

**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.

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

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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  
 $= 62.5 \text{ m}$  A1 [3]
- (ii)  $a = (18 - 32)/2.5 (= -5.6)$  C1  
 $F = ma$  C1  
 $F = 1500 \times (-) 5.6 = (-) 8400 \text{ N}$  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  $\times$  displacement (in direction of force) B1  
power = force  $\times$  displacement/time (taken) = force  $\times$  velocity B1 [2]
- (b) (i) weight =  $mg$  C1  
 $P = Fv = 2500 \times 9.81 \times \sin 9^\circ \times 8.5$  (or use  $\cos 81^\circ$ ) 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  $200 \text{ (N)} + 880 \text{ (N)}$  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  
 $F_B = (440 + 500)/5.0 = 188 \text{ N}$  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 =  $\frac{1}{2}mv^2$   
 $= \frac{1}{2} \times 0.040 \times (2.8)^2 = 0.157 \text{ J or } 0.16 \text{ J}$  C1  
A1 [2]
- (b) (i)  $k = F/x$  or  $F = kx$  C1  
 $X_B = 14/800$   
 $= 0.0175 \text{ m}$  A1 [2]
- (ii) area under graph = elastic potential energy stored C1  
or  $\frac{1}{2}kx^2$  or  $\frac{1}{2}Fx$   
(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  
 $= 4.2 \text{ cm or } 4.2 \times 10^{-2} \text{ m}$  A1 [2]
- (ii)  $v = \lambda/T$  or  $v = f\lambda$  and  $T = 1/f$  C1  
 $T = 4.2/7.5 = 0.56 \text{ s}$  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 of the wave / wavefronts 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 less than 12 V  
or there are lost volts / power / energy in the battery / internal resistance B1 [1]
- (ii)  $R = V^2/P$  (or  $V = RI$  and  $P = VI$ ) C1  
 $= 144/48$   
 $= 3.0 \Omega$  A1 [2]

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

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

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

7 (a)  $\alpha$ : helium nucleus

$\beta$ : electron

$\gamma$ : electromagnetic 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]