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

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.

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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]

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]

(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]