FOR OFFICIAL USE

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

G

K & U	PS

Total Marks

3220/101

SCOTTISH CERTIFICATE OF EDUCATION 1996

FRIDAY, 17 MAY
9.30 AM – 11.00 AM

PHYSICS
STANDARD GRADE
General Level

Fill in these boxes and read what is printed below.

Full name of school or college

Town

First name and initials

Surname

Date of birth
Day Month Year

Candidate number

Number of seat

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 1–10, 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 11–27, 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.

SAB 3220/101 6/3/28110

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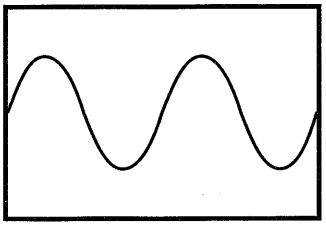
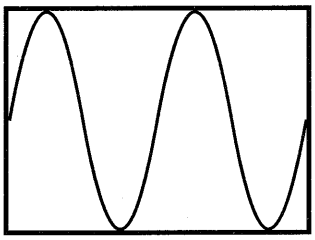
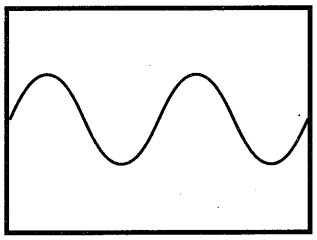
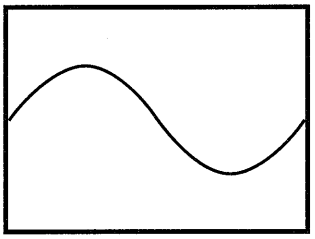
1. A pupil whistles a note into a microphone connected to an oscilloscope and the pattern observed is shown in the diagram below.

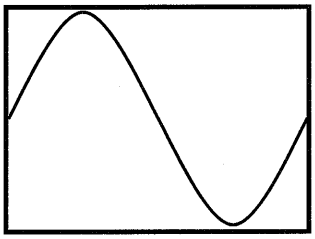


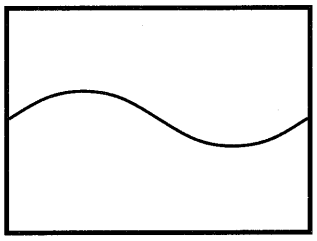
Without changing the controls on the oscilloscope, a second pupil whistles a louder note of lower frequency into the microphone. Which of the following shows the pattern which would be observed on the screen?

A 

B 

C 

D 

E 

Answer ☐ **(1)**

2. In a radio, the amplifier is used to

A pick out one signal from all the signals reaching the aerial

B make the electrical signal stronger

C change electrical energy to sound energy

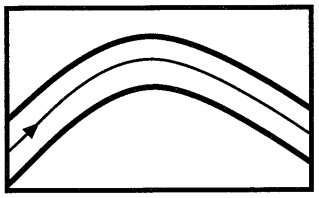
D change sound energy to electrical energy

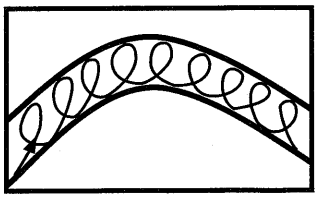
E supply the energy to the radio.

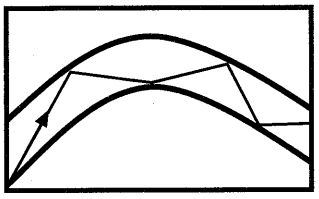
Answer ☐ **(1)**

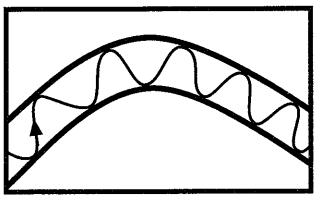
Marks

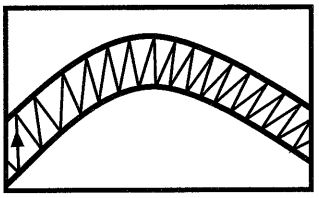
3. Which of the following shows the path of a ray of light through an optical fibre?

A 

B 

C 

D 

E 

Answer ☐ **(1)**

4. Sounds can travel through

A a vacuum

B solids only

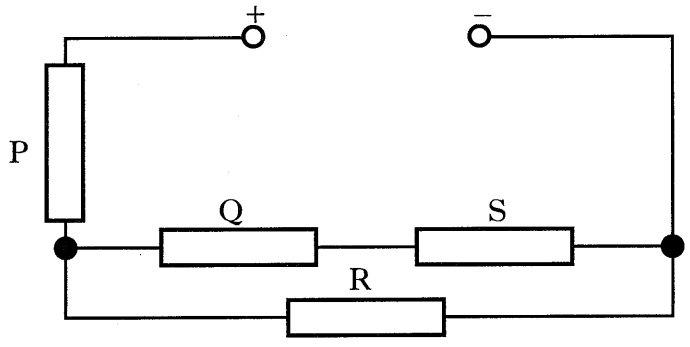
C liquids only

D gases only

E solids, liquids and gases.

Answer ☐ **(1)**

5. In the circuit below, the resistors P, Q, R and S have the same value.



In which of the resistors is the current the same?

A Q and S only

B P, Q and S only

C P, Q, R and S

D P and R only

E R and Q only

Answer ☐ **(1)**

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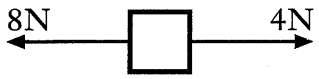
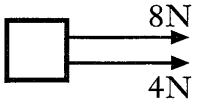
6. The diagrams below show the forces acting on a number of moving objects. Which object is moving at constant speed?

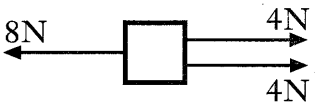
A



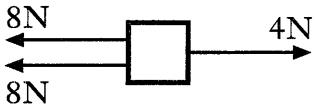
B



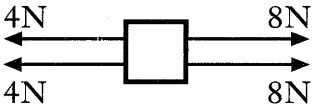
C



D



E



Answer ☐ **(1)**

7. The kinetic energy of a car travelling along a level road depends on

A the distance the car travels

B the frictional forces acting on the car

C the mass of the car only

D the speed of the car only

E the mass and speed of the car.

Answer ☐ **(1)**

8. The activity of a radioactive source is measured in

A bequerels

B watts

C coulombs

D joules

E sieverts.

Answer ☐ **(1)**

9. The energy given out when one kilogram of a material changes from a gas to a liquid, without the temperature of the material changing, is called the

A specific latent heat of fusion of the material

B specific latent heat of vaporisation of the material

C melting point of the material

D specific heat capacity of the material

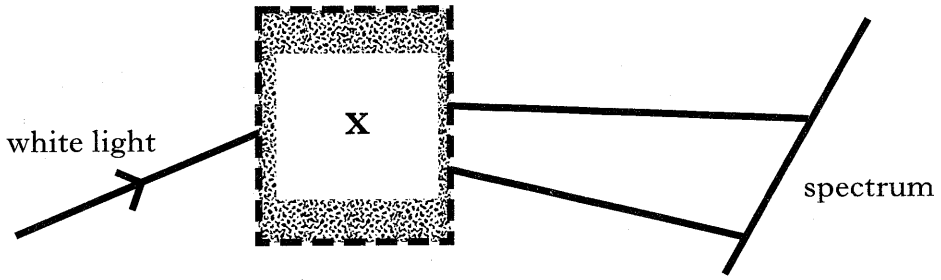
E boiling point of the material.

Answer ☐ **(1)**

K&U	PS

Marks

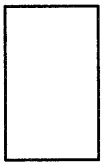
10. White light is allowed to strike a glass object placed under a cover at X and a spectrum is produced as shown.

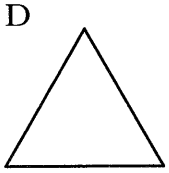


Which of the following objects was placed under the cover at X?

A 

B 

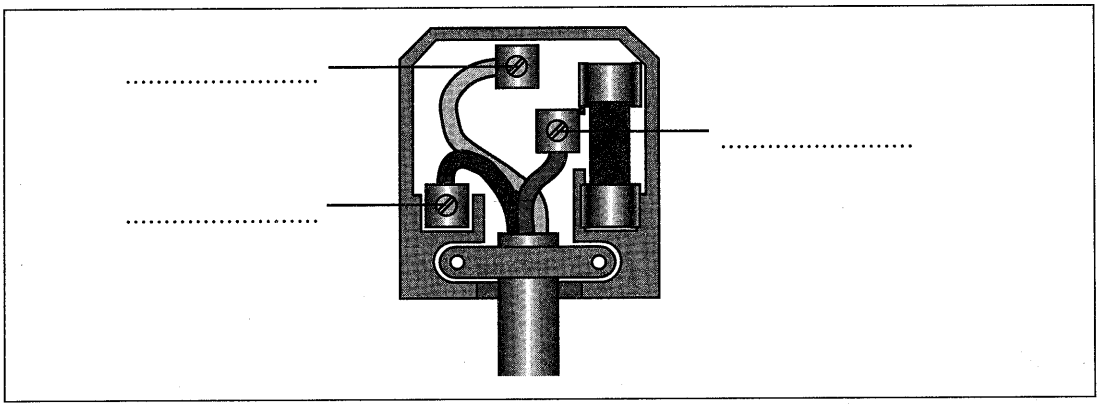
C 

D 

E 

Answer ☐ **(1)**

11. The diagram shows a plug which has been correctly wired.



Label the colour of the insulation on the wire connected to each of the terminals shown on the diagram. **(1)**

12. In the space below, draw the circuit symbol for a variable resistor.

Space for drawing

(1)

K&U	PS

Marks

13. A pupil looks at a sheet of paper which has the letter F drawn on it as shown below.

F

In the space below, draw the image of the letter which would be formed on the pupil's retina.

Space for drawing

(1)

14. The engines of European Space Agency rocket Arianne produced 8 000 000 000 joules of energy during the first 5 seconds after take off.

Calculate the average power of the engines during the first 5 seconds after take off.

Space for working and answer

(2)

15. A cyclist travels a distance of 400 metres at constant speed. A constant frictional force of 70 newtons acts on the cyclist.

Calculate the work done by the cyclist against friction.

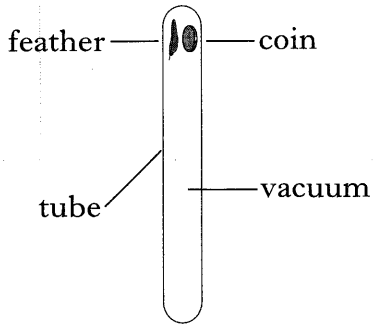
Space for working and answer

(2)

K&U	PS

Marks

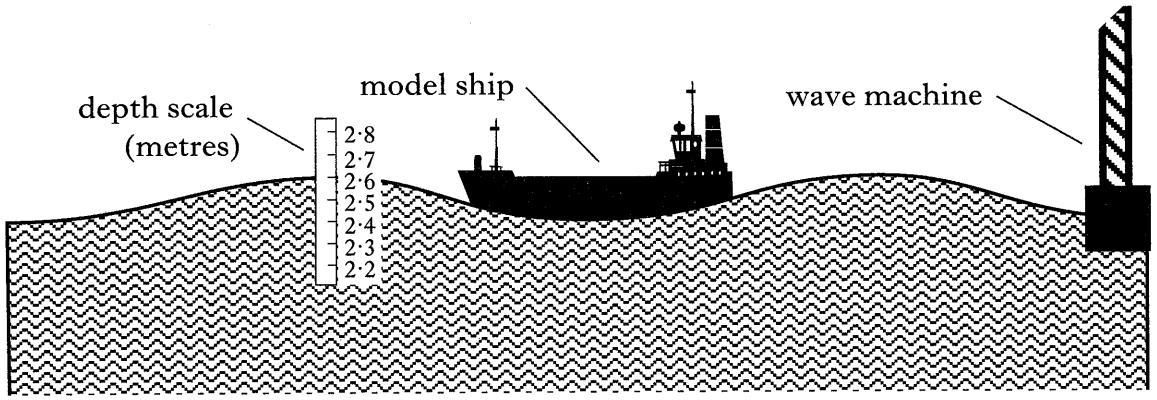
16. Many years ago, a famous experiment was carried out in which a gold coin and a feather were dropped at the same time from the top of a vertical evacuated tube as shown.



Which of the objects, if any, hit the bottom of the tube first?

..... **(1)**

17. The diagram below shows part of a water tank in which models of ships are tested. The tank is 100 metres long and has a wave machine at one end. A depth scale is marked on the wall of the tank as shown.



(*a*) The crest of a wave from the machine takes 25 seconds to travel from one end of the tank to the other.
Calculate the speed of the waves in the tank.

Space for working and answer

(2)

K&U	PS

Marks

17. (continued)

(*b*) The deck of the model ship in the tank moves between the 2·6 metre mark and the 2·8 metre mark on the depth scale as the waves travel along the tank.

Calculate the amplitude of the waves in the tank.

Space for working and answer

(2)

(*c*) The depth of the water in the tank is changed so that the waves have a speed of 3·8 metres per second. The wave machine operates at a frequency of 0·5 hertz.

Calculate the wavelength of the waves in the tank.

Space for working and answer

(2)

Marks

18. A kitchen is fitted with an electric cooker. The cooker has cooker rings and a hood. A filament lamp is built into the cooker hood. The work tops near the cooker are lit by fluorescent lamps as shown in figure 1. The lamps and the cooker rings transform electrical energy into other forms of energy.

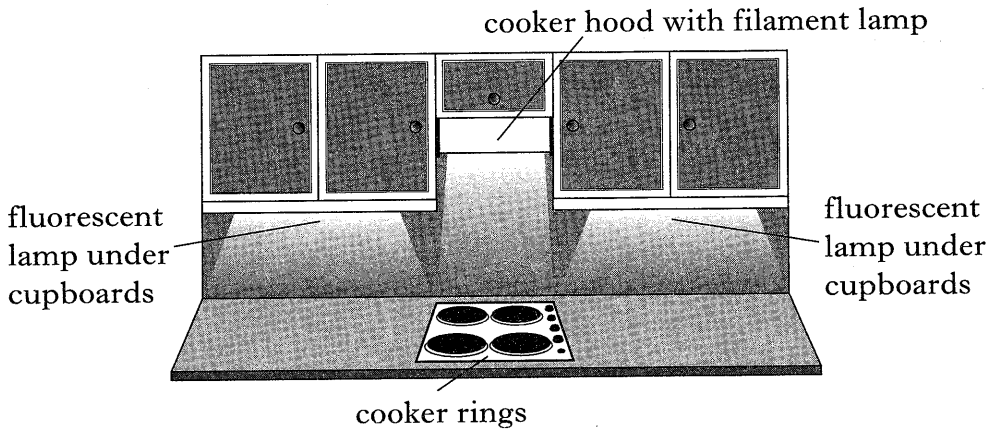


figure 1

(*a*) Complete the table below to show the **useful** energy produced by each of the devices listed.

Device	*Useful energy produced*
Filament lamp	
Fluorescent lamp	
Cooker ring	

(2)

(*b*) Figure 2 shows the way in which each of the above devices is constructed.

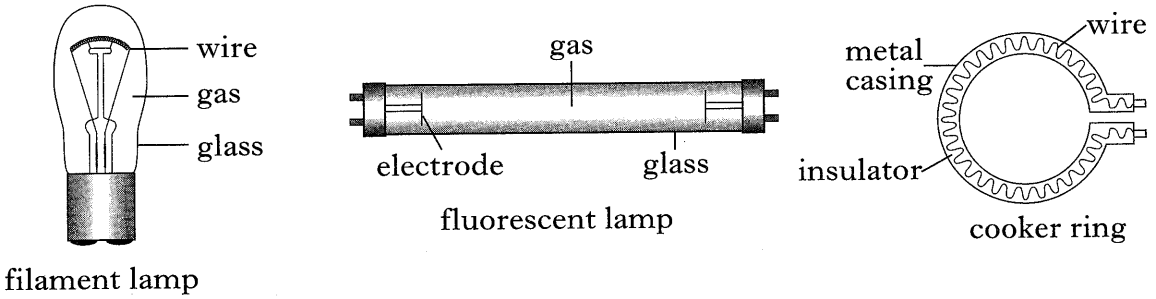


figure 2

Where does the energy transformation take place in:

(i) the filament lamp; .....

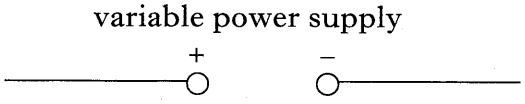
(ii) the fluorescent lamp; .....

(iii) the cooker ring? ..... **(3)**

Marks

19. You are supplied with a resistor, an ammeter, a voltmeter, a variable power supply and leads.

(*a*) Complete the diagram below to show how the components would be connected to obtain a value for the resistance of the resistor.



(3)

(*b*) A pupil uses the above components correctly and obtains the following measurements.

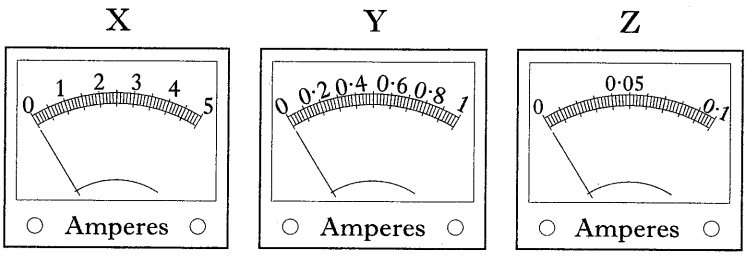
Reading on voltmeter (volts)	*Reading on ammeter (amperes)*
2·0	0·1
4·0	0·2
6·0	0·3
8·0	0·4

(i) Calculate the resistance of the resistor in the circuit.

Space for working and answer

(2)

(ii) In setting up the circuit, the pupil had the choice of ammeters X, Y and Z shown below.



Which ammeter could **not** have been used to obtain all the current readings shown in the table?

.....

(1)

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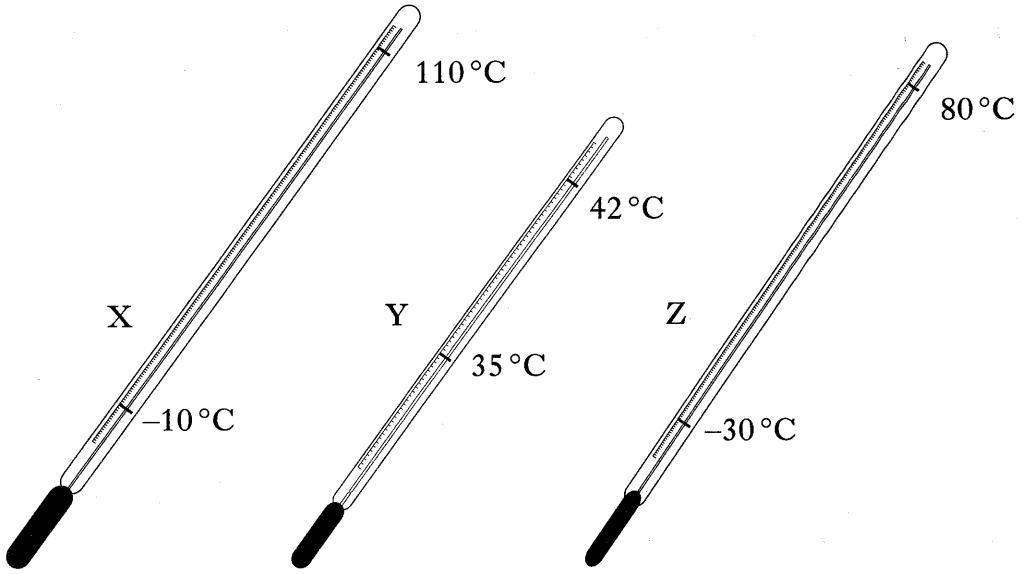
Marks

20. The diagrams below show three types of liquid-in-glass thermometer.



laboratory mercury thermometer | clinical thermometer | laboratory alcohol thermometer

(*a*) Which of the thermometers should be used to:

(i) measure the temperature of boiling water;

.....

(ii) check that a freezer is at its correct temperature of –18 degrees celsius?

..... **(2)**

(*b*) Give a reason why the clinical thermometer scale ranges only from 35 degrees celsius to 42 degrees celsius.

.....

..... **(1)**

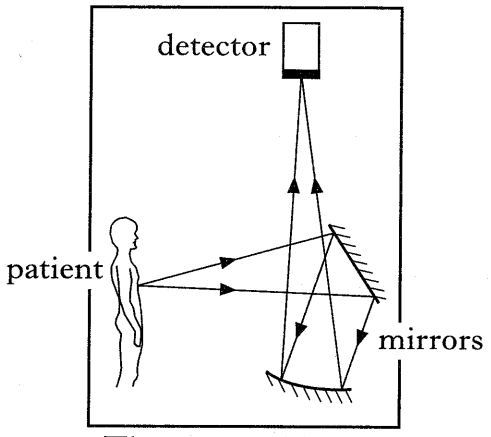
(*c*) Nowadays, doctors often use electronic digital thermometers rather than liquid-in-glass thermometers.

Suggest a temperature sensor which could be used in electronic digital thermometers.

..... **(1)**

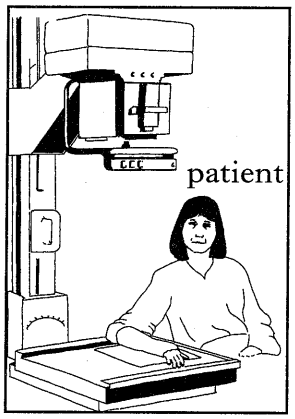
21. Read the following carefully.

Different types of radiation are used by medical devices in the treatment and detection of illness. Some of the devices which make use of radiation are shown in the diagrams below.



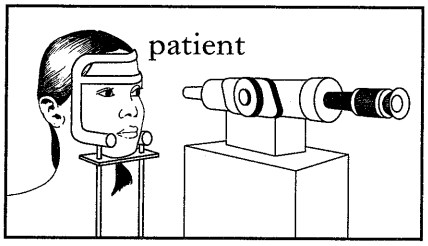
Thermographic unit

A thermographic unit senses radiation from the surface of a patient's body and is used to detect small changes in temperature.



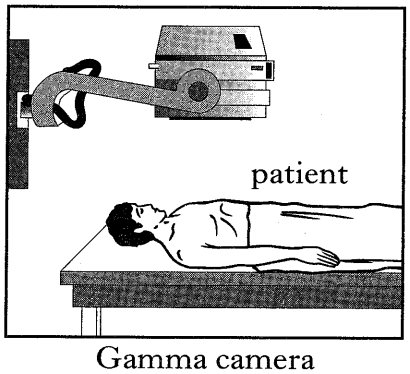
X-ray unit

An X-ray unit is used to examine for broken bones.



Laser

Laser light is used to heal blood vessels in the eye. The laser emits light radiation with a wavelength greater than that of X-rays.



Gamma camera

A gamma camera is used to trace the path of a radioactive material through the body. The radioactive material which has been injected into the body emits gamma radiation. The gamma radiation emitted has a wavelength which is nearly the same as X-rays.

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21. (continued)

Answer the following questions about the radiations used by the medical devices.

(*a*) Which two radiations have similar wavelengths?

..... **(1)**

(*b*) Which of the radiations, light or X-rays, has the greater wavelength?

..... **(1)**

(*c*) Name the type of radiation used by the thermographic unit.

..... **(1)**

(*d*) Explain why, when tracing the path of a radioactive material through the body, the radioactive material injected into the body must emit gamma radiation.

.....

..... **(1)**

(*e*) State the use made of light radiation.

..... **(1)**

[Turn over

22. Three members of a school electronics club are planning their next projects. One project is to build a light meter. A second project is to build a circuit which will control the opening and closing of curtains from a distance. The third project is to build a sound operated baby alarm.

The members use a catalogue to select components for their projects. The catalogue has the following list giving details of input and output devices.

Reference	Device	Details
MIC 1	*Microphone*	*Table type*
LDR 70	*Light dependent resistor*	*Resistance in dark—1 000 000 ohms* *Resistance in light—1000 ohms*
THERM 94	*Thermistor*	*Resistance at 25 °C is 5000 ohms*
SOL 2	*Solar cell*	*Complete with leads*
MOT 1	*Motor*	*Input voltage 9 volts*
LS 3	*Loudspeaker*	*Resistance 3 ohms*
SOL (4 cm)	*Solenoid*	*Spring return*

(*a*) Which of the devices listed in the catalogue is a suitable input device for the baby alarm?

..... **(1)**

(*b*) Name **two** devices in the list which are output devices.

(1) .....

(2) ..... **(2)**

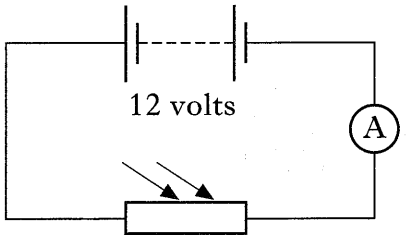
(*c*) Name, from the list, a suitable output device for the curtain control circuit.

..... **(1)**

(*d*) State the useful energy change which takes place in the solar cell.

..... **(1)**

(*e*) The light meter project involves the use of the light dependent resistor (LDR) in a circuit as shown below.



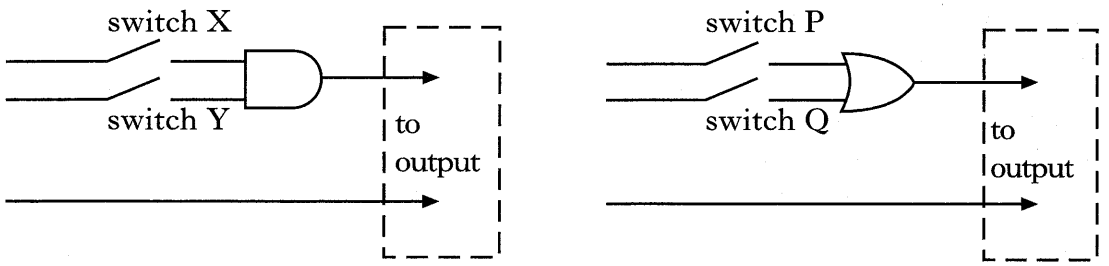
Calculate the current in the circuit when the LDR is exposed to light.

Space for working and answer

(3)

Marks

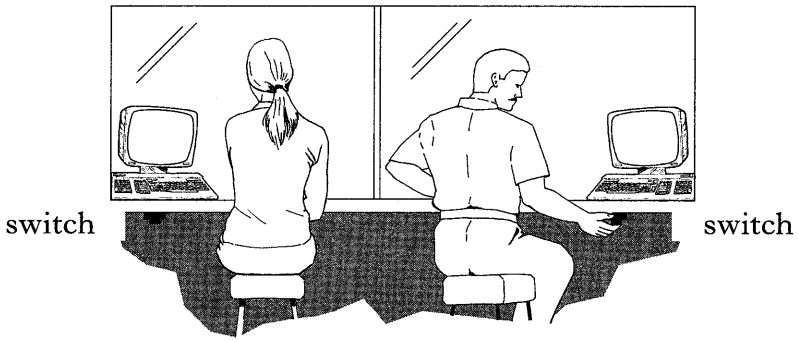
23. Study the logic systems A and B below.



System A System B

Explain which system should be used in each of the following cases.

(*a*) A bank alarm can be switched on by either of two employees using the switches shown.

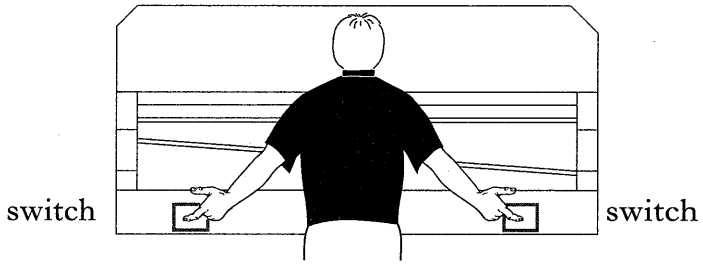


.....

.....

..... **(2)**

(*b*) A paper cutting guillotine works only when the operator uses both hands to press two switches at the same time.



.....

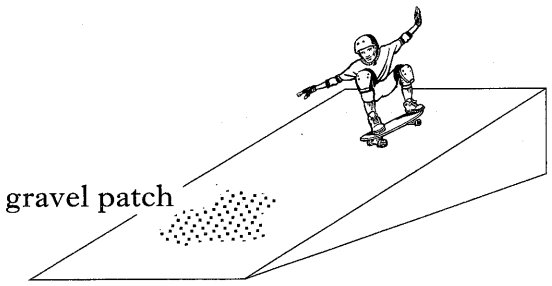
.....

..... **(2)**

K&U	PS

Marks

24. A skateboarder starts from rest at the top and skates down a slope as shown.



(*a*) After 2·5 seconds, the skateboarder has reached a speed of 10 metres per second.

Calculate the acceleration of the skateboarder.

Space for working and answer

(2)

(*b*) The skateboarder has a mass of 60 kilograms.

Calculate the unbalanced force causing the skateboarder's acceleration.

Space for working and answer

(2)

(*c*) Near the bottom of the slope, the skateboarder reaches a patch of gravel and quickly comes to rest.

Explain why this happens.

.....

.....

..... **(2)**

Marks

25. A heating engineer designs a heating system for a house. The engineer suggests to the householder that the radiator in the living room should be able to raise the temperature of the air in the room by 20 degrees celsius. The mass of the air in the room is 80 kilograms.

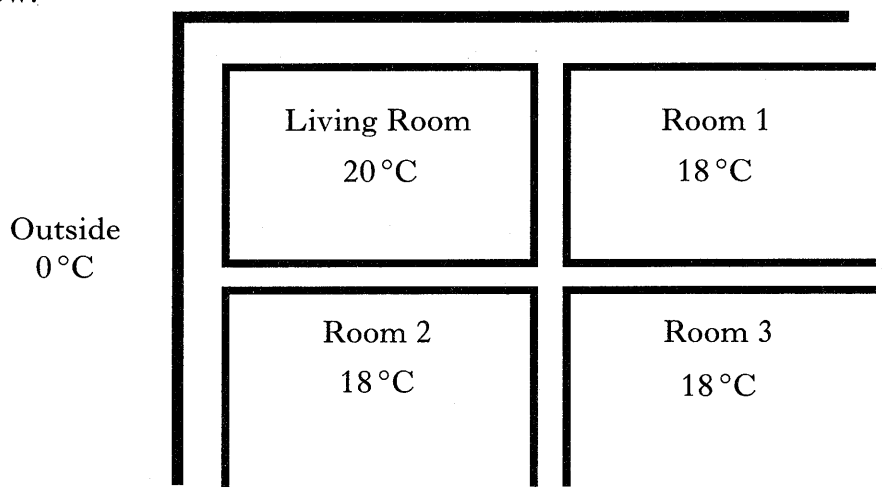
(*a*) Calculate the energy which the radiator supplies to raise the temperature of the air by 20 degrees celsius.

(specific heat capacity of air = 1000 joules per kilogram per degree celsius)

Space for working and answer

(2)

(*b*) The living room has two outside walls. The living room also has two inside walls which back on to other heated rooms in the house as shown below.



Explain why heat is transferred more quickly through the outside walls than through the inside walls of the room, even although the outside walls are thicker.

.....

.....

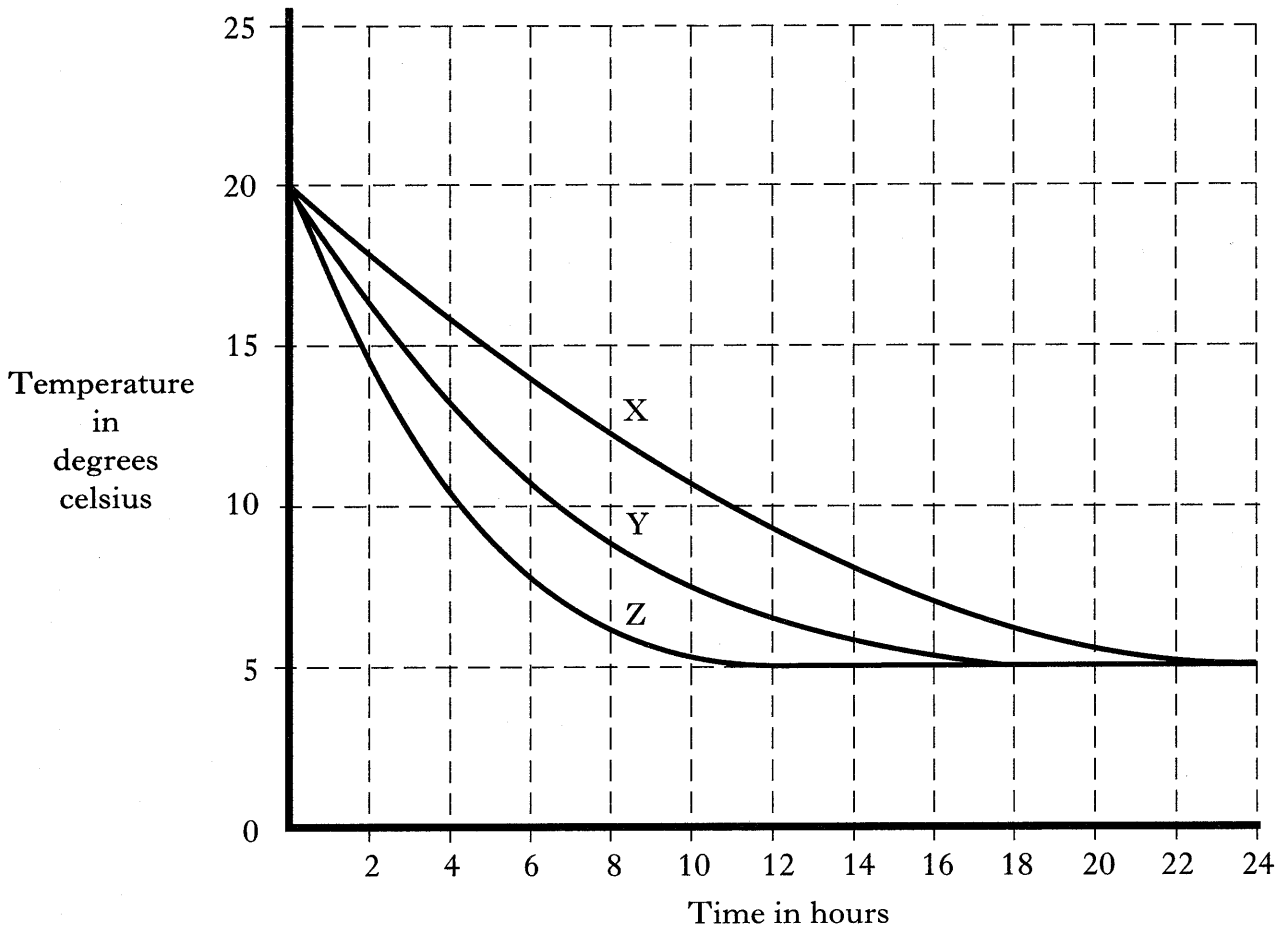
..... **(2)**

K&U	PS

Marks

25. (continued)

(*c*) The engineer says that it is important to reduce heat losses. One way of doing this is to put in wall insulation. The graphs below show how the temperature in a room falls from 20 degrees celsius, after switching off the heating, when three different types of foam X, Y and Z are used to insulate the walls.



(i) Explain which of the foams X, Y or Z would best reduce heat losses.

.....

.....

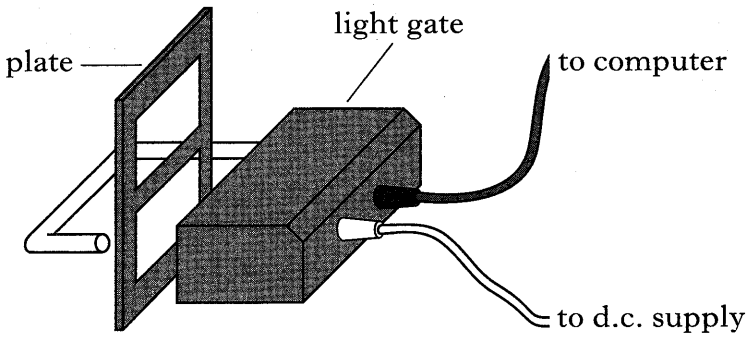
..... **(2)**

(ii) What was the outside temperature when the data for the graphs was collected?

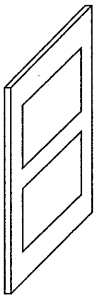
..... **(1)**

Marks

26. Three pupils P, Q and R are checking the value for the acceleration due to gravity. They drop different plates, shaped as shown, through a light gate. The light gate is connected to a computer which measures the acceleration.



The type of plate dropped and the results obtained by each pupil are shown below.

Pupil P	*Pupil Q*	*Pupil R*
 metal plate	 metal plate	 paper plate
Results 10·1 Acceleration = 10·1 (metres per second per second)	*Results* 10·0 9·7 9·6 10·3 9·9 Average = 9·9 Acceleration = 9·9 (metres per second per second)	*Results* 8·6 8·3 8·4 8·8 8·4 Average = 8·5 Acceleration = 8·5 (metres per second per second)

(*a*) From the information given above, suggest which pupil has used the best procedure.

..... **(1)**

(*b*) Explain what is wrong with each of the procedures used by the other two pupils.

.....

.....

.....

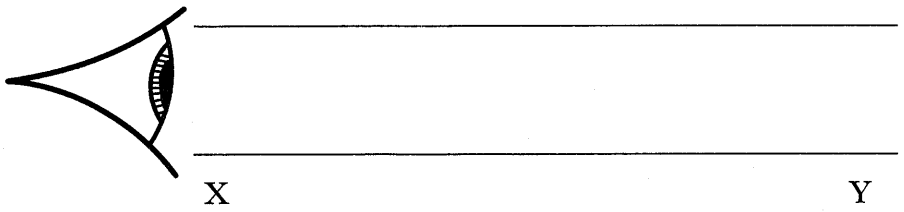
..... **(2)**

K&U	PS

Marks

27. (*a*) An astronomer uses an astronomical telescope to view stars.

The diagram below shows the tube of the telescope. The lenses at X and Y have been left out.



....

(i) Complete the diagram by drawing the two lenses in their correct positions and showing their shape.

Write the name of each of the lenses on the diagram. **(3)**

(ii) What is the purpose of:

(A) lens X; .....

..... **(1)**

(B) lens Y? .....

..... **(1)**

(*b*) Complete the following passage by choosing entries from the following list.

Saturn	the Sun	Alpha Centauri	
1·2 seconds	8 minutes	4·3 years	100 000 years

The nearest star to the Earth is ..... . *Light takes approximately* ..... *to travel from this star to Earth. Light takes about* ..... *to reach the Earth from the edge of our galaxy.* **(2)**

(*c*) Telescopes have been designed to detect waves from space. Name a type of wave other than light which can be detected from space.

..... **(1)**

[*END OF QUESTION PAPER*]

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.