

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**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
vector has magnitude and direction B1 B1 [2]
- (b) kinetic energy, mass, power all three underlined B1 [1]
- (c) (i) $s = ut + \frac{1}{2} at^2$
 $15 = 0.5 \times 9.81 \times t^2$
 $T = 1.7 \text{ s}$ C1 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
 $v = 26 \text{ ms}^{-1}$ 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 ms^{-2} B1
radius: m velocity: ms^{-1} B1
- base units of D : $[F / (R \times v)] \text{ kg ms}^{-2} / (\text{m} \times \text{ms}^{-1})$ M1
 $= \text{kg m}^{-1} \text{s}^{-1}$ A0 [3]
- (ii) 1. $F = 6\pi \times D \times R \times v = [6\pi \times 6.6 \times 10^{-4} \times 1.5 \times 10^{-3} \times 3.7]$
 $= 6.9 \times 10^{-5} \text{ N}$ A1 [1]
2. $mg - F = ma$ hence $a = g - [F / m]$
 $m = \rho \times V = \rho \times \frac{4}{3} \pi R^3 = (1.4 \times 10^{-5})$ C1
 $a = 9.81 - [6.9 \times 10^{-5} / \rho \times \frac{4}{3} \pi \times (1.5 \times 10^{-3})^3]$ (9.81 – 4.88) M1
 $a = 4.9(3) \text{ ms}^{-2}$ 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 $\times$ 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 $= \frac{1}{2} mv^2$
 $= 0.5 \times 600 (9.5)^2$
 $= 27075 \text{ (J)} = 27 \text{ kJ}$ C1
C1
A1 [3]
- (ii) potential energy $= mgh$
 $= 600 \times 9.81 \times 4.1$
 $= 24132 \text{ (J)}$
 $= 24 \text{ kJ}$ M1
A1
A0 [2]
- (iii) work done $= 27 - 24 = 3.0 \text{ kJ}$ A1 [1]
- (iv) resistive force $= 3000 / 8.2$ (distance along slope $= 4.1 / \sin 30^\circ$)
 $= 366 \text{ N}$ C1
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 $\times l / A$ (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) $E_B - E_A = I(R + r_B + r_A)$
 $12 - 3 = I(3.3 + 0.1 + 0.2)$
 $I = 2.5 \text{ A}$ C1
A1 [2]
- (ii) Power = $E \times I$
 $= 12 \times 2.5$
 $= 30 \text{ W}$ C1
A1 [2]
- (iii) $P = I^2 \times R$ or $P = V^2 / R$ or $P = VI$
 $= (2.5)^2 \times 3$ $= 9^2 / 3.6$ $= 9 \times 2.5$
 $= 22.5 \text{ J s}^{-1}$ C1
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. $360^\circ / 2\pi \text{ rad}$ allow $n \times 360^\circ$ or $n \times 2\pi$ (unit missing –1) B1 [1]
2. $180^\circ / \pi \text{ rad}$ allow $(n \times 360^\circ) - 180^\circ$ or $(n \times 2\pi) - \pi$ 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
 $= 639 \text{ nm}$ A1 [3]