SCOTTISH QUALIFICATIONS AUTHORITY

2003 Physics

Intermediate 1

Finalised Marking Instructions

Marks

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

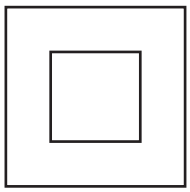
Answer **A** **1**

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 **E** **1**

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



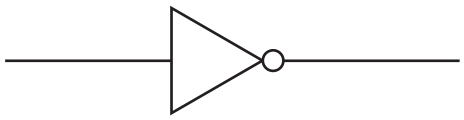
This tells you that the appliance

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 **D** **1**

Marks

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 **C** **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 **D** **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 **B** **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 **C** **1**

Marks

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	**more information carried OR cheaper**
Advantage 2	**less energy loss OR thinner**
Advantage 3	**no interference**

ANY 3 (½) each

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

easier to join (½)

2

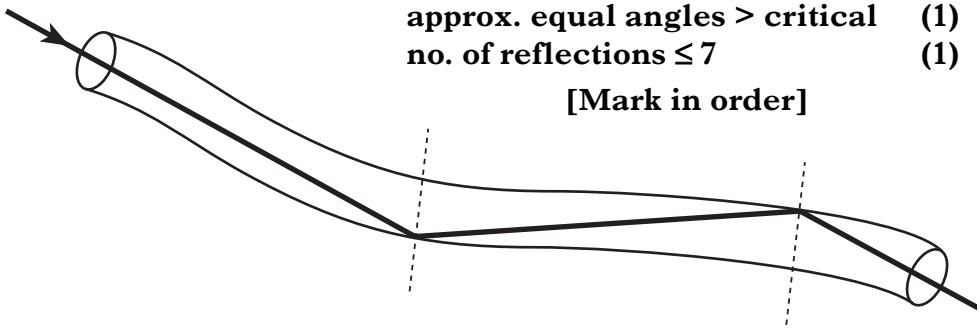
(*b*) Copper wires carry electrical signals and optical fibres carry light signals to transmit telephone communications.

How are telephone communications transmitted through air?

radio waves OR microwaves OR radio (1)

1

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



approx. equal angles > critical (1)
no. of reflections ≤ 7 (1)
[Mark in order]

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.

light is shone down one (bundle of) fibres (1)
light reflects up second (bundle of) fibres (1)

(NOT wires or tubes)

2

Marks

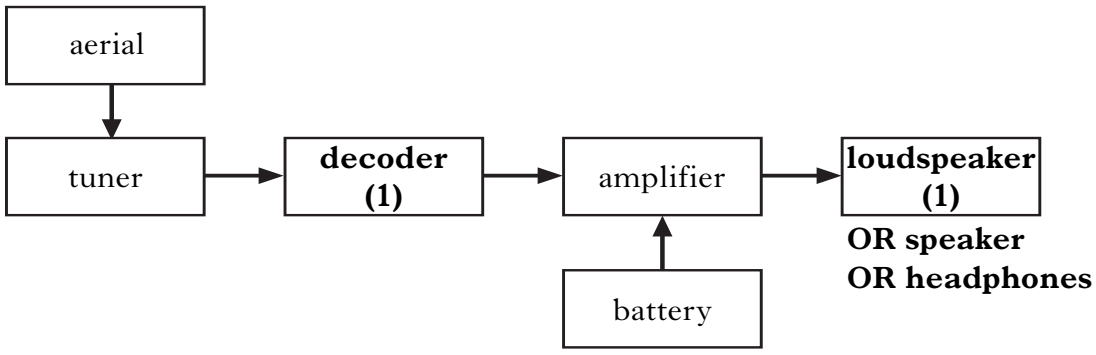
9. (*a*) The table below contains statements about radio waves.

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**?

C (1) and **E (1)** **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?

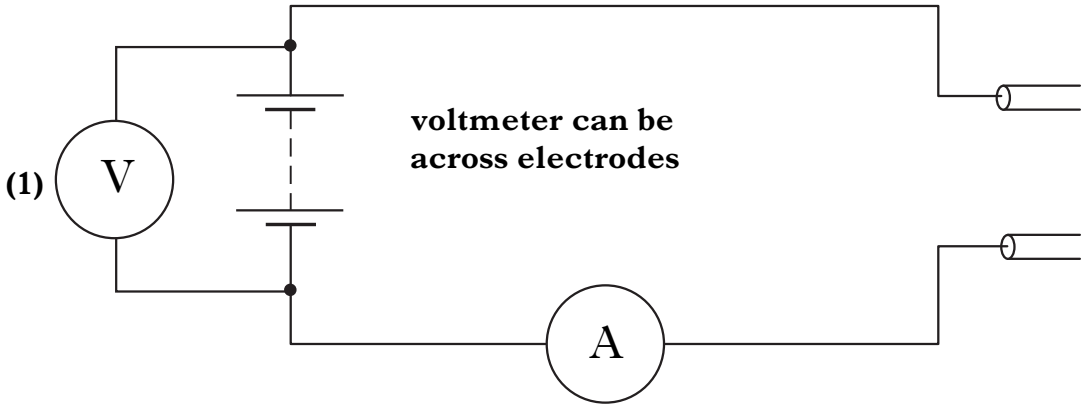
makes amplitude of signal bigger
OR
increases signal strength
OR
boosts signal **(1)**

1

(NOT to make sound louder)

Marks

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.

mains voltage is too high
OR
mains voltage is 230 volts
OR
electrocution
OR
shock (1)

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.

any value greater than 0·0002 amperes (1) **$\frac{1}{2}$unit deduction**
wet hands conduct better than dry hands
OR
wetness decreases body's resistance (therefore greater current) (1)

2

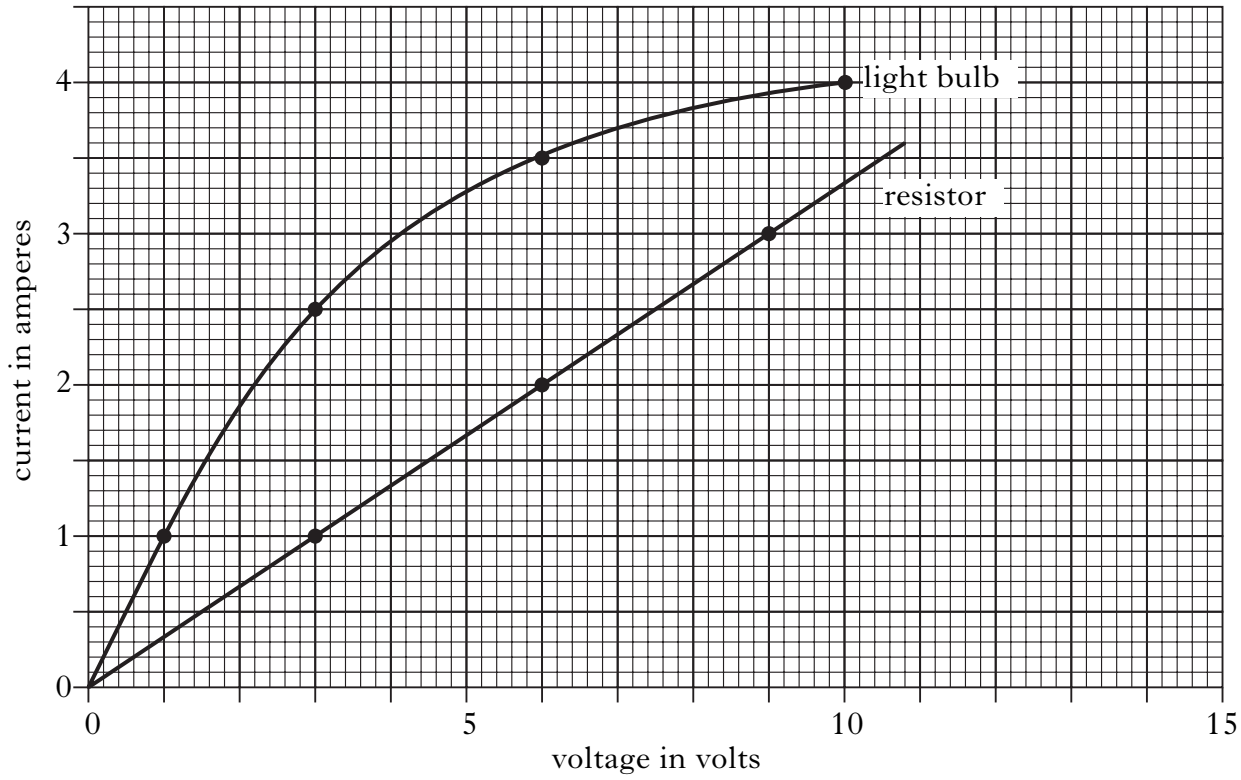
NOTE: Bigger current OR bigger reading gets $\frac{1}{2}$for first statement

NOTE: there must be a <u>comparison</u> between wet and dry for second mark

Marks

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

$$\textbf{resistance} = \frac{\textbf{voltage}}{\textbf{current}} \quad (\tfrac{1}{2})$$

$$= \frac{9}{3} \quad (\tfrac{1}{2})$$

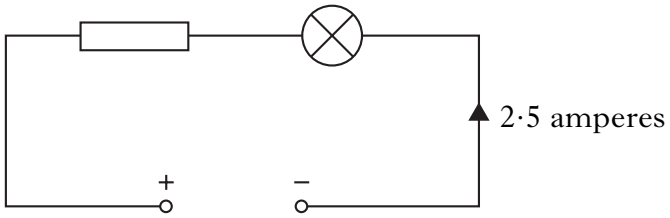
$$= 3 \text{ ohms} \quad (\tfrac{1}{2}) \quad (\tfrac{1}{2})$$

2

Marks

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.

voltage across resistor = 7·5 volts (1) **½ unit deduction**
7·5 ± 0·1 volts

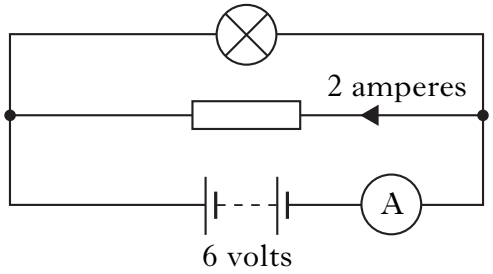
1

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

voltage of power supply = 10·5 volts (1) **½ unit deduction**
MUST be answer (*b*)(i) + 3 volts

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?

parallel (1)

1

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

current through bulb = 3·5 amperes (1) **½ unit deduction**

1

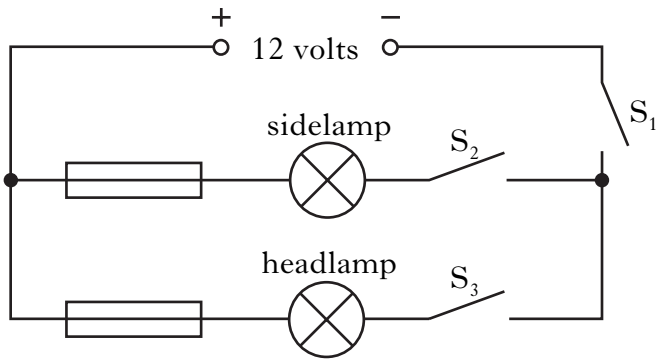
(iii) Calculate the current in the ammeter.

reading on ammeter = 5·5 amperes (1) **½ unit deduction**
MUST be answer (*c*)(ii) + 2 amperes

1

Marks

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?

S_1 and S_2 (1 or 0) **1**

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

(i) Calculate the current in the headlamp.

$$\textbf{current} = \frac{\textbf{power}}{\textbf{voltage}} \quad (\tfrac{1}{2})$$

$$= \frac{60}{12} \quad (\tfrac{1}{2})$$

$$= \textbf{5 amperes} \quad (\tfrac{1}{2}) \quad (\tfrac{1}{2})$$

2

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

(1)

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

15 amperes **30 amperes** **1**

NOTE: (ii) must be consistent with (i)

NOTE: if (i) blank then only answer allowed for (ii) is 6 amperes

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?

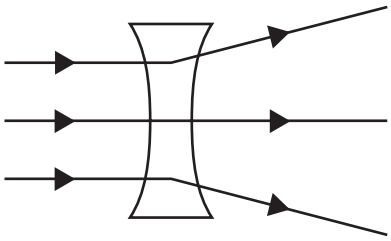
short sight OR near sight (1) — **1**

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

diverging OR concave (1) — **1**

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

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



diverging rays after lens (1) — **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.

infra red (radiation) OR IR (1) — **1**

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

healing sports injuries
OR
healing damaged muscles

OR taking temperatures
thermograms
sealing blood vessels
laser scalpel
burning tumors **(1)** — **1**

Marks

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 **sterilising surgical instruments OR D (1) OR inspection of welded joints OR A**

A use for ultraviolet rays is **treating vitamin D deficiency OR B (1)**

A use for X-rays is **inspection of welded joints OR A (1)** **3**

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

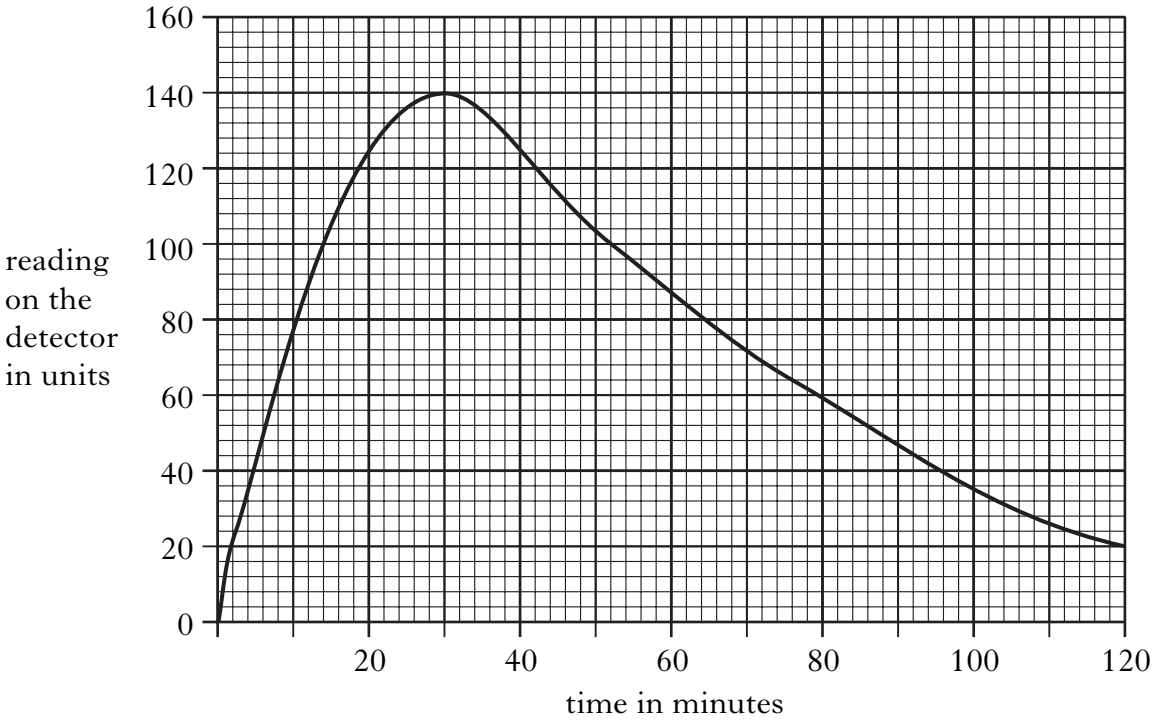
(i) State **one** safety precaution that medical staff should take when working with sources of gamma rays.

don't handle OR keep distance OR wear gloves OR use tongs OR wear lead apron

OR film badge
screening
goggles
go out of room
restrict length of time **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?

rises to 100 units after 14 ± 1 minutes (½)

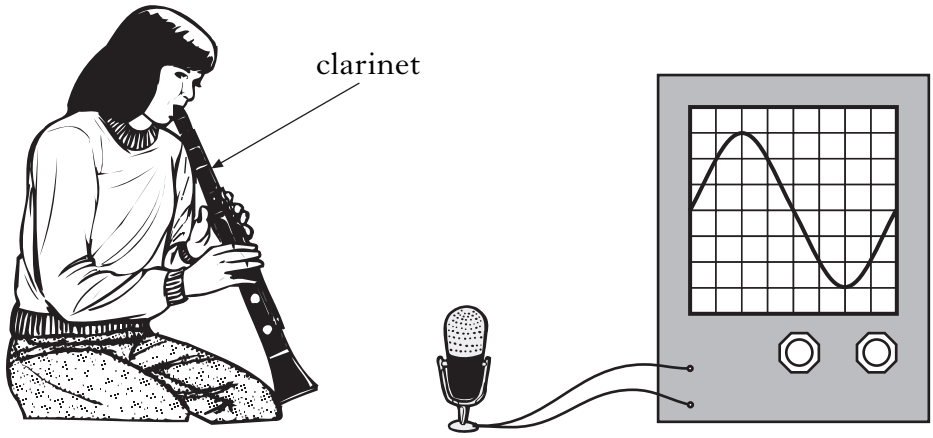
falls to 100 units after 52 ± 1 minutes (½)

above 100 units for 52–14 = 38 ± 2 minutes (½) (½)

2

Marks

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?

sound (energy) → electrical (energy) (1)

1

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

512 hertz (1) **$\frac{1}{2}$ unit deduction**

1

(ii) Holes in the clarinet are uncovered to produce higher notes.

Why does this produce higher notes?

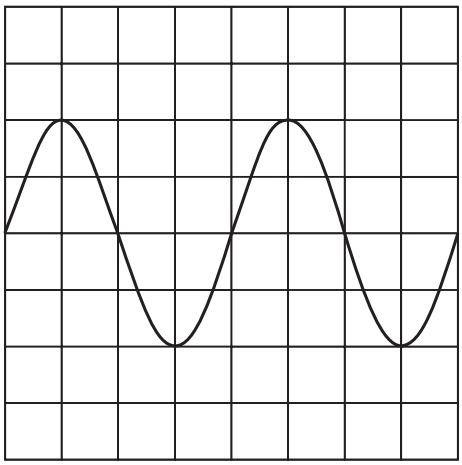
length of air column is altered OR shortened (1)

1

Marks

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.



smaller amplitude (1)

any higher frequency (½)

two complete waves (½)

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.

$$\textbf{speed} = \frac{\textbf{distance}}{\textbf{time}} \quad (\tfrac{1}{2})$$

$$= \frac{2 \cdot 45}{0 \cdot 007} \quad (\tfrac{1}{2})$$

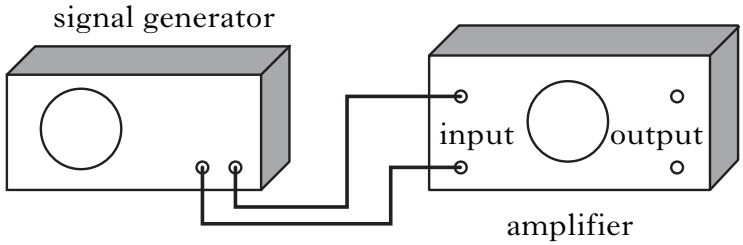
= 350 metres per second (½) (½)

[DO NOT accept mps as units]

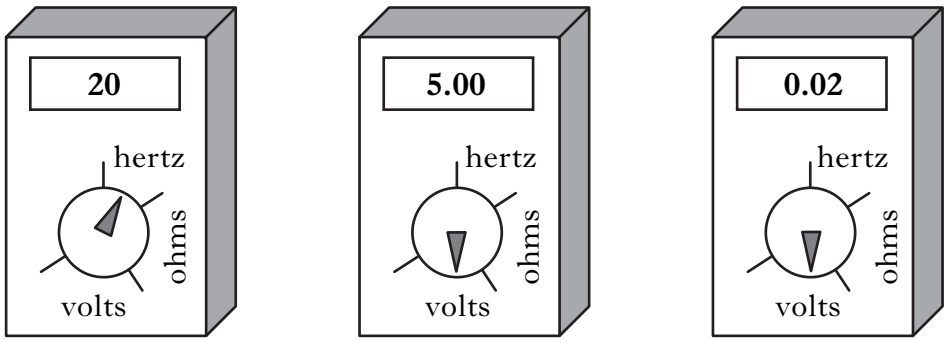
2

Marks

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.



Meter P **Meter Q** **Meter R**

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

meter Q (1)

1

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

$$\textbf{voltage gain} = \frac{\textbf{output voltage}}{\textbf{input voltage}} \ (\tfrac{1}{2})$$

$$= \frac{5 \cdot 00}{0 \cdot 02} \ (\tfrac{1}{2})$$

$$= 250 \quad (1)$$

$\frac{1}{2}$ unit deduction if any unit given

2

Marks

16. (continued)

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

20 hertz (1) ½unit deduction

1

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

20 hertz (1) ½unit deduction
answer must be equal to (*c*)(i)

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.

20 000 hertz (1) ½unit deduction
accept range 17000–20000 hertz
accept "greater than 20000 hertz"

1

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

ultra sound OR ultrasonic (1)

1

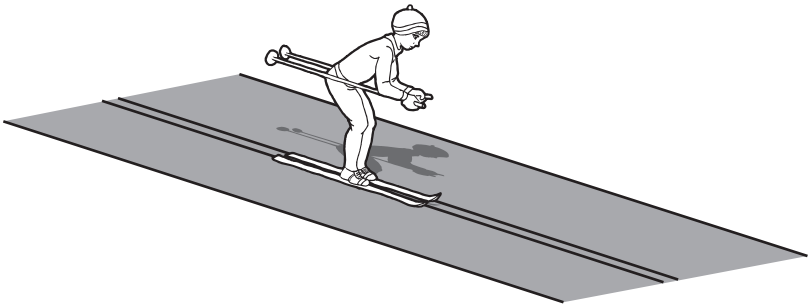
(*e*) State **one** use for high frequency sounds which are beyond the normal range of human hearing.

scanning unborn babies
OR shattering kidney stones
OR descaling teeth
OR tape measures
OR dog whistles (1)
OR sonar
sports injuries
blood flow
bats to navigate or hunt
dolphins/whales to communicate
pest control
cracks testing

1

Marks

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.

weight OR gravity <u>force</u> (1)

1

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

friction OR air friction OR air resistance OR drag (1)

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.

reduces <u>friction</u> between skis and slope (1)

1

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

more aerodynamic clothing OR crouch more (1)
OR push harder
use poles
spray water

1

Marks

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.

distance (from start to finish) (½)
time (to travel this distance) (½)

1

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

(distance)—tape OR trundle wheel OR metre stick (½)
(time)—stopwatch (½)

1

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

$$\textbf{(average) speed} = \frac{\textbf{distance}}{\textbf{time}} \quad \textbf{(1)}$$

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.

$$\textbf{(average) speed} = \frac{\textbf{distance}}{\textbf{time}} \quad (\tfrac{1}{2})$$

$$= \frac{120}{9 \cdot 6} \quad (\tfrac{1}{2})$$

= 12·5 metres per second (½) (½)

[DO NOT accept mps as unit]

2

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

prevent skin cancer **OR absorb reflected UV/sunlight**
OR prevent ageing **OR prevent rashes or sores**
OR prevent sunburn **OR higher altitude = more UV**
(1)

1

Marks

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.

Any TWO from
Buzzer, motor, LED, lamp, loudspeaker (1) (1)
OR correct reference numbers **2**

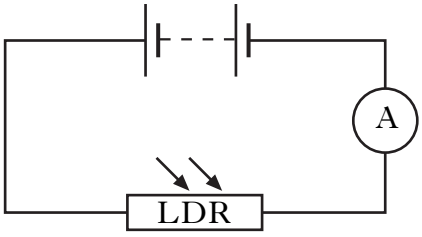
(ii) From the list, name **one** input device.

Any ONE from
microphone, thermistor (1)
OR correct reference numbers **1**

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

electrical (energy) → sound (energy) (1) **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?

high (1) **1**

Marks

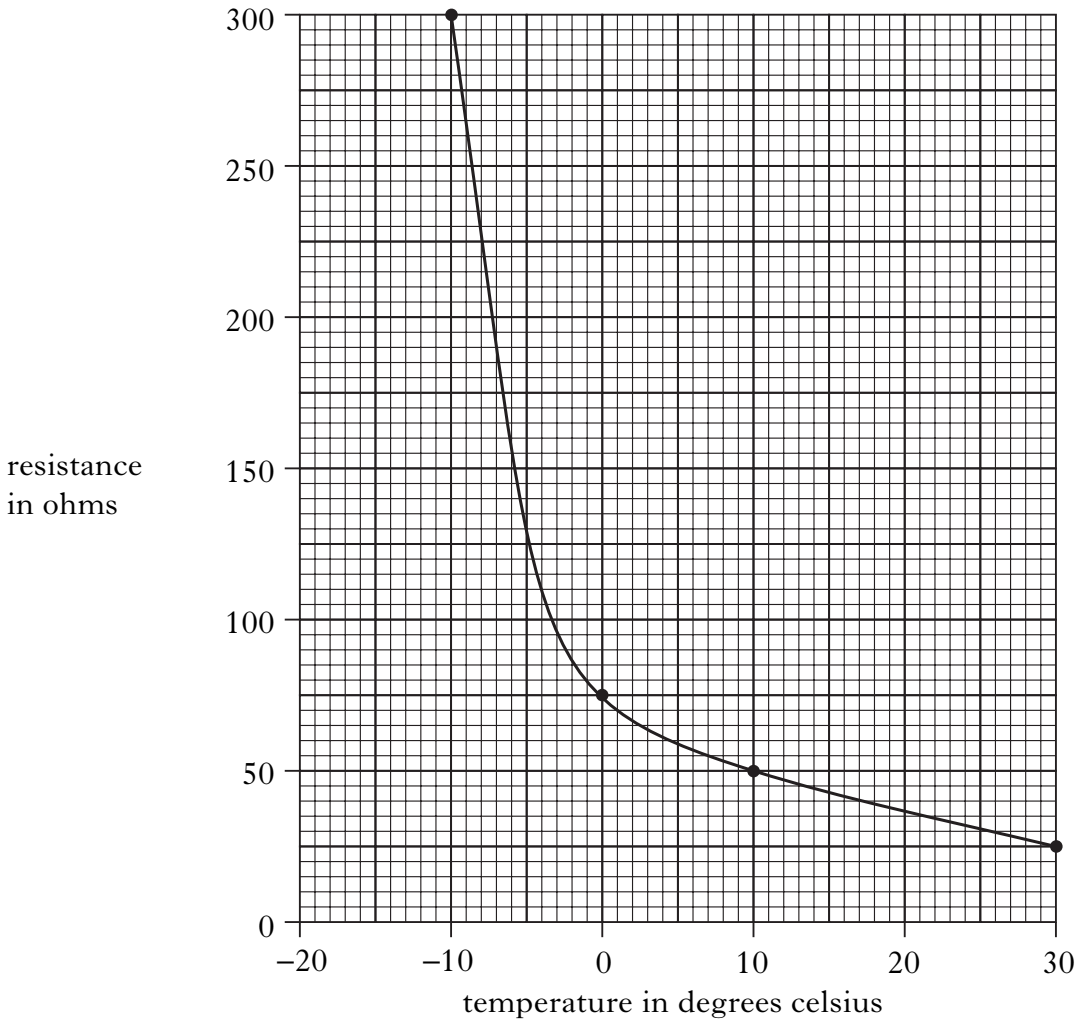
18. (*b*) (continued)

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

(current) increases (1)
(LDR in light) has decreased resistance (1)

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?

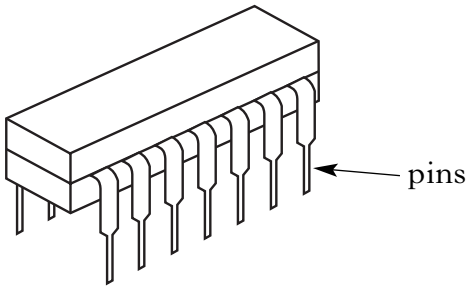
at 10 °C resistance = 50 (ohms) (½)
at –10 °C resistance = 300 (ohms) (½)

change in resistance resistance = 250 ohms (½) (½)

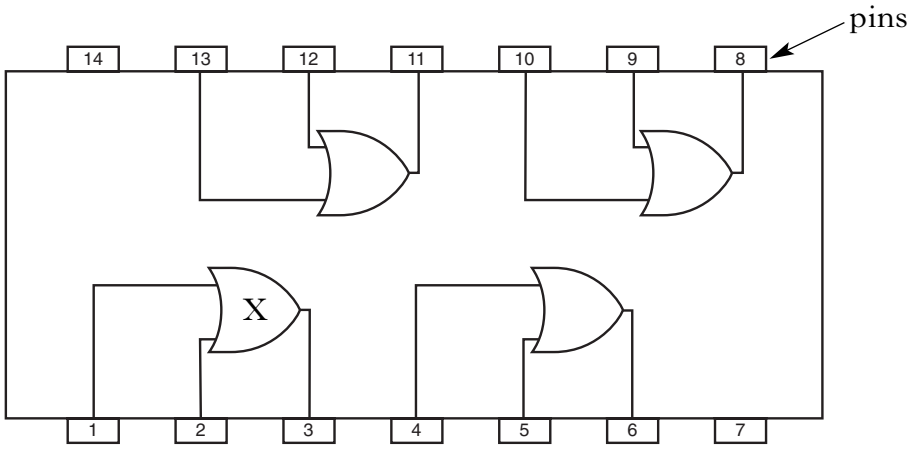
2

Marks

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.

OR gates (1)

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**
0	1	**1**
1	0	**1**
1	1	**1**

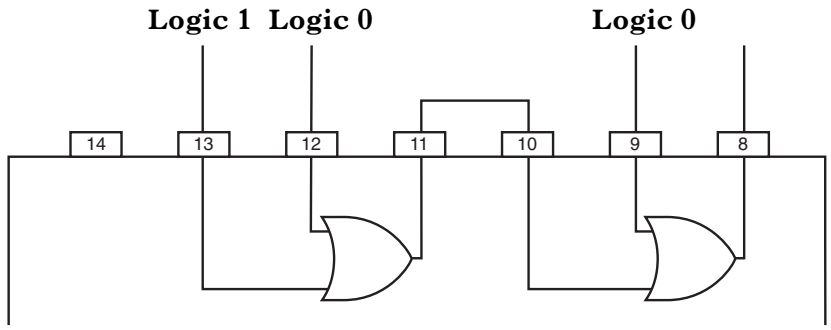
1

(1) or (0)

Marks

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 — **High OR 1 (1)** — **1**

(ii) pin 8 — **High OR 1 (1)** — **1**

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

a NOT gate OR inverter (1) — **1**

[*END OF MARKING INSTRUCTIONS*]