CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

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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1 (a) power = energy / time   C1
     = (force × distance / time) = kg m^2 s^{-2} / s   C1
     = kg m^2 s^{-3} A1   [3]

(b) (i) units of L^2: m^2 and units of ρ: kg m^{-3} and units of v^3: m^3 s^{-3} C1
($C = P / L^2 \rho v^3$) hence units of C: kg m^2 s^{-3} m^{-2} kg^{-1} m^3 m^{-3} s^3
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 × 10^5 × 100 / 55 (= 6.36 × 10^5)   C1
v^3 = 3.5 × 10^5 × 100 / (55 × 0.931 × (25)^2 × 1.3)   C1
v = 9.4 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
produced in generator / bearings etc   B1   [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 s ± ½ square, a > 0   M1
horizontal line at 3.5 on graph from 0 to 2 s   A1
vertical line at t = 2.0 s to a = 0 or sharp step without a line   B1
horizontal line from t = 2 s to t = 4 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°) = 23 N   A1   [1]

(ii) the sum of the clockwise moments about a point equals the sum of the
anticlockwise moments (about the same point)   B1   [1]

(iii) (moments about A): 23 × 1.2 (27.58)   M1
                  = 8.5 × 0.60 + 1.2 × 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]

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(c) (for equilibrium) resultant force (and moment) = 0   B1
upward force does not equal downward force / horizontal component of T
not balanced by forces shown   B1   [2]

4 (a) apparatus: cell with particles e.g. smoke (container must be closed)   B1
diagram showing suitable arrangement with light illumination and microscope   B1   [2]

(b) specks / flashes of light   M1
in random motion   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) $v = f\lambda$ C1
λ = 40 / 50 = 0.8(0) m   A1   [2]

(ii) waves (travel along string and) reflect at Q / wall / fixed end   B1
incident and reflected waves interfere / superpose   B1   [2]

(b) (i) nodes labelled at P, Q and the two points at zero displacement   B1
antinodes labelled at the three points of maximum displacement   B1   [2]

(ii) (1.5λ for PQ hence PQ = 0.8 × 1.5) = 1.2 m   A1   [1]

(iii) T = 1 / f = 1/50 = 20 ms   C1
5 ms is ¼ of cycle   A1
horizontal line through PQ drawn on Fig. 5.2   B1   [3]

6 (a) charge = current × time   B1   [1]

(b) (i) $P = V^2 / R$ C1
$= (240)^2 / 18 = 3200$ W   A1   [2]

(ii) $I = V / R$ = 240 / 18 = 13.3 A   A1   [1]

(iii) charge = It = 13.3 × 2.6 × 10^6 C1
$= 3.47 × 10^7$ C   A1   [2]

(iv) number of electrons = 3.47 × 10^7 / 1.6 × 10^{-19} (= 2.17 × 10^{26})   C1
number of electrons per second = 2.17 × 10^{26} / 2.6 × 10^6 = 8.35 × 10^{19} A1   [2]

7 **(a) (i)** W = 206 and X = 82   A1
            Y = 4 and Z = 2   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