CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 series

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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1 **(a)** current, mass and temperature
two correct 2/2, one omission or error 1/2 A2 [2]

(b) σ: no units, V: m^3 C1
E_P: kg m^2 s^{-2} C1
C: kg m^2 s^{-2} × m^{-3} = kg m^{-1} s^{-2} A1 [3]

2 **(a)** scalar has magnitude only B1
vector has magnitude and direction B1 [2]

(b) **(i)** $v^2 = 0 + 2 \times 9.81 \times 25$ (or using $\frac{1}{2} mv^2 = mgh$) C1
v = 22(.1) m s^{-1} A1 [2]

(ii) $22.1 = 0 + 9.81 \times t$ (or $25 = \frac{1}{2} \times 9.81 \times t^2$) M1
t (=22.1 / 9.81) = 2.26 s or t [=(5.097)$^{1/2}$] = 2.26 s A0 [1]

(iii) horizontal distance = 15 × t
= 15 × 2.257 = 33.86 (allow 15 × 2.3 = 34.5) C1

(displacement)^2 = (horizontal distance)^2 + (vertical distance)^2 C1
= (25)^2 + (33.86)^2 C1

displacement = 42 (42.08) m (allow 43 (42.6) m, allow 2 or more s.f.) A1 [4]

(iv) distance is the actual (curved) path followed by ball B1
displacement is the straight line / minimum distance P to Q B1 [2]

3 **(a)** work done is the product of force and the distance <u>moved</u> in the direction of the force
or product of force and displacement in the direction of the force B1 [1]

(b) (i) work done equals the <u>decrease</u> in GPE – <u>gain</u> in KE — B1 [1]

(ii) 1. distance = area under line — C1
= (7.4 × 2.5) / 2 = 9.3 m (9.25 m) — M1 [2]

or

acceleration from graph a = 7.4 / 2.5 (= 2.96) — (C1)
and equation of motion $(7.4)^2 = 2 \times 2.96 \times s$ gives s = 9.3 (9.25) m — (A1)

2. kinetic energy = $\frac{1}{2} m v^2$ — C1

$= \frac{1}{2} \times 75 \times (7.4)^2$ — C1

= 2100 J — A1 [3]

3. potential energy = mgh — C1
h = 9.3 sin 30° — C1
PE = 75 × 9.81 × 9.3 sin 30° = 3400 J — A1 [3]

4. work done = energy loss — C1
R = (3421 – 2054) / 9.3 — C1
= 150 (147) N — A1 [3]

4 (a) <u>add small mass</u> to cause extension then remove mass to see if spring returns to original length — M1

repeat for larger masses and note maximum mass for which, when load is removed, the spring does return to original length — A1 [2]

(b) Hooke's law requires force proportional to extension — B1
graph shows a straight line, hence obeys Hooke's law — M1 [2]

(c) k = force / extension — C1
= (0.42 × 9.81) / [(30 – 21.2) × 10^{-2}] — C1
= 47 (46.8) N m^{-1} — A1 [3]

5 (a) lost volts / energy used within the cell / internal resistance — B1
when cell supplies a current — B1 [2]

	(b)	**(i)**	$E = I(R + r)$ $4.5 = 0.65\ (6.0 + r)$ $r = 0.92\,\Omega$	C1 A1	 [2]
		(ii)	$I = 0.65$ (A) and $V = IR$ $V = 0.65 \times 6 = 3.9\,V$	C1 A1	 [2]
		(iii)	$P = V^2 / R$ or $P = I^2R$ and $P = IV$ $= (3.9)^2 / 6 = 2.5\,W$	C1 A1	 [2]
		(iv)	efficiency = power out / power in $= I^2R / I^2(R + r) = R / (R + r) = 6.0 / (6.0 + 0.92) = 0.87$	C1 A1	 [2]
	(c)		(circuit) resistance decreases current increases more heating effect	B1 M1 A1	 [3]
6	**(a)**	**(i)**	progressive wave transfers energy, stationary wave no transfer of energy / keeps energy within wave	B1	[1]
		(ii)	(progressive) wave / wave from loudspeaker reflects at end of tube reflected wave overlaps (another) progressive wave same frequency and speed hence stationary wave formed	B1 B1 B1	 [3]
		(iii)	(side to side) along length of tube / along axis of tube	B1	[1]
	(b)		all three nodes clearly marked with N / clearly labelled at cross-over points	B1	[1]
	(c)		phase difference = 0	A1	[1]
	(d)	**(i)**	$v = f\lambda$ $\lambda = 330 / 440 = 0.75\,m$	C1 A1	 [2]
		(ii)	$L = 5/4\ \lambda$ $= 5/4 \times 0.75 = 0.94\,m$	C1 A1	 [2]