

## **MARK SCHEME for the May/June 2013 series**

### **9702 PHYSICS**

**9702/22**

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

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Page 2	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2013	9702	22

- 1 (a) power = energy / time  
= (force × distance / time) =  $\text{kg m}^2 \text{s}^{-2} / \text{s}$   
=  $\text{kg m}^2 \text{s}^{-3}$  C1  
C1  
A1 [3]
- (b) (i) units of  $L^2$ :  $\text{m}^2$  and units of  $\rho$ :  $\text{kg m}^{-3}$  and units of  $v^3$ :  $\text{m}^3 \text{s}^{-3}$   
( $C = P / L^2 \rho v^3$ ) hence units of C:  $\text{kg m}^2 \text{s}^{-3} \text{m}^{-2} \text{kg}^{-1} \text{m}^3 \text{m}^{-3} \text{s}^3$  C1  
or any correct statement of component units M1  
argument /discussion / cancelling leading to C having no units A1 [3]
- (ii) power available from wind =  $3.5 \times 10^5 \times 100 / 55$  (=  $6.36 \times 10^5$ ) C1  
 $v^3 = 3.5 \times 10^5 \times 100 / (55 \times 0.931 \times (25)^2 \times 1.3)$  C1  
 $v = 9.4 \text{ m s}^{-1}$  A1 [3]
- (iii) not all kinetic energy of wind converted to kinetic energy of blades B1  
generator / conversion to electrical energy not 100% efficient / heat B1  
produced in generator / bearings etc [2]  
(there must be cause of loss and where located)
- 2 (a) force = rate of change of momentum A1 [1]
- (b) (i) horizontal line on graph from  $t = 0$  to  $t$  about  $2.0 \text{ s} \pm \frac{1}{2}$  square,  $a > 0$  M1  
horizontal line at 3.5 on graph from 0 to 2 s A1  
vertical line at  $t = 2.0 \text{ s}$  to  $a = 0$  or sharp step without a line B1  
horizontal line from  $t = 2 \text{ s}$  to  $t = 4 \text{ s}$  with  $a = 0$  B1 [4]
- (ii) straight line and positive gradient M1  
starting at (0,0) A1  
finishing at (2,16.8) A1  
horizontal line from 16.8 M1  
from 2.0 to 4.0 A1 [5]
- 3 (a) the point where (all) the weight (of the body) M1  
is considered / seems to act A1 [2]
- (b) (i) vertical component of  $T$  (=  $30 \cos 40^\circ$ ) = 23 N A1 [1]
- (ii) the sum of the clockwise moments about a point equals the sum of the B1  
anticlockwise moments (about the same point) [1]
- (iii) (moments about A):  $23 \times 1.2$  (27.58) M1  
=  $8.5 \times 0.60 + 1.2 \times W$  M1  
working to show  $W = 19$  or answer of 18.73 (N) A1 [3]
- (iv) ( $M = W / g = 18.73 / 9.81$ ) = 1.9(09) kg A1 [1]

Page 3	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2013	9702	22

	(c) (for equilibrium) resultant force (and moment) = 0 upward force does not equal downward force / horizontal component of $T$ not balanced by forces shown	B1 B1	[2]
4	(a) apparatus: cell with particles e.g. smoke (container must be closed) diagram showing suitable arrangement with light illumination and microscope	B1 B1	[2]
	(b) specks / flashes of light in random motion	M1 A1	[2]
	(c) cannot see what is causing smoke to move hence molecules smaller than smoke particles	(B1)	
	continuous motion of smoke particles implies continuous motion of molecules	(B1)	
	random motion of particles implies random motion of molecules	(B1)	
		max. 2	[2]
5	(a) (i) $v = f\lambda$ $\lambda = 40 / 50 = 0.8(0) \text{ m}$	C1 A1	[2]
	(ii) waves (travel along string and) reflect at Q / wall / fixed end incident and reflected waves interfere / superpose	B1 B1	[2]
	(b) (i) nodes labelled at P, Q and the two points at zero displacement antinodes labelled at the three points of maximum displacement	B1 B1	[2]
	(ii) $(1.5\lambda \text{ for PQ hence } PQ = 0.8 \times 1.5) = 1.2 \text{ m}$	A1	[1]
	(iii) $T = 1 / f = 1/50 = 20 \text{ ms}$ 5 ms is $\frac{1}{4}$ of cycle horizontal line through PQ drawn on Fig. 5.2	C1 A1 B1	[3]
6	(a) charge = current $\times$ time	B1	[1]
	(b) (i) $P = V^2 / R$ $= (240)^2 / 18 = 3200 \text{ W}$	C1 A1	[2]
	(ii) $I = V / R = 240 / 18 = 13.3 \text{ A}$	A1	[1]
	(iii) charge = $It = 13.3 \times 2.6 \times 10^6$ $= 3.47 \times 10^7 \text{ C}$	C1 A1	[2]
	(iv) number of electrons = $3.47 \times 10^7 / 1.6 \times 10^{-19} (= 2.17 \times 10^{26})$ number of electrons per second = $2.17 \times 10^{26} / 2.6 \times 10^6 = 8.35 \times 10^{19}$	C1 A1	[2]

Page 4	Mark Scheme	Syllabus	Paper
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- 7 (a) (i)  $W = 206$  and  $X = 82$   
 $Y = 4$  and  $Z = 2$  A1  
A1 [2]
- (ii) mass-energy is conserved B1  
mass on rhs is less because energy is released B1 [2]
- (b) not affected by external conditions/factors/environment B1 [1]  
or two examples temperature and pressure