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GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

9702 PHYSICS

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

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

(b) kinetic energy, mass, power all three underlined B1 [1]

(c) **(i)** $s = ut + \frac{1}{2}at^2$
$15 = 0.5 \times 9.81 \times t^2$ C1
$T = 1.7$ s A1 [2]

if $g = 10$ is used then –1 but only once on paper

(ii) vertical component v_v:
$v_v^2 = u^2 + 2as = 0 + 2 \times 9.81 \times 15$ or $v_v = u + at = 9.81 \times 1.7(5)$
$v_v = 17.16$ C1
resultant velocity: $v^2 = (17.16)^2 + (20)^2$ C1
$v = 26\ \text{m s}^{-1}$ A1 [3]

If $u = 20$ is used instead of $u = 0$ then 0/3
Allow the solution using:
initial (potential energy + kinetic energy) = final kinetic energy

(iii) distance is the actual path travelled B1
displacement is the straight line distance between start and finish points (in that direction) / minimum distance B1 [2]

2 **(a)** **(i)** base units of D:
force: kg m s^{-2} B1
radius: m velocity: m s^{-1} B1

base units of D: $[F / (R \times v)]\ \text{kg m s}^{-2} / (\text{m} \times \text{m s}^{-1})$ M1
$= \text{kg m}^{-1}\text{s}^{-1}$ A0 [3]

(ii) **1.** $F = 6\pi \times D \times R \times v = [6\pi \times 6.6 \times 10^{-4} \times 1.5 \times 10^{-3} \times 3.7]$
$= 6.9 \times 10^{-5}$ N A1 [1]

2. $mg - F = ma$ hence $a = g - [F / m]$
$m = \rho \times V = \rho \times 4/3\ \pi R^3 = (1.4 \times 10^{-5})$ C1
$a = 9.81 - [6.9 \times 10^{-5}] / \rho \times 4/3\ \pi \times (1.5 \times 10^{-3})^3$ (9.81 – 4.88) M1
$a = 4.9(3)\ \text{m s}^{-2}$ A1 [3]

(b) **(i)** $a = g$ at time $t = 0$ B1
a decreases (as time increases) B1
a goes to zero B1 [3]

(ii) Correct shape below original line M1
sketch goes to terminal velocity earlier A1 [2]

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3 **(a)** **(i)** work done equals force × distance moved / displacement in the direction of the force — B1 [1]

(ii) power is the rate of doing work / work done per unit time — B1 [1]

(b) **(i)** kinetic energy = $\frac{1}{2} mv^2$ — C1
= $0.5 \times 600\ (9.5)^2$ — C1
= 27075 (J) = 27 kJ — A1 [3]

(ii) potential energy = mgh
= $600 \times 9.81 \times 4.1$ — M1
= 24132 (J) — A1
= 24 kJ — A0 [2]

(iii) work done = 27 – 24 = 3.0 kJ — A1 [1]

(iv) resistive force = 3000 / 8.2 (distance along slope = 4.1 / sin 30°) — C1
= 366 N — A1 [2]

4 **(a)** clamped horizontal wire over pulley or vertical wire attached to ceiling with mass attached — B1
details: reference mark on wire with fixed scale alongside — B1 [2]

(b) measure original length of wire to reference mark with metre ruler / tape — (B1)
measure diameter with micrometer / digital calipers — (B1)
measure initial and final reading (for extension) with metre ruler or other suitable scale — (B1)
measure / record mass or weight used for the extension — (B1)
good physics method:
measure diameter in several places / remove load and check wire returns to original length / take several readings with different loads — (B1)

MAX of 4 points — B4 [4]

(c) determine extension from final and initial readings — (B1)
plot a graph of force against extension — (B1)
determine gradient of graph for F / e — (B1)
calculate area from $\pi d^2 / 4$ — (B1)
calculate E from $E = F l / e A$ or gradient × l / A — (B1)

MAX of 4 points — B4 [4]

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5 (a) (i) energy converted from chemical to electrical when charge flows through cell or round complete circuit — B1

(ii) (resistance of the cell) causing loss of voltage or energy loss in cell — B1 [2]

(b) (i) $E_B - E_A = I(R + r_B + r_A)$
$12 - 3 = I(3.3 + 0.1 + 0.2)$ — C1
$I = 2.5$ A — A1 [2]

(ii) Power $= E \times I$
$= 12 \times 2.5$ — C1
$= 30$ W — A1 [2]

(iii) $P = I^2 \times R$ or $P = V^2 / R$ or $P = VI$
$= (2.5)^2 \times 3$ $= 9^2 / 3.6$ $= 9 \times 2.5$ — C1
$= 22.5\ \text{J s}^{-1}$ — A1 [2]

(c) power supplied from cell B is greater than energy lost per second in circuit — B1 [1]

6 (a) (i) to produce coherent sources or constant phase difference — B1 [1]

(ii) 1. 360° / 2π rad allow n × 360° or n × 2π (unit missing –1) — B1 [1]
2. 180° / π rad allow (n × 360°) – 180° or (n × 2π) – π — B1 [1]

(iii) 1. waves overlap / meet — B1
(resultant) displacement is sum of displacements of each wave — B1 [2]
2. at P crest on trough (OWTTE) — B1 [1]

(b) $\lambda = ax / D$ — C1
$= 2 \times 2.3 \times 10^{-3} \times 0.25 \times 10^{-3} / 1.8$ — C1
$= 639$ nm — A1 [3]

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