OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL GCSE

COMBINED SCIENCE DOUBLE AWARD

9204/PE PHYSICS – PAPER 3 – EXTENSION PAPER

Specimen material 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler with millimetre measurements
- a calculator
- the Physics Equation sheet.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the bottom of this page.
- Answer **all** questions.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname

Forename(s)

Candidate signature _____

Answer **all** questions in the spaces provided.

1 Atoms contain three types of particle.

0 1 . 1 Which particles are found in the nucleus of an atom?

Tick **one** box.

[1 mark]

- electrons and neutrons ☐
- electrons and protons ☐
- neutrons and protons ☐
- protons, electrons and neutrons ☐

Table 1 gives information about four radioactive isotopes.

Table 1

Isotope	Type of radiation emitted	Half-life
iridium-192	gamma ray	74 days
polonium-210	alpha particle	138 days
polonium-213	alpha particle	less than 1 second
technetium-99	gamma ray	6 hours

0 1 . 2 Two isotopes of polonium are given in **Table 1**.

Compare the two isotopes of polonium in terms of the particles in their nuclei.

[1 mark]

_____

_____

0 1 . 3 A doctor injects a patient with a very small dose of technetium-99 to monitor the blood flow through the patient's heart.

The radiation detected outside of the patient's body can be used to see if the heart is working correctly.

Explain why technetium-99 is the most suitable for this use.

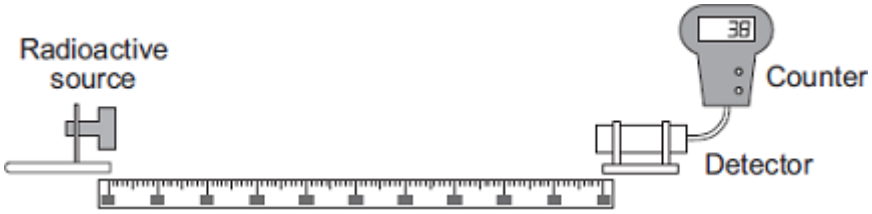
[2 marks]

Question 1 continues on the next page

A teacher used the equipment shown in the diagram to measure the count rate at different distances from a radioactive source.

The detector detected radiation. The number detected per minute is called the count rate.

Figure 1



Her results are shown in **Table 2**.

Table 2

Distance in metres	Count rate in counts per minute	Corrected count rate in counts per minute
0.4	143	125
0.6	74	56
0.8	49	31
1.0	38	20
1.2	32	14
1.4	28	10
1.6	18	0
1.8	18	0
2.0	18	0

0 1 . 4 Calculate, using data from **Table 2**, the value of the background count rate.

[1 mark]

Background count rate = _____counts per minute

0 1 . 5 Name the type of error caused by the background count in this experiment.

[1 mark]

_____

0 1 . 6 The radioactive source used in the demonstration emits only one type of radiation.

How can you tell from the data in the table that the radioactive source is **not** an alpha emitter?

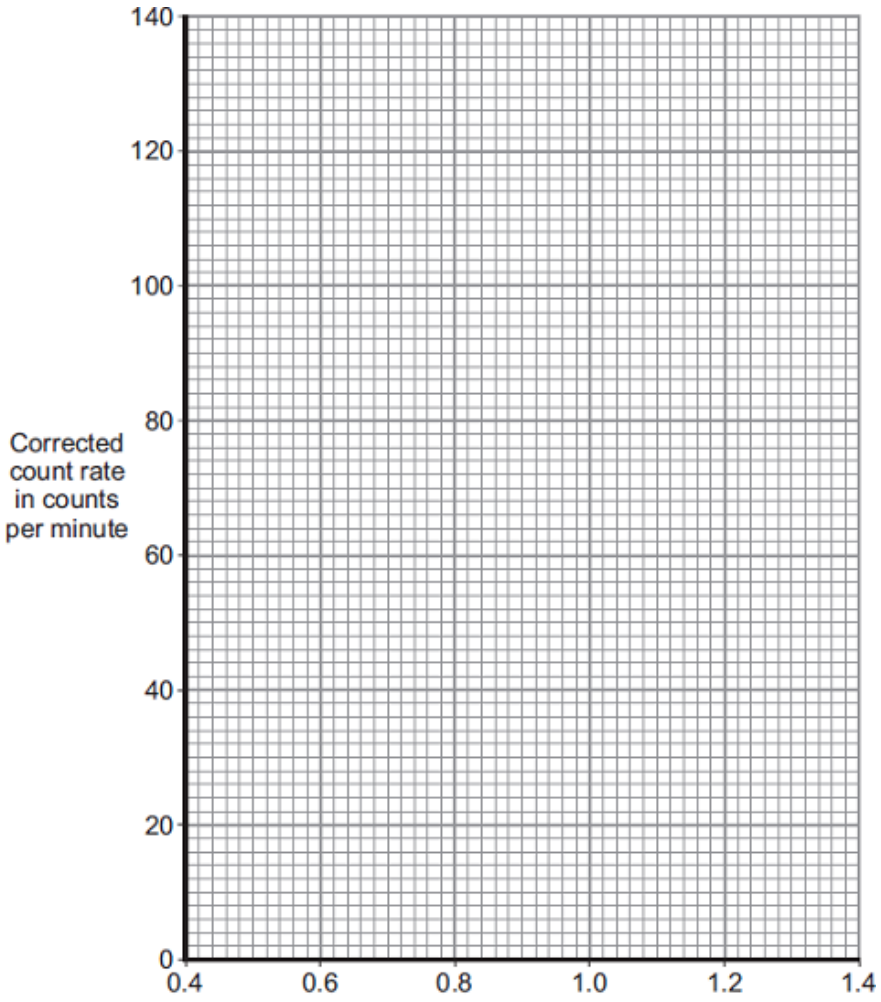
[1 mark]

0 1 . 7 Plot a graph of corrected count rate against distance for distances between 0.4 m and 1.4 m.

Draw a line of best fit to complete the graph in **Figure 2**.

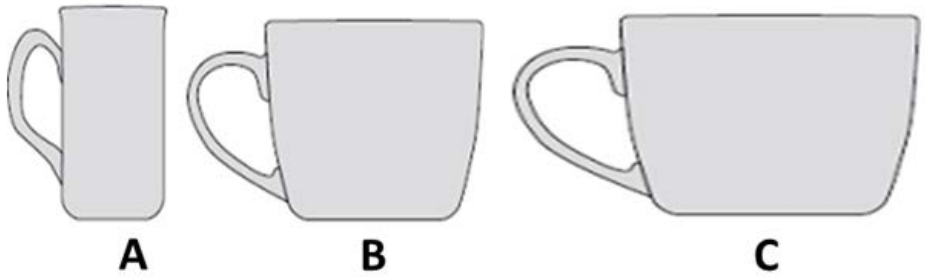
[3 marks]

Figure 2



2 The diagram shows three cups.

A student would like to investigate the rate of cooling when each cup is filled with hot water.



0 2 . 1 Write a method to perform this investigation.

Include:

- an equipment list
- the independent variable
- the dependent variable
- the variables you need to control
- what you will need to measure
- safety issues.

[6 marks]

0 2 . 2 Complete the **headings** in the table of results to collect this data.

[2 marks]

0 2 . 3 The table of results above does not allow any room to take repeat readings.

Suggest **two** reasons why it is always a good idea to repeat your experiment.

[2 marks]

_____

_____

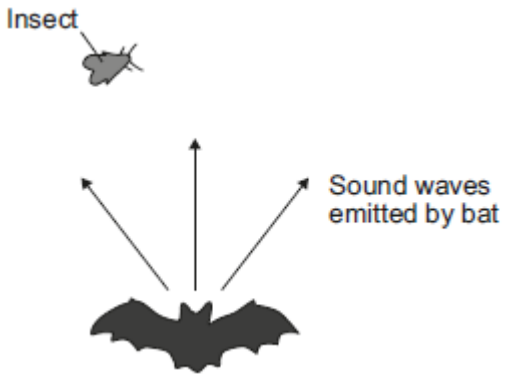
_____

_____

3 Bats use the reflection of high pitched sound waves to determine the position of objects.

Figure 3 shows a bat and an insect flying in front of the bat.

Figure 3



0 3 . 1 What determines the pitch of a sound wave?

Tick **one** box.

[1 mark]

- amplitude ☐
- frequency ☐
- velocity ☐

0 3 . 2 State the name given to reflected sound waves.

[1 mark]

_____

0 3 . 3 The bat emits a sound wave with a frequency of 25.0 kHz and a wavelength of 0.0136 metres.

Calculate the speed of this sound wave.

[2 marks]

_____

_____

Speed = _____ m/s

0 3 . 4 Sound waves are longitudinal.

Describe a longitudinal sound wave.

[2 marks]

Infrared and microwaves are two types of electromagnetic radiation.

0 3 . 5 State **one** example of the use of each type of radiation for communication.

[2 marks]

Infrared

Microwaves

0 3 . 6 Some of the properties of infrared and microwaves are the same.

State **two** of these properties.

[2 marks]

4 Sweating helps to prevent people from getting too hot.

0 4 . 1 When sweat evaporates, it cools the skin.

Explain why.

[4 marks]

0 4 . 2 Higher temperature increases the rate at which sweat will evaporate from a person's skin.

State **two** other factors that will increase the rate of evaporation.

[2 marks]

Air conditioning units are used to cool a room.

Warm air enters the air conditioning unit and the air is cooled.

0 4 . 3 Air conditioning units are usually positioned near the ceiling.

Explain why.

[2 marks]

0 4 . 4 The air in the room has a specific heat capacity of 1250 J/kg °C.

The air is cooled from 33 °C to 18 °C by an air conditioning unit.

The air conditioning unit removes 6000 J of energy per second.

Calculate the mass of air per second passing through the air conditioning unit.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

Turn over for the next question

0 5 . 1 Describe the difference between an alternating current (ac) and a direct current (dc).

[2 marks]

Figure 4 shows a hairdryer.

Figure 5 shows how the heaters and fan of the hairdryer are connected to a 3-pin plug.

The hairdryer does not have an earth wire.

Figure 4

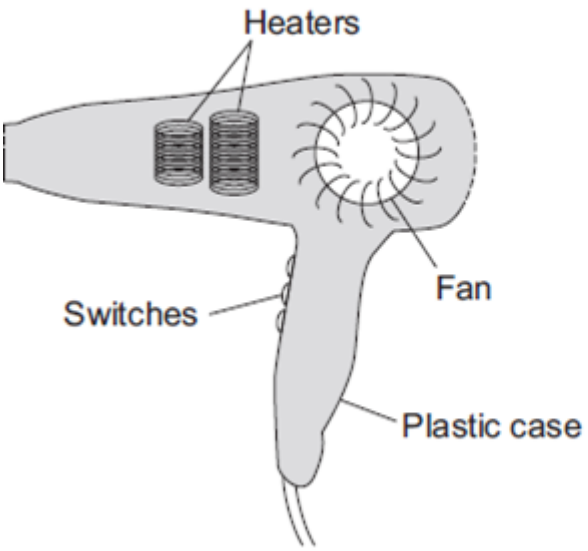
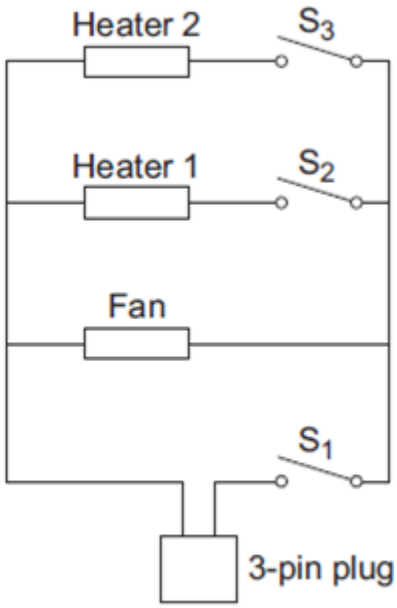


Figure 5



0 5 . 2 Why does the hairdryer **not** need an earth wire?

[2 marks]

0 5 . 3 All the switches are shown in the OFF position.

Which switch(es) should you close to allow:

[2 marks]

only the fan to work; _____

heater 2 to work?_____

0 5 . 4 Explain why the heaters can only be switched on when the fan is also switched on.

[2 marks]

_____

_____

_____

_____

_____

Question 5 continues on the next page

Table 3 shows the current drawn from the 230 volt mains electricity supply when different parts of the hairdryer are switched on.

Table 3

	Current in amps
Fan only	1.0
Fan and heater 1	4.4
Fan and both heaters	6.5

0 5 . 5 Calculate the maximum power of the hairdryer.

Use the correct equation from the Physics Equation Sheet.

[2 marks]

Maximum power = _____ W

6 In 2012 a skydiver set a world record for the highest free fall from an aircraft.

After falling from the aircraft, he reached a maximum velocity after 632 seconds.

0 6 . 1 Velocity is a vector, chose one other vector.

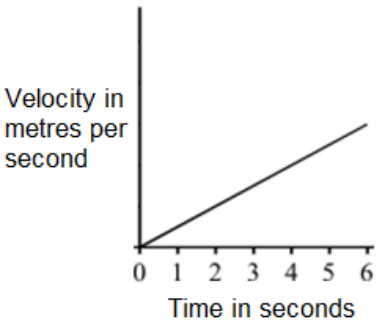
Tick **one** box.

[1 mark]

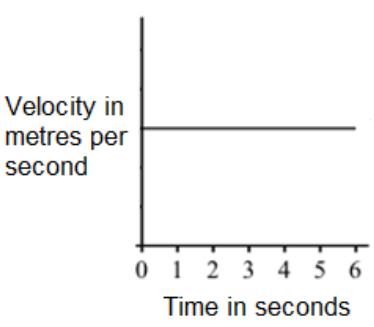
- acceleration ☐
- distance ☐
- speed ☐
- time ☐

0 6 . 2 Suggest which **one** of the velocity-time graphs, **K**, **L** or **M,** shows the motion of the skydiver during the 5 seconds after he reaches maximum velocity.

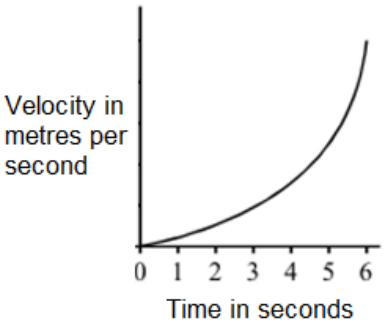
K



L



M



Tick **one** box.

[1 mark]

- K ☐
- L ☐
- M ☐

0 6 . 3 The skydiver wore a chest pack containing monitoring and tracking equipment.

The weight of the chest pack was 54 N.

The gravitational field strength is 9.8 N / kg.

Calculate the mass of the chest pack.

[2 marks]

_____

Mass of chest pack = _____ kg

During his fall, the skydiver's acceleration was not uniform.

Immediately after leaving the aircraft, the skydiver's acceleration was 10 m/s^2.

Estimate, without any calculation, his acceleration a few seconds after leaving the aircraft.

0 6 . 4 Explain your value of acceleration in terms of forces.

[3 marks]

Estimate_____

Explanation_____

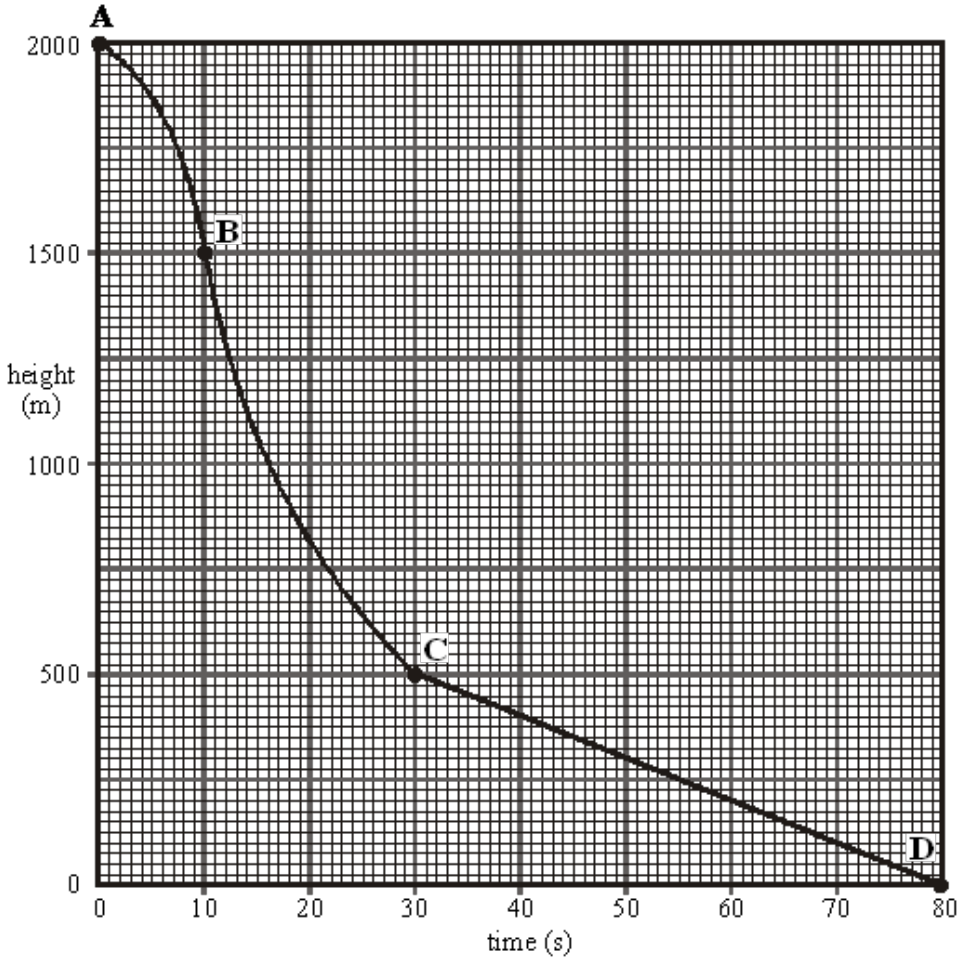
_____

_____

_____

The graph in **Figure 6** below shows how the height of a different sky-diver changes with time.

Figure 6



0 6 . 5 Describe the skydiver's motion during each of the following stages of the dive.

[2 marks]

A - B

C - D

0 6 . 6 Calculate the average speed during the descent.

[1 mark]

speed_____m/s

7 Nuclear fission and nuclear fusion are two processes that release energy.

0 7 . 1 Complete the sentences.

[2 marks]

Nuclear fisson takes place within a _____ .

Nuclear fusion naturally takes place within a _____ .

0 7 . 2 State **one** way in which the process of nuclear fusion differs from the process of nuclear fission.

[1 mark]

_____

_____

The following nuclear equation represents the fission of uranium-235 (U-235).

$$^{1}_{0}n + {}^{235}_{92}U \longrightarrow {}^{236}_{92}U \longrightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\,{}^{1}_{0}n + \text{energy}$$

Chemical symbols:

Ba - barium

Kr - krypton

0 7 . 3 Describe, using the information in the equation, the process of nuclear fission.

[4 marks]

0 7 . 4 An isotope of barium is Ba-139.

Ba-139 decays by beta decay to lanthanum-139 (La-139).

Complete the nuclear equation that represents the decay of Ba-139 to La-139.

[3 marks]

$$\_\_\_\_\_\ {}^{139}\mathbf{Ba} \longrightarrow \_\_\_\_\ {}^{139}\mathbf{La} + \_\_\_\_\_$$

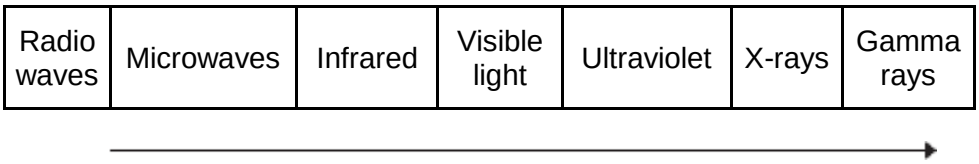
8 Waves may be longitudinal or transverse.

0 8 . 1 Describe the differences between longitudinal waves and transverse waves.

[3 marks]

Figure 7 shows the electromagnetic spectrum.

Figure 7



0 8 . 2 Use the correct answer from the box to complete the sentence.

[1 mark]

amplitude	**frequency**	**speed**	**wavelength**

The arrow in the diagram is in the direction of increasing _____

0 8 . 3 What is the range of wavelengths for waves in the electromagnetic spectrum?

Tick **one** box.

[1 mark]

10^{-15} to 10^{4} m ☐

10^{-4} to 10^{4} m ☐

10^{4} to 10^{15} m ☐

10^{-15} to 10^{15} m ☐

0 8 . 4 The wavelength of a radio wave is 1500 m.

The speed of radio waves is 3.0×10^{8} m/s.

Calculate the frequency of the radio wave.

[2 marks]

Frequency = _____ Hz

0 8 . 5 State **one** hazard of exposure to X-rays.

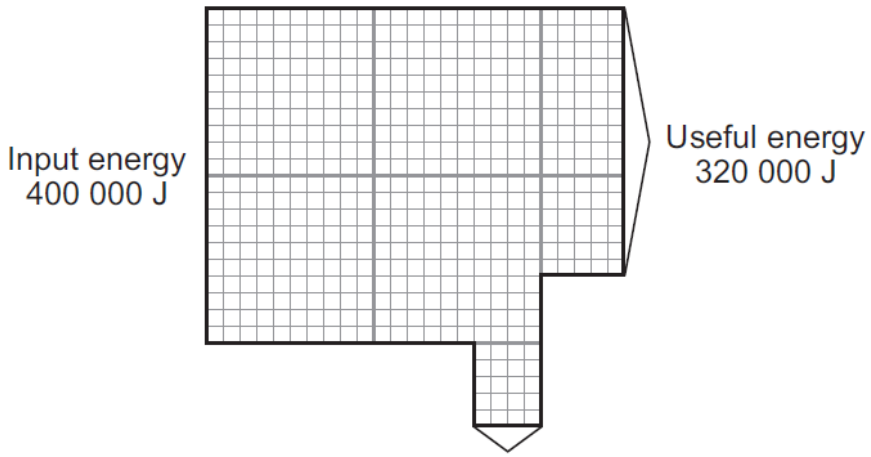
[1 mark]

0 8 . 6 Give **one** reason why X-rays are still used as part of medical treatments.

[1 mark]

9 **Figure 8** shows the Sankey diagram for a kettle.

Figure 8



0 9 . 1 Give **one** way the input energy would be wasted.

[1 mark]

_____

_____

0 9 . 2 Calculate the efficiency of the kettle.

Use the correct equation from the Physics Equation sheet.

[3 marks]

_____

_____

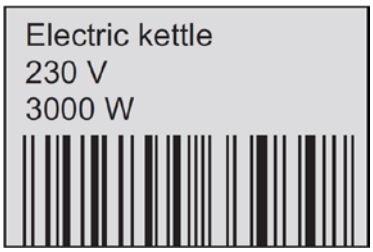
_____

_____

Efficency = _____

Figure 9 shows the label on a different electric kettle.

Figure 9



0 9 . 3 The kettle is filled with water. It takes 2000 C of charge to boil this volume of water.

Calculate the energy transferred by this kettle.

Use the correct equation from the Physics Equation sheet.

[2 marks]

Energy transferred = _____ J

0 9 . 4 Calculate how many minutes it takes the kettle to boil.

Use the correct equation from the Physics Equation sheet.

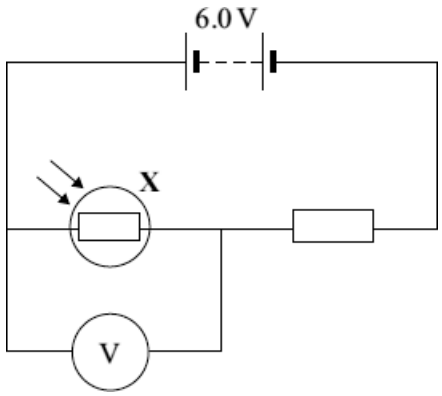
Give your answer to two significant figures.

[4 marks]

Time = _____ s

10 **Figure 10** shows a simple light-sensing circuit.

Figure 10



1 0 . 1 What is component **X**?

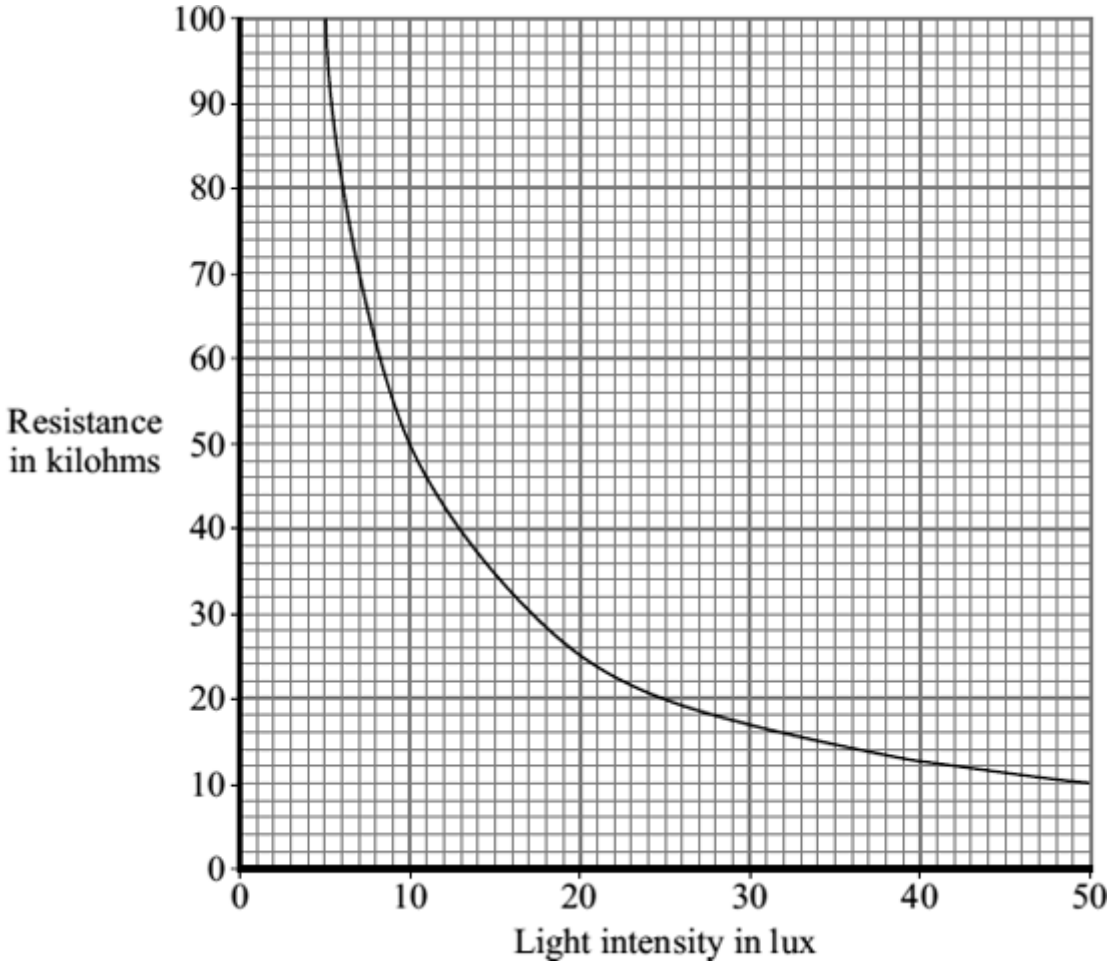
Tick **one** box.

[1 mark]

- Light dependent resistor ☐
- Light emitting diode ☐
- Thermistor ☐
- Variable resistor ☐

Figure 11 shows how the resistance of the component labelled **X** varies with light intensity.

Figure 11



1 0 . 2 Determine, using the graph in **Figure 11**, the resistance of component **X** when the light intensity is 20 lux.

[1 mark]

_____

1 0 . 3 When the light intensity is 20 lux, the current through the circuit is 0.0002 A.

Calculate the reading on the voltmeter when the light intensity is 20 lux.

[2 marks]

_____

_____

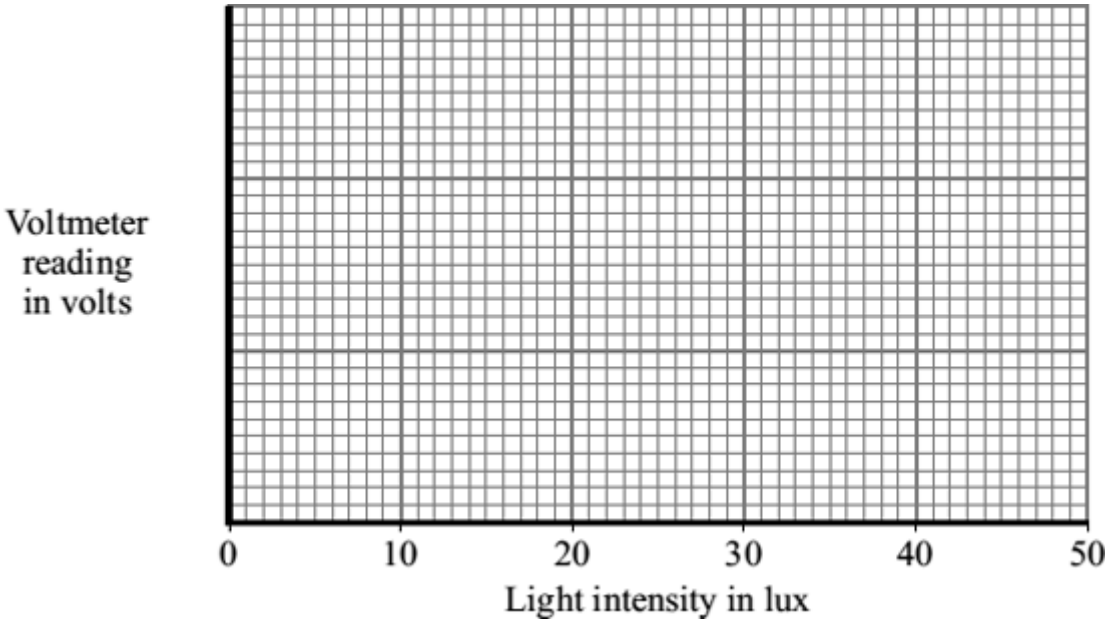
Voltmeter reading = _____ volts

Question 10 continues on the next page

1 0 . 4 Complete the sketch graph in **Figure 12**, including a suitable scale on the y-axis, to show how the voltmeter reading in the light-sensing circuit varies with light intensity.

[2 marks]

Figure 12



The following passage is taken from the technical data supplied for component **X** by the manufacturer.

> For any given light intensity, the resistance of this component can vary by plus or minus 50% of the value shown on the **graph of light intensity and resistance**.

1 0 . 5 Calculate the maximum resistance that component **X** could have at 20 lux light intensity.

[2 marks]

Maximum resistance = _____ kΩ

1 0 . 6 Explain why this light-sensing circuit would **not** be used to measure values of light intensity.

[2 marks]

END OF QUESTIONS

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