CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9702 PHYSICS

9702/21 Paper 2 (AS Structured Questions), maximum raw mark 60

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International Examinations

1 (a) temperature B1
current B1 [2]
(allow amount of substance and luminous intensity)

(b) base units of force constant: $\text{kg m s}^{-2}\text{ m}^{-1}$ or kg s^{-2} B1
base units of time and mass: s and kg C1
base units of C: $\text{s}\,(\text{kg s}^{-2}/\text{kg})^{1/2}$ cancelling to show no units B1 [3]

2 (a) pressure = force / area (normal to the force) [clear ratio essential] B1 [1]

(b) (i) $P = mg / A = (5.09 \times 9.81) / A$ C1

$A = (\pi d^2 / 4) = \pi \times (9.4 \times 10^{-2})^2 / 4$ $(= 0.00694\,\text{m}^2)$ C1

$P = 49.93 / 0.00694$
$= 7200\ (7195)\,\text{Pa}$ (minimum of 2 s.f. required) A1 [3]

(ii) $\Delta P / P = \Delta m / m + 2\Delta d / d$ C1

$= 0.01 / 5.09 + (2 \times 0.1) / 9.4$ $(= 0.0020 + 0.021$ or $2.3\%)$ C1

$\Delta P = 170\ (165 \text{ to } 167)\,\text{Pa}$ A1 [3]

(iii) $P = 7200 \pm 200\,\text{Pa}$ A1 [1]

3 (a) <u>random</u> error (in the measurements) of the length OR resistance B1 [1]

(b) gradient = $(3.6 - 1.9) / (0.8 - 0.4)$ C1
$= 4.25$ A1 [2]

(c) $R = \rho l / A$ C1

ρ = gradient × area $= 4.25 \times 0.12 \times 10^{-6}$ C1

$= 5.1(0) \times 10^{-7}\,\Omega\,\text{m}$ A1 [3]

(d) resistance decreasing with increasing area B1
correct shape with curve being asymptote to both axes B1 [2]

4 **(a)** **(i)** acceleration = $(v - u) / t$ or $(12 - 0.5) / 4$ C1

= $(12 - 0.5) / 4$ = 2.9 (2.875) (= approximately $3\,m\,s^{-2}$) M1 [2]

(ii) $x = (u + v)t / 2$

= $[(12 + 0.5) \times 4] / 2$ C1

= 25 m A1 [2]

(iii) line with increasing gradient M1
non-zero gradient at origin A1 [2]

(b) **(i)** weight down slope = $2 \times 9.81 \times \sin 25°$ = 8.29 / 8.3 M1 [1]

(ii) ($F = ma$) $8.3 - F_R = 2 \times 2.9$ C1

F_R = 2.5 (2.3 if 3 used for a) N A1 [2]

5 **(a)** **(i)** change in kinetic energy = $\frac{1}{2}mv^2$ C1

= $0.5 \times 25 \times (0.64)^2$ = 5.1(2) J A1 [2]

(ii) zero A1 [1]

(iii) (–) 5.1(2) J A1 [1]

(b) **(i)** PE = mgh C1

= $350 \times 0.64 \times 25$ C1

= 5600 J A1 [3]

(If full length used allow 1/3)

(ii) $P = Fv$ or gain in PE / t, E_P / t or work done / t, W / t C1

= 350×0.64 or 5600 / 25

= 220 (224) W A1 [2]

6 melting: solid to liquid B1
at a specific / one temperature / at the melting point B1

evaporation: liquid to vapour / gas OR molecules escape from surface of liquid B1
at all temperatures B1 [4]

7 **(a)** due to the lost volts in internal resistance / cell or energy losses in the internal resistance / cell — B1 [1]

(b) **(i)** $V = IR$ — C1

$= 1.2 \times 6 = 7.2\,\text{V}$ — A1 [2]

(ii) p.d. across Y and internal resistance $r = 4.8\,(\text{V})$ [12 – 7.2] — C1

resistance of Y + $r = 4.8 / 1.2 = 4\,(\Omega)$ — C1

resistance of Y = 4 – 0.5 = 3.5 Ω — A1 [3]

or

$R_{\text{total}} = 12 / 1.2 = 10\ (\Omega)$ — (C1)

X + $r = 6.5\ (\Omega)$ — (C1)

resistance of Y = 3.5 Ω — (A1)

(iii) $P = I^2 r$ — C1

$= (1.2)^2 \times 0.5 = 0.72\,\text{W}$ — A1 [2]

(c) terminal p.d. increases as R is increased
current decreases so there are less lost volts — B1 [1]

8 **(a)** two waves (of the same kind) travelling in opposite directions overlap — B1
waves have same frequency / wavelength and speed — B1 [2]

(b) **(i)** $T = 0.8\,(\text{ms})$ — C1

$f = 1 / (0.8 \times 10^{-3}) = 1250\,(\text{Hz})$ — A1 [2]

(ii) microphone is moved from plate to loudspeaker or vice versa — B1
wavelength is the twice the distance between adjacent maxima or minima (seen on c.r.o.) — B1 [2]

(iii) $v = f\lambda$ — C1

$= 1250 \times 0.26$

$= 330\ (325)\,\text{m s}^{-1}$ — A1 [2]