FOR OFFICIAL USE

Total Marks

X069/101

NATIONAL QUALIFICATIONS

MONDAY, 4 JUNE
9.00 AM – 10.30 AM

PHYSICS
INTERMEDIATE 1

2003

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 7–20 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

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1. On a colour television screen, which colours of light are mixed to produce yellow?

   A Red and green
   B Cyan and blue
   C Blue and red
   D Green and blue
   E Magenta and red

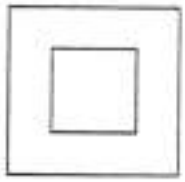
   Answer ☐ 1

2. Which row in the table gives the units of power and resistance?

	Power	*Resistance*
A	watt	volt
B	volt	ohm
C	ohm	watt
D	ohm	volt
E	watt	ohm

   Answer ☐ 1

3. The symbol below is seen on the rating plates of some appliances.



   This tells you that the appliance

   A does not need a live wire
   B comes in a square box
   C operates at 110 volts
   D does not need an earth wire
   E does not need a fuse.

   Answer ☐ 1

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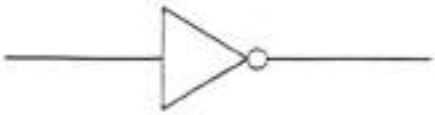
4. This symbol represents an electronic component.



This symbol represents

A an AND gate
B a variable resistor
C a NOT gate
D a fuse
E an OR gate.

Answer ☐ 1

5. The table below shows performance figures for some makes of car. Which row shows the car with the greatest acceleration?

Car	*Top speed* (mph)	*Time to go from 0–60 mph* (seconds)
A	107	12·6
B	116	11·1
C	118	11·4
D	119	10·1
E	126	10·4

Answer ☐ 1

6. Which of the following improves the streamlining of a car?

A Using a more powerful engine
B Making the car lower to the ground
C Making the car taller
D Adding a roof rack
E Making the car lighter

Answer ☐ 1

7. A mass of 0·1 kg is suspended from a newton balance at the Earth's surface. What is the reading on the balance?

A 0·01 newton
B 0·1 newton
C 1 newton
D 10 newtons
E 100 newtons

Answer ☐ 1

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8. (*a*) Read the following passage taken from a leaflet about optical fibres.

A much greater amount of information can be carried on an optical fibre compared to a copper cable. In both optical fibres and copper wires, however, the signal loses energy but less energy is lost in optical fibres. Copper cables experience electrical interference and optical fibres do not. Copper cables are easier to join together than optical fibres. Optical fibres are cheaper and thinner than copper cables.

(i) **From the passage**, give **three** advantages of optical fibres compared to copper wires.

Advantage 1

Advantage 2

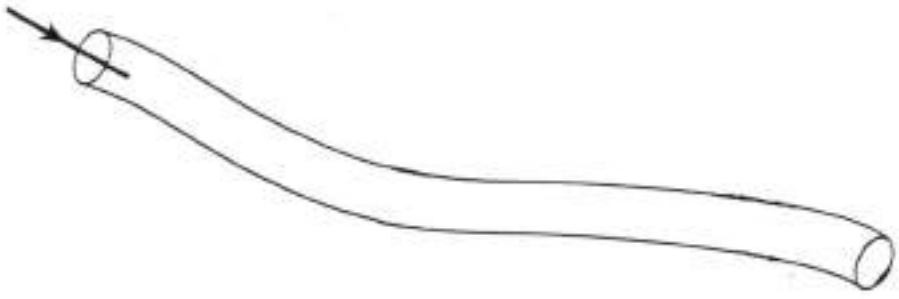
Advantage 3

(ii) **From the passage**, give **one** advantage of copper wires compared to optical fibres. **2**

(*b*) Copper wires carry electrical signals and optical fibres carry light signals to transmit telephone communications.

How are telephone communications transmitted through air? **1**

(*c*) Complete the diagram below to show how the light ray travels along the optical fibre.

 **2**

(*d*) A doctor may use a fibrescope to look inside the body. A fibrescope has **two bundles** of optical fibres.

Describe how the fibrescope is used to see inside the body. **2**

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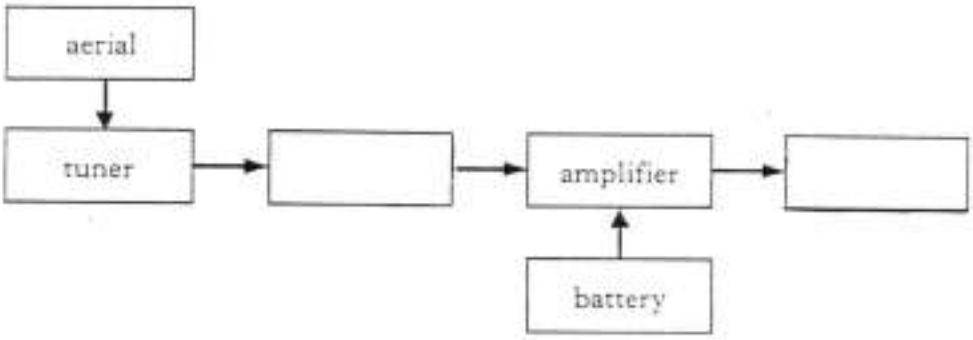
9. (*a*) The table below contains statements about radio waves.

A Transmitted through air at 300 million metres per second	B Can be transmitted through space	C Number of waves produced per second
D Do not require wires for transmission	E Measured in hertz	F Transfer energy from one place to another

Which **two** boxes contain statements referring to **frequency**?

_____ and _____ 2

(*b*) (i) The block diagram below represents a radio receiver. Two of the components are missing. Complete the diagram.



2

(ii) What is the purpose of the amplifier?

_____ 1

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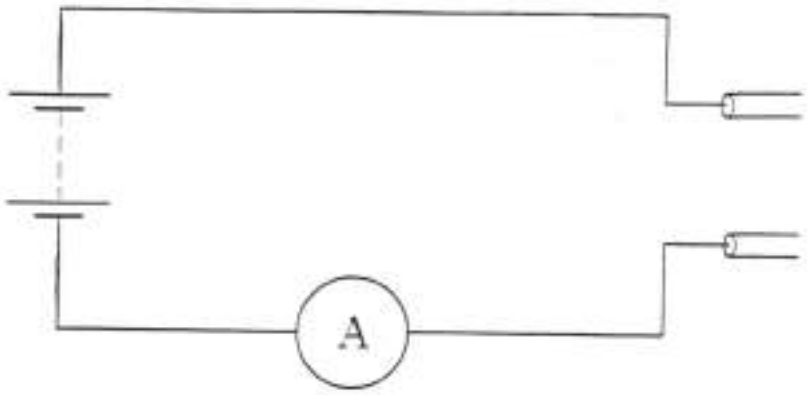
10. A student uses a low voltage battery and an ammeter to investigate how a human body conducts electricity. The circuit is set up as shown and the student holds the brass electrodes.



(*a*) (i) In the circuit diagram above, draw a voltmeter connected so that the voltage of the battery can be measured. 1

(ii) Explain why the student does not use mains voltage in this experiment.

1

(*b*) The student grasps the electrodes with dry hands. The reading on the ammeter is 0·0002 amperes.

The student then wets her hands and grasps the electrodes again.

Suggest a possible reading on the ammeter when she has wet hands. You **must** explain your answer.

2

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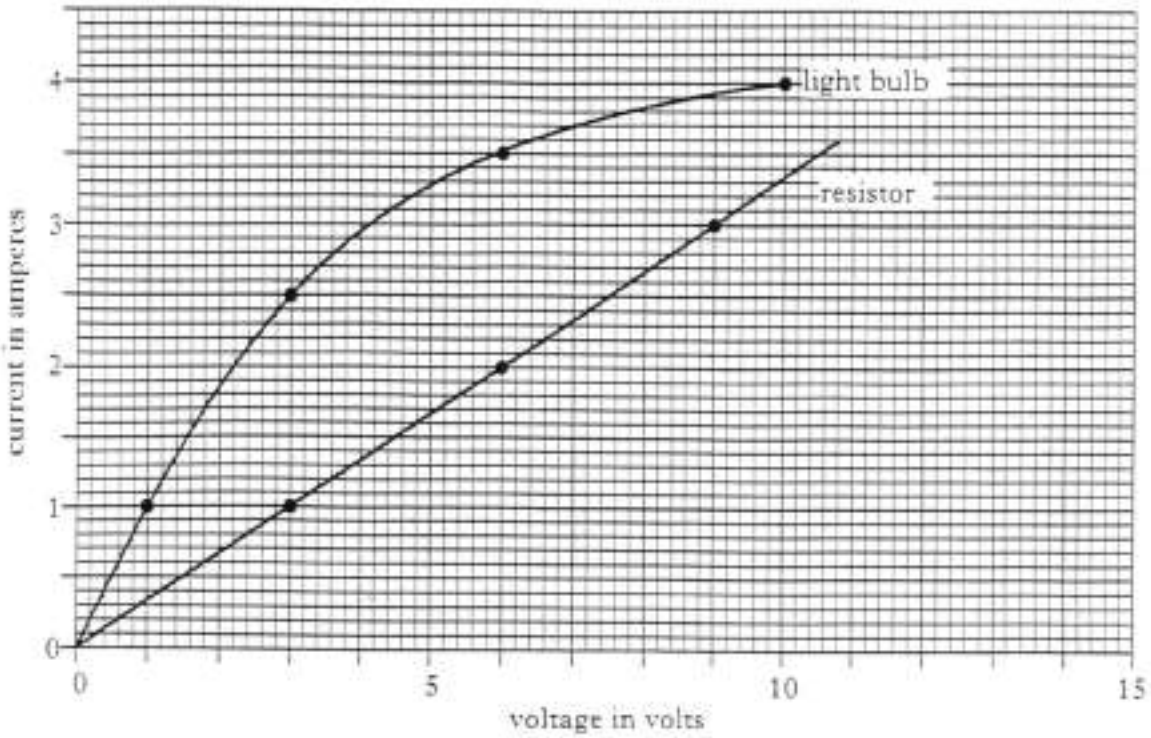
11. A light bulb and a resistor both conduct electricity.

The graph below shows how the currents through the light bulb and the resistor change as the voltage across each is altered.



(*a*) Use the values from the following point on the graph to calculate the resistance of the resistor.

Current = 3 amperes
Voltage = 9 volts

2

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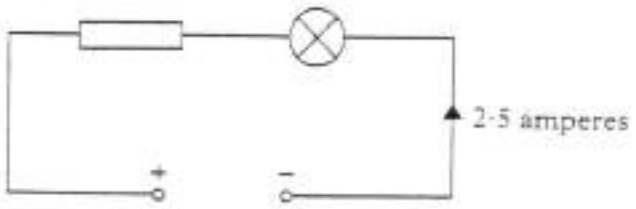
11. (continued)

(*b*) The light bulb and resistor are connected as shown below. The current in the circuit is 2·5 amperes.



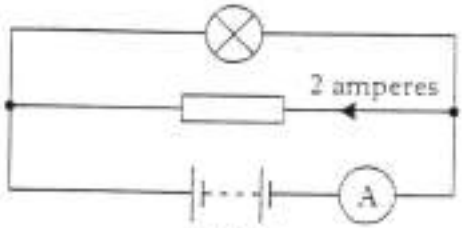
(i) **Use the graph** to state the voltage across **the resistor** when the current is 2·5 amperes.

1

(ii) The voltage across the light bulb is 3·0 volts.
Calculate the voltage of the power supply.

1

(*c*) The light bulb and resistor are now connected to a 6 volt battery as shown below.



(i) Are the light bulb and resistor connected in series or parallel?

1

(ii) **Use the graph** to find the current in the light bulb.

1

(iii) Calculate the current in the ammeter.

1

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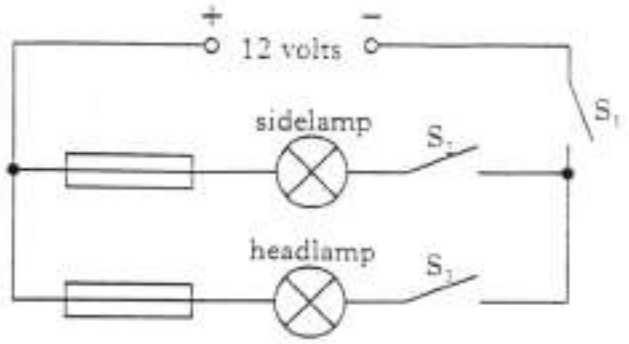
12. The following circuit is set up using a car headlamp and a car sidelamp.



(*a*) Which switch or switches must be closed to allow only the sidelamp to light?

1

(*b*) The headlamp is now switched on. It is rated at 12 volts, 60 watts.

(i) Calculate the current in the headlamp.

2

(ii) From the fuse values shown below, select the most appropriate value for use with the headlamp. **Circle your choice.**

3 amperes **6 amperes** **13 amperes**

15 amperes **30 amperes**

1

Marks

13. Some people can see close-up objects clearly but cannot see far away objects clearly.

(a) (i) What is the name of this sight defect?

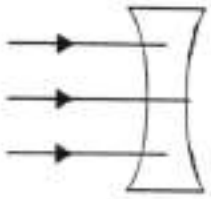
1

(ii) Name the type of lens that corrects this defect.

1

(b) The diagram shows three rays of light approaching a lens.

Draw the rays of light after they have passed through the lens.



1

(c) Some sight defects can be treated using a special type of laser. The laser uses heat radiation. State another name for heat radiation.

1

(d) Give **one** other medical use for heat radiation.

1

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14. (*a*) The boxes below give uses of different types of radiation.

A Inspection of welded joints	B Treating vitamin D deficiency	C Removing birthmarks
D Sterilising surgical instruments	E Seeing things	F Thermograms

From the boxes above, select **one use each** for gamma rays, ultraviolet rays and X-rays and complete the following sentences.

A use for gamma rays is _____

A use for ultraviolet rays is _____

A use for X-rays is _____ 3

(*b*) In hospitals, medical staff use tracers that give out gamma rays.

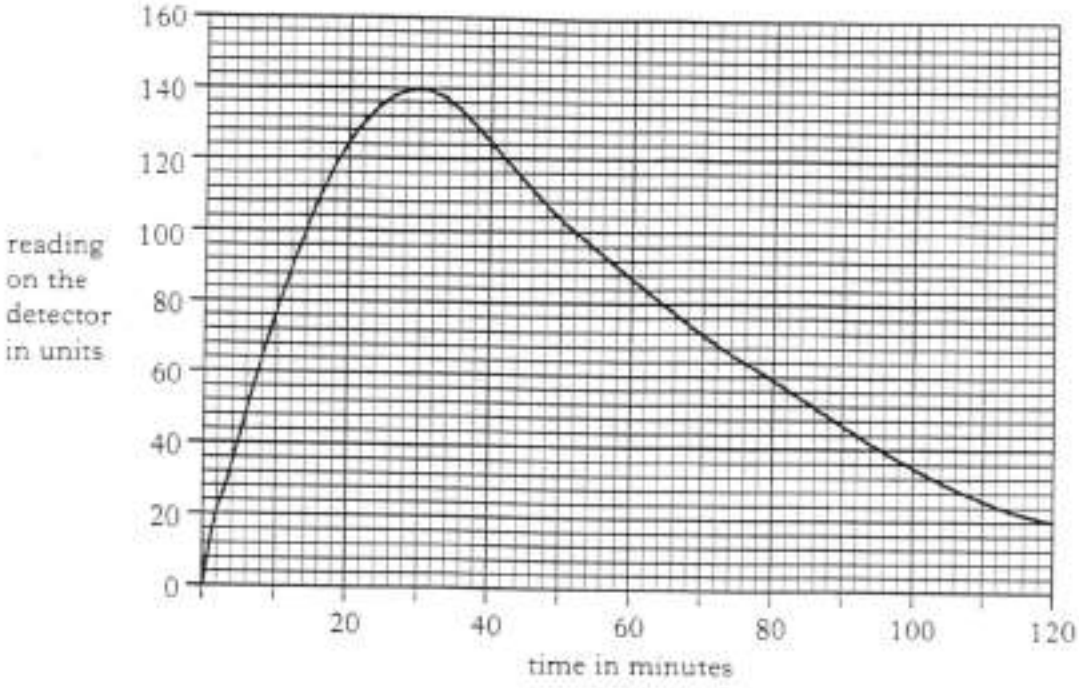
(i) State **one** safety precaution that medical staff should take when working with sources of gamma rays.

_____ 1

14. (*b*) (continued)

Marks

(ii) A doctor wants to find out how well a patient's kidney is working. The doctor injects the patient with a tracer that gives out gamma rays. The doctor places a detector over the kidney area. The graph below shows how the reading on the detector changes after injection of the tracer.



The doctor can only investigate the kidney when the reading is 100 units or above.

How much time is available for the doctor to conduct the investigation?

2

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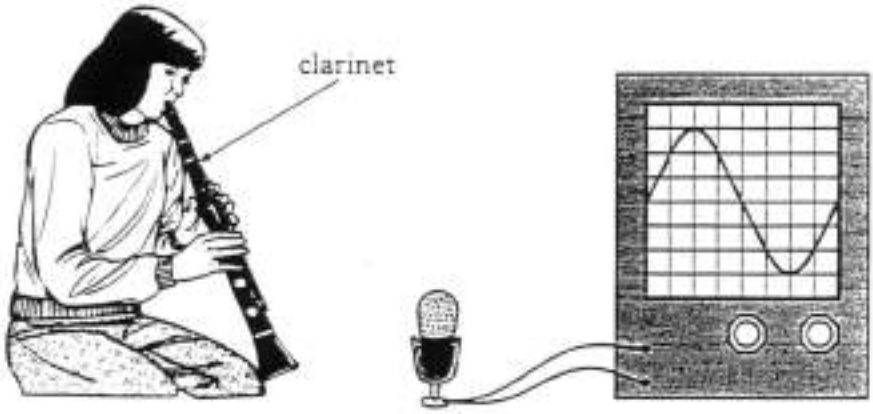
15. A student plays a clarinet near a microphone which is connected to an oscilloscope. A loud note of frequency 256 hertz produces the trace shown.



(*a*) What useful energy change takes place in the microphone?

1

(*b*) (i) What is the frequency of a note one octave higher than 256 hertz?

1

(ii) Holes in the clarinet are uncovered to produce higher notes.
Why does this produce higher notes?

1

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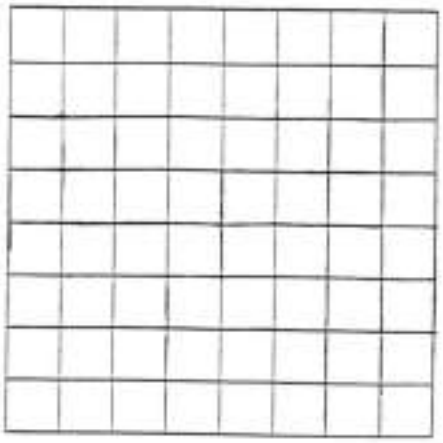
15. **(continued)**

(*c*) The student plays a quiet note one octave higher than 256 hertz. On the grid below, draw the trace produced on the oscilloscope screen.



2

(*d*) The open end of the clarinet is 2·45 metres from the microphone. The sound takes 0·007 seconds to travel from the clarinet to the microphone.

Use this information to calculate the speed of sound.

2

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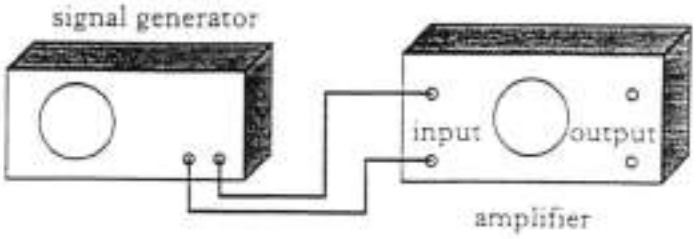
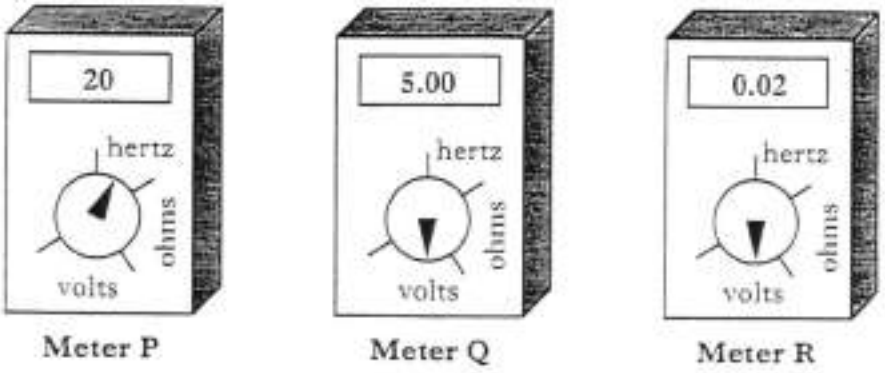
16. A student connects a signal generator to the input of an audio amplifier. The student measures the input frequency and input voltage to the amplifier and the output voltage from the amplifier.



The three meters **P**, **Q** and **R** used for the measurements are shown below.



(*a*) **Meter R** shows the input voltage. Which meter shows the output voltage from the amplifier?

1

(*b*) Use readings from the meters to calculate the voltage gain of the amplifier.

2

Marks

16. **(continued)**

(c) (i) What is the frequency of the input signal to the amplifier?

1

(ii) What is the frequency of the output signal from the amplifier?

1

(d) The output is now connected to a loudspeaker and the frequency increased until the sound is no longer heard.

(i) Suggest a possible frequency at which this is likely to occur for a young student with normal hearing.

1

(ii) What is the name given to high frequency sounds which are beyond the normal range of human hearing?

1

(e) State **one** use for high frequency sounds which are beyond the normal range of human hearing.

1

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17. The diagram below shows a skier going down an artificial ski slope.

(*a*) (i) Name the force that pulls the skier down the slope.

1

(ii) Name a force that opposes the motion of the skier down the slope.

1

(*b*) (i) In order to go faster, the skier rubs wax on the base of the skis before going down the slope. Explain why this is done.

1

(ii) State **one** other method of making the skier go faster.

1

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17. **(continued)**

(c) The skier starts from rest at the top of the slope and skis down to the bottom. The **average** speed of the skier is to be measured.

(i) List the measurements you would make.

1

(ii) Name the pieces of equipment you would use to take these measurements.

1

(iii) State clearly how you would use these measurements to calculate the average speed.

1

(d) The distance between the start and finish is 120 metres. The time for the skier to travel from start to finish is 9·6 seconds. Calculate the average speed of the skier.

2

(e) For health reasons skiers put suntan cream on their faces when skiing on snow. State why they do this.

(1)

1

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18. A list of electronic components is shown below.

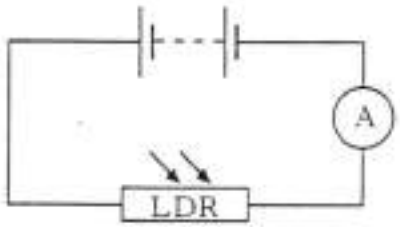
Reference	*Device*	*Details*
BZ102	Buzzer	Resistance 2 ohms
MOT01	Motor	Input voltage 6 volts
LEDRED	Light-emitting diode	0·01 amperes, 3 volts
MIC6	Microphone	Lapel
LT5	Lamp	5 volts, 0·2 amperes
THERM16	Thermistor	Resistance at 30 degrees celsius is 25 ohms
LS2	Loudspeaker	Resistance 6 ohms

(*a*) (i) From the list, name **two** output devices. 2

(ii) From the list, name **one** input device. 1

(iii) State the useful energy change that takes place in a loudspeaker. 1

(*b*) A light dependent resistor (LDR) is connected in the circuit shown. The circuit is in a dark room.



(i) Is the resistance of the LDR high or low in the dark? 1

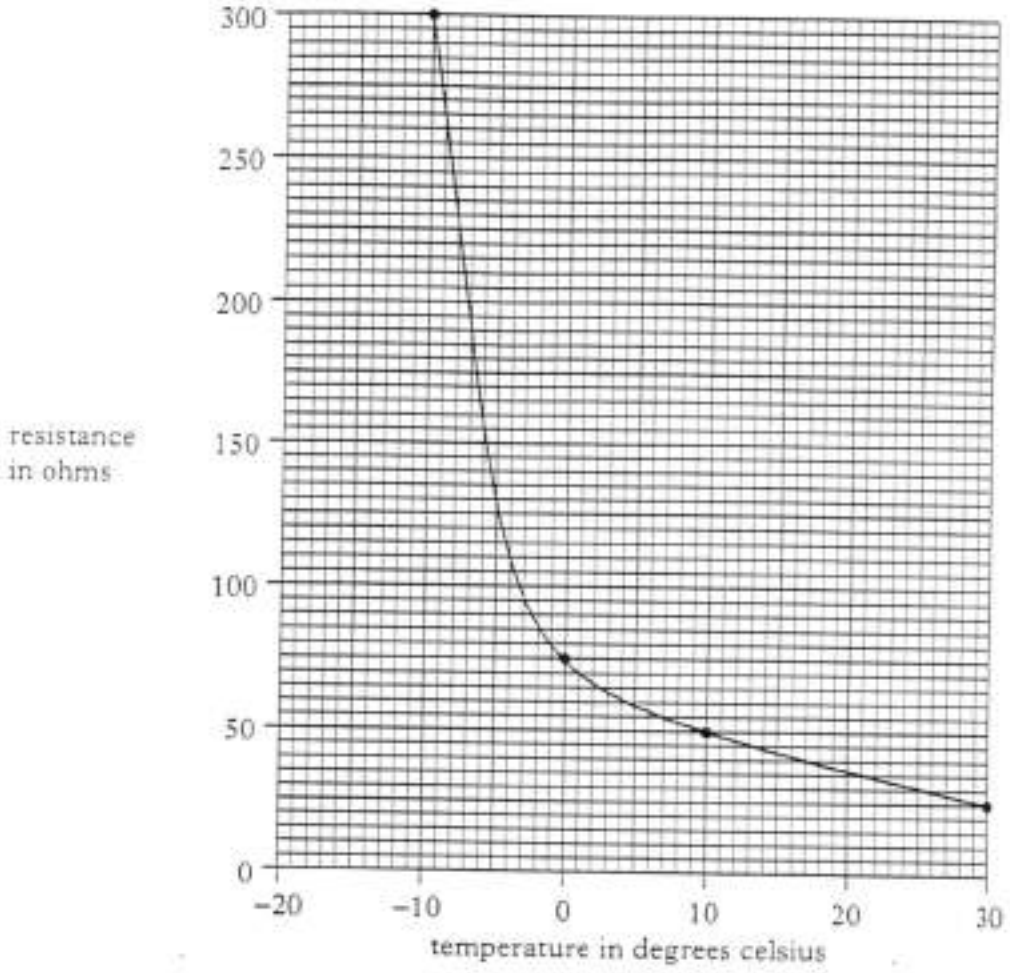
Marks

18. (*b*) **(continued)**

(ii) The circuit is now moved into a well-lit room. What happens to the reading on the ammeter? You **must** explain your answer.

2

(*c*) The graph below shows how the resistance of thermistor THERM16 changes as its temperature changes.



What is the **change** in resistance of the thermistor when its temperature drops from 10 degrees celsius to −10 degrees celsius?

2

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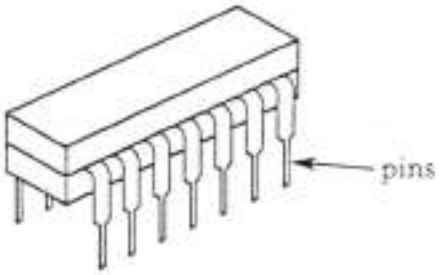
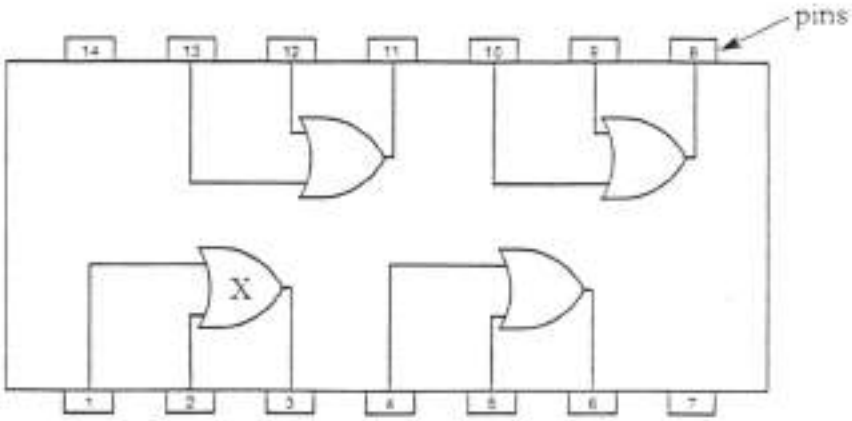
19. A 14-pin "chip" contains four logic gates.



The diagram shows how the gates are connected to the pins.



(*a*) Name the type of gates in this chip.

1

(*b*) The table shows all the possible input logic levels to gate X. Complete the table to show the output logic levels of gate X.

Input to pin 1	*Input to pin 2*	*Output at pin 3*
0	0	
0	1	
1	0	
1	1	

1

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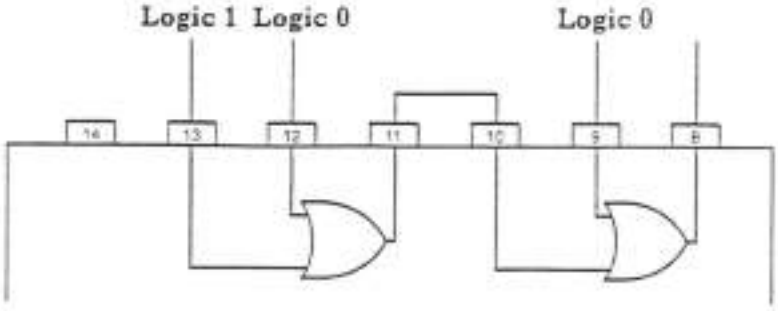
19. **(continued)**

(*c*) The input signals to pins 9, 12 and 13 are as shown. Pins 10 and 11 are connected together.



State the logic levels at the following pins.

(i) pin 11 _____ 1

(ii) pin 8 _____ 1

(*d*) Name the type of gate which is used to convert logic 0 to logic 1.

_____ 1

[END OF MARKING INSTRUCTIONS]