FOR OFFICIAL USE

Total Marks

X069/101

NATIONAL QUALIFICATIONS 2000

WEDNESDAY, 31 MAY
9.00 AM – 10.30 AM

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 7–17 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.

SCOTTISH QUALIFICATIONS AUTHORITY

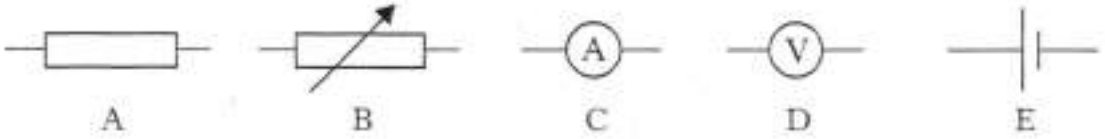
Marks

1. Which of the following colours of light can be mixed to give all the colours seen on a television screen?

A Red, orange and yellow
B Red, yellow and green
C Green, blue and violet
D Red, green and blue
E Red, blue and violet

Answer ☐ 1

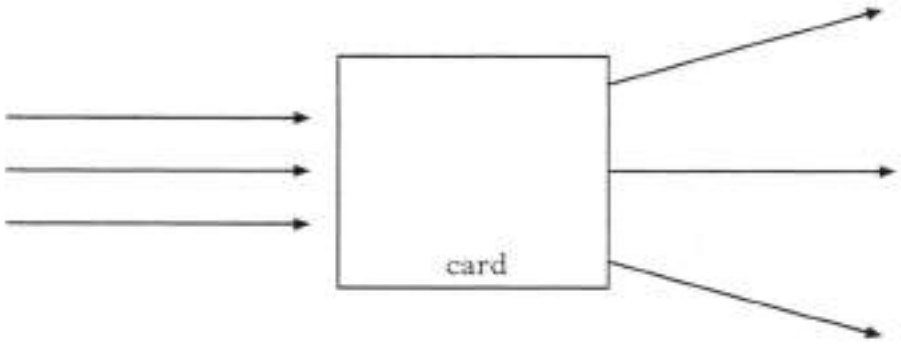
2. Which of the circuit symbols shown below is the symbol for a variable resistor?



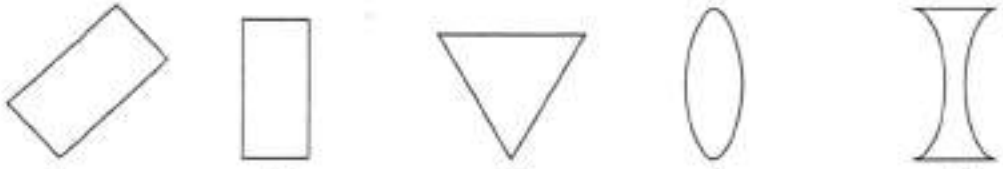
A B C D E

Answer ☐ 1

3. Three light rays pass through a clear plastic 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?



A B C D E

Answer ☐ 1

Marks

4. Which of the following is true?

   A Sound can travel through solids, liquids, gases and a vacuum.
   B Sound can only travel through a vacuum.
   C Sound can travel through solids, liquids and gases but cannot travel through a vacuum.
   D Sound can only travel through solids and liquids.
   E Sound can travel through gases but cannot travel through solids and liquids.

Answer ☐ 1

5. Which of the following shows the correct order for the parts of an electronic system?

A INPUT → OUTPUT → PROCESS

B PROCESS → INPUT → OUTPUT

C OUTPUT → PROCESS → INPUT

D PROCESS → OUTPUT → INPUT

E INPUT → PROCESS → OUTPUT

Answer ☐ 1

6. The table shows information about a number of electronic devices.
Which row in the table is correct?

	Name of device	*Type of device*	*Energy change*
A	LDR	input	electrical to light
B	microphone	output	sound to electrical
C	motor	output	electrical to movement
D	lamp	input	electrical to light
E	buzzer	output	sound to electrical

Answer ☐ 1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

7. (*a*) Information is transmitted through materials using different types of signal. Complete the table to show the approximate speeds of the signals given. The first one has been done for you.

Type of signal	*Approximate speed of signal*
Radio signal through air	300 000 000 metres per second
Light signal through glass fibre	
Telephone signal through metal wire	

2

(*b*) (i) Use the terms below to complete the block diagram of a radio receiver.

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

2

(ii) Complete the sentence below.

In a radio, a loudspeaker changes _____ energy to _____ energy.

1

(iii) Describe the function of the tuner in a radio receiver.

2

Marks

8. (*a*) The table includes information about different types of radiation. Complete the table.

Description	*Type of radiation*	*Medical use*	*Non-medical use*
sometimes called heat radiation		easing pain in muscles	
can be detected by photographic film		identifying broken bones	
can cause skin cancer			identifying security markings
can kill living cells			used as a tracer in industry

4

(*b*) A scientist is using a source of gamma radiation.
Give **two** safety precautions needed when dealing with this source.

2

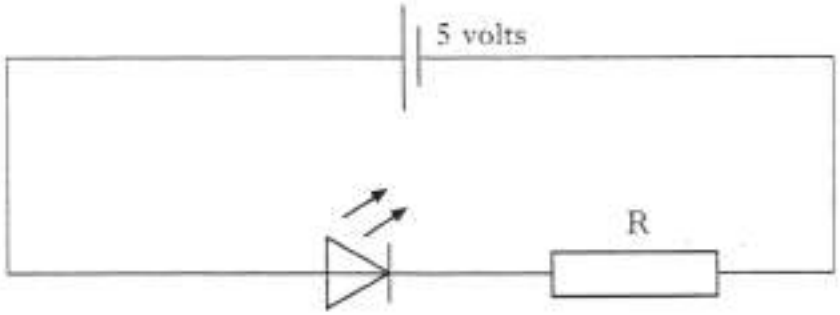
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

9. A 3 volt, 0·02 ampere light emitting diode (LED) is operating as shown in the circuit diagram below.

Resistor R protects the LED.



(*a*) The voltage across the LED is 3 volts.
What is the voltage across resistor R?

1

(*b*) The current through the LED is 0·02 amperes.
What is the current through resistor R?

1

(*c*) Calculate the value of resistor R.

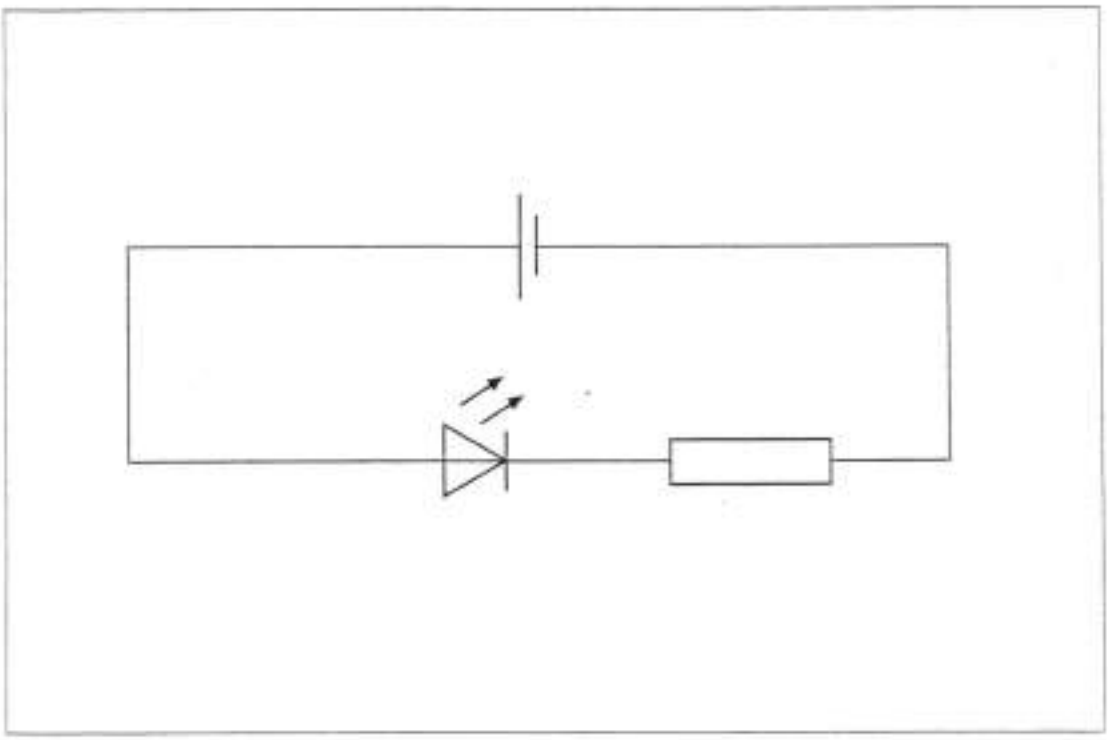
2

Marks

9. (continued)

(*d*) The circuit diagram is drawn in the space below.

Complete the diagram to show how a voltmeter is connected to measure the voltage across the **resistor**.

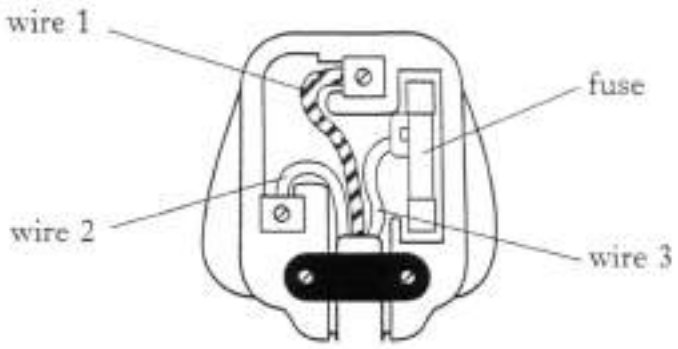


1

[Turn over

Marks

10. (*a*) The diagram for a correctly wired plug is shown below.



(i) Complete the table below.

	Name of wire	*Colour of insulation*
wire 1		
wire 2		
wire 3		

3

(ii) Explain how a fuse acts as a safety device.

2

Marks

10. (continued)

(*b*) A hair dryer with a power rating of 805 watts is connected to the mains.

(i) What is the declared value for mains voltage?

1

(ii) Calculate the current in this hair dryer.

2

(iii) The following fuses are available.

2 amperes **3 amperes** **5 amperes** **13 amperes**

Which fuse should be selected for the hair dryer?

1

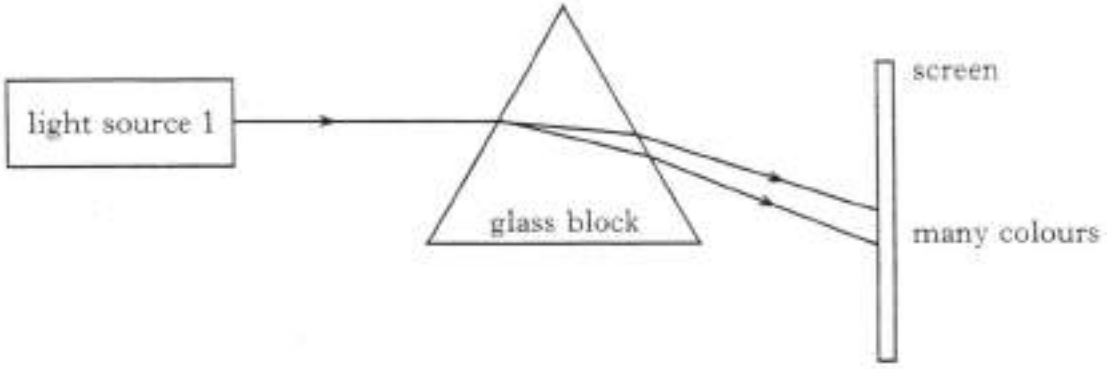
(*c*) Two houses have different sized electricity bills although both are charged at the same rate per unit.
Give **two** reasons why their electricity bills might be different.

2

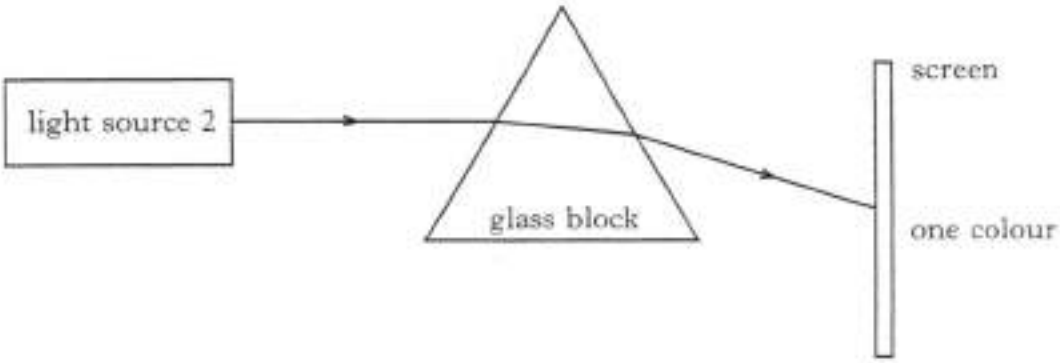
[Turn over

Marks

11. (*a*) Light from light source 1 is shone through a triangular glass block onto a screen.



Light from light source 2 is then shone through the same block of glass.



(i) Which source could be a laser?

1

(ii) Give a reason for your choice.

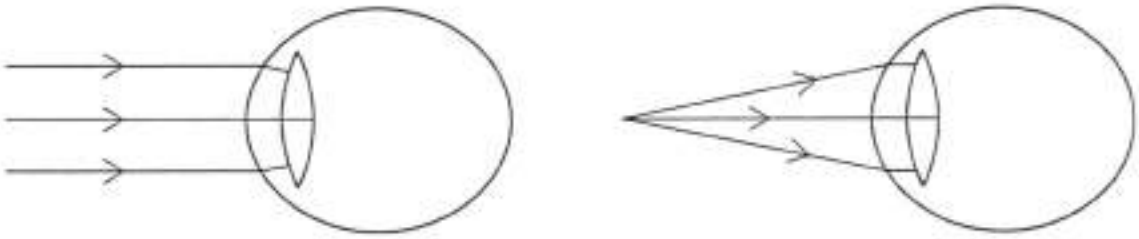
1

Marks

11. (continued)

(*b*) A long sighted person can see distant objects clearly but cannot focus on near objects.

(i) Complete **both** diagrams below to show the path of the light rays in the eye of a long sighted person.



Distant object Near object **2**

(ii) The long sighted person uses spectacles for reading a book.

Draw the shape of a lens that could be used in these spectacles.

1

(iii) What name is given to this type of lens?

1

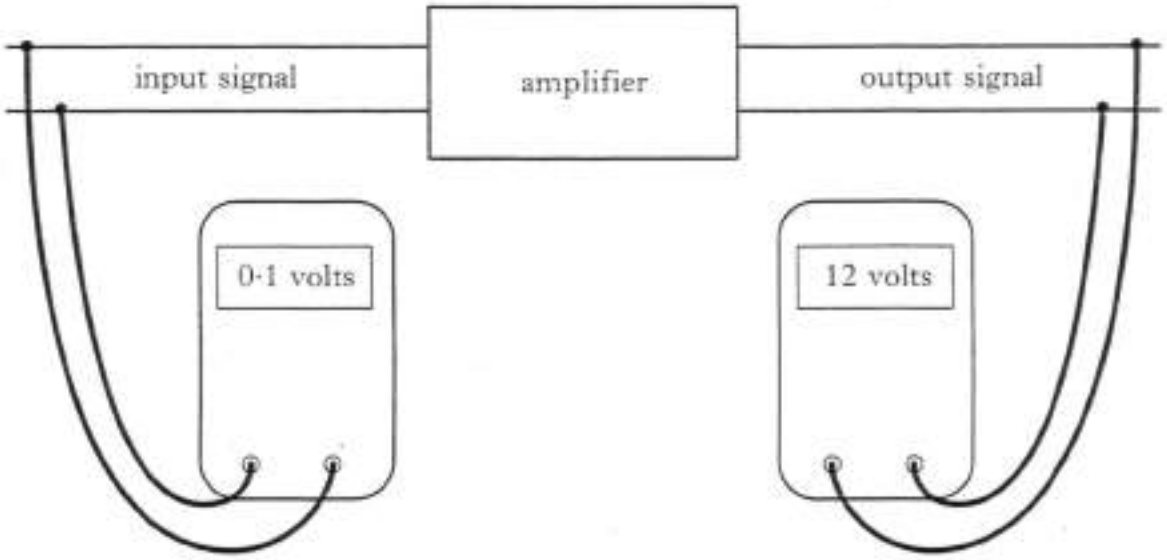
[Turn over

Marks

12. (*a*) At a pop concert the system shown below is used to make the sound louder.

Name device X. _____ 1

(*b*) An amplifier is tested using the equipment shown below.



(i) Calculate the voltage gain of the amplifier.

_____ 2

(ii) The input signal to the amplifier has a frequency of 300 hertz.
What is the frequency of the output signal?

_____ 1

DO NOT WRITE IN THIS MARGIN

Marks

12. (continued)

(*c*) Engineers measure and control sound levels.

(i) What is the unit of sound level?

1

(ii) When you listen to yourself speaking and then listen to a tape recording of what you said, your voice always sounds different to you.

Explain why a recording of your voice sounds different **to you**.

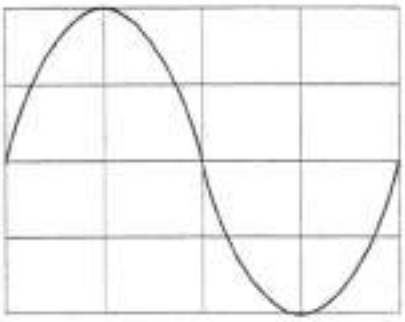
2

[Turn over

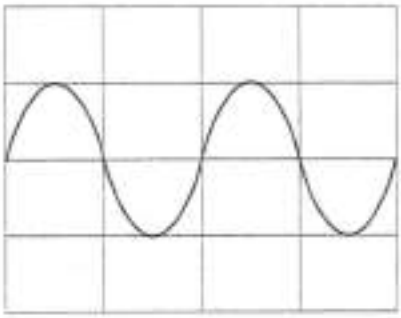
Marks

13. Engineers can use sound equipment to detect underground water.

(*a*) The diagrams below show oscilloscope traces obtained by the engineers when testing their equipment. The oscilloscope controls are at the same settings for both traces.



trace 1



trace 2

(i) Which trace represents the quieter sound?

1

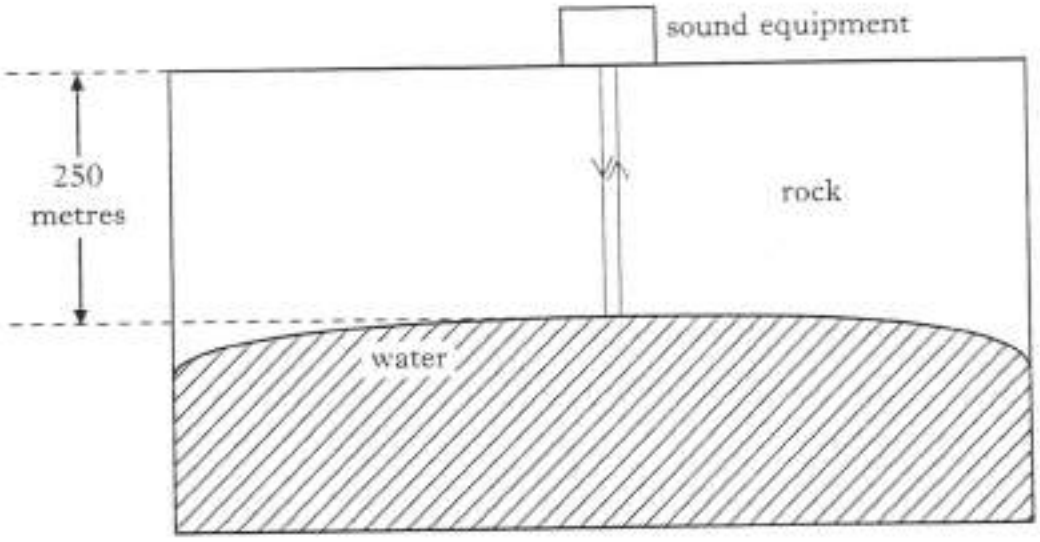
(ii) Trace 1 displays a sound of frequency 200 hertz.
What is the frequency of the sound displayed in trace 2?

1

Marks

13. (continued)

(*b*) The sound equipment is able to transmit and receive sound pulses. Sound travels from the equipment through the rock and reflects from the top of the water as shown below.



The top of the water is 250 metres below the sound equipment.
The time between a pulse being transmitted and received is 0·1 seconds.

(i) Calculate the speed of a sound pulse as it travels through the rock.

3

(ii) What is meant by the **frequency** of sound?

1

(iii) The sound equipment transmits 48 000 pulses in 1·6 seconds. Calculate the frequency of the sound.

2

Marks

14. (*a*) The diagram below shows a car designed to reach high speeds.

(i) What effect does streamlining have on the friction forces acting on a car?

1

(ii) Give **two** ways of improving the streamlining of a car.

2

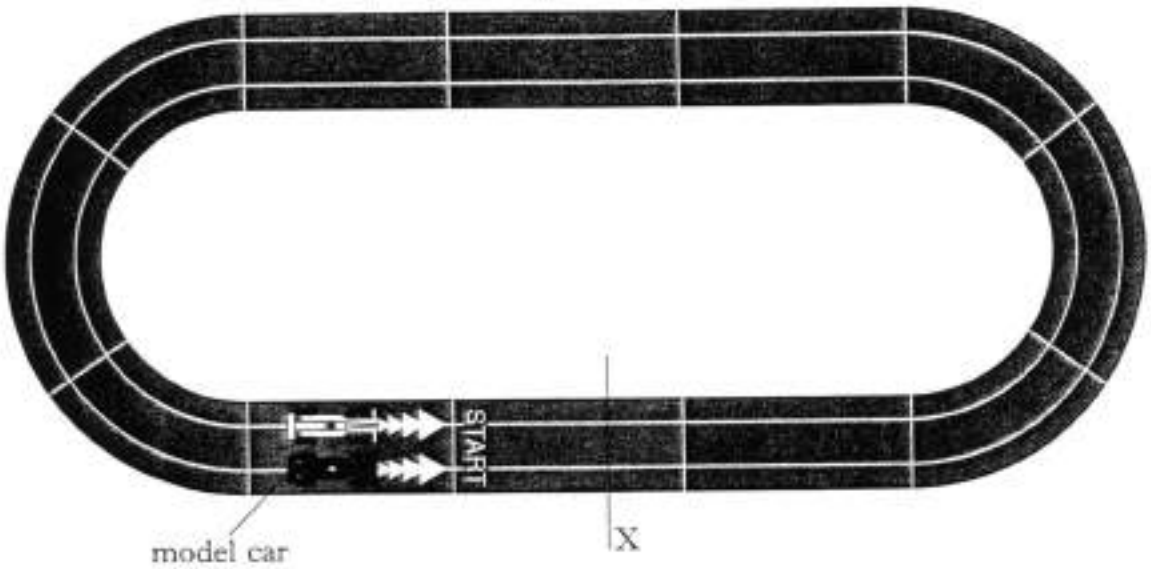
(iii) During part of a test run, a car travels 120 metres in 2 seconds. Calculate the average speed of the car in this time.

2

Marks

14. (continued)

(*b*) A student is investigating the motion of a model racing car as it moves around a track.



(i) The student finds that at point X the car has an *acceleration*. What is meant by the term acceleration?

1

(ii) Describe how the student could measure the instantaneous speed of the car as it passes point X.

3

[Turn over

Marks

15. (*a*) At lift off from Earth, a spacecraft and its fuel have a total mass of 200 000 kilograms.

(i) Calculate the weight of the spacecraft and fuel at lift off.

2

(ii) After lift off, the weight of the spacecraft and fuel decreases. Give a reason for this decrease.

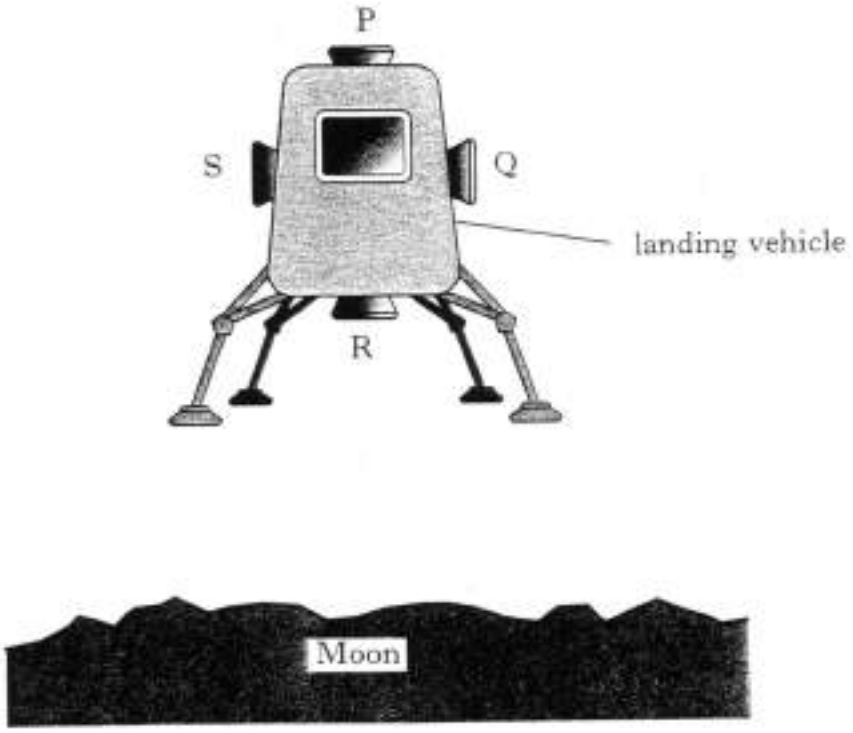
1

Marks

15. (continued)

(*b*) As a spacecraft approaches the Moon, a landing vehicle is released. This vehicle makes a vertical landing on the surface of the Moon.

The vehicle and its rocket engines P, Q, R and S are shown below.



(i) Which rocket engine should be fired to achieve a soft landing?

1

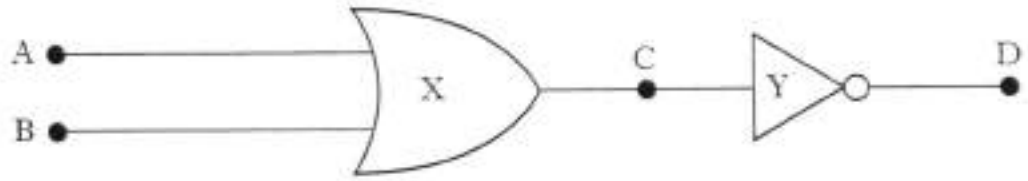
(ii) Describe how the rocket engines should be used to return the landing vehicle to the spacecraft in the shortest possible time.

2

[Turn over

Marks

16. (*a*) Part of an electronic circuit is shown below.



(i) What name is given to gate X?

What name is given to gate Y? **1**

(ii) The table shows the possible logic levels of inputs A and B. Complete this table to show the logic levels of points C and D.

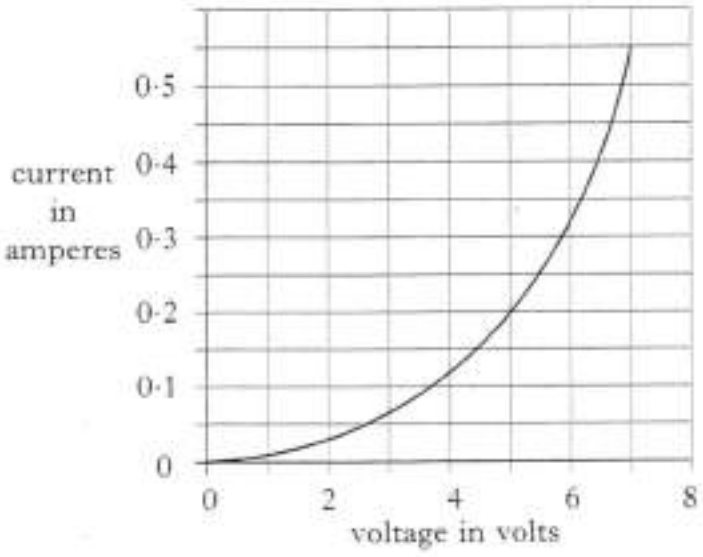
A	B	C	D
0	0		
0	1		
1	0		
1	1		

2

(*b*) A thermistor is used as a temperature sensor.

Graph 1 shows how the current in the thermistor changes as the voltage across it changes.

Graph 1



Marks

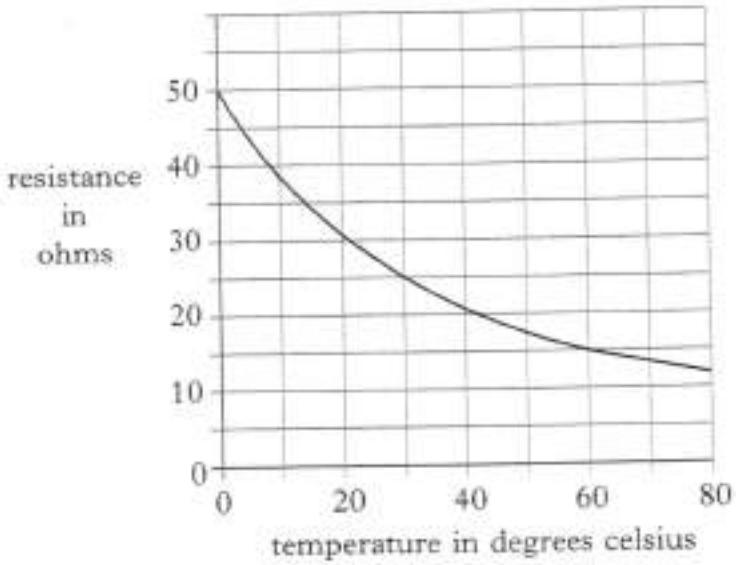
16. (*b*) **(continued)**

(i) Show that the resistance of the thermistor is 25 ohms when the voltage across the thermistor is 5 volts.

3

(ii) Graph 2 shows how the resistance of the thermistor changes as the temperature changes.

Graph 2

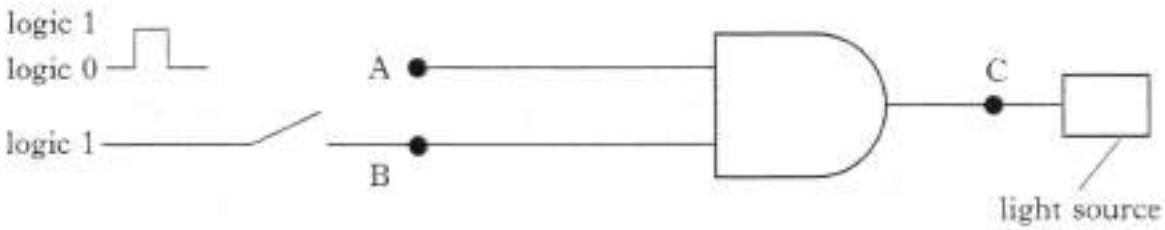


What is the temperature when the voltage across the thermistor is 5 volts?

1

Marks

17. The electronic system below is designed to produce a flash of light.



A single pulse is applied at input A of the AND gate.
A switch is connected to input B.

(*a*) The light source is a light emitting diode.
State the energy change in a light emitting diode.

1

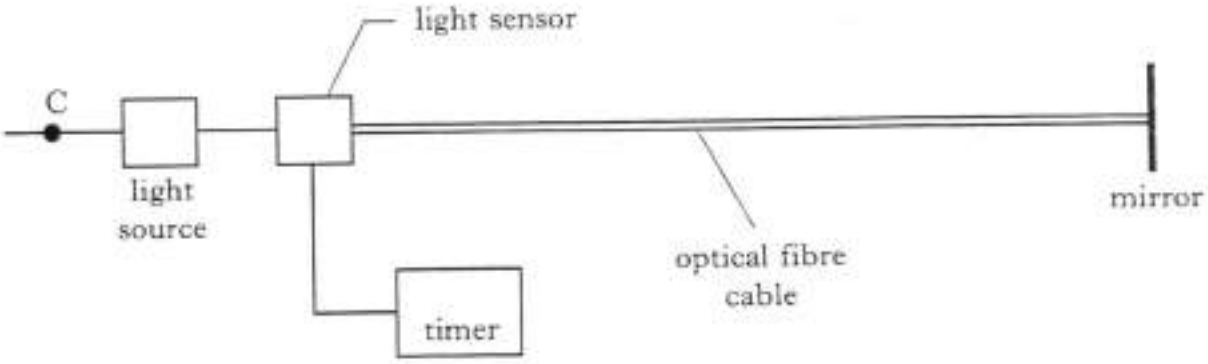
(*b*) Explain how output C from the AND gate can become logic 1.

2

Marks

17. (continued)

(*c*) The electronic system is now connected to a light sensor as shown below. A test is carried out to measure the speed of light through an optical fibre cable connected to the light sensor.



(i) The timer starts when the light sensor detects a flash of light and stops when it detects a second flash of light.

A single logic 1 pulse at C produces a flash of light which starts the timer.
Explain how this flash of light also stops the timer.

1

(ii) Explain how the speed of light through the fibre could be calculated.

2

[END OF QUESTION PAPER]