

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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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
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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  
 $v = 26 \text{ m s}^{-1}$  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:  $\text{kg m s}^{-2}$  B1  
radius: m velocity:  $\text{m s}^{-1}$  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.  $F = 6\pi \times D \times R \times v = [6\pi \times 6.6 \times 10^{-4} \times 1.5 \times 10^{-3} \times 3.7]$   
 $= 6.9 \times 10^{-5} \text{ N}$  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  
 $a = 4.9(3) \text{ m s}^{-2}$  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  $\times$  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]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
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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]