FOR OFFICIAL USE

Total Marks

X069/101

NATIONAL QUALIFICATIONS 2002

WEDNESDAY, 22 MAY
1.00 PM – 2.30 PM

PHYSICS
INTERMEDIATE 1

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

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 1–6 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 7–18 write your answer where indicated by the question or in the space provided at the end of the answer book.

5 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.

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.

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DO NOT WRITE IN THIS MARGIN

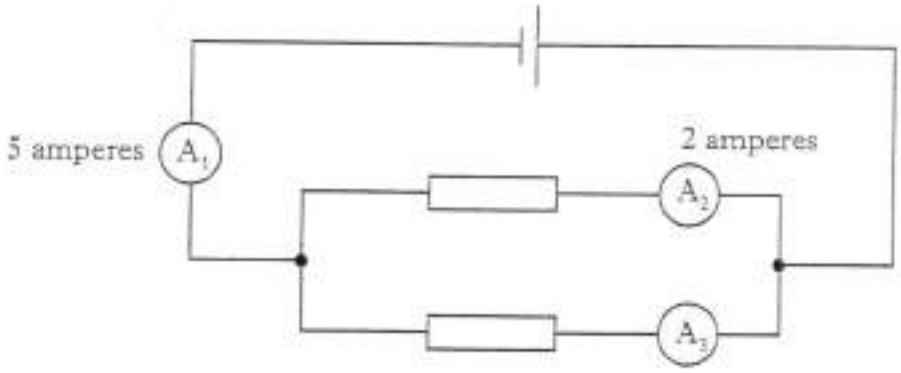
Marks

1. The normal range of human hearing is

   A 20 hertz to 1000 hertz
   B 20 hertz to 2000 hertz
   C 20 hertz to 20 000 hertz
   D 200 hertz to 20 000 hertz
   E 200 hertz to 200 000 hertz.

Answer ☐ 1

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



The reading on ammeter A_3 is

   A 0 amperes
   B 2 amperes
   C 3 amperes
   D 5 amperes
   E 7 amperes.

Answer ☐ 1

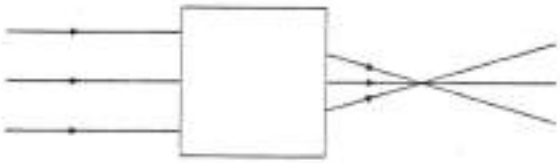
3. The unit of sound level is the

   A hertz
   B second
   C metre per second
   D decibel
   E volt.

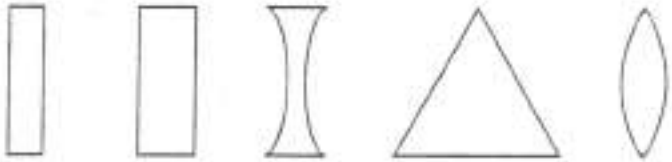
Answer ☐ 1

Marks

4. Three light rays pass through a glass shape that is hidden under a card. The path of the light rays is shown in the diagram below.

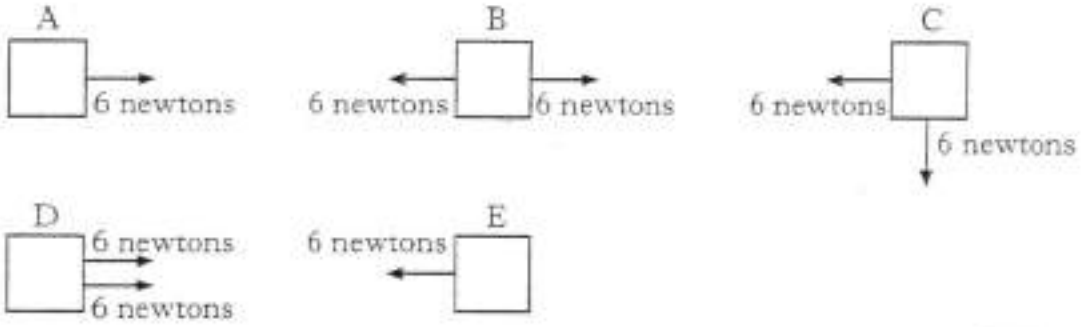


Which of the following shapes is under the card?



Answer ☐ 1

5. The diagrams below show forces acting on an object. Which diagram shows balanced forces?



Answer ☐ 1

6. Which row in the table contains input devices only?

	Device 1	*Device 2*	*Device 3*
A	microphone	thermistor	switch
B	LED	thermistor	loudspeaker
C	microphone	amplifier	loudspeaker
D	switch	buzzer	LDR
E	electric motor	thermistor	switch

Answer ☐ 1

DO NOT WRITE IN THIS MARGIN

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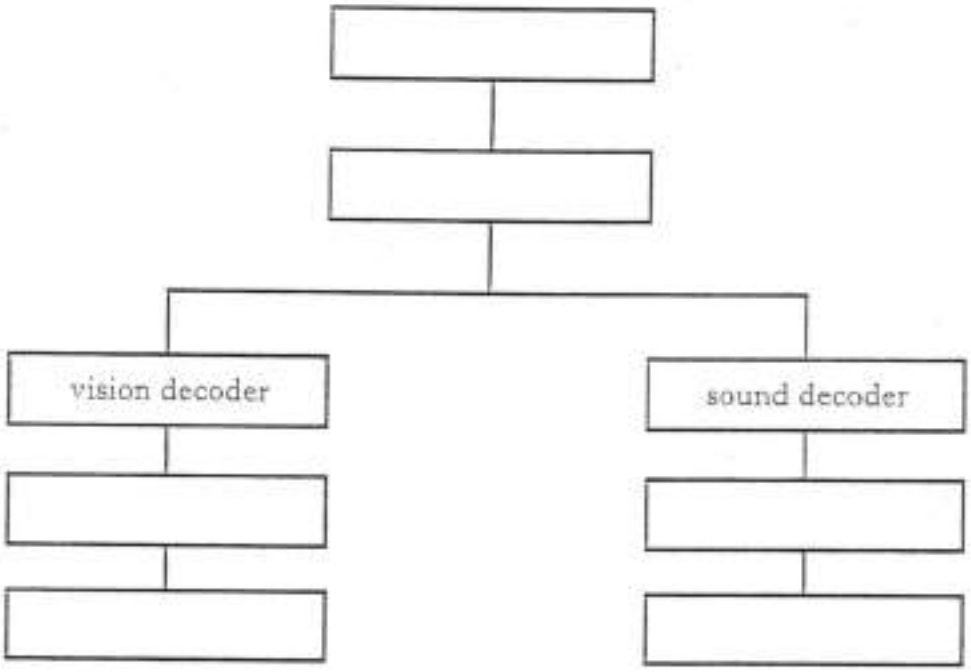
7. (*a*) Use the terms below to complete the block diagram of a television receiver. You may use the same term more than once.

amplifier **tube** **aerial** **loudspeaker** **tuner**



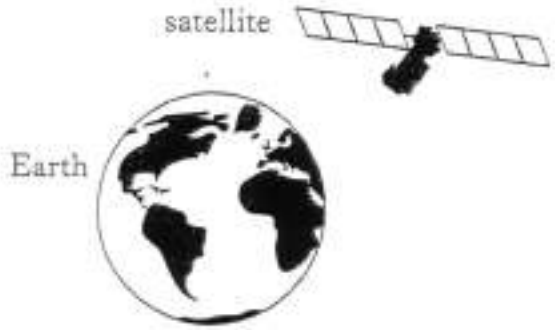
3

(*b*) What is the function of the aerial?

1

Marks

9. Satellites are used in some telecommunication systems.



(*a*) What is the name given to a satellite which stays above the same point on the Earth's surface?

1

(*b*) Four satellites P, Q, R and S orbit at different heights above the Earth. Information about the orbits of the satellites is shown below.

Satellite name	*Height above the Earth* (kilometres)	*Time to orbit the Earth* (hours)
P	42 000	28
Q	36 000	24
R	16 000	9
S	2000	2

(i) Which satellite could stay above the same point on the Earth's surface?

1

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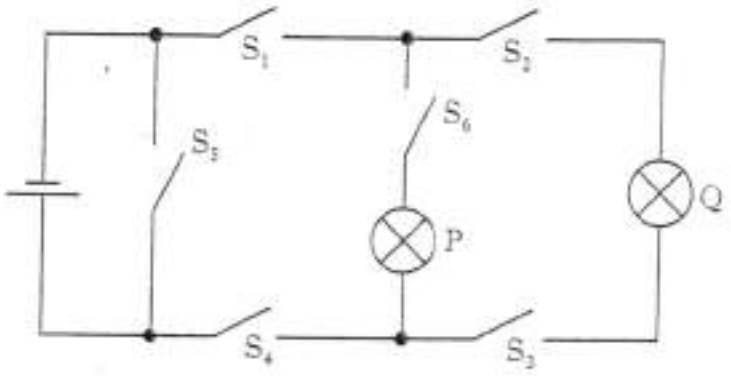
10. (*a*) A student builds the circuit shown below.



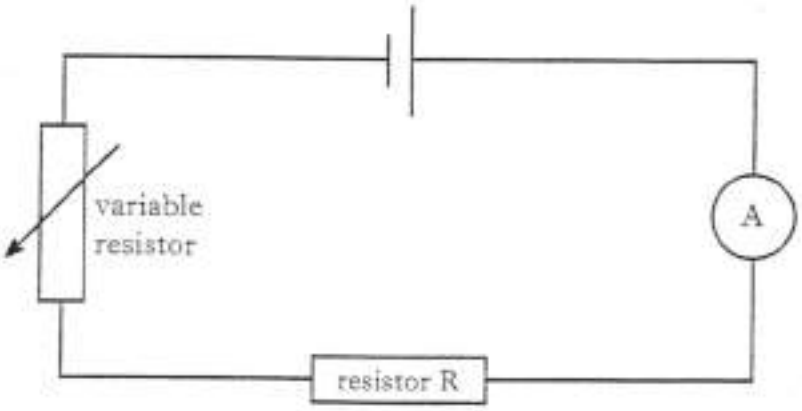
(i) Which switches should be closed so that **only** lamp P lights?

1

(ii) Which switches should be closed so that **only** lamp Q lights?

1

(*b*) The student builds a new circuit.



(i) On the diagram above, add a voltmeter to show how the voltage across resistor R could be measured. 1

Marks

11. (*a*) The table below contains information about different types of radiation.

Complete the table.

Type of radiation	*Description or effect*	*Medical use*
	heat radiation	easing pain in muscles
Ultra violet	can cause skin cancer	
X-rays	can blacken photographic film	
	can kill living cells	killing cancer cells

2

(*b*) These radiations also have **non-medical** uses.

Choose **one** type of radiation shown in your completed table.

Give **one** non-medical use for this type of radiation.

Type of radiation	Non-medical use

1

Marks

12. (*a*) The strength of a source of gamma radiation is measured using a detector and counter.

(i) The counter is switched on for five minutes and records 8000 counts. Calculate the count rate **per minute**.

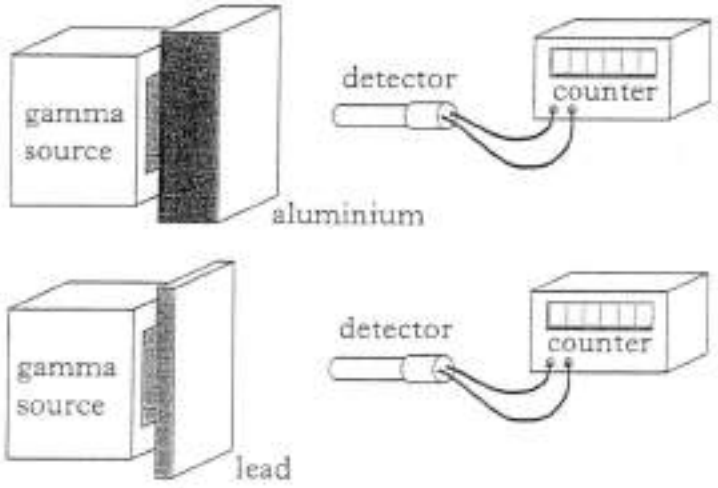
1

(ii) The experiment is repeated with the same source several years later. The counter is again switched on for five minutes. Is the new count likely to be more than, equal to or less than 8000?

1

(*b*) Metals can absorb gamma radiation.

Aluminium and lead are tested using the arrangement shown below to find which is the better absorber of gamma radiation.



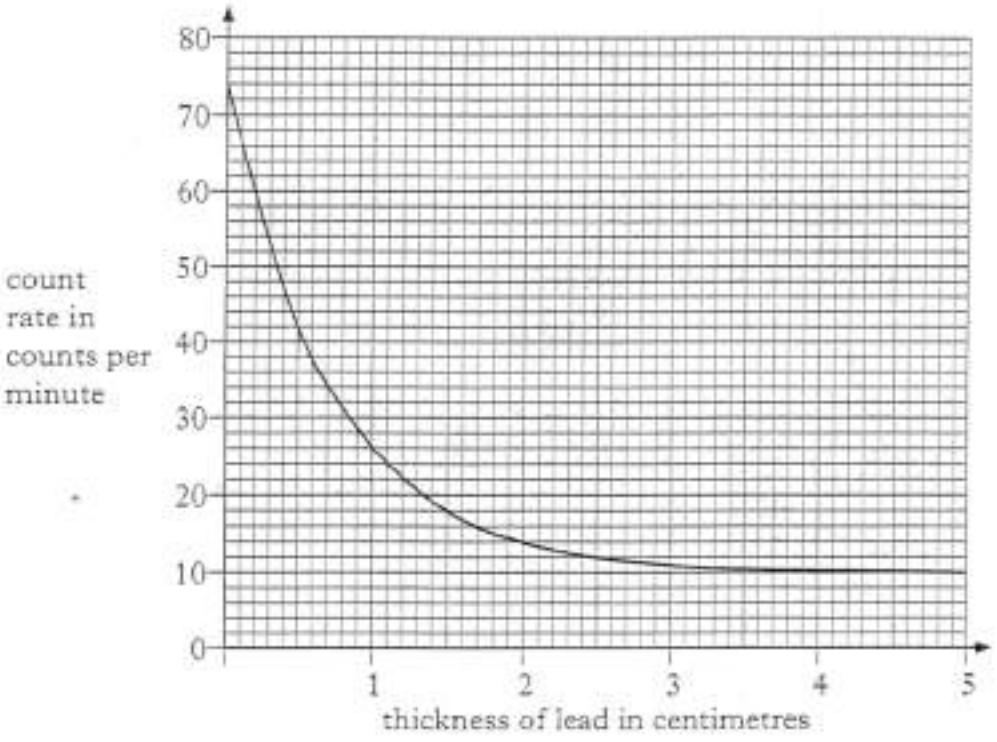
Give a reason why this is not a fair test.

1

Marks

12. (continued)

(c) Different thicknesses of lead are now placed between the detector and the gamma source. The count rate for each thickness of lead is obtained. The graph of count rate against thickness of lead is shown below.



(i) What is the count rate when 2 centimetres of lead is placed between the detector and the source?

1

(ii) Why does the count rate not fall below 10 counts per minute?

1

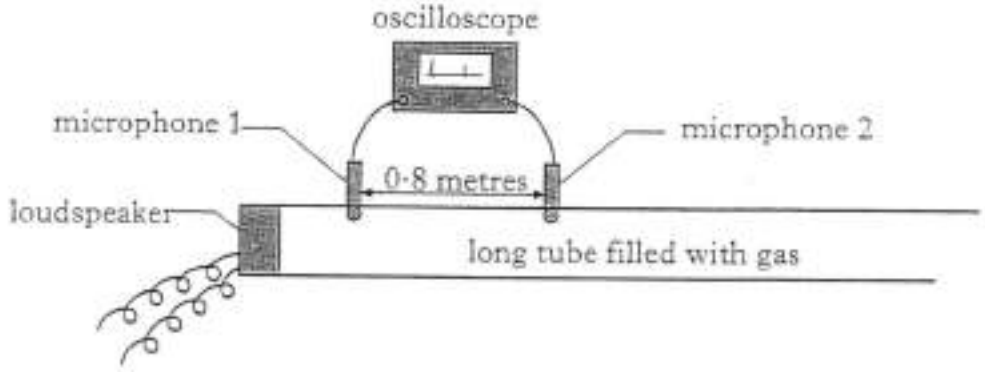
[Turn over

13. Sound from a loudspeaker is to be used in an investigation of the speed of sound in different gases. *Marks*

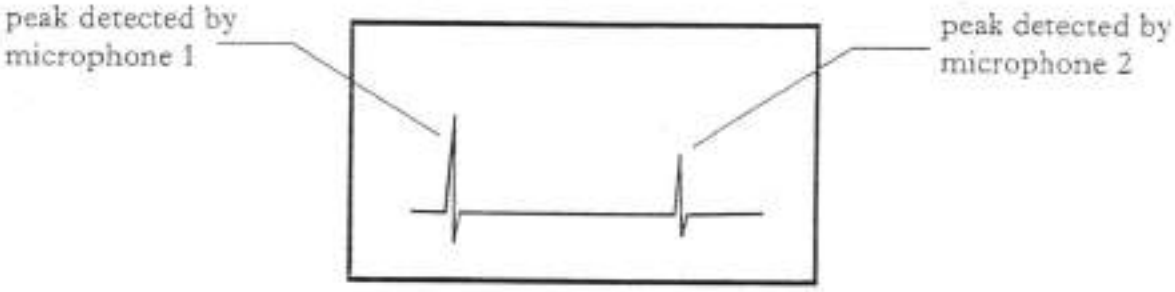
(*a*) How does the loudspeaker produce sound?

1

(*b*) The following experiment is set up.



A pulse of sound from the loudspeaker is directed along the tube. The sound detected by each microphone produces a peak on the oscilloscope screen.



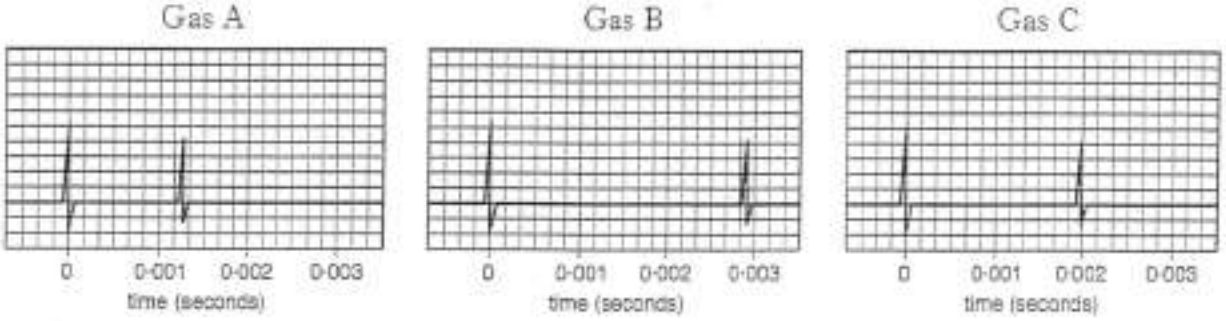
(i) Explain why the second peak is smaller than the first peak.

1

Marks

13. (*b*) (continued)

(ii) The experiment is carried out for three different gases A, B and C.
The student records the information from the oscilloscope as shown on the graphs below.



In which of the gases, A, B or C, does sound travel fastest?
You must explain your answer.

2

(iii) Using information from the graph for **gas C** and the distance between the microphones, calculate the speed of sound in gas C.

3

(iv) All gas is now removed from the tube and the experiment is repeated. Describe and explain what is seen on the oscilloscope screen.

2

DO NOT WRITE IN THIS MARGIN

Marks

14. (*a*) Complete the block diagram for an electronic system.

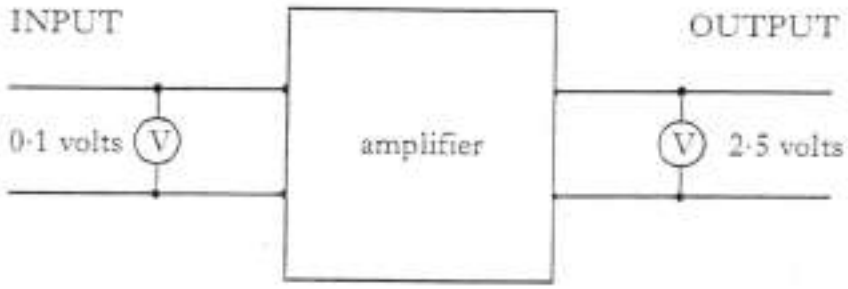
1

(*b*) A hearing aid consists of a microphone, amplifier and loudspeaker. State the energy change which takes place in the microphone.

1

(*c*) For the hearing aid in part (*b*), the voltage gain of the amplifier must be more than twenty.

The circuit below is used to check the voltage gain of an amplifier.



(i) Calculate the voltage gain of this amplifier.

2

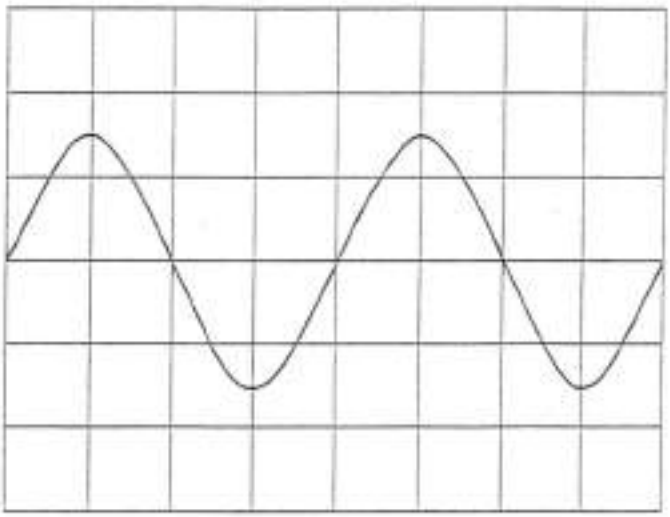
(ii) State whether or not this amplifier is suitable for the hearing aid.

1

Marks

14. (*c*) **(continued)**

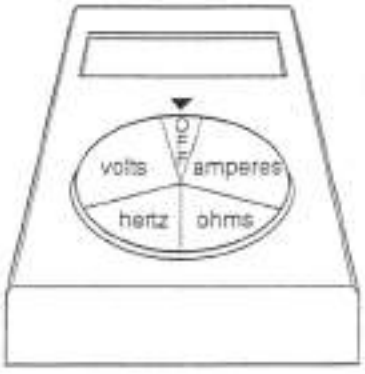
(iii) The output from the amplifier is connected to an oscilloscope. The following trace appears on the screen.



On the grid draw a second trace showing a louder sound of the same frequency. 2

(*d*) The frequency of the signal from the amplifier is now measured using the meter shown below. The dial on the meter has five settings:

off **amperes** **ohms** **hertz** **volts**



What is the correct setting of the dial when the meter is used to measure frequency?

1

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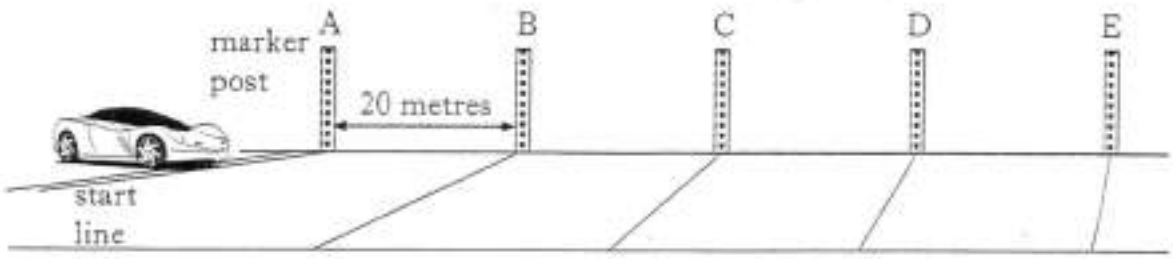
15. A rally car is at the start line for a race.

(*a*) Marker posts are placed every 20 metres as shown.



The time taken for the rally car to reach marker post E is 2·5 seconds.

Calculate the average speed of the car between marker posts A and E.

3

(*b*) The car has a high acceleration as it leaves the start line.

Explain what is meant by *acceleration*.

1

(*c*) Later in the day the road is covered with a layer of snow and the car tyres have less grip.

(i) Name the force which is reduced by the layer of snow.

1

Marks

15. (c) (continued)

(ii) At one sharp bend four cars A, B, C and D skid and collide head on into a crash barrier. The following table contains information about the cars involved in the collisions.

Car	*Mass of car* (kilograms)	*Speed of car* (metres per second)
A	1500	20
B	1800	25
C	1800	20
D	1500	25

Which of the cars A, B, C or D suffered most damage during the collision? Use information from the table to explain your answer.

2

(d) A rally driver is involved in a collision and uses a mobile phone to call for help.

(i) State **one** advantage of a mobile phone.

1

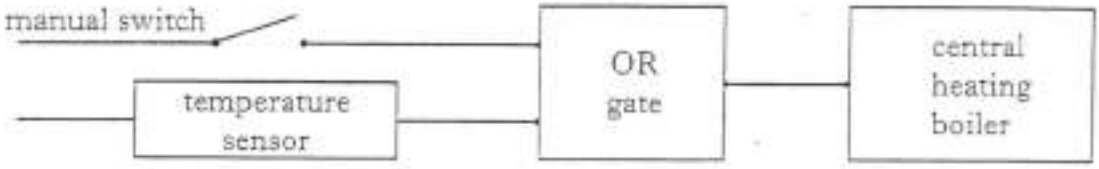
(ii) State **one** disadvantage of a mobile phone.

1

DO NOT WRITE IN THIS MARGIN

Marks

16. Part of a central heating system uses a manual switch, a temperature sensor and an OR gate connected as shown below.



(*a*) (i) Draw the symbol for an OR gate.

1

(ii) The central heating boiler switches on when the output from the OR gate is high. Can the central heating boiler come on if the manual switch is open?

Explain your answer.

2

(*b*) An LED is used to show that the central heating is switched on.

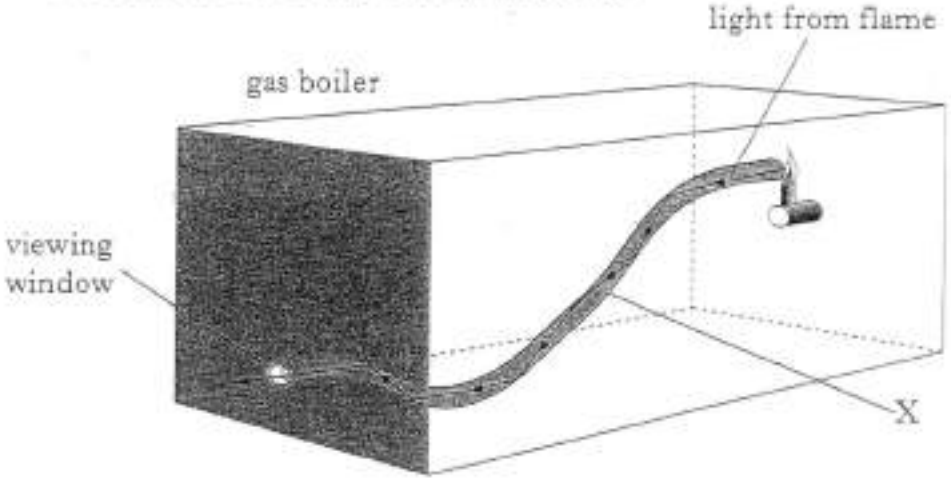
State the energy change in the LED.

1

Marks

16. **(continued)**

(c) A gas boiler is used to provide energy for the central heating. To check that the boiler flame is lit, light from the flame is transmitted from inside the boiler to a viewing window as shown.



Name part X.

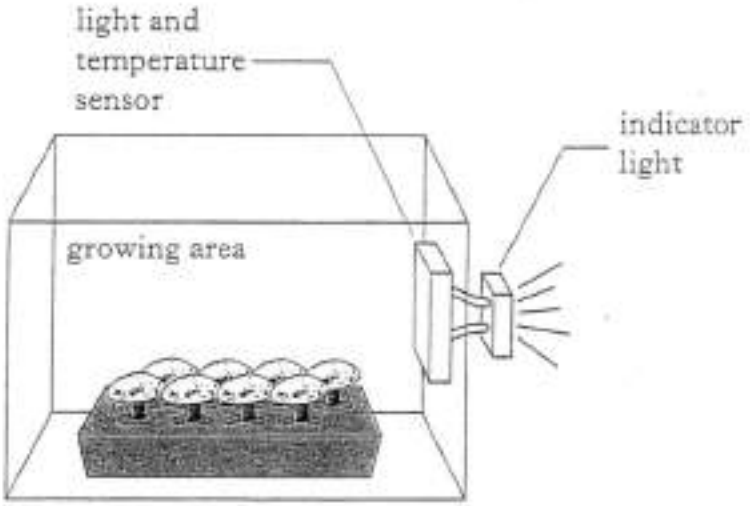
1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

17. Mushrooms require certain conditions of light and temperature to grow quickly. At a mushroom farm an indicator light comes on when conditions in the growing area are correct.



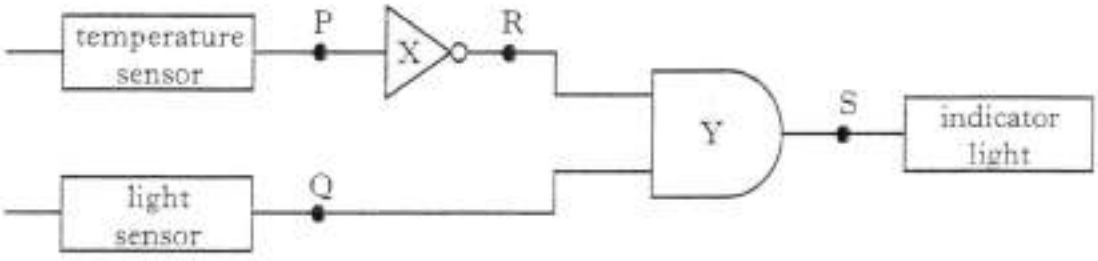
(*a*) The light and temperature sensor inside the growing area requires two input devices. From the following list, choose **two** input devices which could be used as part of the sensor.

microphone **thermistor** **light bulb** **switch** **LDR**

	Input device
Light	
Temperature	

1

(*b*) Part of the electronic circuit is shown below.



(i) Name logic gate X. 1

Name logic gate Y. 1

Marks

17. (b) (continued)

(ii) The table below shows the possible logic levels of inputs P and Q. Complete the table to show the logic levels at R and S.

	P	Q	R	S
Row 1	0	0		
Row 2	0	1		
Row 3	1	0		
Row 4	1	1		

2

(iii) The logic level at S must be 1 for the indicator light to turn on. Which **row** in the table shows the logic levels when the indicator light is on?

1

(iv) Use the row you selected in part (iii) and the information given below to state the conditions in the growing area when the indicator light is on.

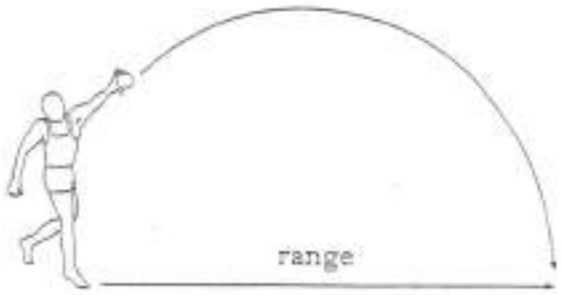
	Condition	*Output logic level*
Temperature sensor	COLD	0
	HOT	1
Light sensor	LIGHT	0
	DARK	1

2

[Turn over for Question 18 on *Page twenty-four*

Marks

18. An athlete is training indoors for the shot putt event.



(*a*) (i) Describe how to use a Newton balance to find the weight of the shot.

1

(ii) The shot has a mass of 7 kilograms.
Calculate the weight of the shot.

2

(*b*) The athlete uses the same shot for each throw. What **two** things can the athlete change to alter the range of the throw?

2

(*c*) The athlete drops the shot and notices that it bounces a small amount after hitting the floor surface.
Give **one** factor which affects the height to which the shot rebounds.

1

[END OF QUESTION PAPER]