CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 series

9702 PHYSICS

9702/21 Paper 2 (AS Structured Questions), maximum raw mark 60

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1 (a) (i) *either* rate of change of displacement
or (change in) displacement / time (taken) B1 [1]

(ii) speed has magnitude only B1
velocity has magnitude and direction B1 [2]

(b) (i) idea of area under graph / use of $s = \frac{(u+v)}{2} \times t$ C1

$s = \frac{(18+32)}{2} \times 2.5$ C1

$= 62.5$ m A1 [3]

(ii) $a = (18 - 32)/2.5$ (= –5.6) C1
$F = ma$ C1
$F = 1500 \times (-) 5.6 = (-) 8400$ N A1 [3]

(c) arrow labelled A and arrow labelled F both to the left B1 [1]

2 (a) (i) work (done) / time (taken) B1 [1]

(ii) work = force × displacement (in direction of force) B1
power = force × displacement / time (taken) = force × velocity B1 [2]

(b) (i) weight = mg C1

$P = Fv = 2500 \times 9.81 \times \sin 9° \times 8.5$ (or use $\cos 81°$) C1
$= 33$ (32.6) kW A1 [3]

(ii) no gain or loss of KE B1
no work (done) against air resistance B1 [2]

3 (a) (i) resultant force is zero B1

weight of plank + weight of man $= F_A + F_B$
or 200 (N) + 880 (N) *or* $1080 = F_A + F_B$ B1 [2]

(ii) principle of moments used C1
(anticlockwise moments) $F_B \times 5.0$ C1
(clockwise moments) $880 \times 0.5 + 200 \times 2.5$ C1
$F_B = (440 + 500)/5.0 = 188$ N A1 [4]

(b) straight line with positive gradient (allow freehand) M1
start point (0, 100) A1
finish point (5, 980) A1 [3]

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4 **(a)** kinetic energy = ½ mv^2 C1
= ½ × 0.040 × $(2.8)^2$ = 0.157 J or 0.16 J A1 [2]

(b) **(i)** $k = F/x$ *or* $F = kx$ C1
X_B = 14 / 800
= 0.0175 m A1 [2]

(ii) area under graph = elastic potential energy stored C1
or ½ kx^2 *or* ½ Fx
(energy stored =) 0.1225 J less than KE (of 0.16 J) A1 [2]

5 **(a)** **(i)** displacement is the distance from the
equilibrium position / undisturbed position / midpoint / rest position B1

amplitude is the maximum displacement B1 [2]

(ii) frequency is the number of wavefronts / crests passing a point
per unit time / number of oscillations per unit time B1

time period is the time between adjacent wavefronts
or time for one oscillation B1 [2]

(b) **(i)** **1.** amplitude = 1.5 mm A1 [1]

2. wavelength = 25 / 6 C1
= 4.2 cm or 4.2 × 10^{-2} m A1 [2]

(ii) $v = \lambda / T$ *or* $v = f\lambda$ <u>*and*</u> $T = 1/f$ C1
T = 4.2 / 7.5 = 0.56 s A1 [2]

(c) **(i)** progressive M0
wavefront / crests moving / energy is transferred by the waves A1 [1]

(ii) transverse M0
the vibration is perpendicular to the direction of energy transfer / wave velocity
or travel <u>of the wave / wavefronts</u> A1 [1]

6 **(a)** e.m.f.: energy converted from chemical / other forms to electrical
per unit charge B1
p.d.: energy converted from electrical to other forms per unit charge B1 [2]

(b) **(i)** the p.d. across the lamp is <u>less than</u> 12 V
or there are lost volts / power / energy in the battery / internal resistance B1 [1]

(ii) $R = V^2/P$ (or $V = RI$ <u>and</u> $P = VI$) C1
= 144 / 48
= 3.0 Ω A1 [2]

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(iii) $I = E/(R_T + r)$ C1
$= 12/2.0$
$= 6.0\,A$ A1 [2]

(iv) power of each lamp $= I^2R$
$= (3.0)^2 \times 3.0$ C1
$= 27\,W$ A1 [2]

(c) less resistance (in circuit) / more current M1
more lost volts / less p.d. across battery A1 [2]

7 **(a)** α: helium nucleus

β: electron

γ: <u>electromagnetic</u> radiation / wave / ray *or* photon

three correct 2 / 2, two correct 1 / 2 B2 [2]

(b) **(i)** atomic number / proton number / Z –2, nucleon / mass number / A –4 B1 [1]

(ii) atomic number / proton number / Z +1
nucleon / mass number / A no change B1 [1]

(iii) no change in proton or mass number
or "no change" B1 [1]

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