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Class	Student Number	Name

CAMBRIDGE A LEVEL PROGRAMME

SEMESTER ONE EXAMINATION DECEMBER 2012

(July 2012 Intake, 2 years)

Monday **10 December 2012** **9.45 am – 10.45 am**

PHYSICS 9702/2

PAPER 2 AS Structured Questions **1 hour**

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and student number in the spaces at the top of this page.
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.

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

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
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7	
8	
Total	

This document consists of **13** printed pages.

[Turn over

1 A simple pendulum may be used to determine a value for the acceleration of free fall g. Measurements are made of the length L of the pendulum and the period T of oscillation.
The values obtained, with their uncertainties, are as shown.

$$T = (1.92 \pm 0.02)\ \text{s}$$
$$L = (91 \pm 1)\ \text{cm}$$

(a) Calculate the percentage uncertainty in the measurement of

(i) the period T

uncertainty = ... % [1]

(ii) the length L

uncertainty = ... % [1]

(b) **(i)** The relationship between T, L and g is given by

$$g = \frac{4\pi^2 L}{T^2}$$

Using your answers in (a), calculate the percentage uncertainty in the value of g.

uncertainty = ...% [2]

(ii) The values of L and T are used to calculate a value of g as 9.745 m s^{-2}. By reference to the measurements of L and T, suggest why it would not be correct to quote the value of g as 9.745 m s^{-2}.

.....

.....

..... [1] 2

(c) An object is acted upon by two forces at right angles to each other. One of the forces has a magnitude of 5.0 N and the resultant force produced on the object is 9.5 N.

Determine

(i) the magnitude of the other force,

force = ... N [2]

(ii) the angle between the resultant force and the 5.0 N force.

angle = ...° [2]

2 (a) Complete Fig. 2.1 to show whether each of the quantities listed is a vector or a scalar.

	vector/scalar
distance moved	.....
speed	.....
acceleration	.....

Fig 2.1

[3]

(b) A ball falls vertically in air from rest. The variation with time t of the distance *d* moved by the ball is shown in Fig. 2.2

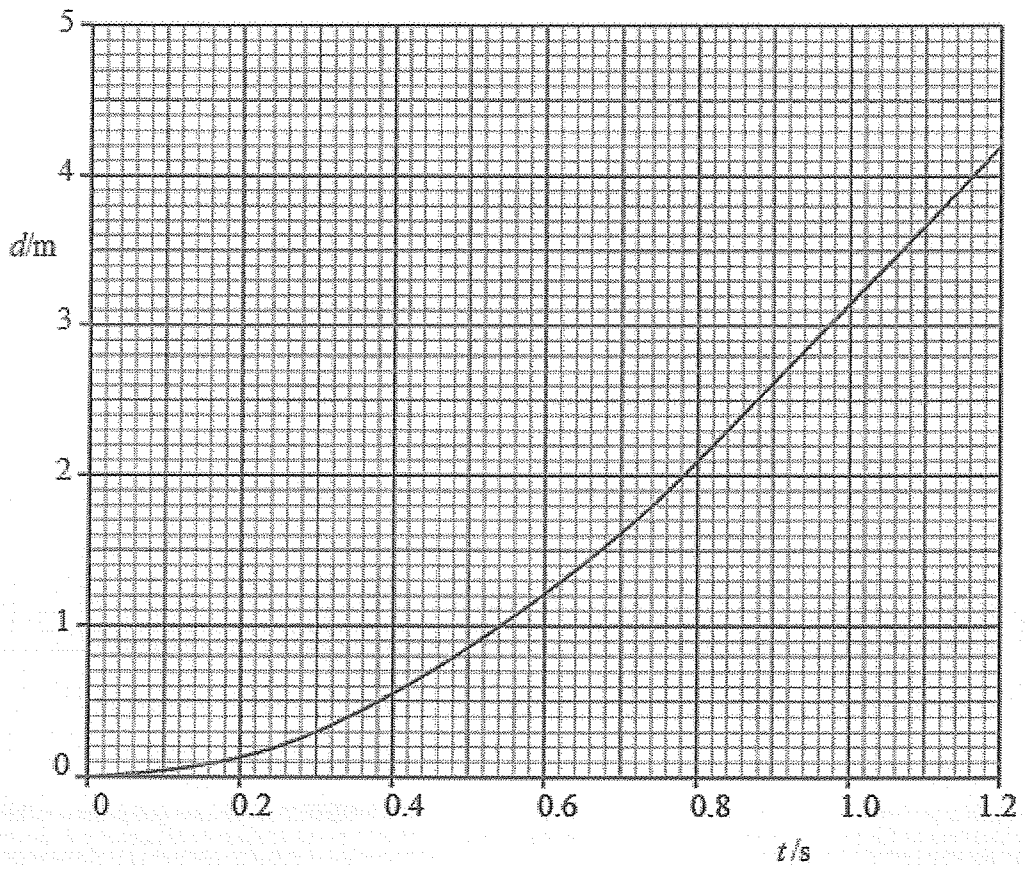


Fig. 2.2

(i) By reference to Fig. 2.2, explain how it can be deduced that

1. the ball is initially at rest,

.....

.....

..... [2]

2. air resistance is not negligible.

.....

.....

..... [1]

(ii) Use **Fig. 2.2** to determine the speed of the ball at a time of 0.40 s after it has been released.

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

(iii) On Fig. 2.2, sketch a graph to show the variation with time t of the distance d moved by the ball for negligible air resistance. You are not expected to carry out any further calculations. [3]

3 (a) State the relation between force and momentum.

.....[1]

(b) A rigid bar of mass 450g is held horizontally by two supports A and B, as shown in Fig. 3.1.

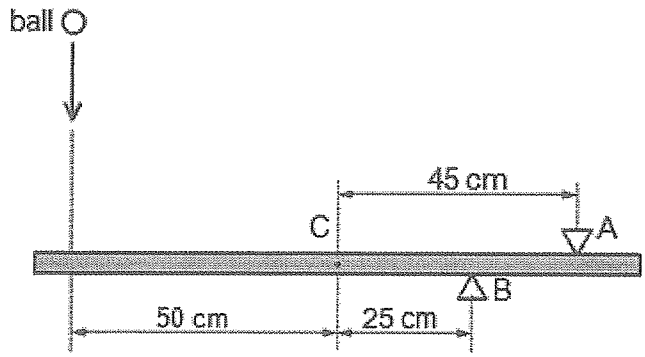


Fig. 3.1

The support A is 45 cm from the centre of gravity C of the bar and support B is 25 cm from C.

A ball of mass 140 g falls vertically onto the bar such that it hits the bar at a distance of 50 cm from C, as shown in Fig. 3.1.
The variation with time t of the velocity v of the ball before, during and after hitting the bar is shown in Fig. 3.2

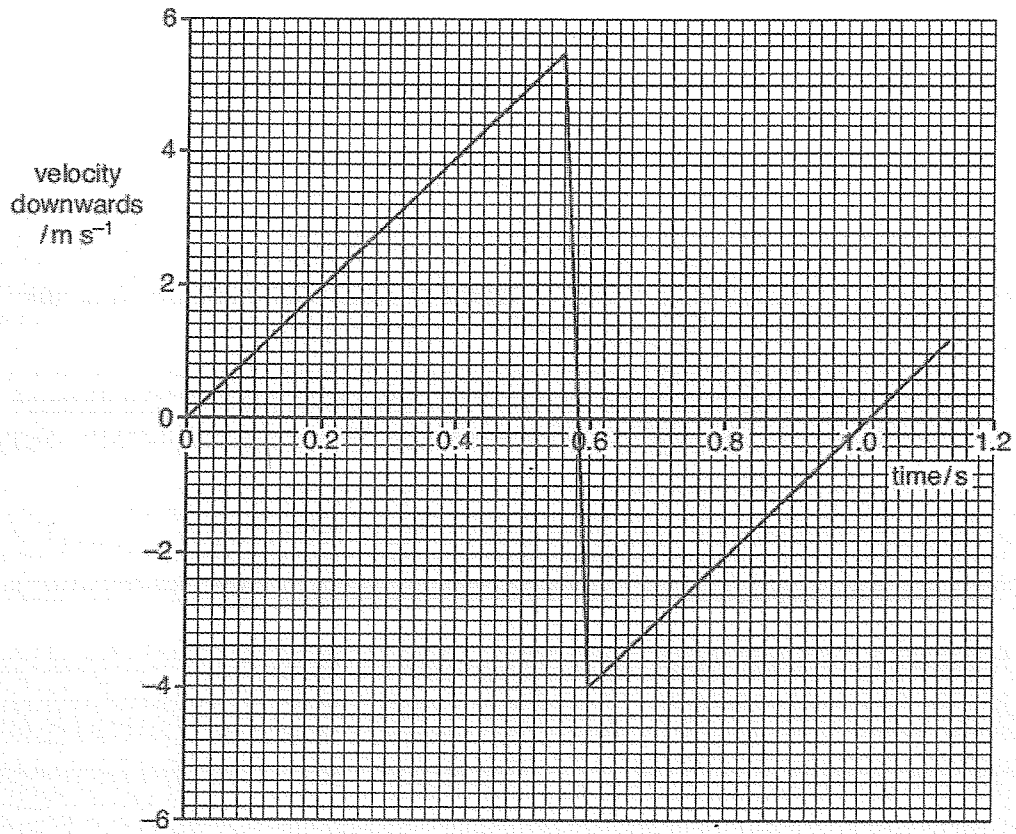


Fig. 3.2

For the time that the ball is in contact with the bar, use Fig. 3.2

(i) to determine the change in momentum of the ball,

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

(ii) to show that the force exerted by the ball on the bar is 33 N.

[1]

(c) For the time that the ball is in contact with the bar, use data from Fig. 3.1 and (b)(ii) to calculate the force exerted on the bar by

(i) the support A,

force = ... N [3]

(ii) the support B.

force = ... N [2]

4 A car has steady speed of 110 km h^{-1} on a straight, level road. The total resistive force due to air resistance is 750 N.

(a) Show that the speed of the car is 30.6 m s^{-1}.

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

(b) Calculate,

(i) the work done against air resistance over a distance of 10 km.

work done = ... J [2]

(ii) the output power of the car.

output power = ... W [2]

(iii) the input power of the car if its overall efficiency is 30%.

input power = ... W [2]

5 **(a)** State the difference between *elastic deformation* and *plastic deformation* in terms of extension and energy stored in the wire.

.....

.....

.....

.....

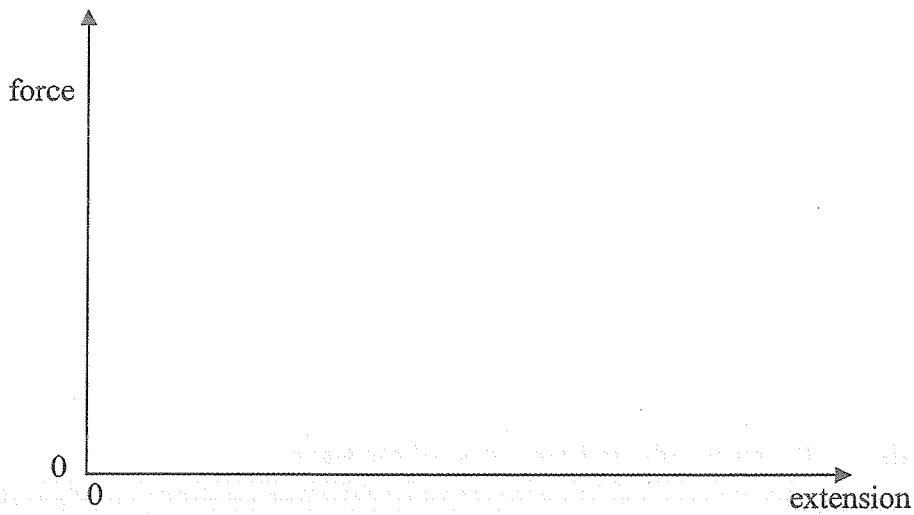
..... [2]

(b) On the axes below, sketch typical force-extension curves for

(i) a metal

(ii) natural rubber

(iii) glass [3]



6 **Fig. 6.1** shows the variation with time t of the displacement x of a particle in a medium as a result of the passage of a transverse wave T_1 through the medium.

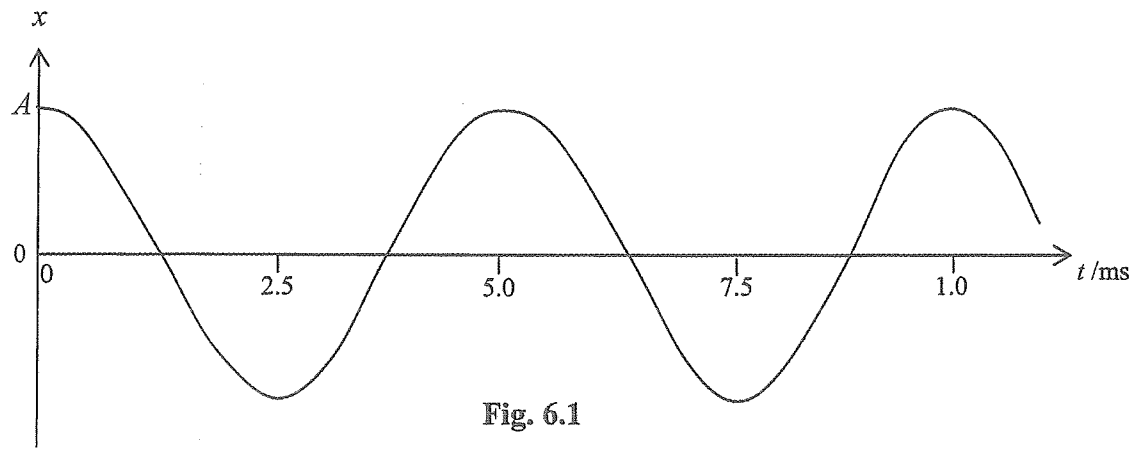


Fig. 6.1

The wave T_1 has intensity I. It causes the particle to oscillate with amplitude A. a second similar wave T_2 has the same frequency but has intensity $\frac{1}{4}I$.

(a) Calculate

(i) the frequency of the waves

frequency = ... Hz [1]

(ii) the amplitude, in terms of A, of the wave T_2.

amplitude = ... [2]

(b) The phase difference between the two waves is 90°. On the axes of **Fig. 6.1**, sketch the waveform of the second wave T_2. [3]

7 In a Young's double-slit experiment, *monochromatic* light from two *coherent* sources are used to produce the interference fringes. The slit separation is 0.60 mm. A fringe pattern is formed on a screen 2.0 m away from the slits. The fringe separation produced is 2.0 mm.

(a) Explain what is meant by

(i) *monochromatic light,*

.....

..... [1]

(ii) *coherent* light sources.

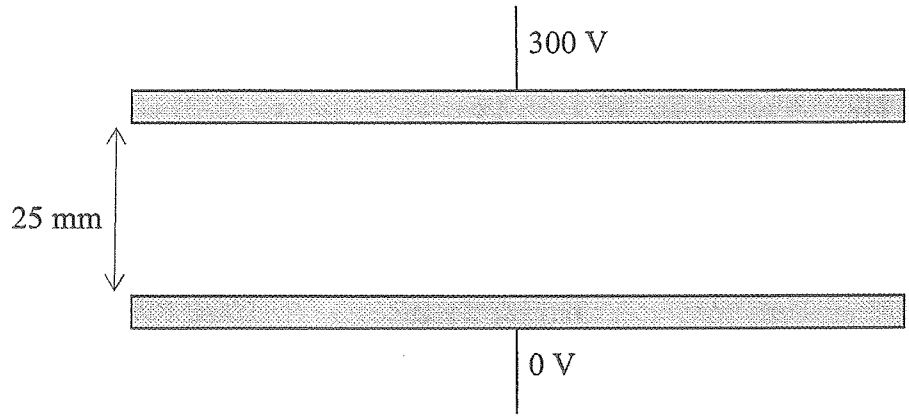
.....

..... [1]

(b) Calculate the wavelength of the light source.

wavelength = ... m [2]

8 (a) The diagram show two parallel plates with a potential difference of 300 V applied across them. The plates are in a vacuum.



On the diagram, sketch the electric field pattern in the region between the plates. [1]

(b) The plates are 25 mm apart. Show that the force experienced by an electron just above the bottom plate is about 2×10^{-15} N.

force ..... N [3]

(c) This force causes the electron to accelerate. The electron is initially at rest at the bottom plate when the potential difference is applied. Calculate

(i) its acceleration,

acceleration = ... $m\ s^{-2}$ [2]

(ii) its speed as it reaches the upper plate.

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