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 = $3.5 \times 10^5 \times 100 / 55$ ($= 6.36 \times 10^5$) — C1
$v^3 = 3.5 \times 10^5 \times 100 / (55 \times 0.931 \times (25)^2 \times 1.3)$ — C1
$v = 9.4$ 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
$= 8.5 \times 0.60 + 1.2 \times W$ — 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]

(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 = $It = 13.3 \times 2.6 \times 10^6$ C1
$= 3.47 \times 10^7$ C A1 [2]

(iv) number of electrons = $3.47 \times 10^7 / 1.6 \times 10^{-19}$ ($= 2.17 \times 10^{26}$) C1
number of electrons per second = $2.17 \times 10^{26} / 2.6 \times 10^6 = 8.35 \times 10^{19}$ 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