

--

--	--	--	--	--

--	--	--	--

9702/21

May/June 2012

1 hour

No Additional Materials are required.

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **14** printed pages and **2** blank pages.

Data

speed of light in free space,	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7} \text{ H m}^{-1}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$
	$(\frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \text{ m F}^{-1})$
elementary charge,	$e = 1.60 \times 10^{-19} \text{ C}$
the Planck constant,	$h = 6.63 \times 10^{-34} \text{ J s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27} \text{ kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31} \text{ kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27} \text{ kg}$
molar gas constant,	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$
gravitational constant,	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
acceleration of free fall,	$g = 9.81 \text{ m s}^{-2}$

Formulae

uniformly accelerated motion,

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

work done on/by a gas,

$$W = p\Delta V$$

gravitational potential,

$$\phi = -\frac{Gm}{r}$$

hydrostatic pressure,

$$p = \rho gh$$

pressure of an ideal gas,

$$p = \frac{1}{3} \frac{Nm}{V} \langle c^2 \rangle$$

simple harmonic motion,

$$a = -\omega^2 x$$

velocity of particle in s.h.m.,

$$v = v_0 \cos \omega t$$

$$v = \pm \omega \sqrt{(x_0^2 - x^2)}$$

electric potential,

$$V = \frac{Q}{4\pi\epsilon_0 r}$$

capacitors in series,

$$1/C = 1/C_1 + 1/C_2 + \dots$$

capacitors in parallel,

$$C = C_1 + C_2 + \dots$$

energy of charged capacitor,

$$W = \frac{1}{2} QV$$

resistors in series,

$$R = R_1 + R_2 + \dots$$

resistors in parallel,

$$1/R = 1/R_1 + 1/R_2 + \dots$$

alternating current/voltage,

$$x = x_0 \sin \omega t$$

radioactive decay,

$$x = x_0 \exp(-\lambda t)$$

decay constant,

$$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$$

BLANK PAGE

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

For
Examiner's
Use

- 1 (a) (i) State the SI base units of volume.

base units of volume [1]

- (ii) Show that the SI base units of pressure are $\text{kg m}^{-1} \text{s}^{-2}$.

[1]

- (b) The volume V of liquid that flows through a pipe in time t is given by the equation

$$\frac{V}{t} = \frac{\pi P r^4}{8 C l}$$

where P is the pressure difference between the ends of the pipe of radius r and length l .
The constant C depends on the frictional effects of the liquid.

Determine the base units of C .

base units of C [3]

- 2 A ball is thrown vertically down towards the ground with an initial velocity of 4.23 m s^{-1} . The ball falls for a time of 1.51 s before hitting the ground. Air resistance is negligible.

(a) (i) Show that the downwards velocity of the ball when it hits the ground is 19.0 m s^{-1} .

[2]

(ii) Calculate, to three significant figures, the distance the ball falls to the ground.

distance = ... m [2]

- (b) The ball makes contact with the ground for 12.5 ms and rebounds with an upwards velocity of 18.6 m s^{-1} . The mass of the ball is 46.5 g .

(i) Calculate the average force acting on the ball on impact with the ground.

magnitude of force = ... N

direction of force

[4]

(ii) Use conservation of energy to determine the maximum height the ball reaches after it hits the ground.

height = ... m [2]

- (c) State and explain whether the collision the ball makes with the ground is elastic or inelastic.

.....

.....

.....[1]

- 3 One end of a spring is fixed to a support. A mass is attached to the other end of the spring. The arrangement is shown in Fig. 3.1.

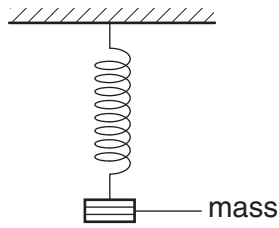


Fig. 3.1

- (a) The mass is in equilibrium. Explain, by reference to the forces acting on the mass, what is meant by equilibrium.

.....

 [2]

- (b) The mass is pulled down and then released at time $t = 0$. The mass oscillates up and down. The variation with t of the displacement of the mass d is shown in Fig. 3.2.

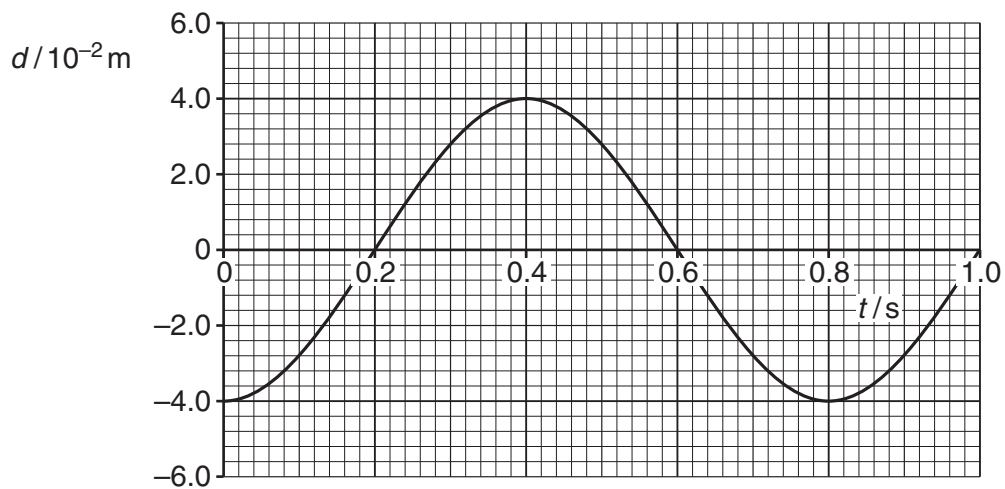


Fig. 3.2

Use Fig. 3.2 to state a time, one in each case, when

- (i) the mass is at maximum speed,

time = ... s [1]

- (ii) the elastic potential energy stored in the spring is a maximum,

time = ... s [1]

- (iii) the mass is in equilibrium.

time = ... s [1]

- (c) The arrangement shown in Fig. 3.3 is used to determine the length l of a spring when different masses M are attached to the spring.

For
Examiner's
Use

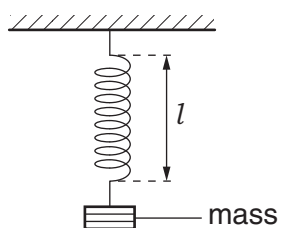


Fig. 3.3

The variation with mass M of l is shown in Fig. 3.4.

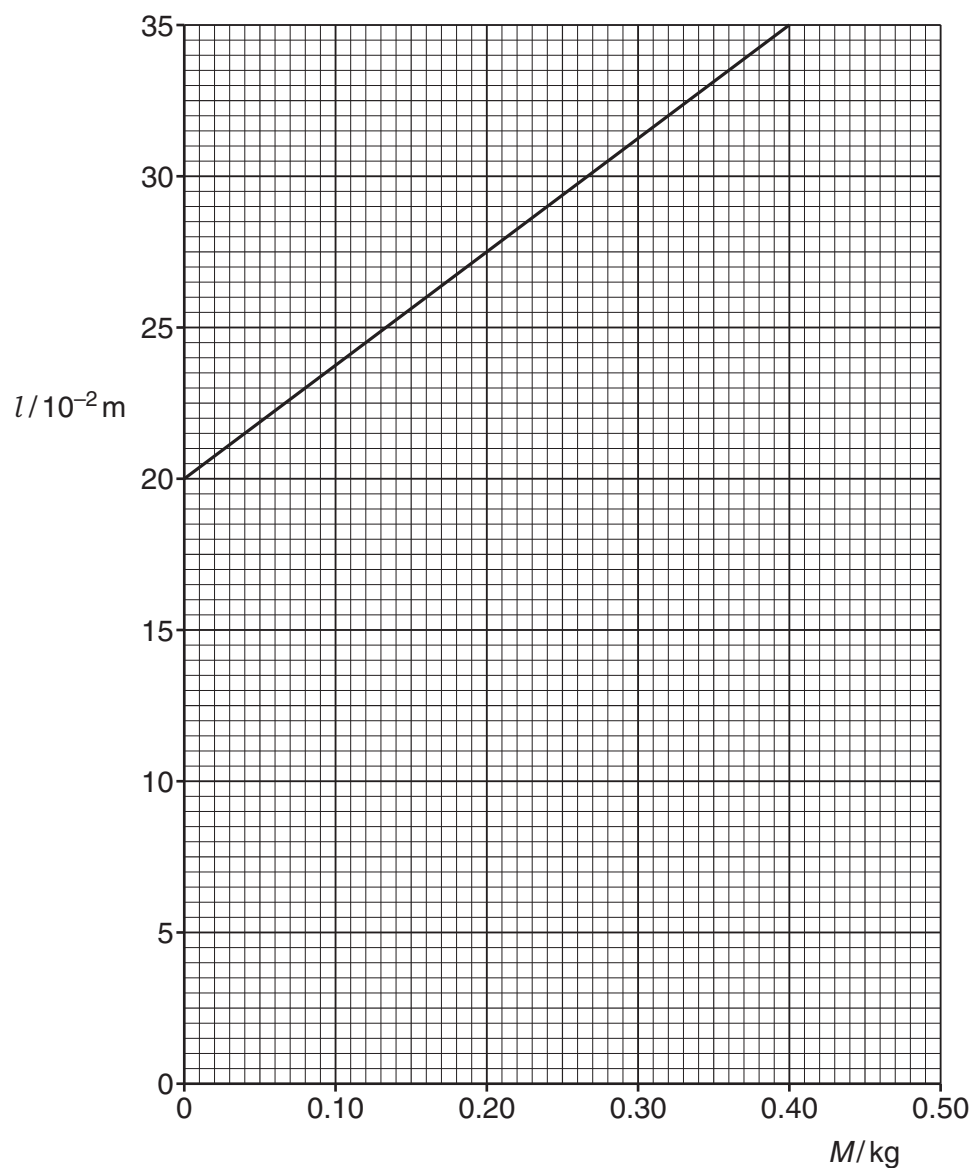


Fig. 3.4

- (i) State and explain whether the spring obeys Hooke's law.

For
Examiner's
Use

.....

 [2]

- (ii) Show that the force constant of the spring is 26 N m^{-1} .

[2]

- (iii) A mass of 0.40 kg is attached to the spring. Calculate the energy stored in the spring.

energy = ... J [3]

- 4 (a) The output of a heater is 2.5 kW when connected to a 220 V supply.

- (i) Calculate the resistance of the heater.

resistance = ... Ω [2]

- (ii) The heater is made from a wire of cross-sectional area $2.0 \times 10^{-7} \text{ m}^2$ and resistivity $1.1 \times 10^{-6} \Omega \text{ m}$.

Use your answer in (i) to calculate the length of the wire.

length = ... m [3]

- (b) The supply voltage is changed to 110 V.

- (i) Calculate the power output of the heater at this voltage, assuming there is no change in the resistance of the wire.

power = ... W [1]

- (ii) State and explain quantitatively **one** way that the wire of the heater could be changed to give the same power as in (a).

.....

 [2]

- 5 (a) (i) State Kirchhoff's second law.

For
Examiner's
Use

.....
..... [1]

- (ii) Kirchhoff's second law is linked to the conservation of a certain quantity. State this quantity.

..... [1]

- (b) The circuit shown in Fig. 5.1 is used to compare potential differences.

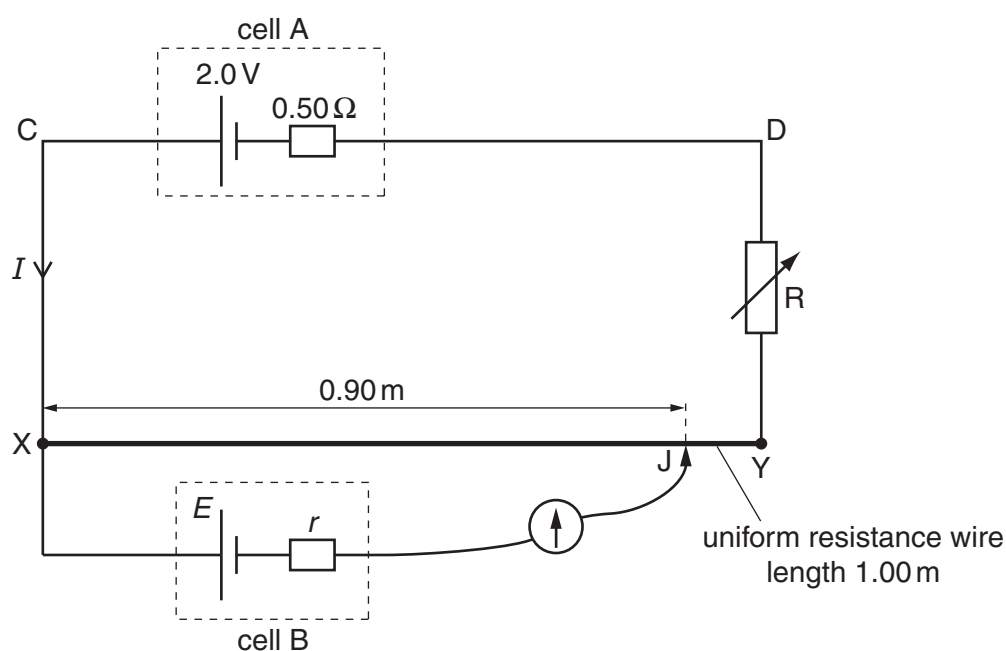


Fig. 5.1

The uniform resistance wire XY has length 1.00 m and resistance $4.0\ \Omega$. Cell A has e.m.f. 2.0 V and internal resistance $0.50\ \Omega$. The current through cell A is I . Cell B has e.m.f. E and internal resistance r .

The current through cell B is made zero when the movable connection J is adjusted so that the length of XJ is 0.90 m. The variable resistor R has resistance $2.5\ \Omega$.

- (i) Apply Kirchhoff's second law to the circuit CXYDC to determine the current I .

$I = \dots\dots\dots$ A [2]

- (ii) Calculate the potential difference across the length of wire XJ.

For
Examiner's
Use

potential difference = ... V [2]

- (iii) Use your answer in (ii) to state the value of E .

$E =$ V [1]

- (iv) State why the value of the internal resistance of cell B is not required for the determination of E .

.....
.....[1]

- 6 (a) A laser is used to produce an interference pattern on a screen, as shown in Fig. 6.1.

For
Examiner's
Use

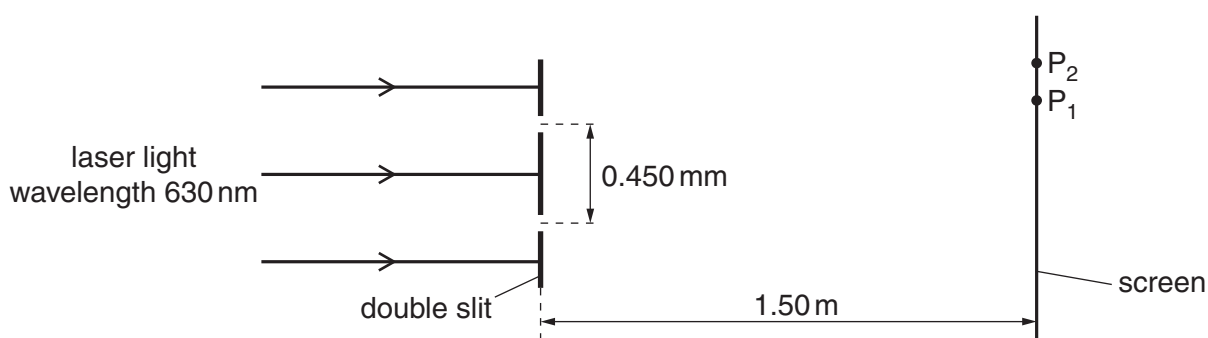


Fig. 6.1 (not to scale)

The laser emits light of wavelength 630 nm. The slit separation is 0.450 mm. The distance between the slits and the screen is 1.50 m. A maximum is formed at P₁ and a minimum is formed at P₂.

Interference fringes are observed only when the light from the slits is coherent.

- (i) Explain what is meant by *coherence*.

.....

 [2]

- (ii) Explain how an interference maximum is formed at P₁.

.....
 [1]

- (iii) Explain how an interference minimum is formed at P₂.

.....
 [1]

- (iv) Calculate the fringe separation.

fringe separation = ... m [3]

- (b) State the effects, if any, on the fringes when the amplitude of the waves incident on the double slits is increased.

For
Examiner's
Use

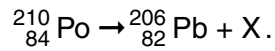
.....

.....

.....

.....[3]

- 7 (a) The spontaneous decay of polonium is shown by the nuclear equation



For
Examiner's
Use

- (i) State the composition of the nucleus of X.

.....
..... [1]

- (ii) The nuclei X are emitted as radiation. State two properties of this radiation.

1.
.....
2.
..... [2]

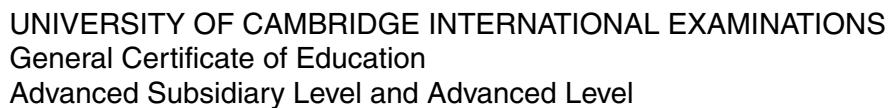
- (b) The mass of the polonium (Po) nucleus is greater than the combined mass of the nuclei of lead (Pb) and X. Use a conservation law to explain qualitatively how this decay is possible.

.....
.....
..... [3]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.



--

--	--	--	--	--

--	--	--	--

9702/22

May/June 2012

1 hour

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **15** printed pages and **1** blank page.

Data

speed of light in free space,	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7} \text{ H m}^{-1}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$
	$(\frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \text{ m F}^{-1})$
elementary charge,	$e = 1.60 \times 10^{-19} \text{ C}$
the Planck constant,	$h = 6.63 \times 10^{-34} \text{ J s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27} \text{ kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31} \text{ kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27} \text{ kg}$
molar gas constant,	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$
gravitational constant,	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
acceleration of free fall,	$g = 9.81 \text{ m s}^{-2}$

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
gravitational potential,	$\phi = -\frac{Gm}{r}$
hydrostatic pressure,	$p = \rho gh$
pressure of an ideal gas,	$p = \frac{1}{3} \frac{Nm}{V} \langle c^2 \rangle$
simple harmonic motion,	$a = -\omega^2 x$
velocity of particle in s.h.m.,	$v = v_0 \cos \omega t$ $v = \pm \omega \sqrt{(x_0^2 - x^2)}$
electric potential,	$V = \frac{Q}{4\pi\epsilon_0 r}$
capacitors in series,	$1/C = 1/C_1 + 1/C_2 + \dots$
capacitors in parallel,	$C = C_1 + C_2 + \dots$
energy of charged capacitor,	$W = \frac{1}{2} QV$
resistors in series,	$R = R_1 + R_2 + \dots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \dots$
alternating current/voltage,	$x = x_0 \sin \omega t$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant,	$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

BLANK PAGE

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

For
Examiner's
Use

- 1 The volume V of liquid flowing in time t through a pipe of radius r is given by the equation

$$\frac{V}{t} = \frac{\pi P r^4}{8 C l}$$

where P is the pressure difference between the ends of the pipe of length l , and C depends on the frictional effects of the liquid.

An experiment is performed to determine C . The measurements made are shown in Fig. 1.1.

$\frac{V}{t} / 10^{-6} \text{ m}^3 \text{ s}^{-1}$	$P / 10^3 \text{ N m}^{-2}$	r / mm	l / m
1.20 ± 0.01	2.50 ± 0.05	0.75 ± 0.01	0.250 ± 0.001

Fig. 1.1

- (a) Calculate the value of C .

$$C = \dots\dots\dots \text{ N s m}^{-2} \text{ [2]}$$

- (b) Calculate the uncertainty in C .

$$\text{uncertainty} = \dots\dots\dots \text{ N s m}^{-2} \text{ [3]}$$

- (c) State the value of C and its uncertainty to the appropriate number of significant figures.

$$C = \dots\dots\dots \pm \dots\dots\dots \text{ N s m}^{-2} \text{ [1]}$$

- 2 (a) A ball is thrown vertically down towards the ground and rebounds as illustrated in Fig. 2.1.

For
Examiner's
Use

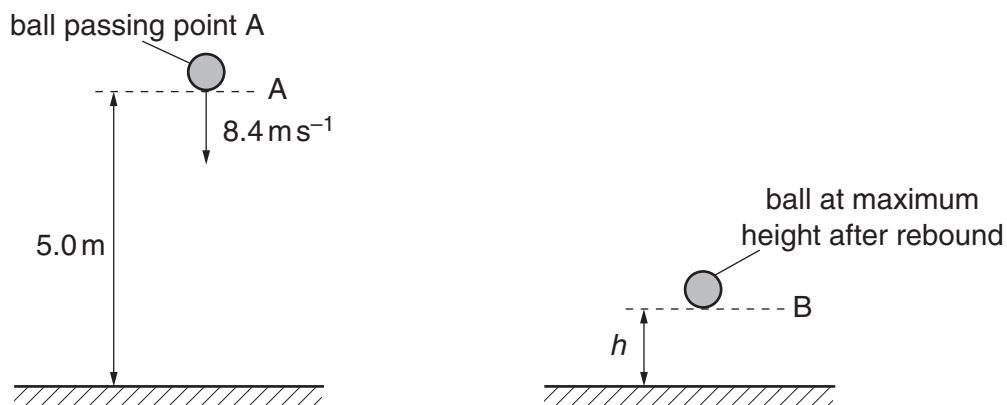


Fig. 2.1

As the ball passes A, it has a speed of 8.4 m s^{-1} . The height of A is 5.0 m above the ground. The ball hits the ground and rebounds to B. Assume that air resistance is negligible.

- (i) Calculate the speed of the ball as it hits the ground.

speed = ... m s^{-1} [2]

- (ii) Show that the time taken for the ball to reach the ground is 0.47 s.

[1]

- (b) The ball rebounds vertically with a speed of 4.2 m s^{-1} as it leaves the ground. The time the ball is in contact with the ground is 20 ms . The ball rebounds to a maximum height h .

For
Examiner's
Use

The ball passes A at time $t = 0$. On Fig. 2.2, plot a graph to show the variation with time t of the velocity v of the ball. Continue the graph until the ball has rebounded from the ground and reaches B.

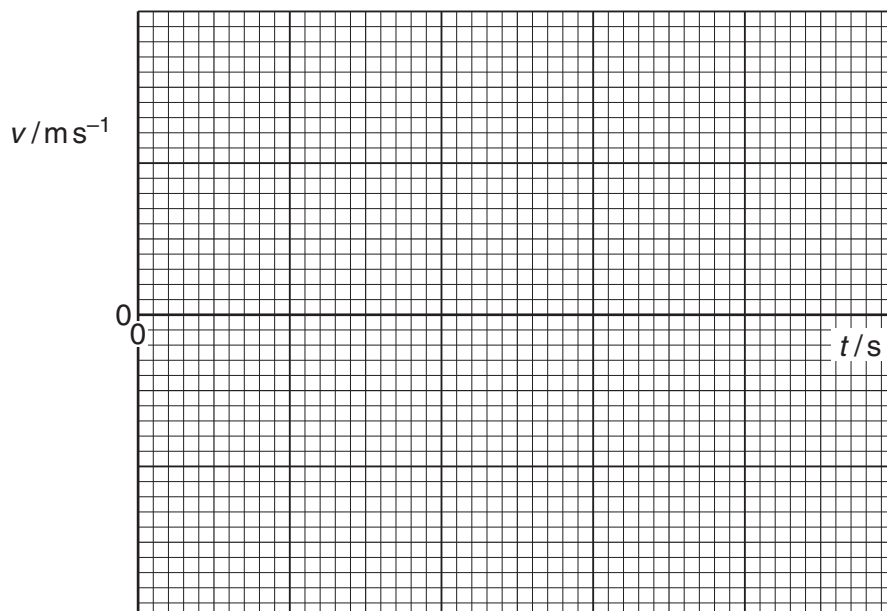


Fig. 2.2

[3]

- (c) The ball has a mass of 0.050 kg . It moves from A and reaches B after rebounding.

- (i) For this motion, calculate the change in

1. kinetic energy,

change in kinetic energy = ... J [2]

2. gravitational potential energy.

change in potential energy = ... J [3]

- (ii) State and explain the total change in energy of the ball for this motion.

*For
Examiner's
Use*

.....

.....

.....

.....[2]

- 3 (a) State Newton's first law.

.....
 [1]

- (b) A log of mass 450 kg is pulled up a slope by a wire attached to a motor, as shown in Fig. 3.1.

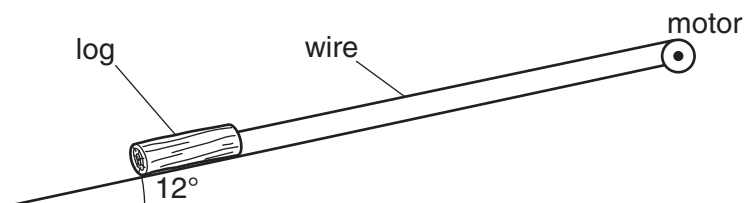


Fig. 3.1

The angle that the slope makes with the horizontal is 12° . The frictional force acting on the log is 650 N. The log travels with constant velocity.

- (i) With reference to the motion of the log, discuss whether the log is in equilibrium.

.....

 [2]

- (ii) Calculate the tension in the wire.

tension = ... N [3]

- (iii) State and explain whether the gain in the potential energy per unit time of the log is equal to the output power of the motor.

.....

 [2]

For
Examiner's
Use

- 4 A battery of electromotive force 12V and negligible internal resistance is connected to two resistors and a light-dependent resistor (LDR), as shown in Fig. 4.1.

For
Examiner's
Use

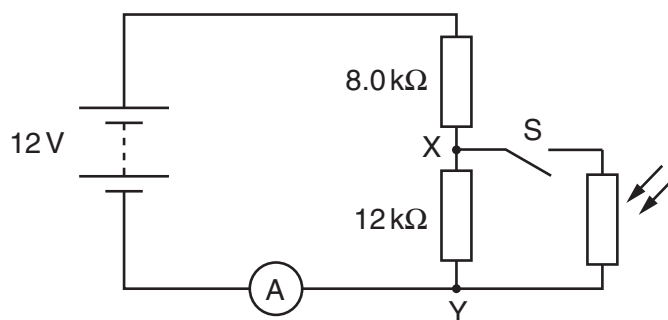


Fig. 4.1

An ammeter is connected in series with the battery. The LDR and switch S are connected across the points XY.

- (a) The switch S is open. Calculate the potential difference (p.d.) across XY.

p. d. = ... V [3]

- (b) The switch S is closed. The resistance of the LDR is $4.0\text{ k}\Omega$. Calculate the current in the ammeter.

current = ... A [3]

- (c) The switch S remains closed. The intensity of the light on the LDR is increased. State and explain the change to

For
Examiner's
Use

- (i) the ammeter reading,

.....
.....
.....[2]

- (ii) the p.d. across XY.

.....
.....
.....[2]

- 5 (a) Define the *Young modulus*.

.....
 [1]

- (b) A load F is suspended from a fixed point by a steel wire. The variation with extension x of F for the wire is shown in Fig. 5.1.

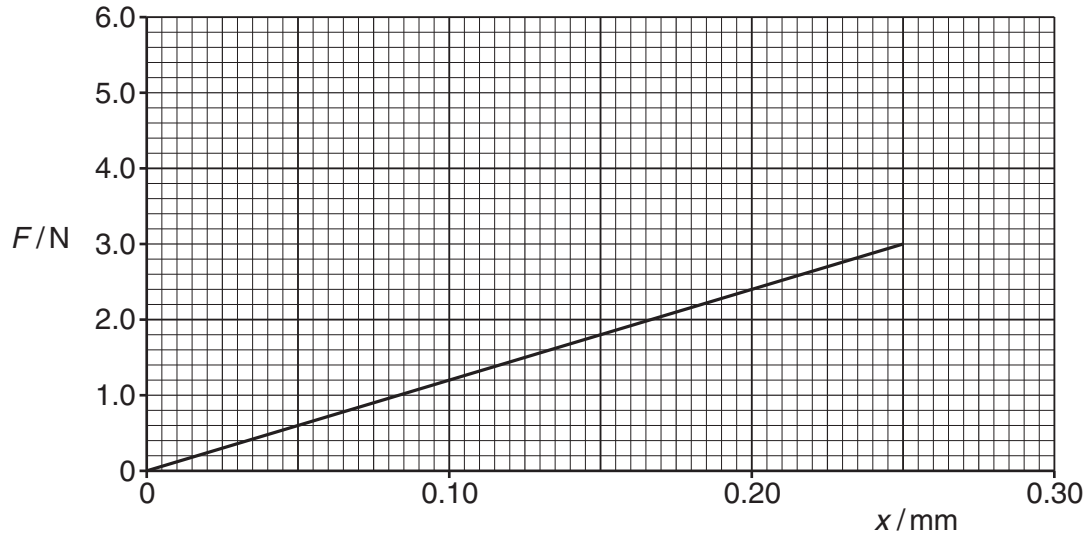


Fig. 5.1

- (i) State two quantities, other than the gradient of the graph in Fig. 5.1, that are required in order to determine the Young modulus of steel.

1.
 2.

[1]

- (ii) Describe how the quantities you listed in (i) may be measured.

.....

 [2]

- (iii) A load of 3.0 N is applied to the wire. Use Fig. 5.1 to calculate the energy stored in the wire.

For
Examiner's
Use

energy = ... J [2]

- (c) A copper wire has the same original dimensions as the steel wire. The Young modulus for steel is $2.2 \times 10^{11} \text{ N m}^{-2}$ and for copper is $1.1 \times 10^{11} \text{ N m}^{-2}$.

On Fig. 5.1, sketch the variation with x of F for the copper wire for extensions up to 0.25 mm. The copper wire is not extended beyond its limit of proportionality. [2]

- 6 (a) Use the principle of superposition to explain the formation of a stationary wave.

For
Examiner's
Use

.....

.....

.....

.....

..... [3]

- (b) Describe an experiment to determine the wavelength of sound in air using stationary waves. Include a diagram of the apparatus in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

- (c) The variation with distance x of the intensity I of a stationary sound wave is shown in Fig. 6.1.

For
Examiner's
Use

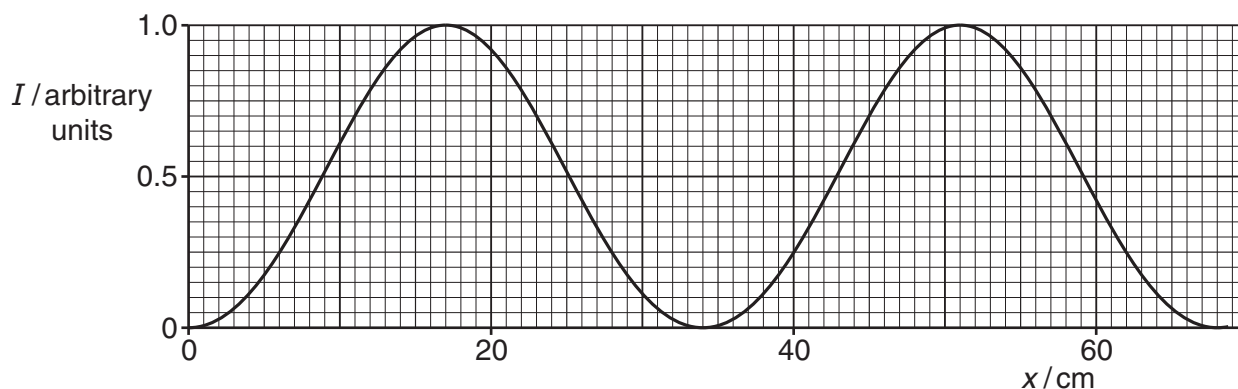


Fig. 6.1

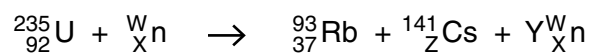
- (i) On the x -axis of Fig. 6.1, indicate the positions of all the nodes and antinodes of the stationary wave. Label the nodes **N** and the antinodes **A**. [1]
- (ii) The speed of sound in air is 340 m s^{-1} .
Use Fig. 6.1 to determine the frequency of the sound wave.

frequency = ... Hz [3]

Please turn over for Question 7.

- 7 (a) A nuclear reaction occurs when a uranium-235 nucleus absorbs a neutron. The reaction may be represented by the equation:

For
Examiner's
Use



State the number represented by the letter

W

X

Y

Z

[3]

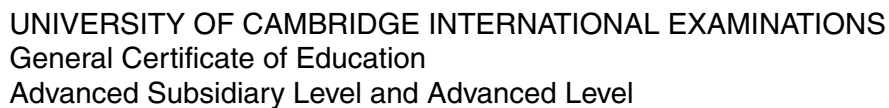
- (b) The sum of the masses on the left-hand side of the equation in (a) is not the same as the sum of the masses on the right-hand side.

Explain why mass seems not to be conserved.

.....

.....

.....[2]



--

--	--	--	--	--

--	--	--	--

9702/23

May/June 2012

1 hour

No Additional Materials are required.

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO NOT WRITE IN ANY BARCODES.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **14** printed pages and **2** blank pages.

Data

speed of light in free space,	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7} \text{ H m}^{-1}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$
	$(\frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \text{ m F}^{-1})$
elementary charge,	$e = 1.60 \times 10^{-19} \text{ C}$
the Planck constant,	$h = 6.63 \times 10^{-34} \text{ J s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27} \text{ kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31} \text{ kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27} \text{ kg}$
molar gas constant,	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$
gravitational constant,	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
acceleration of free fall,	$g = 9.81 \text{ m s}^{-2}$

Formulae

uniformly accelerated motion,

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

work done on/by a gas,

$$W = p\Delta V$$

gravitational potential,

$$\phi = -\frac{Gm}{r}$$

hydrostatic pressure,

$$p = \rho gh$$

pressure of an ideal gas,

$$p = \frac{1}{3} \frac{Nm}{V} \langle c^2 \rangle$$

simple harmonic motion,

$$a = -\omega^2 x$$

velocity of particle in s.h.m.,

$$v = v_0 \cos \omega t$$

$$v = \pm \omega \sqrt{(x_0^2 - x^2)}$$

electric potential,

$$V = \frac{Q}{4\pi\epsilon_0 r}$$

capacitors in series,

$$1/C = 1/C_1 + 1/C_2 + \dots$$

capacitors in parallel,

$$C = C_1 + C_2 + \dots$$

energy of charged capacitor,

$$W = \frac{1}{2} QV$$

resistors in series,

$$R = R_1 + R_2 + \dots$$

resistors in parallel,

$$1/R = 1/R_1 + 1/R_2 + \dots$$

alternating current/voltage,

$$x = x_0 \sin \omega t$$

radioactive decay,

$$x = x_0 \exp(-\lambda t)$$

decay constant,

$$\lambda = \frac{0.693}{t_{\frac{1}{2}}}$$

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

For
Examiner's
Use

- 1 (a) Explain the differences between the quantities *distance* and *displacement*.

.....

 [2]

- (b) State Newton's first law.

.....

 [1]

- (c) Two tugs pull a tanker at constant velocity in the direction XY, as represented in Fig. 1.1.

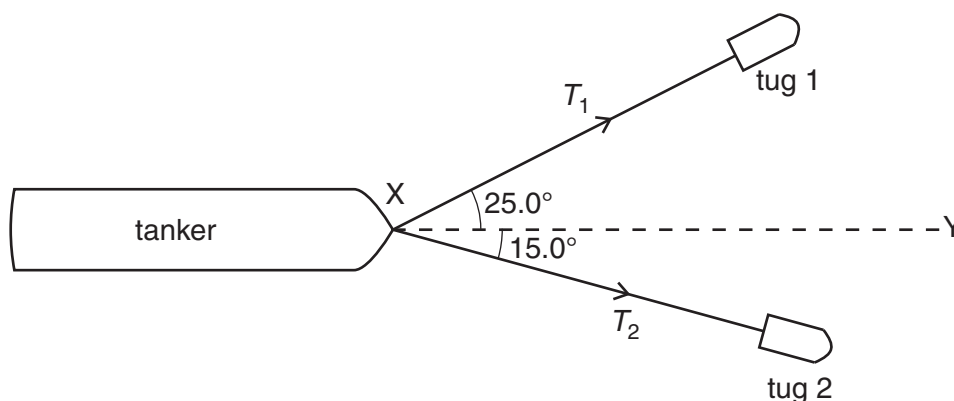


Fig. 1.1

Tug 1 pulls the tanker with a force T_1 at 25.0° to XY. Tug 2 pulls the tanker with a force of T_2 at 15.0° to XY. The resultant force R due to the two tugs is $25.0 \times 10^3 \text{ N}$ in the direction XY.

- (i) By reference to the forces acting on the tanker, explain how the tanker may be described as being in equilibrium.

.....

 [2]

- (ii) 1. Complete Fig. 1.2 to draw a vector triangle for the forces R , T_1 and T_2 . [2]

For
Examiner's
Use

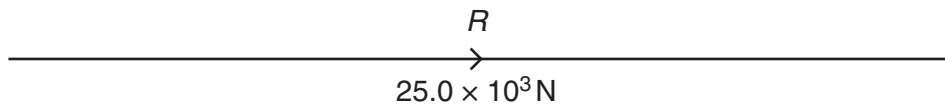


Fig. 1.2

2. Use your vector triangle in Fig. 1.2 to determine the magnitude of T_1 and of T_2 .

$$T_1 = \dots\dots\dots \text{ N}$$

$$T_2 = \dots\dots\dots \text{ N}$$

[2]

- 2 A motor drags a log of mass 452 kg up a slope by means of a cable, as shown in Fig. 2.1.

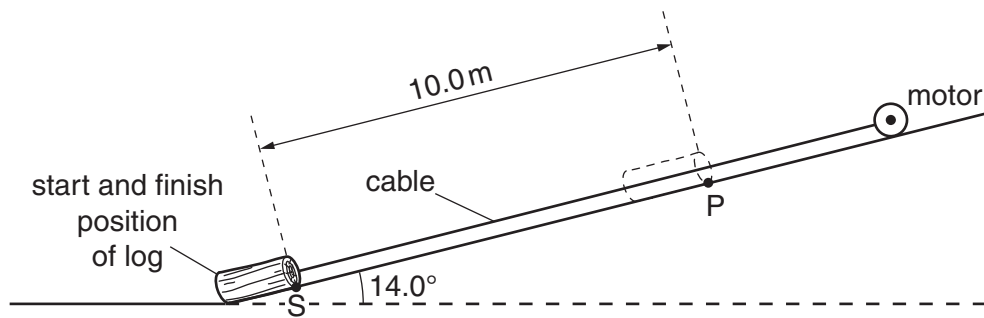


Fig. 2.1

The slope is inclined at 14.0° to the horizontal.

- (a) Show that the component of the weight of the log acting down the slope is 1070 N.

[1]

- (b) The log starts from rest. A constant frictional force of 525 N acts on the log. The log accelerates up the slope at 0.130 m s^{-2} .

- (i) Calculate the tension in the cable.

tension = ... N [3]

- (ii) The log is initially at rest at point S. It is pulled through a distance of 10.0 m to point P.

For
Examiner's
Use

Calculate, for the log,

1. the time taken to move from S to P,

time = ... s [2]

2. the magnitude of the velocity at P.

velocity = ... ms^{-1} [1]

- (c) The cable breaks when the log reaches point P. On Fig. 2.2, sketch the variation with time t of the velocity v of the log. The graph should show v from the start at S until the log returns to S. [4]



Fig. 2.2

BLANK PAGE

- 3 (a) Show that the pressure P due to a liquid of density ρ is proportional to the depth h below the surface of the liquid.

For
Examiner's
Use

[4]

- (b) The pressure of the air at the top of a mountain is less than that at the foot of the mountain. Explain why the difference in air pressure is not proportional to the difference in height as suggested by the relationship in (a).

.....

.....

.....

.....[2]

- 4 (a) Define *electric field strength*.

.....
 [1]

- (b) A uniform electric field is produced by applying a potential difference of 1200V across two parallel metal plates in a vacuum, as shown in Fig. 4.1.

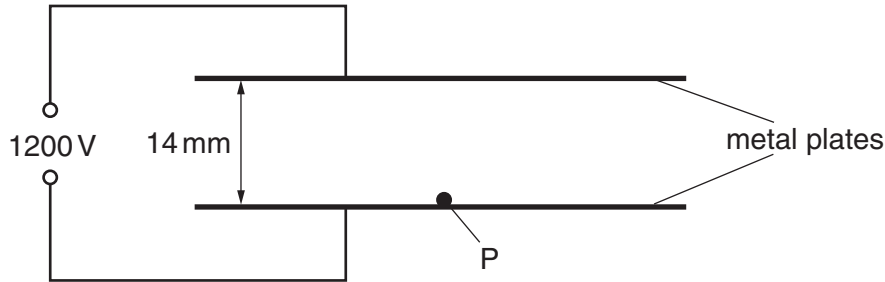


Fig. 4.1

The separation of the plates is 14 mm. A particle P with charge $3.2 \times 10^{-19} \text{ C}$ and mass $6.6 \times 10^{-27} \text{ kg}$ starts from rest at the lower plate and is moved vertically to the top plate by the electric field.

Calculate

- (i) the electric field strength between the plates,

electric field strength = ... V m^{-1} [2]

- (ii) the work done on P by the electric field,

work done = ... J [2]

- (iii) the gain in gravitational potential energy of P,

gain in potential energy = ... J [2]

- (iv) the gain in kinetic energy of P,

For
Examiner's
Use

gain in kinetic energy = ... J [1]

- (v) the speed of P when it reaches the top plate.

speed = ... ms^{-1} [2]

- 5 (a) (i) State Kirchhoff's first law.

.....
 [1]

- (ii) Kirchhoff's first law is linked to the conservation of a certain quantity. State this quantity.

..... [1]

- (b) A variable resistor of resistance R is used to control the current in a circuit, as shown in Fig. 5.1.

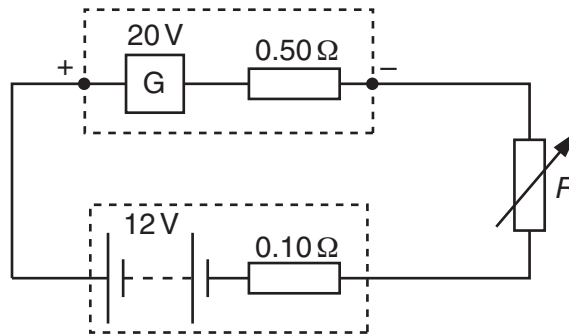


Fig. 5.1

The generator G has e.m.f. 20 V and internal resistance $0.50\ \Omega$. The battery has e.m.f. 12 V and internal resistance $0.10\ \Omega$. The current in the circuit is 2.0 A .

- (i) Apply Kirchhoff's second law to the circuit to determine the resistance R .

$$R = \dots\dots\dots \Omega \text{ [2]}$$

- (ii) Calculate the total power generated by G .

$$\text{power} = \dots\dots\dots \text{ W [2]}$$

- (iii) Calculate the power loss in the total resistance of the circuit.

For
Examiner's
Use

power = ... W [2]

- (iv) The circuit is used to supply energy to the battery from the generator. Determine the efficiency of the circuit.

efficiency = ... [2]

- 6 (a) Monochromatic light is diffracted by a diffraction grating. By reference to this, explain what is meant by

(i) diffraction,

.....
.....
.....[2]

(ii) coherence,

.....
.....
.....[1]

(iii) superposition.

.....
.....
.....[1]

- (b) A parallel beam of red light of wavelength 630 nm is incident normally on a diffraction grating of 450 lines per millimetre.

Calculate the number of diffraction orders produced.

number of orders = ... [3]

- (c) The red light in (b) is replaced with blue light. State and explain the effect on the diffraction pattern.

.....
.....
.....
.....
.....[3]

- 7 A radioactive source emits α -radiation and γ -radiation.

Explain how it may be shown that the source does not emit β -radiation using

For
Examiner's
Use

- (a) the absorption properties of the radiation,

.....

.....

.....

.....

.....[2]

- (b) the effects of a magnetic field on the radiation.

.....

.....

.....

.....

.....[2]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.