

Name:



SHREWSBURY SCHOOL

SIXTH FORM ENTRANCE EXAMINATION 2018

PHYSICS

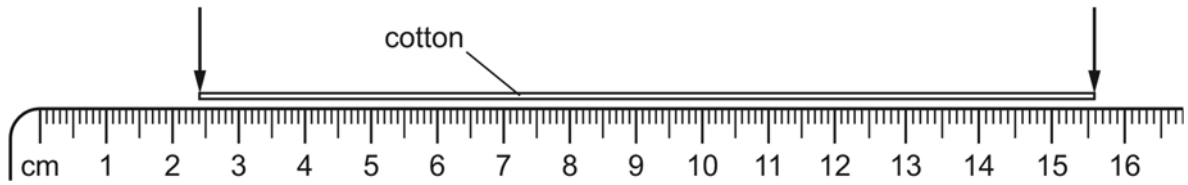
(50 marks)

(1 hour)

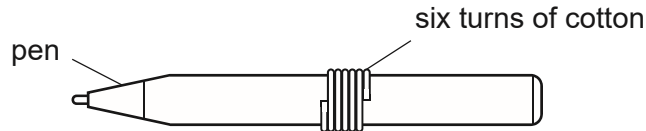
- Attempt all questions.
- Assume $g = 10 \text{ m/s}^2$

Section A: Multiple Choice (please show answers on previous sheet)

- 1 A length of cotton is measured between two points on a ruler.

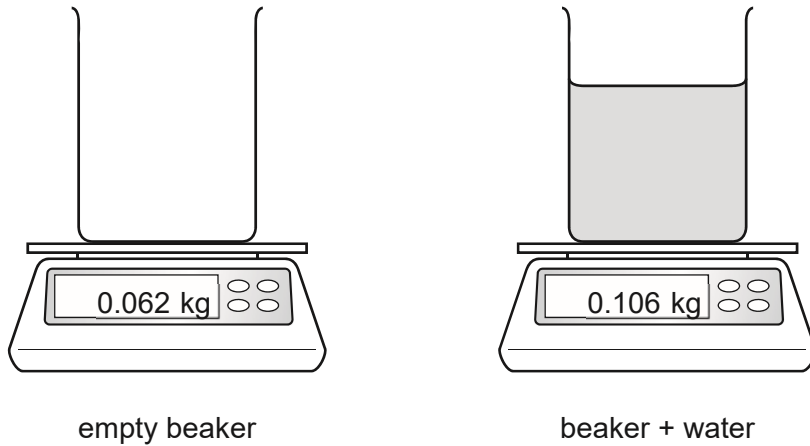


When the length of cotton is wound closely around a pen, it goes around six times.



What is the distance once round the pen?

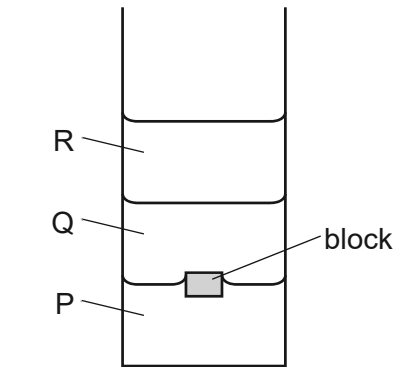
- A** 2.2 cm **B** 2.6 cm **C** 13.2 cm **D** 15.6 cm
- 2 An empty beaker is placed on a top-pan balance. Some water is now poured into the beaker.



What is the weight of the water?

- A** 0.044 kg **B** 0.168 kg **C** 0.0044 N **D** 0.44 N

- 3 Three liquids P, Q and R have different densities and do not mix. The liquids are placed in a measuring cylinder and allowed to settle. A small block is then dropped into the measuring cylinder and comes to rest, as shown.



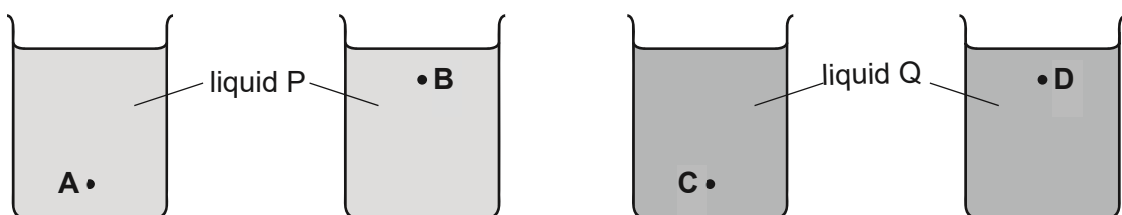
Which statement about the density of the block is correct?

- A It is equal to the density of Q.
 - B It is greater than the density of P.
 - C It is greater than the density of R.
 - D It is less than the density of Q.
- 4 Which energy resource is **not** renewable?

- A fossil fuel
- B sunlight
- C tides
- D wind

- 5 Four identical beakers are filled with equal volumes of liquids P or Q, as shown. Liquid P is more dense than liquid Q.

At which point is the pressure the least?



- 6 A woman has a weight of 600 N. She stands on a horizontal floor. The area of her feet in contact with the floor is 0.050 m².

What is the pressure she exerts on the floor?

- A $1.2 \times 10^3 \text{ N/m}^2$
- B $2.4 \times 10^3 \text{ N/m}^2$
- C $1.2 \times 10^4 \text{ N/m}^2$
- D $2.4 \times 10^4 \text{ N/m}^2$

- 7 Air is trapped in a cylinder by a piston.

The piston is pushed inwards and the volume of the air is reduced.

The temperature of the trapped air remains constant.

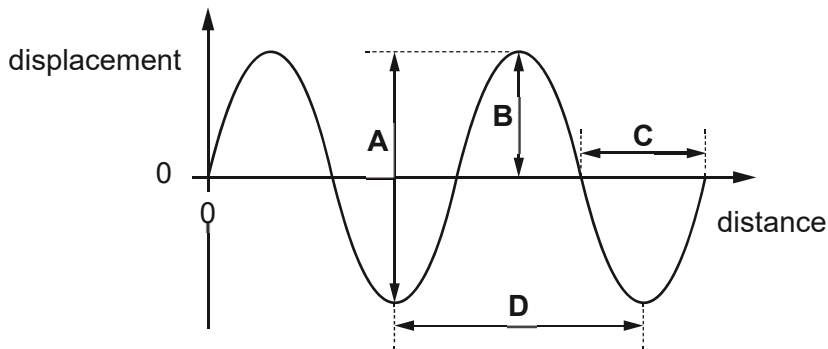
Which row describes how the average speed of the air molecules and the average distance between them changes?

	average speed of molecules	average distance between molecules
A	increases	decreases
B	increases	unchanged
C	unchanged	decreases
D	unchanged	increases

- 8 Which row gives the correct name for each change of state shown?

	change of state		
	gas to liquid	liquid to solid	solid to liquid
A	condensation	melting	solidification
B	condensation	solidification	melting
C	evaporation	melting	solidification
D	evaporation	solidification	melting

9 Which arrow on the graph shows the amplitude of the wave?



10 In which situation is the wavelength of the wave changed?

- A light from the Sun passing from air into water
- B radio waves travelling from an Earth satellite to the Moon
- C sound reflecting from a wall
- D water waves passing through a narrow gap

11 The diagram shows the electromagnetic spectrum. The numbers indicate the approximate wavelength at the boundaries between the various regions of the spectrum.

For a device to be able to make use of electromagnetic radiation, it needs an aerial of approximately the same size as the radiation it is designed to work with.

P	Q	R	S	T	U	V
	1 m	10^{-3} m	7×10^{-7} m	4×10^{-7} m	10^{-8} m	10^{-11} m

Which statement is correct?

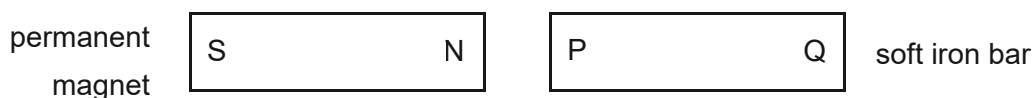
- A A mobile phone uses radiation from region P.
- B A television satellite dish uses radiation from region Q.
- C The receptor cells in an eye use radiation from region R.
- D The remote controller for a television uses radiation from region U.

12 A dolphin has a range of audible frequencies of 150 Hz–150 kHz.

Which range of frequencies can be heard both by humans with good hearing and by dolphins?

- A 20 Hz–150 Hz
- B 20 Hz–150 kHz
- C 20 kHz–150 kHz
- D 150 Hz–20 kHz

13 A permanent magnet is placed close to a bar of soft iron.



What are the polarities of end P and of end Q?

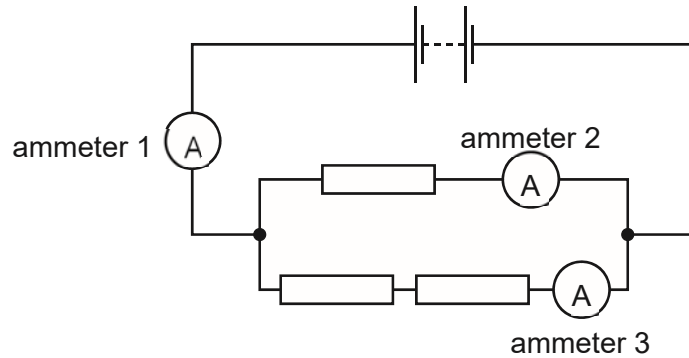
	end P	end Q
A	N	N
B	N	S
C	S	N
D	S	S

14 A plastic rod is rubbed with a cloth. The rod becomes positively charged.

What happens to the plastic rod and what is the charge on the cloth?

	plastic rod	charge on cloth
A	gains electrons	negative
B	gains electrons	positive
C	loses electrons	negative
D	loses electrons	positive

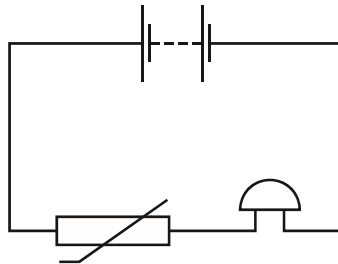
15 The diagram shows three identical resistors, three ammeters and a battery, connected in a circuit.



What is the order of the magnitudes of the readings on the ammeters from smallest to largest?

	smallest	intermediate	largest
A	ammeter 1	ammeter 2	ammeter 3
B	ammeter 1	ammeter 3	ammeter 2
C	ammeter 2	ammeter 3	ammeter 1
D	ammeter 3	ammeter 2	ammeter 1

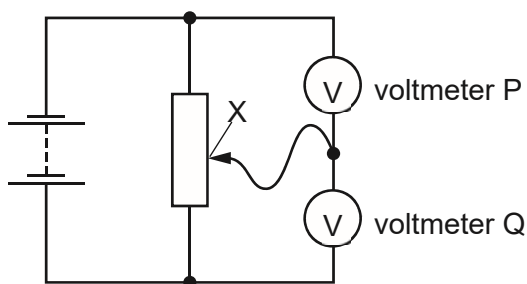
16 A student sets up this circuit.



What is the purpose of the circuit?

- A** to allow a lamp to be made dimmer or brighter as required
- B** to amplify the sound of a voice
- C** to light a lamp in the dark
- D** to sound a bell when the temperature rises

17 The diagram shows two voltmeters P and Q connected to a potential divider.



The sliding connection at point X is moved towards the top of the diagram.

What happens to the reading on P and to the reading on Q?

	reading on P	reading on Q
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

18 A neutral atom of argon-40 ($^{40}_{18}\text{A}$) and a neutral atom of potassium-39 ($^{39}_{19}\text{K}$) are compared.

Which atom has more electrons, and which atom has more protons?

	more electrons	more protons
A	argon	argon
B	argon	potassium
C	potassium	argon
D	potassium	potassium

19 Which statement about α -particles and β -particles is correct?

- A** α -particles are less ionising than β -particles.
- B** α -particles are more penetrating than β -particles.
- C** α -particles have greater mass than β -particles.
- D** α -particles have the same charge as β -particles.

20 An explosion in a nuclear reactor spread the isotope caesium-137 across a large area.

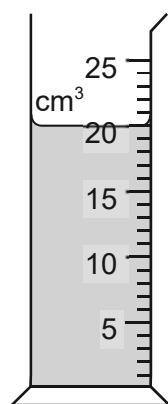
Ninety years after the explosion, the quantity of caesium-137 present will be 12.5% of its original level.

What is the half-life of caesium-137?

- A 11.25 years B 22.5 years C 30.0 years D 45.0 years

21 The diagram shows some liquid in a measuring cylinder.

The mass of the liquid is 16 g.



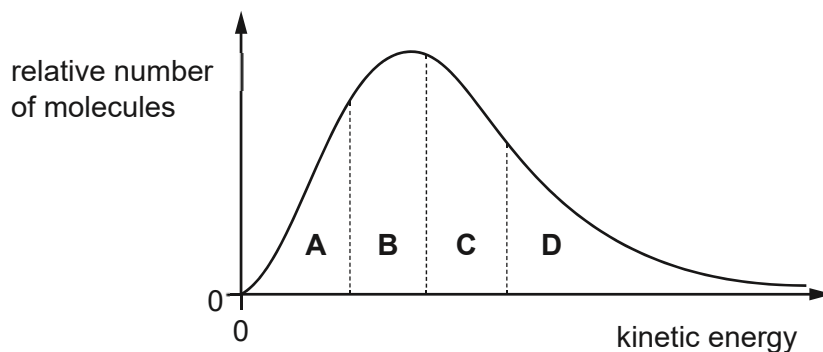
What is the density of the liquid?

- A 0.80 g/cm^3 B 1.25 g/cm^3 C 36 g/cm^3 D 320 g/cm^3

22 The diagram shows the relative number of molecules in a liquid that have a given kinetic energy.

The graph is divided into sections so that each section contains the same number of molecules.

From which section does the greatest number of molecules escape from the liquid per unit time?



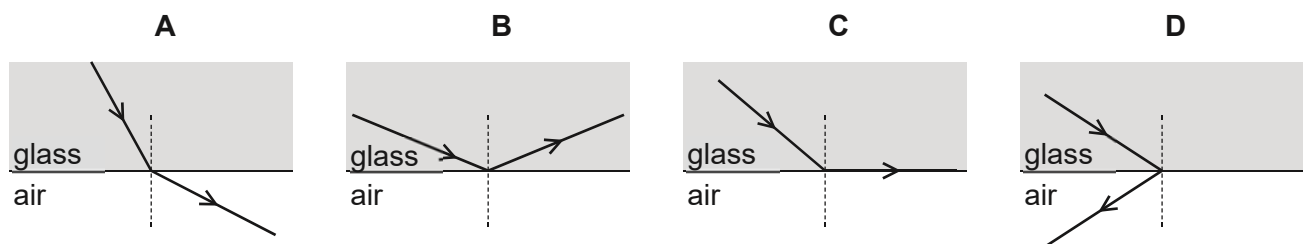
23 Four thermometers, with their bulbs painted different colours, are placed at equal distances from a radiant heater.

Which thermometer shows the slowest temperature rise when the heater is first switched on?

- A** matt black
- B** matt white
- C** shiny black
- D** shiny white

24 Light passes from glass into air.

Which diagram shows a ray of light incident at the critical angle on the air-glass boundary?



25 The table describes white light that passes through a prism and forms a spectrum.

Which row is correct?

	colour refracted the most	colour next to the red
A	red	orange
B	red	yellow
C	violet	orange
D	violet	yellow

26 A lamp is connected across one cell, then across two cells. The potential difference (p.d.) across the lamp and the current in it are measured in each case.

The results are shown.

number of cells	p.d./V	current/A
1	2.8	0.25
2	5.4	0.40

What is the change in the resistance of the lamp when the number of cells is increased from one to two?

- A** It decreases by $0.015\ \Omega$.
- B** It increases by $1.5\ \Omega$.
- C** It increases by $2.3\ \Omega$.
- D** It increases by $17\ \Omega$.

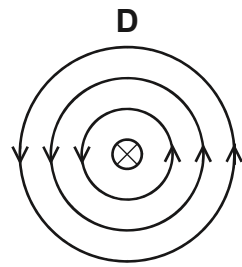
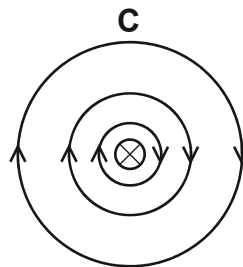
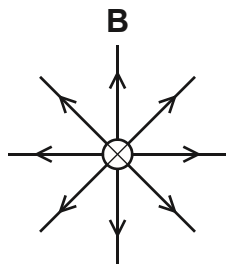
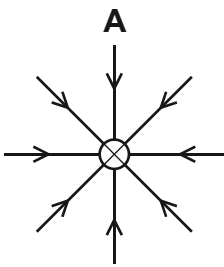
27 A transformer has N_p turns in the primary coil and N_s turns in the secondary coil.

Which row gives the values of N_p and N_s for a transformer that steps up a voltage of 1200 V to 36000 V?

	N_p	N_s
A	2000	60 000
B	2000	600 000
C	60 000	2000
D	600 000	2000

28 A straight wire is perpendicular to the paper. It carries a current into the paper.

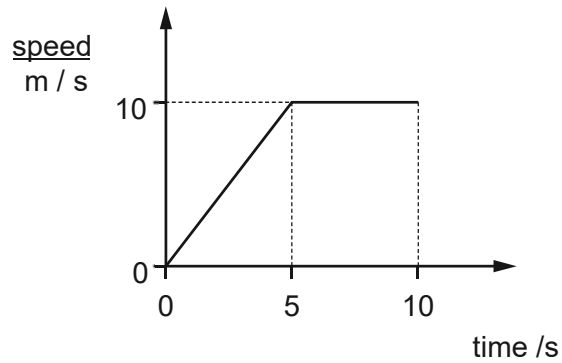
What is the magnetic field pattern and its direction near the wire?



key

⊗ wire with current into the page

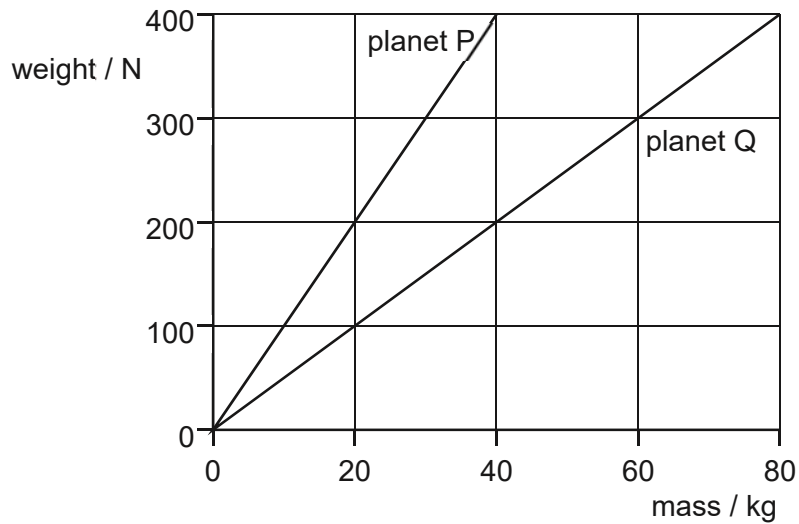
29 The graph shows how the speed of a car varies over a period of 10 s.



How far does the car travel during the 10 s?

- A 10 m B 50 m C 75 m D 100 m

30 The graph shows how weight varies with mass on planet P and on planet Q.



An object weighs 400 N on planet P. The object is taken to planet Q.

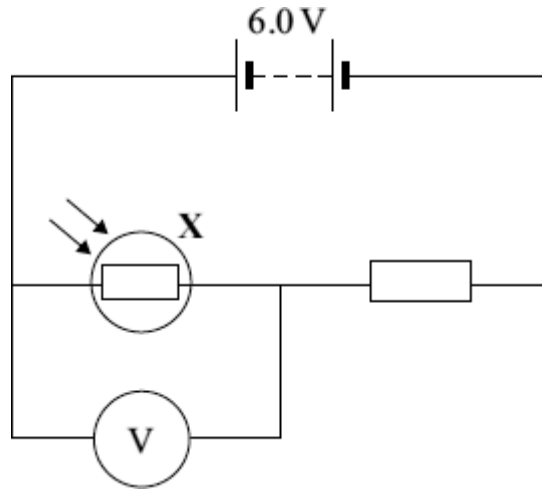
Which row is correct?

	mass of object on planet Q/kg	weight of object on planet Q/N
A	40	200
B	40	400
C	80	200
D	80	400

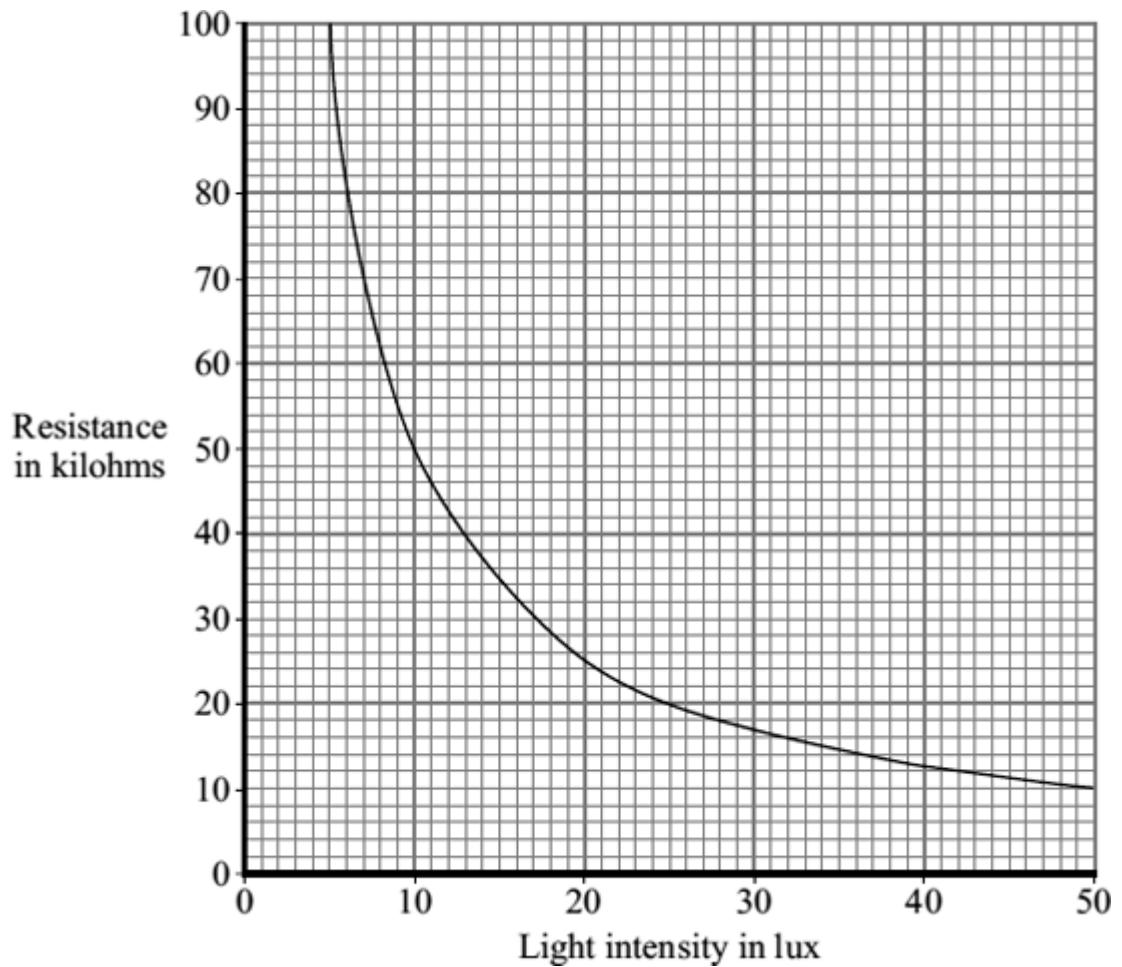
Section B

Q. 31

The diagram shows a simple light-sensing circuit.



- (a) The graph, supplied by the manufacturer, shows how the resistance of the component labelled **X** varies with light intensity.



(i) What is component **X**?

(1)

(ii) Use the graph to find the resistance of component **X** when the light intensity is 20 lux.

(1)

(iii) 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.

Show clearly how you work out your answer.

Voltmeter reading = _____ volts

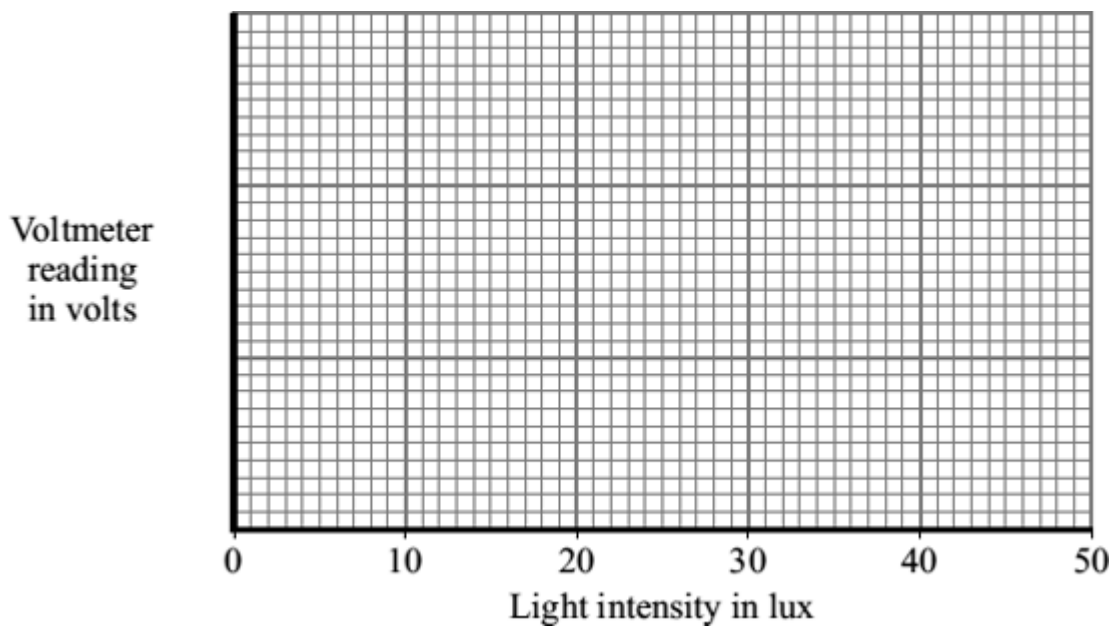
(2)

(b) Use the grid below to show how the voltmeter reading in the light-sensing circuit varies with light intensity.

(i) Add a suitable scale to the *y*-axis (vertical axis).

(1)

(ii) Complete the sketch graph by drawing a line on the grid to show how the voltmeter reading will vary with light intensity.



(3)

- (c) 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**.

- (i) Calculate the maximum resistance that component **X** could have at 20 lux light intensity.

Maximum resistance = _____ kilohms

(1)

- (ii) Explain why this light-sensing circuit would **not** be used to measure values of light intensity.

(1)

(Total 10 marks)

Q. 32

In 2011, some of the scientists working at the CERN particle laboratory published the results of experiments they had conducted over the previous three years.

The scientists said that the results had shown that a particle, called a neutrino, was able to travel faster than the speed of light.

These unexpected results challenged the physics theory that nothing can travel faster than the speed of light.

- (a) Suggest why most other scientists thought that the experimental results were unbelievable.

(1)

- (b) The scientists at CERN believed their results were correct but could not explain them.

Suggest a reason why the scientists decided to publish their results.

(1)

- (c) The experiments conducted by the scientists involved measuring the time it took neutrinos to travel from CERN to another laboratory 730 000 m away.

Using the data, the speed of the neutrinos was calculated to be 300 007 400 m/s.

Calculate the time it would take the neutrinos to travel 730 000 m at a speed of 300 007 400 m/s.

Give your answer in standard form.

Time = _____ s

(3)

(Total 5 marks)

Q. 33

- (a) A car being driven at 9.0 m/s collides with the back of a stationary lorry. The car slows down and stops in 0.20 seconds. The total mass of the car and driver is 1200 kg.

Calculate the average force exerted by the lorry on the car during the collision.

Show clearly how you work out your answer.

Force = _____ N

(2)

- (b) Within 0.04 s of the car hitting the back of the lorry, the car driver's airbag inflates. The airbag deflates when it is hit by the driver's head.



Use the idea of momentum to explain why the airbag reduces the risk of the driver sustaining a serious head injury.

(3)

(Total 5 marks)

END OF TEST