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

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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 ρ is constant (and g) B1 [4]

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

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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]

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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) λ blue is less than λ 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 α B1
addition of 1 cm of aluminium causes little more count rate reduction hence only other radiation is γ 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 β not present. B1 [2]

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