**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

# MARK SCHEME for the May/June 2012 question paper

# for the guidance of teachers

## 9702 PHYSICS

**9702/23** Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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**1 (a)** displacement is a vector, distance is a scalar B1
displacement is straight line between two points / distance is sum of lengths moved / example showing difference B1 [2]
(either one of the definitions for the second mark)

**(b)** a body continues at rest or at constant velocity unless acted on by a resultant (external) force B1 [1]

**(c) (i)** sum of $T_1$ and $T_2$ equals frictional force B1
these two forces are in opposite directions B1 [2]
*(allow for 1/2 for travelling in straight line hence no rotation / no resultant torque)*

**(ii) 1.** scale vector triangle with correct orientation / vector triangle with correct orientation both with arrows B1
scale given or mathematical analysis for tensions B1 [2]

**2.** $T_1 = 10.1 \times 10^3 (\pm 0.5 \times 10^3)$ N A1
$T_2 = 16.4 \times 10^3 (\pm 0.5 \times 10^3)$ N A1 [2]

**2 (a)** weight = 452 × 9.81
component down the slope = 452 × 9.81 × sin 14° M1
= 1072.7 = 1070 N A0 [1]

**(b) (i)** $F = ma$ C1
$T - (1070 + 525) = 452 \times 0.13$ C1
$T$ = 1650 (1653.76) N *any forces missing 1/3* A1 [3]

**(ii) 1.** $s = ut + \frac{1}{2}at^2$ hence $10 = 0 + \frac{1}{2} \times 0.13t^2$ C1
$t = [(2 \times 10) / 0.13]^{1/2}$ = 12.4 or 12 s A1 [2]

**2.** $v = (0 + 2 \times 0.13 \times 10)^{1/2}$ = 1.61 or 1.6 m s$^{-1}$ A1 [1]

**(c)** straight line from the origin B1
line down to zero velocity in short time compared to stage 1 B1
line less steep negative gradient B1
final velocity larger than final velocity in the first part – at least 2× B1 [4]

**3 (a)** $V = h \times A$
$m = V \times \rho$ B1
$W = h \times A \times \rho \times g$ B1
$P = F / A$ B1
$P = h\rho g$
$P$ is proportional to $h$ if $\rho$ is constant (and $g$) B1 [4]

**(b)** density changes with height B1
hence density is not constant with link to formula B1 [2]

**4** **(a)** electric field strength is the force per unit positive charge (acting on a stationary charge) B1 [1]

**(b)** **(i)** $E = V / d$ C1
$= 1200 / 14 \times 10^{-3}$
$= 8.57 \times 10^{4}\,\text{V m}^{-1}$ A1 [2]

**(ii)** $W = QV$ or $W = F \times d$ and therefore $W = E \times Q \times d$ C1
$= 3.2 \times 10^{-19} \times 1200$
$= 3.84 \times 10^{-16}\,\text{J}$ A1 [2]

**(iii)** $\Delta U = mgh$ C1
$= 6.6 \times 10^{-27} \times 9.8 \times 14 \times 10^{-3}$
$= 9.06 \times 10^{-28}\,\text{J}$ A1 [2]

**(iv)** $\Delta K = 3.84 \times 10^{-16} - \Delta U$
$= 3.84 \times 10^{-16}\,\text{J}$ A1 [1]

**(v)** $K = ½mv^2$ C1
$v = [(2 \times 3.8 \times 10^{-16}) / 6.6 \times 10^{-27}]^{1/2}$
$= 3.4 \times 10^{5}\,\text{m s}^{-1}$ A1 [2]

**5** **(a)** **(i)** sum of currents into a junction = sum of currents out of junction B1 [1]

**(ii)** charge B1 [1]

**(b)** **(i)** $\Sigma E = \Sigma IR$
$20 - 12 = 2.0(0.6 + R)$ (*not used 3 resistors 0/2)* C1
$R = 3.4\,\Omega$ A1 [2]

**(ii)** $P = EI$ C1
$= 20 \times 2$
$= 40\,\text{W}$ A1 [2]

**(iii)** $P = I^2R$ C1
$P = (2)^2 \times (0.1 + 0.5 + 3.4)$
$= 16\,\text{W}$ A1 [2]

**(iv)** efficiency = useful power / output power C1
24 / 40 = 0.6 or 12 × 2 / 20 × 2 or 60% A1 [2]

**6** **(a)** **(i)** diffraction bending/spreading of light at edge/slit B1
this occurs at each slit B1 [2]

**(ii)** constant phase difference between each of the waves B1 [1]

**(iii)** (when the waves meet) the resultant displacement is the sum of the displacements of each wave B1 [1]

**(b)** $d\sin\theta = n\lambda$
$n = d / \lambda = 1 / 450 \times 103 \times 630 \times 10^{-9}$ C1
$n = 3.52$ M1
hence number of orders = 3 A1 [3]

**(c)** $\lambda$ blue is less than $\lambda$ red M1
more orders seen A1
each order is at a smaller angle than for the equivalent red A1 [3]

**7** **(a)** thin paper reduces count rate hence $\alpha$ B1
addition of 1 cm of aluminium causes little more count rate reduction hence only other radiation is $\gamma$ B1 [2]

**(b)** magnetic field perpendicular to direction of radiation B1
look for a count rate in expected direction / area if there were negatively charged radiation present. If no count rate recorded then $\beta$ not present. B1 [2]