CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 series

9702 PHYSICS

9702/22 Paper 2 (AS Structured Questions), maximum raw mark 60

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1 **(a)** power = energy / time *or* work done / time B1

force: kg m s^{-2} (including from *mg* in *mgh* or *Fv*)

or kinetic energy ($\frac{1}{2}mv^2$): kg (m s^{-1})^2 B1

(distance: m and (time)$^{-1}$: s^{-1}) and hence power: kg m s^{-2} m s^{-1} = kg m^2 s^{-3} B1 [3]

(b) Q/t : kg m^2 s^{-3} C1

A: m^2 and x: m and T: K C1

correct substitution into $C = (Qx)/tAT$ or equivalent, or with cancellation C1

units of C : kg m s^{-3} K^{-1} A1 [4]

2 **(a)** $\rho = m/V$ C1

$V = (\pi d^2/4) \times t = 7.67 \times 10^{-7}$ m^3

$\rho = (9.6 \times 10^{-3})/[\pi(22.1/2 \times 10^{-3})^2 \times 2.00 \times 10^{-3}]$ C1

$\rho = 12513$ kg m^{-3} (allow 2 or more s.f.) A1 [3]

(b) **(i)** $\Delta\rho/\rho = \Delta m/m + \Delta t/t + 2\Delta d/d$ C1

= 5.21% + 0.50% + 0.905% [or correct fractional uncertainties] C1

= 6.6% (6.61%) A1 [3]

(ii) $\rho = 12\,500 \pm 800$ kg m^{-3} A1 [1]

3 **(a)** a body / mass / object continues (at rest or) at constant / uniform velocity unless acted on by a <u>resultant</u> force B1 [1]

(b) **(i)** weight <u>vertically</u> down B1

normal / reaction / contact (force) perpendicular / normal <u>to the slope</u> B1 [2]

(ii) **1.** acceleration = gradient *or* $(v - u)/t$ *or* $\Delta v/t$ C1

= (6.0 – 0.8)/(2.0 – 0.0) = 2.6 m s^{-2} M1 [2]

2. $F = ma$

= 65 × 2.6

= 169 N (allow to 2 or 3 s.f.) A1 [1]

3. weight component seen: mg sin θ (218 N) C1

218 – R = 169 C1

R = 49 N (require 2 s.f.) A1 [3]

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4 **(a)** GPE: energy of a mass due to its position in a gravitational field B1
KE: energy (a mass has) due to its motion / speed / velocity B1 [2]

(b) **(i)** **1.** KE $= \frac{1}{2} mv^2$ C1

$= \frac{1}{2} \times 0.4 \times (30)^2$ C1

$= 180\,\text{J}$ A1 [3]

2. $s = 0 + \frac{1}{2} \times 9.81 \times (2.16)^2$ *or* $s = (30 \sin 45°)^2 / (2 \times 9.81)$ C1

$= 22.88\ (22.9)\,\text{m}$ $= 22.94\ (22.9)\,\text{m}$ A1 [2]

3. GPE $= mgh$ C1
$= 0.4 \times 9.81 \times 22.88 = 89.8\ (90)\,\text{J}$ A1 [2]

(ii) **1.** KE = initial KE – GPE = 180 – 90 = 90 J A1 [1]

2. (horizontal) velocity is not zero / (object) is still moving / answer explained in terms of conservation of energy B1 [1]

5 **(a)** (Young modulus / E =) stress / strain B1 [1]

(b) **(i)** stress $= F/A$
or $= F/(\pi d^2/4)$
or $= F/(\pi d^2)$ M1

ratio = 4 (or 4:1) A1 [2]

(ii) E is the same for both wires (as same material) [e.g. $E_P = E_Q$] M1
strain = stress / E
ratio = 4 (or 4:1) [*must be same as* ***(i)***] A1 [2]

6 **(a)** there are no lost volts / energy lost in the battery
or there are no lost volts / energy lost in the internal resistance B1 [1]

(b) the current / I decreases (as R increases) M1
p.d. decreases (as R increases) A1

or

the parallel resistance (of X and R) increases M1
p.d. across parallel resistors increases, so p.d. (across Y) decreases A1 [2]

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(c) (i) current = 2.4 (A) C1
p.d. across AB = $24 - 2.4 \times 6 = 9.6\,\text{V}$ M1

or

total resistance = $10\,\Omega$ (= $24\,\text{V}/2.4\,\text{A}$) C1
(parallel resistance = $4\,\Omega$), p.d. = $24 \times (4/10) = 9.6$ V M1 [2]

(ii) R (AB) = $9.6/2.4 = 4.0\,\Omega$ C1
$1/6 + 1/X = 1/4$ [must correctly substitute for R] C1
$X = 12\,\Omega$ A1

or

$I_R = 9.6/6.0 = 1.6$ (A) (C1)
$I_X = 2.4 - 1.6 = 0.8$ (A) (C1)
X (= $9.6/0.8$) = $12\,\Omega$ (A1) [3]

(iii) power = VI *or* EI *or* V^2/R *or* E^2/R *or* I^2R C1
= 24×2.4 *or* $(24)^2/10$ *or* $(2.4)^2 \times 10$
= 57.6 W (allow 2 or more s.f.) A1 [2]

(d) power decreases M0

e.m.f. constant or power = 24 × current, and current decreases
or e.m.f. constant or power = 24^2 / resistance, and resistance increases A1 [1]

7 (a) waves from the double slit are coherent / constant phase difference B1

waves (from each slit) overlap / superpose / meet (**not** interfere) B1

maximum / bright fringe where path difference is $n\lambda$
or phase difference is $n360°/2\pi n$ rad
or minimum / dark fringe where path difference is $(n + \frac{1}{2})\lambda$
or phase difference is $(2n + 1)\,180°/(2n + 1)\pi$ rad B1 [3]

(b) $v = f\lambda$ C1
$\lambda = (3 \times 10^8) / 670 \times 10^{12} = 448$ (or 450) (nm) M1 [2]

(c) $w = 12 / 9$ C1
a (= $D\lambda/w$) = $(2.8 \times 450 \times 10^{-9}) / (12 / 9 \times 10^{-3})$ [allow nm, mm] C1
= 9.5×10^{-4} m [9.4×10^{-4} m using $\lambda = 448$ nm] A1 [3]

(d) (red light has) larger / higher / longer wavelength (must be comparison) M1
fringes further apart / larger separation A1 [2]

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