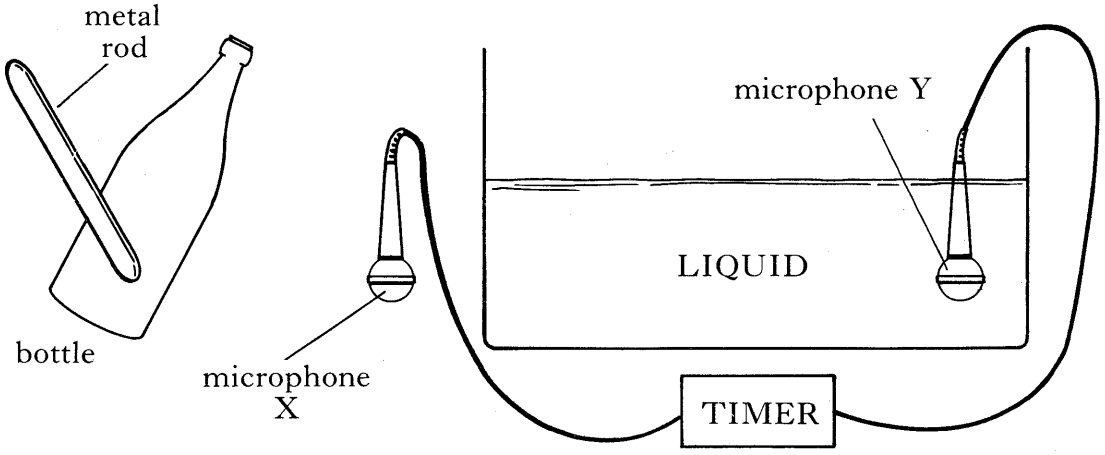
13. Scott tries to measure the speed of sound in a liquid. The equipment used is shown below.



The liquid is in a thin glass container. The bottle is hit and a pulse of sound is produced. When the sound pulse reaches microphone X, the timer starts. When the sound pulse reaches microphone Y, the timer stops. The microphones have been adapted to work in this liquid.

(*a*) What quantity, other than time, must be measured before the speed of sound in the liquid could be calculated?

..... **1**

(*b*) Alan says that the result of Scott's experiment will not be accurate.

How could you rearrange the equipment to obtain a more accurate value for the speed of sound in the liquid?

.....

..... **1**

14. (*a*) Describe an experiment which would allow you to measure the focal length of a convex lens. If you wish, you may draw a diagram to illustrate your answer.

.....

.....

.....

.....

.....

..... **3**

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14. (continued)

(*b*) Andrew has an eye defect. He can see clearly an object which is very close to his eye but distant objects appear blurred.

(i) What name is given to this eye defect?

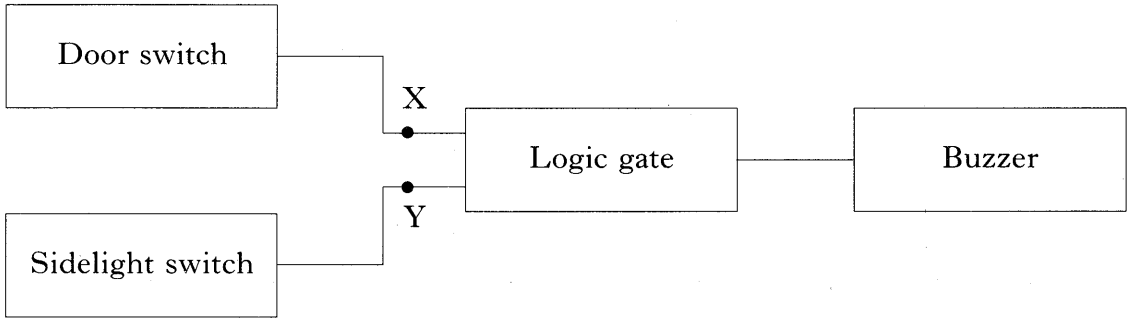
..... **1**

(ii) State the type of spectacle lens which would allow Andrew to see clearly distant objects.

..... **1**

15. A warning system in a car is used to remind the driver that the sidelights have been left on. When the sidelights are on, a buzzer sounds when the driver's door is opened.

A block diagram of the warning system is shown below.



When the door is open, the output from the door switch is at logic level 1.
When the door is closed, the output from the door switch is at logic level 0.

When the car sidelights are on, the output from the light switch is at logic level 1.
When the car sidelights are off, the output from the light switch is at logic level 0.

The buzzer sounds when the output from the logic gate is at logic level 1.

(*a*) Name the logic gate used in the warning system.

..... **1**

(*b*) What are the logic levels at the points X and Y when the buzzer sounds?

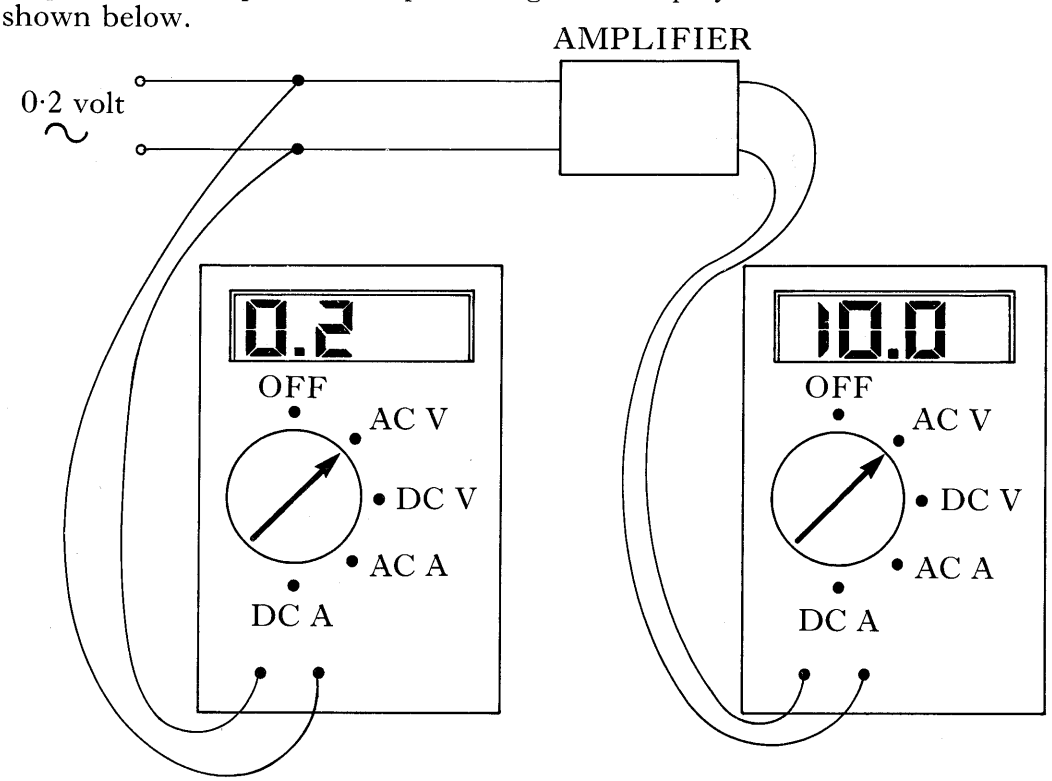
Logic level at X: ..... Logic level at Y: **2**

K&U	PS

16. (*a*) State the lowest noise level, in decibels, which, over a long period of time, could cause damage to hearing.

..... | 1 |

(*b*) A hearing aid may be used to help with hearing loss. A hearing aid contains an amplifier. Laura carries out an experiment to measure the voltage gain of the amplifier in a hearing aid. She applies a 250 hertz, 0·2 volt signal to the amplifier. The input and output voltages are displayed on the voltmeters as shown below.



(i) Calculate the voltage gain of the amplifier.

Space for working and answer | 3

(ii) She decides to measure the gain of the amplifier at a frequency one octave above 250 hertz.

What is the frequency of the signal which should be applied to the amplifier?

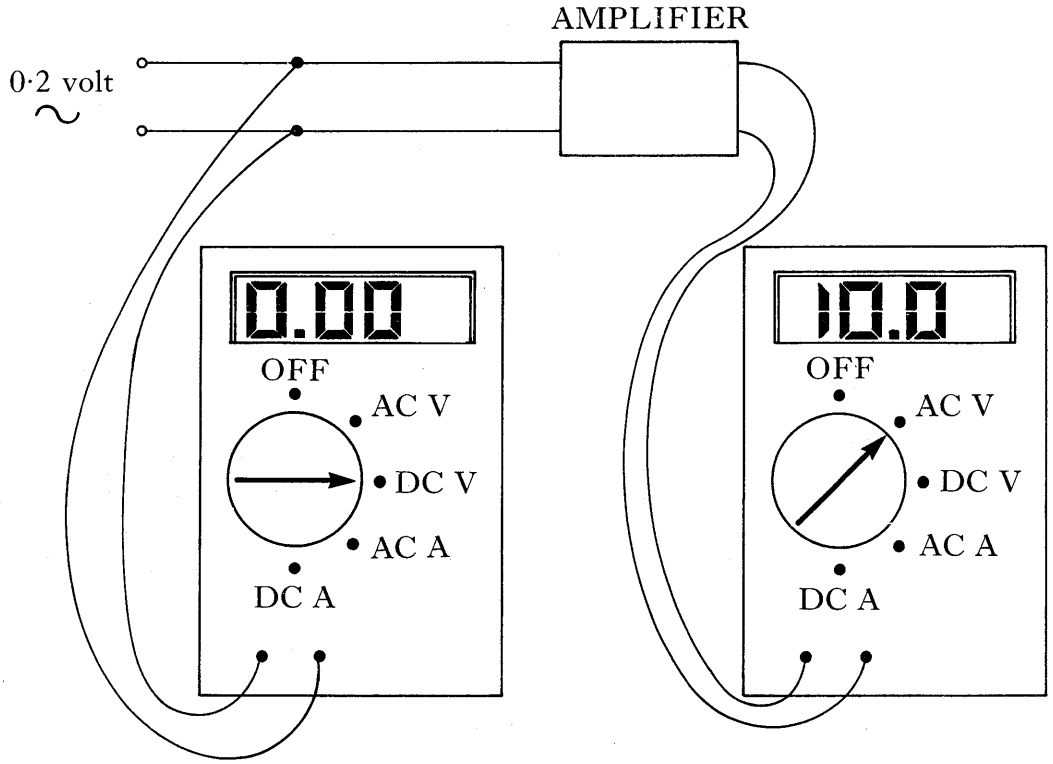
..... | 1

[Turn over

K&U	PS

16. (continued)

(*c*) Carol tries the same experiment to measure the voltage gain by setting up the circuit shown below.



Carol was unable to obtain a value for the input voltage to the amplifier, although the meter was switched on.

What mistake did Carol make?

..... **1**

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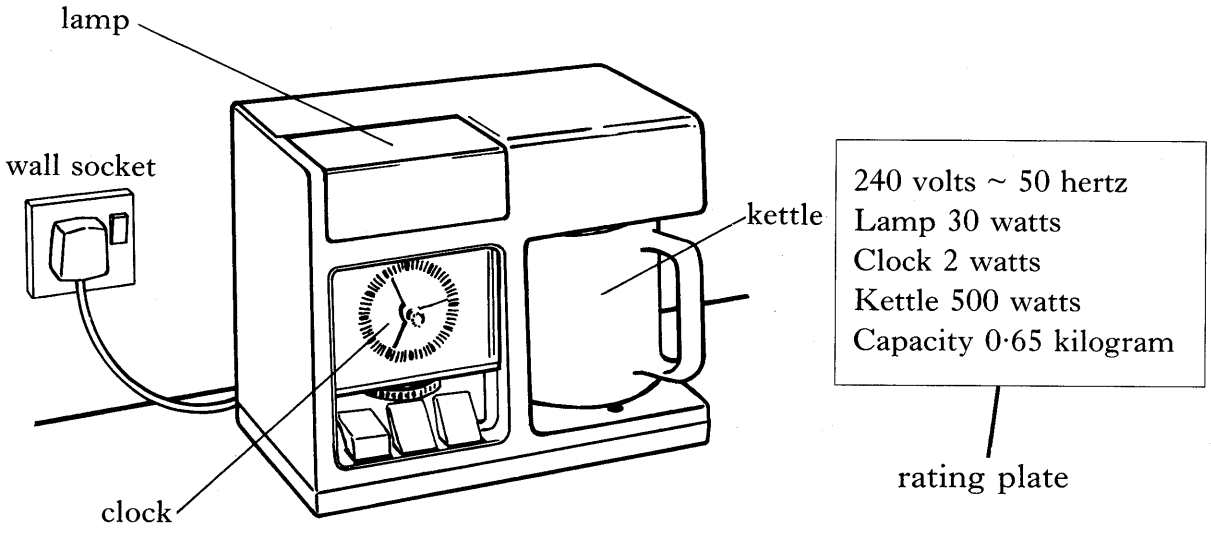
17. The electrical appliance in the diagram below is called a teamaker.



The teamaker consists of a lamp, a clock and a kettle. The rating plate for the teamaker is also shown on the diagram.

(*a*) Calculate the current drawn from the mains supply when the lamp, clock and kettle are all switched on.

Space for working and answer

3

(*b*) Fuses for the plug are available as shown below.

Fuse values in amperes (A)	1A	2A	3A	10A	13A

Select the correct fuse value for the plug of the teamaker.

.....

1

(*c*) The kettle contains 0·65 kilogram of water at 20 degrees celsius. How much energy is required to increase the temperature of the water to 100 degrees celsius?

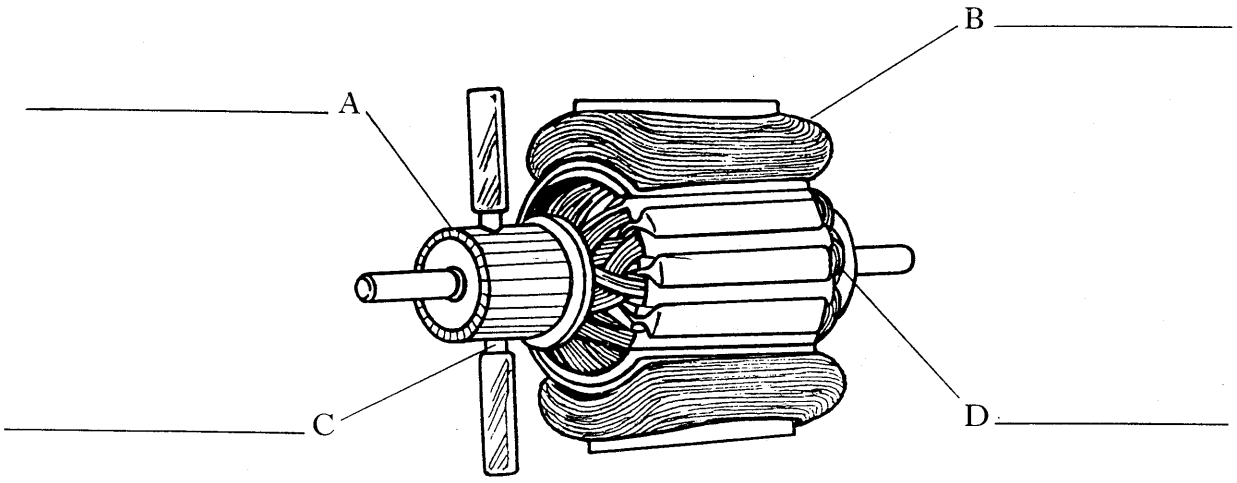
(Specific heat capacity of water = 4180 joules per kilogram per degree celsius)

Space for working and answer

2

	K&U	PS

18. (*a*) The diagram below shows the main parts of an electric motor.



The parts of the motor are listed below.

Rotating coil *Field coil (magnet)* *Brushes* *Commutator*

Use the list of parts to label the spaces A, B, C and D provided on the diagram. **2**

(*b*) Some car manufacturers are developing battery powered electric cars. One make of electric car has a mass of 500 kilograms. During a test run, the car accelerates from rest to 30 metres per second in 8 seconds.

(i) Calculate the acceleration of the car.

Space for working and answer **2**

(ii) State the main energy transfer in the electric motor while the electric car is accelerating.

..... **1**

K&U	PS

18. (continued)

(*c*) During a 50 minute journey, the car battery delivers a constant power of 9000 watts.

(i) Calculate the energy supplied by the battery for this journey.

Space for working and answer

2

(ii) The cost of electricity to charge the battery is 2 pence for one million joules.

Calculate the cost of the electricity for this journey.

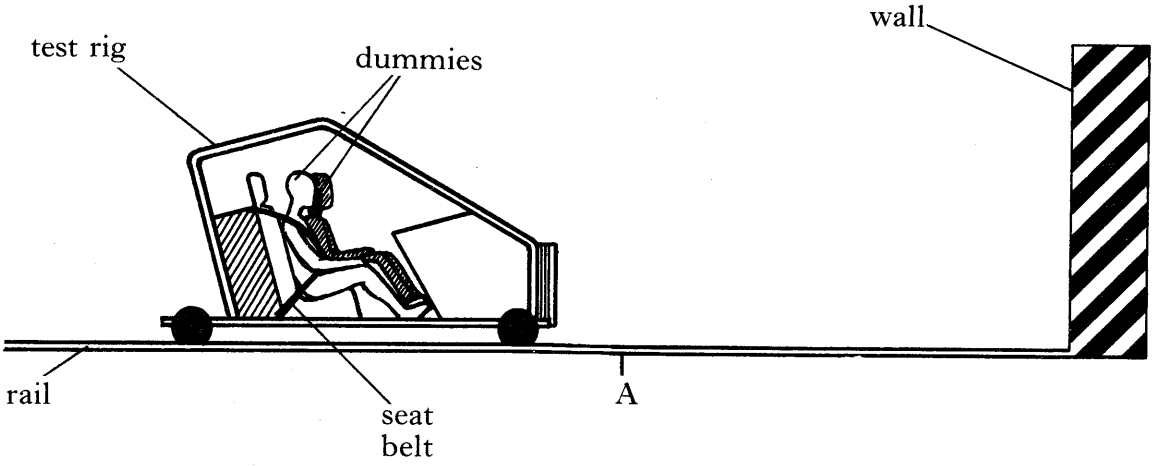
Space for working and answer

2

[Turn over

K&U	PS

19. During the testing of a material which is to be used for making seat belts, a test rig is crashed into a wall. During the crash, the rig decelerates at 20 metres per second per second. The rig contains two dummies, each of mass 65 kilograms. One of the dummies is wearing a seat belt while the other dummy is not.



(*a*) Describe how the speed of the test rig could be measured, at point A, just before the collision. Your description should include:

(i) the way you would set up your apparatus;

(ii) the measurements you would make;

(iii) how you would calculate your result.

.....

.....

.....

.....

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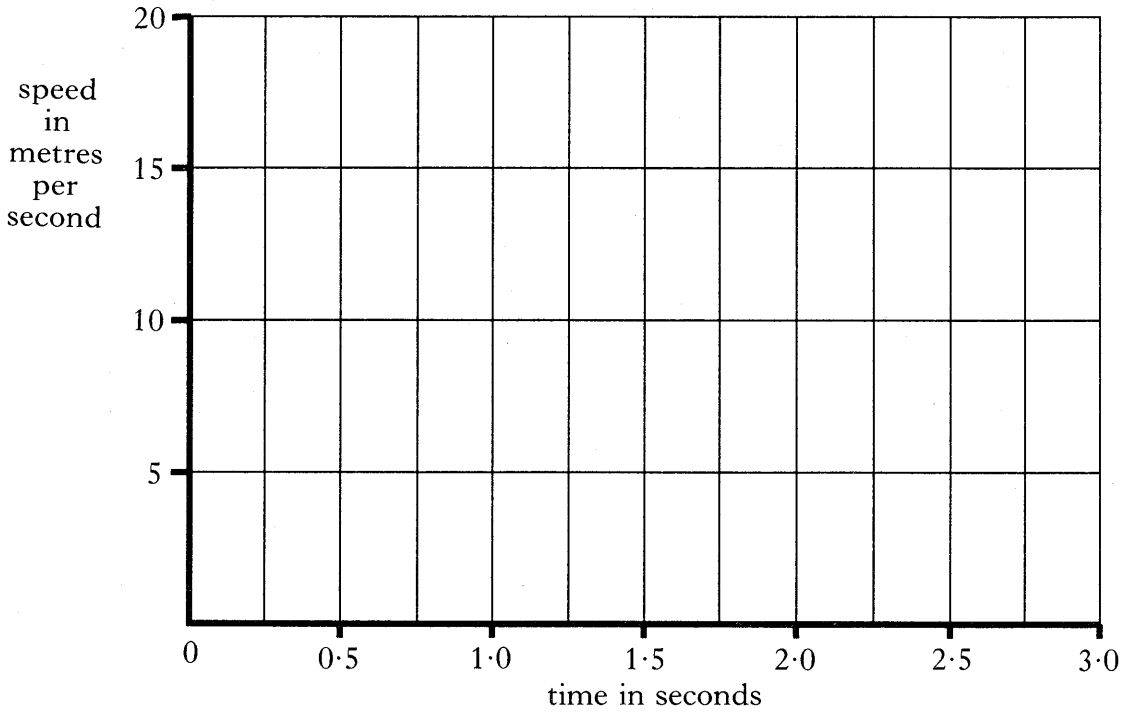
.....

..... | 3

(*b*) The dummy wearing the seat belt has the same deceleration as the test rig. Calculate the average force exerted by the seat belt on the dummy.

Space for working and answer | 2

	K&U	PS
19. (continued)		
(*c*) Describe the motion of the dummy which was not wearing the seat belt during the collision and hence explain why seat belts are used in cars.		
.....		
.....		
.....		
.....		
.....		**2**
(*d*) For 2 seconds before hitting the wall, the test rig was travelling at a constant speed of 15 metres per second. The collision with the wall lasted for 0·75 second before the rig was brought to rest.		
Using the axes below, draw a speed–time graph which represents the motion of the test rig from a time 2 seconds before hitting the wall.		



2

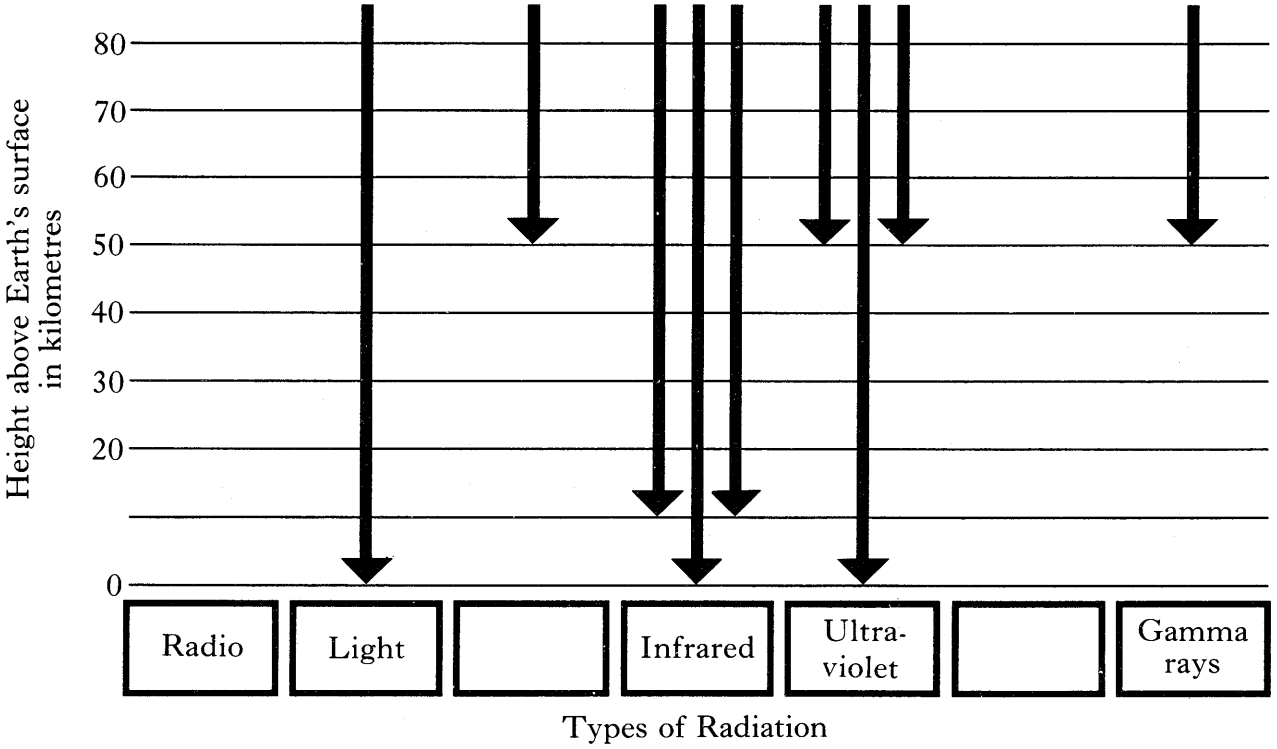
[Turn over

K&U	PS

20. (*a*) Radiations travelling from outer space vary in their ability to pass through the Earth's atmosphere. A pupil collects information about some of these radiations. Her description of this information is given below.

Radio and light waves are able to reach the Earth's surface. Microwaves, however, are absorbed about 50 kilometres above the Earth's surface while infrared rays are mostly absorbed about 10 kilometres from the surface. Ultraviolet rays are mostly absorbed at about the same height as microwaves although some do reach ground level. X-rays are absorbed at a height of 40 kilometres and gamma rays at 50 kilometres.

The pupil displays some of this information on a diagram as shown below.



(i) Complete the diagram for the other radiations mentioned in the pupil's description by filling the blank boxes and drawing the **two** missing lines on the diagram. **3**

(ii) What radiations from outer space, mentioned in the pupil's description, reach a satellite in an orbit 35 kilometres above the Earth's surface?

.....

..... **2**

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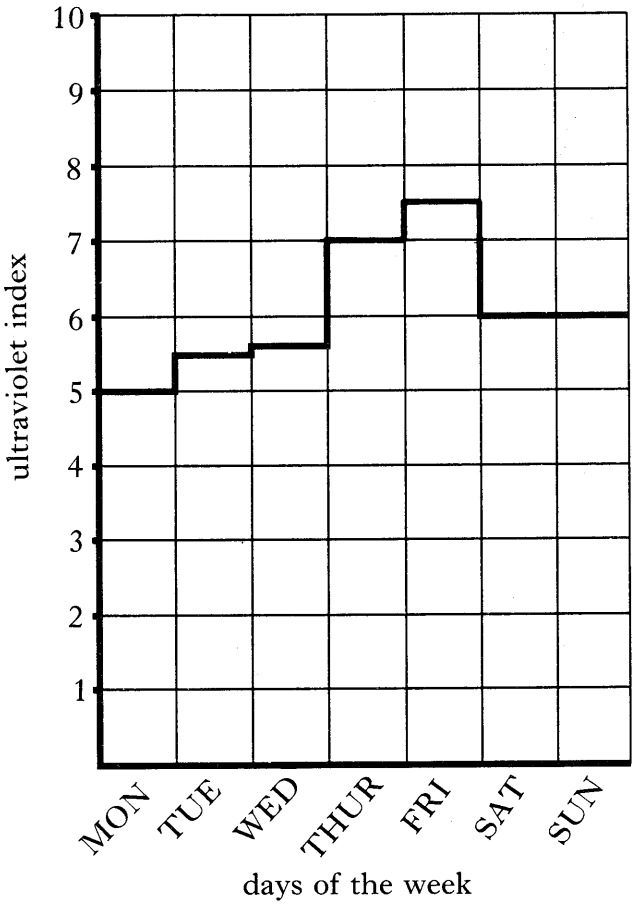
20. (continued)

(*b*) In some parts of North America, a daily ultraviolet index is published to give a guide to the amount of time that a person can sunbathe safely. The table shows such an index. The chart shows how the index changed during a week in May.

Ultraviolet index	*Time to sunbathe*
Greater than 9	15 minutes
7–8·9	20 minutes
4–6·9	30 minutes
0–3·9	1 hour



(i) Use the chart and the table to estimate the maximum safe time allowed for sunbathing on Friday of that week.

..... **1**

(ii) Why may it be dangerous for a person to be exposed to too much ultraviolet radiation?

.....

..... **1**

[Turn over

K&U	PS

21. (*a*) During space missions, crews experience the effect known as "weightlessness". "Weightlessness" can be demonstrated on Earth. Figure 1 shows a person holding a newton balance from which a 2 kilogram mass is suspended. Figure 2 shows the person shortly after stepping off a diving board.

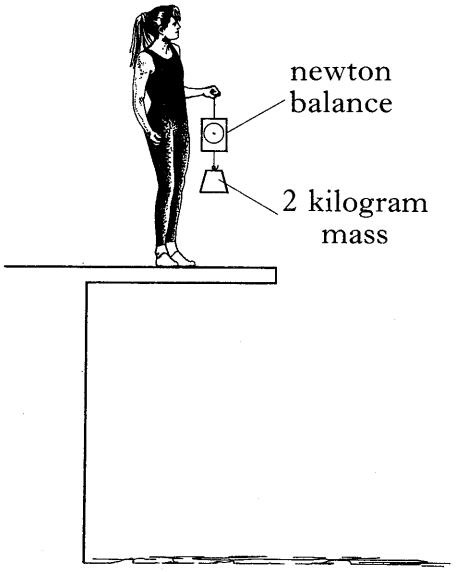


figure 1

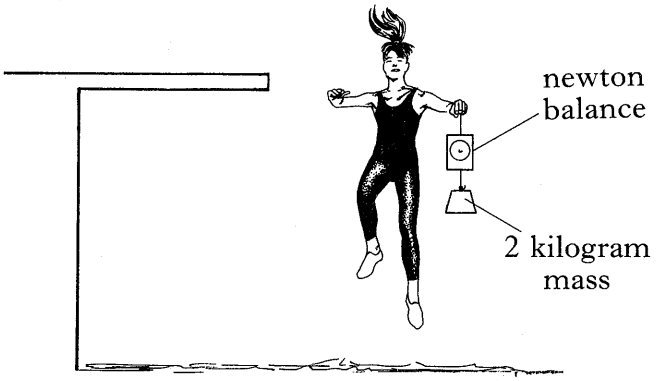


figure 2

(i) What is the reading on the newton balance while the person is standing still on the board as shown in figure 1?

Space for working and answer

2

(ii) What happens to the reading on the newton balance as the person is falling towards the water?

.....

1

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21. (continued)

(*b*) An astronaut wears a backpack during a space walk. The astronaut uses the backpack to control his position during the walk. The backpack contains a pressurised gas cylinder connected to a valve. When the valve is opened, gas is released from the cylinder.

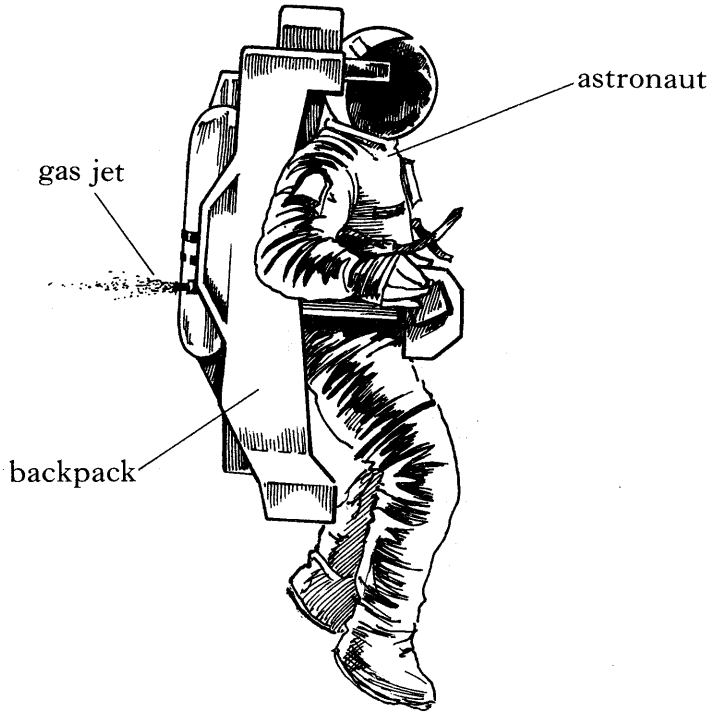


figure 3

Complete the passage below by selecting words from the following list.

same *opposite* *accelerated* *decelerated*

When the astronaut opens the valve, the cylinder pushes gas backwards. The gas pushes the cylinder in the ..... direction. A forward force is exerted on the cylinder. The cylinder, backpack and astronaut are therefore ..... forwards. **2**

[Turn over

	K&U	PS

22. (*a*) The main sources of energy used in the UK are listed below.

Oil *Coal* *Natural gas* *Nuclear fuel* *Hydroelectricity*

(i) Select from the list one source of energy which is **not** a fossil fuel.

..... **1**

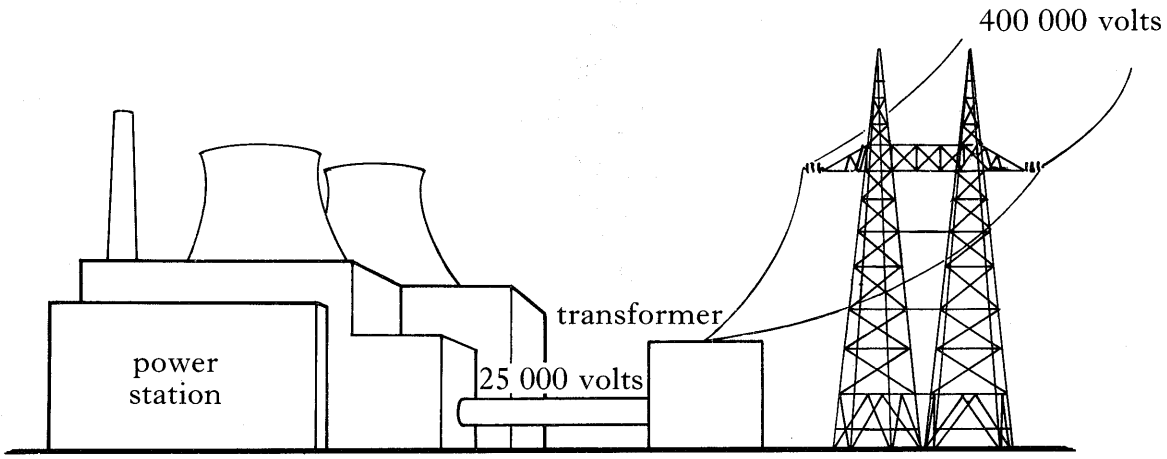
(ii) Name a renewable source of energy which is **not** in the list.

..... **1**

(iii) Give an advantage of generating electricity using hydroelectric power.

..... **1**

(*b*) A power station produces electricity at 25 000 volts. This voltage is stepped up to 400 000 volts by a transformer.



(i) The number of turns on the primary coil of the transformer is 20 000. Calculate the number of turns on the secondary coil.

Space for working and answer

2

(ii) Why is a voltage as high as 400 000 volts used in the transmission of electrical energy?

.....

..... **1**

[END OF QUESTION PAPER]

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