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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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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.	$T_1 = 10.1 \times 10^3\ (\pm 0.5 \times 10^3)$ 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.	$s = ut + ½at^2$ hence $10 = 0 + ½ \times 0.13t^2$	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]

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
$= 1200 / 14 \times 10^{-3}$
$= 8.57 \times 10^4 \text{ V m}^{-1}$ A1 [2]

(ii) $W = QV$ or $W = F \times d$ and therefore $W = E \times Q \times d$ C1
$= 3.2 \times 10^{-19} \times 1200$
$= 3.84 \times 10^{-16}$ 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) $K = ½mv^2$ 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
$= 20 \times 2$
$= 40$ W A1 [2]

(iii) $P = I^2R$ 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 × 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) 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]