JAYAKUMAR.

TAYLOR'S COLLEGE

Wisdom • Integrity • Excellence
since 1969

Class	Student Number	Name Marking Scheme

CAMBRIDGE A LEVEL PROGRAMME

AS TRIAL EXAMINATION JUN 2012

(June 2011 Intake)

Wednesday 04 April 2012 9.45 am – 10.45 am

PHYSICS 9702/02

PAPER 2 AS Structured Questions 1 hour

Candidates answer on the Question Paper.
Data booklet.

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.
The number of marks is given in brackets [ ] at the end of each question or part question.
You may lose marks if you do not show your working or if you do not use appropriate units.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **11** printed pages.

1 (a) An equation is said to be homogeneous. Explain this statement.

same base unit B2

All the terms represent the same physical ~~Bt~~ quantity than the equation is homogeneous ~~Bt~~

[2]

(b) The period T of a simple pendulum is assumed to be dependent on its mass m, length l and the acceleration g of free fall, as given by the relationship below.

$T = k\,m^{x}\,l^{y}g^{z}$

where k is a dimensionless quantity.

By equating the base units on both sides of the equation, deduce the values of x, y and z.

$T = k\,m^x . l^y . g^z$

$[T] = s$

$[m^x] = kg^x$

$[l^y] = m^y$

$[g^z] = (ms^{-2})^z$
$= m^z s^{-2z}$

$[T] = [m^x].[l^y].[g^z]$

$s^1 = kg^x . m^y . m^z . s^{-2z}$ C1

L.H.S = R.H.S

$1 = -2z$
$z = -\frac{1}{2}$

$x = 0$
$y + z = 0$ C1
$y = -z$
$y = -(-\frac{1}{2})$
$y = \frac{1}{2}$

A1

$x =$ 0 $y =$ ½ $z =$ −½ [3]

2 (a) State *Newton's second law of motion.* B1

The rate of change of momentum of a body is directly proportional to the net force acting on it and takes place in the direction of the force. [2] B1

(b) Starting from Newton's second law, derive the relationship $F = ma$, stating the meaning of each symbol. [2]

$$F \propto \frac{dp}{dt}$$

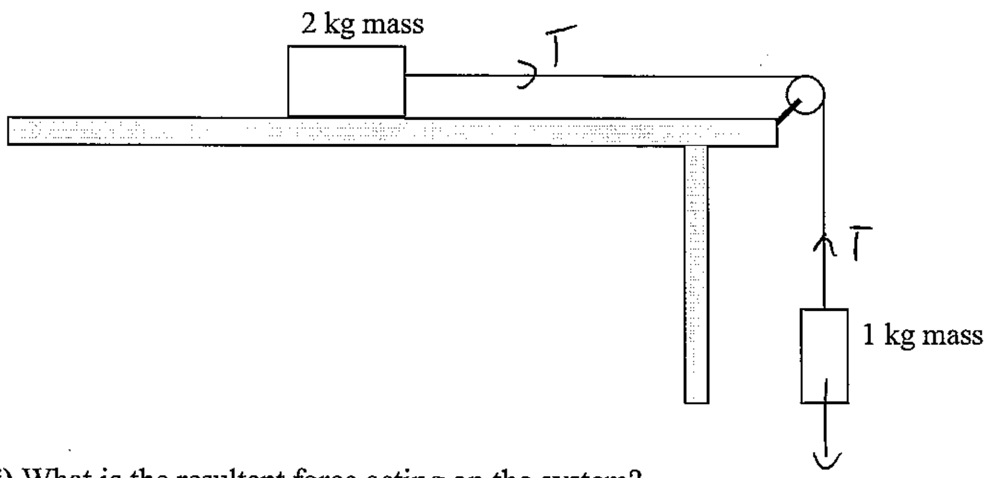
$$F = \frac{\Delta p}{t} \text{ ..... M1}$$

$$= \frac{mv - mu}{t}$$

$$= m\left[\frac{v-u}{t}\right] \text{ ..... A1}$$

$$F = ma \text{ .... A1}$$

(c) The figure below shows a system consisting of a 2.0 kg mass and a 1.0 kg connected together by an inextensible string. The 2.0 kg mass is placed on a smooth horizontal surface. The string passes through a light smooth pulley.



(i) What is the resultant force acting on the system?

$W = (1)(9.81)$

$$F_R = 1 \times 9.81$$

$$= 9.81 \text{ N .... A1}$$

resultant force = 9.81 N [1]

[Turn over

(ii) The whole system is released from rest. What is the acceleration of both the masses?

$$W - T = (1)(a) \quad -(1)$$
$$T = (2)(a) - (2)$$

$$\therefore W - 2a = a \qquad -(C1)$$
$$a = \frac{(1)(9.81)}{3}$$
$$= 3.27 ms^{-2} \qquad -(A1)$$

acceleration = ...3.27.......ms^{-2} [2]

(iii) By considering the motion of the 2.0 kg mass, determine the tension in the string.

$$\therefore T = 2a$$
$$= 2(3.27)$$
$$= 6.54 \qquad -A1$$

tension = ...6.54.......N [1]

3

3 In **Fig.3.1**, a package is dropped on an target by an aeroplane flying with a horizontal velocity of 180 km hr^{-1} and at a height of 490 m.

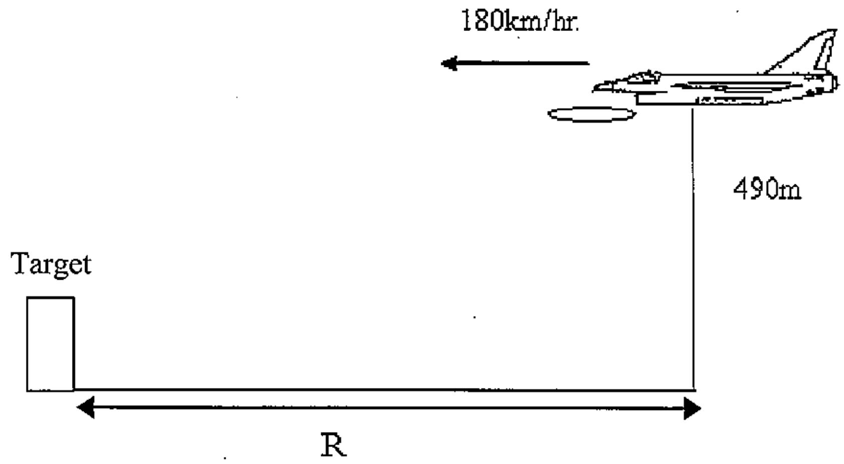


Fig. 3.1

At what distance *R* must the aeroplane be at the time of dropping the package that it may directly hit the target? Neglect the dimensions of the target.

Time taken for the package to drop; $S = \frac{1}{2}gt^2$

$490 = \frac{1}{2}(9.81)(t^2)$ C1

$t \doteq 10s$

Horizontal Velocity $= 180$ km/hr C1

$= 50ms^{-1}$

Distance, R = Horizontal Velocity $\times t$

$= 50(10)$

$= 500m$ A1

R = 500 m [3]

[Turn over

4

4 A square uniform trapdoor is shown in Fig. 4.1. It is hinged on a wall and is held open at an angle to the horizontal by means of a rope attached as shown.

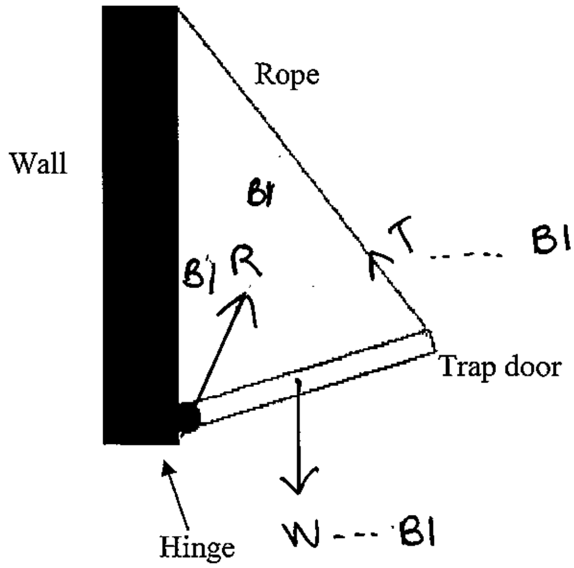


Fig.4.1

(a) On the diagram, mark with an arrow labeled *W*, the weight of the trapdoor. [1]

(b) Mark on the diagram an arrow labeled *T*, to represent the tension of the rope acting on the trapdoor [1]

(c) Finally draw an arrow labeled *R*, to represent the force on the trapdoor due to the hinge. [2]

5

5 The Young's modulus, E of a copper wire can be represented by the equation:

$$E = \frac{4MgL}{\pi D^2 e}$$

Where M is the mass of the wire
g is the acceleration of gravity
L is the original length of the wire
D is the diameter of the wire
e is the change in length of the wire

(a) (i) What are the base S.I. units for Young's modulus ?

$$[E] = \frac{kg \cdot ms^{-2} \cdot m}{m^2 \cdot m} \text{ ..... C1}$$

$$= kg\, m^{-1} s^{-2} \text{ ..... A1}$$

Units = $kg m^{-1} s^{-2}$ [2]

(ii) Suggest another physical quantity which has the same units.

Pressure ..... A1 [1]

(b) The value of the Young's modulus of copper is 1.2 x 10^{11} N m^{-2} and the % uncertainties of M is 3 %, L = 2 %, e =1 % and D = 2 %. Find the uncertainty in the value of E and write down the answer together with its uncertainty

$$\left[\frac{\Delta E}{E} \times 100\right] = \left[\frac{\Delta M}{M} \times 100\right] + \left[\frac{\Delta L}{L} \times 100\right] + 2\left[\frac{\Delta D}{D} \times 100\right] + \left[\frac{\Delta e}{e} \times 100\right]$$

$$= 3 + 2 + 2(2) + 1 \text{ ..... C1}$$

$$= 10$$

$$\left[\frac{\Delta E}{E} \times 100\right] = 10$$

$$\Delta E = 0.1(1.2 \times 10^{11}) \text{ ..... C1}$$

$$= 1.2 \times 10^{10}$$

$$= 0.12 \times 10^{11} \text{ .... A1}$$

E = $(1.2 \pm 0.1) \times 10^{11}$ N m^{-2} [3]

[Turn over

6

(c) Distinguish between elastic and plastic deformation.

B1 Elastic Deformation: The material will return to its original shape and size once the deformed force is removed.

B1 Plastic Deformation: The material suffers a permanent deformation once the ~~dot~~ deforming force is removed. [2]

(d) Explain why Young Modulus (E) is a better quantity to represent elasticity than force constant (k). Young Modulus → const & independent of the material.

B1

It represent the elasticity of the material rather than the shape and size B1 of the object.

[2]

6 (a) Explain what is meant by superposition of waves.

....

....

....[2]

(b) Distinguish between constructive and destructive interference.

....

....

....

....

....

....[4]

(c) State two conditions necessary for sources of waves to be coherent.

1 ....

2 ....[2]

7

6 (a) Explain what is meant by superposition of waves.

Waves coinciding at a point in space.......... (B1)

Disturbances add together .... (B1) [2]

(b) Distinguish between constructive and destructive interference.

Any relevant Info.

Constructive: Waves meet in phase as they meet ....(B1)

Displacement is added to give a larger amplitude ....(B1)

Destructive: Waves meet anti-phase ....(B1)

Cancelation to give zero amplitude ....(B1) [4]

(c) State two conditions necessary for sources of waves to be coherent.

1 Same frequency ....(B1)

2 Constant phase difference ....(B1) [2]

(d) Why is it necessary to have two coherent sources to produce an interference pattern?

So that phase difference is constant ....(B1)

Steady interference pattern is obtained. ....(B1) [2]

7 (a) (i) State what is meant by the diffraction of a wave.

Spreading of a wave when passing through an aperture or around an obstacle ....(B1)

Size is comparable to the wavelength. ....(B1) [2]

(ii) The diagram of figure 1.1 and figure 1.2 represents plane wavefronts approaching a wide gap and a narrow gap respectively.

Same λ – B1

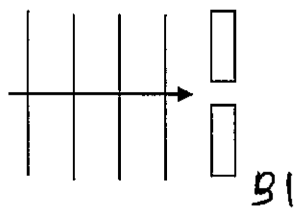


Fig. 1.1

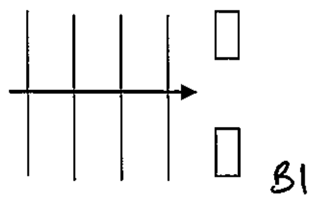
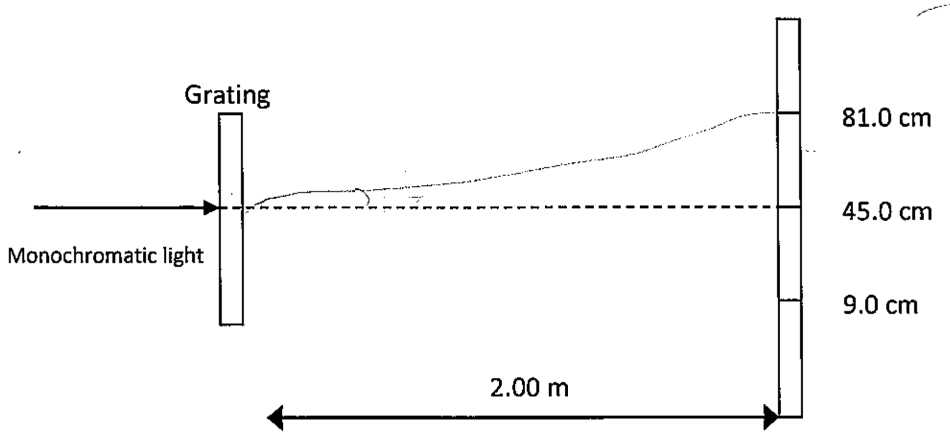


Fig. 1.2

Draw on each diagram, lines illustrating diffraction, to represent the wavefronts after passing through the gaps. [3]

(b) Parallel monochromatic light is incident normally on a diffraction grating having 3.0 x 10^5 lines per meter. A meter rule positioned 2.00 m from the grating and parallel to its plane is shown below.



The axis of the rule is normal to the lines of the grating. Bright lines are observed on the rule at the 9.0 cm, 45.0 cm and 81.0 cm marks. Calculate the wavelength of the light. $d \sin\theta = n\lambda$

(1 / 3.0 x 10^5) (36/200) = (1)λ ....(C1)

λ = 600 x 10^{-9} ....(A1)

wavelength = 600n ....m [2]

8 (a) (i) Define electromotive force (e.m.f) and potential difference (p.d).

Energy per unit charge other form → e. energy

E.M.F: Total work done per unit ~~positive~~ charge to transfer the charge in the entire .(B1) circuit.

P.D :Work done per unit ~~positive~~ charge to transfer the charge between two points. (B1)

electrical energy → other form

[2]

9

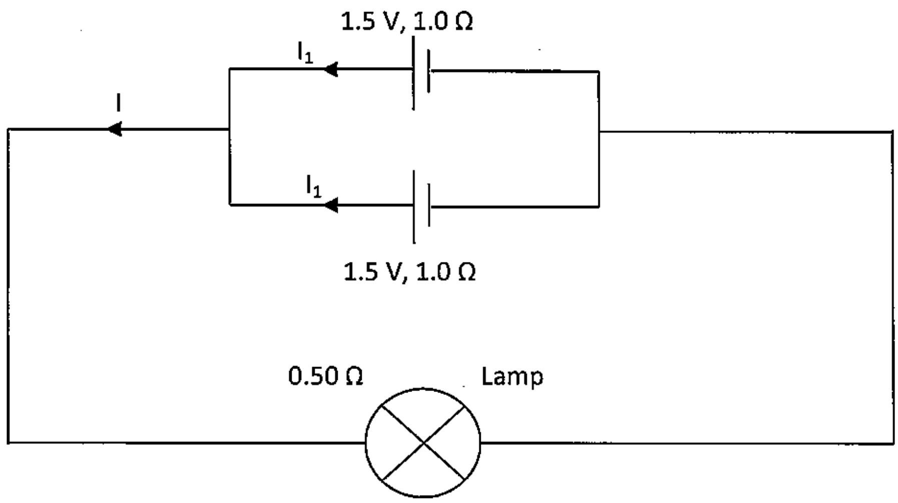
(ii) Explain briefly why p.d. will be less than e.m.f. across a cell in a closed circuit.

When current flows through the internal resistance, some voltage is lost. [3]

(b) (i) State Kirchhoff's second law.

In a closed loop circuit sum of e.m.fs = sum of p.ds ....(B2) [2]

(ii) In order to supply sufficient current to light a lamp of resistance 0.50 Ω a student uses two dry batteries, each with e.m.f. 1.5 V and internal resistance 1.0 Ω. They are connected in parallel as shown in the diagram on the next page below.



Calculate the power dissipated by the lamp. [3]

$1.5 = I_1\,(1) + I\,(0.50)$ ....(1) ....(C1)

$2I_1 = I$ ....(2)

$I = 1.5A$ ....(C1)

$P=(1.5)^2\,(0.50)= 1.13W$ ....(A1)

9 State the nature of the following radiations.

Alpha particles: (4,2) Helium nucleus ....(B1)

Beta particles: High energy (0,-1) electron ....(B1)

Gamma ray: E.M radiation with very high frequency ....(B1) [3]