CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9702 PHYSICS

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

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1 (a) kelvin / K B1
ampere / amp / A B1 [2]
[allow mole / mol and candela / Cd]

(b) (i) energy OR work = force × distance [allow any energy expression] C1
units: kg m s^{-2} × m OR kg $(m\,s^{-1})^2$ for ½ mv^2 or mc^2 M1
(ignore any numerical factor)
= kg m^2 s^{-2} A0 [2]

(ii) units: ρ: kg m^{-3} g: m s^{-2} A: m^2 l_0: m C1
C: kg m^2 s^{-2} / kg^2 m^{-6} m^2 s^{-4} m^2 m^3 [any subject] C1
= kg^{-1} $m\,s^2$ (allow $m\,s^2$ / kg) A1 [3]

2 (a) $d = v \times t$ C1
$t = 0.2 \times 4$ (allow $t = 0.2 \times 2$) C1
$d = 3 \times 10^8 \times 0.8 \times 10^{-6}$ OR $3 \times 10^8 \times 0.4 \times 10^{-6}$ C1
d = 240 m hence distance from source to reflector = 120 m A1 [4]

(b) speed of sound 300 cf speed of light 3×10^8 OR time = 240 / 300 (= 0.8)
OR time = 120 / 300 (= 0.4) C1
sound slower by factor of 10^6 OR time for one division 0.8 / 4
OR time for one division 0.4 / 2 C1
time base setting 0.2 s cm^{-1} [unit required] A1 [3]

3 (a) (work =) force × distance moved / displacement in the direction of the force
OR when a force moves in the direction of the force work is done B1 [1]

(b) kinetic energy = ½ mv^2 C1
= ½ 0.4 $(2.5)^2$ = 1.25 / 1.3 J A1 [2]

(c) (i) area under graph is work done / work done = ½ Fx C1
1.25 = (14 x) / 2 C1
x = 0.18 (0.179) m [allow x = 0.19 m using kinetic energy = 1.3 J] A1 [3]

(ii) smooth curve from v = 2.5 at x = 0 to v = 0 at Q M1
curve with increasing gradient A1 [2]

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4 **(a)** torque of a couple = <u>one</u> of the forces / a force × distance — M1
multiplied by the <u>perpendicular distance between the forces</u> — A1 [2]

(b) **(i)** weight at P (vertically) down — B1
normal reaction OR contact force at (point of contact with the pin) P (vertically) up — B1 [2]

(ii) torque = 35 × 0.25 (or 25) × 2 — C1
= 18 (17.5) N m — A1 [2]

(iii) the two 35 N forces are equal and opposite and the weight and the upward / contact / reaction force are equal and opposite — B1 [1]

(iv) not in equilibrium as the (resultant) torque is not zero — B1 [1]

5 **(a)** **(i)** displacement is the distance the rope / particles are (above or below) from the equilibrium / mean / rest / undisturbed position (not 'distance moved') — B1 [1]

(ii) **1.** amplitude (= 80 / 4) = 20 mm — B1 [1]

2. $v = f\lambda$ or $v = \lambda / T$ — C1
$f = 1 / T = 1 / 0.2$ (5 Hz) — C1
$v = 5 \times 1.5 = 7.5\ \text{m s}^{-1}$ — A1 [3]

(b) point A of rope shown at equilibrium position — B1
same wavelength, shape, peaks / wave moved ¼λ to right — B1 [2]

(c) **(i)** progressive as energy OR peaks OR troughs is/are transferred/moved /propagated (by the waves) — B1 [1]

(ii) transverse as particles/rope movement is perpendicular to direction of travel /propagation of the energy/wave velocity — B1 [1]

6 **(a)** p.d. = work (done) / charge OR energy transferred from (electrical to other forms) / (unit) charge — B1 [1]

(b) **(i)** $R = \rho l / A$ — C1
$\rho = 18 \times 10^{-9}$ — C1
$R = (18 \times 10^{-9} \times 75) / 2.5 \times 10^{-6} = 0.54\ \Omega$ — A1 [3]

(ii) $V = IR$ — C1
$R = 38 + (2 \times 0.54)$ — C1
$I = 240 / 39.08 = 6.1$ (6.14) A — A1 [3]

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(iii) $P = I^2R$ or $P = VI$ **and** $V = IR$ or $P = V^2/R$ **and** $V = IR$ C1
$= (6.14)^2 \times 2 \times 0.54$ C1
$= 41\ (40.7)$ W A1 [3]

(c) area of wire is less (1/5) hence resistance greater ($\times 5$) M1
OR R is $\propto 1/A$ therefore R is greater
p.d. across wires greater so power loss in cables increases A1 [2]

7 **(a)** **(i)** the direction of the fields is the same OR fields are uniform OR constant electric field strength OR $E = V / d$ with symbols explained B1 [1]

(ii) reduce p.d. across plates B1
increase separation of plates B1 [2]

(iii) α opposite charge to β (as deflection in opposite direction) B1
β has a range of velocities OR energies (as different deflections) and
α all have same velocity OR energy (as constant deflection) B1
α are more massive (as deflection is less for greater field strength) B1 [3]

(b) $W = 234$ and $X = 90$ B1
$Y = 4$ and $Z = 2$ B1 [2]

(c) $A = 32$ and $B = 16$ and $C = 0$ and $D = -1$ B1 [1]

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