**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 <u>resultant</u>
(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.** $T_1 = 10.1 \times 10^3 \ (\pm 0.5 \times 10^3)\,\text{N}$      A1
$T_2 = 16.4 \times 10^3 \ (\pm 0.5 \times 10^3)\,\text{N}$      A1   [2]

**2 (a)** weight $= 452 \times 9.81$
component down the slope $= 452 \times 9.81 \times \sin 14°$      M1
$= 1072.7 = 1070\,\text{N}$      A0   [1]

**(b) (i)** $F = ma$      C1
$T - (1070 + 525) = 452 \times 0.13$      C1
$T = 1650\ (1653.76)\,\text{N}$   *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 $12\,\text{s}$      A1   [2]

         **2.** $v = (0 + 2 \times 0.13 \times 10)^{1/2} = 1.61$ or $1.6\,\text{m s}^{-1}$      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 <u>per unit positive</u> charge (acting on a stationary charge)　　　　B1　[1]

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

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

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

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

**(v)** $K = \frac{1}{2}mv^2$　　　　C1
$v = [(2 \times 3.8 \times 10^{-16}) / 6.6 \times 10^{-27}]^{1/2}$
$= 3.4 \times 10^5 \, m \, s^{-1}$　　　　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
$= 20 \times 2$
$= 40 \, W$　　　　A1　[2]

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

**(iv)** efficiency = useful power / output power　　　　C1
$24 / 40 = 0.6$ or $12 \times 2 / 20 \times 2$ 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)** $d\sin\theta = n\lambda$
     $n = d / \lambda = 1 / 450 \times 10^3 \times 630 \times 10^{-9}$      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]