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: $kg\,m^2\,s^{-2} \times m^{-3} = kg\,m^{-1}\,s^{-2}$ — 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 = $15 \times t$
$= 15 \times 2.257 = 33.86$ (allow $15 \times 2.3 = 34.5$) — 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 decrease in GPE – gain 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 = $\frac{1}{2} mv^2$ 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) add small mass 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) $E = I(R + r)$ C1
$4.5 = 0.65\ (6.0 + r)$
$r = 0.92\,\Omega$ A1 [2]

(ii) $I = 0.65$ (A) and $V = IR$ C1
$V = 0.65 \times 6 = 3.9\,\text{V}$ A1 [2]

(iii) $P = V^2/R$ or $P = I^2R$ and $P = IV$ C1
$= (3.9)^2/6 = 2.5\,\text{W}$ A1 [2]

(iv) efficiency = power out / power in C1
$= I^2R/I^2(R + r) = R/(R + r) = 6.0/(\ 6.0 + 0.92\ ) = 0.87$ A1 [2]

(c) (circuit) resistance decreases B1
current increases M1
more heating effect 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 B1
reflected wave overlaps (another) progressive wave B1
same frequency and speed hence stationary wave formed 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) $v = f\lambda$ C1
$\lambda = 330/440 = 0.75\,\text{m}$ A1 [2]

(ii) $L = 5/4\ \lambda$ C1
$= 5/4 \times 0.75 = 0.94\,\text{m}$ A1 [2]