

**PHYSICS****9702/23**

Paper 2 AS Level Structured Questions

**October/November 2016**

MARK SCHEME

Maximum Mark: 60

**Published**

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- 1 (a) (density =) mass/volume B1 [1]
- (b) (i)  $d = [(6 \times 7.5) / (\pi \times 8100)]^{1/3}$   
 $= 0.12(1) \text{ m}$  A1 [1]
- (ii) percentage uncertainty =  $(4 + 5) / 3$  (= 3%)  
*or*  
fractional uncertainty =  $(0.04 + 0.05) / 3$  (= 0.03) C1  
absolute uncertainty =  $(0.03 \times 0.121) = 0.0036$  C1  
 $d = 0.121 \pm 0.004 \text{ m}$  A1 [3]
- 2 (a) force per unit positive charge B1 [1]
- (b) (i) time =  $5.9 \times 10^{-2} / 3.7 \times 10^7$   
 $= 1.6 \times 10^{-9} \text{ s}$  ( $1.59 \times 10^{-9} \text{ s}$ ) A1 [1]
- (ii)  $E = V/d$  C1  
 $= 2500 / 4.0 \times 10^{-2}$   
 $= 6.3 \times 10^4 \text{ NC}^{-1}$  ( $6.25 \times 10^4$  or  $62500 \text{ NC}^{-1}$ ) A1 [2]
- (iii)  $a = Eq/m$  *or*  $F = ma$  and  $F = Eq$  C1  
 $= (6.3 \times 10^4 \times 1.60 \times 10^{-19}) / 9.11 \times 10^{-31} = 1.1 \times 10^{16} \text{ ms}^{-2}$  A1 [2]
- (iv)  $s = ut + \frac{1}{2}at^2$   
 $= \frac{1}{2} \times 1.1 \times 10^{16} \times (1.6 \times 10^{-9})^2$  C1  
 $= 1.4 \times 10^{-2} \text{ (m)}$  C1  
distance from plate =  $2.0 - 1.4$   
 $= 0.6 \text{ cm}$  (*allow 1 or more s.f.*) A1 [3]
- (v) electric force  $\gg$  gravitational force (on electron)/weight  
*or*  
acceleration due to electric field  $\gg$  acceleration due to gravitational field B1 [1]
- (vi)  $v_x-t$  graph: horizontal line at a non-zero value of  $v_x$  B1  
 $v_y-t$  graph: straight line through the origin with positive gradient B1 [2]

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- 3 (a) force/load is proportional to extension/compression (provided proportionality limit is not exceeded) B1 [1]
- (b) (i)  $k = F/x$  or  $k = \text{gradient}$  C1  
 $k = 600 \text{ N m}^{-1}$  A1 [2]
- (ii)  $(W =) \frac{1}{2}kx^2$  or  $(W =) \frac{1}{2}Fx$  or  $(W =) \text{area under graph}$  C1  
 $(W =) 0.5 \times 600 \times (0.040)^2 = 0.48 \text{ J}$  or  $(W =) 0.5 \times 24 \times 0.040 = 0.48 \text{ J}$  A1 [2]
- (iii) 1.  $(E_k =) \frac{1}{2}mv^2$  C1  
 $= \frac{1}{2} \times 0.025 \times 6.0^2$   
 $= 0.45 \text{ J}$  A1 [2]
2. (work done against resistive force  $=$ )  $0.48 - 0.45 [= 0.03(0) \text{ J}]$  C1  
average resistive force  $= 0.030/0.040$  C1  
 $= 0.75 \text{ N}$  A1 [3]
- (iv) efficiency  $= [\text{useful energy out}/\text{total energy in}] (\times 100)$  C1  
 $= [0.45/0.48] (\times 100)$   
 $= 0.94$  or  $94\%$  A1 [2]
- 4 (a) the number of oscillations per unit time of the source/of a point on the wave/of a particle (in the medium) M1  
or A1 [2]  
the number of wavelengths/wavefronts per unit time passing a (fixed) point (M1)  
(A1)
- (b)  $T$  or period  $= 2.5 \times 250 (\mu\text{s}) (= 625 \mu\text{s})$  M1  
frequency  $= 1/(6.25 \times 10^{-4})$  or  $1/(2.5 \times 250 \times 10^{-6}) = 1600 \text{ Hz}$  A1 [2]
- (c) (i) for maximum frequency:  $f_o = f_s v / (v - v_s)$   
 $1640 = (1600 \times 330) / (330 - v_s)$  C1  
 $v_s = 8(.0) \text{ m s}^{-1} (8.049 \text{ m s}^{-1})$  A1 [2]
- (ii) loudspeaker moving towards observer causes rise in/higher frequency B1  
loudspeaker moving away from observer causes fall in/lower frequency B1 [2]  
or  
repeated rise and fall/higher and then lower frequency (M1)  
caused by loudspeaker moving towards and away from observer (A1)

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- 5 (a) wave incident on/passes by or through an aperture/edge  
wave spreads (into geometrical shadow) B1  
B1 [2]
- (b)  $n\lambda = d \sin \theta$  C1  
substitution of  $\theta = 90^\circ$  or  $\sin \theta = 1$  C1  
 $4 \times 500 \times 10^{-9} = d \times \sin 90^\circ$   
line spacing =  $2.0 \times 10^{-6}$  m A1 [3]
- (c) wavelength of red light is longer (than 500 nm) M1  
(each order/fourth order is now at a greater angle so) the fifth-order maximum cannot be formed/not formed A1 [2]
- 6 (a)  $\frac{\text{work done or energy (transformed) (from electrical to other forms)}}{\text{charge}}$  B1 [1]
- (b) (i) 1.  $V = IR$  or  $E = IR$  C1  
 $I = 14/6.0$   
 $= 2.3$  (2.33) A A1 [2]
2. total resistance of parallel resistors =  $8.0 \Omega$  C1  
current =  $14/(6.0 + 8.0)$   
 $= 1.0$  A A1 [2]
- (ii)  $P = EI$  (allow  $P = VI$ ) or  $P = V^2/R$  or  $P = I^2R$  C1  
change in power =  $(14 \times 2.33) - (14 \times 1.0)$   
or  $(14^2/6.0) - (14^2/14)$   
or  $(2.33^2 \times 6.0) - (1.0^2 \times 14)$   
 $= 19$  W (18 W if 2.3 A used) A1 [2]
- (c)  $I = Anvq$   
ratio =  $(0.50n/n) \times (1.8 \text{ A}/\text{A})$  or ratio =  $0.50 \times 1.8$  C1  
 $= 0.90$  A1 [2]

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- 7 (a) hadron not a fundamental particle/lepton is fundamental particle  
*or*  
 hadron made of quarks/lepton not made of quarks  
*or*  
 strong force/interaction acts on hadrons/does not act on leptons B1 [1]
- (b) (i) proton: up, up, down/uud B1  
 neutron: up, down, down/udd B1 [2]
- (ii) composition:  $2(\text{uud}) + 2(\text{udd})$   
 $= 6 \text{ up, } 6 \text{ down}/6\text{u, } 6\text{d}$  B1 [1]
- (c) (i) most of the atom is empty space  
*or*  
 the nucleus (volume) is (very) small compared to the atom B1 [1]
- (ii) nucleus is (positively) charged B1
- the mass is concentrated in (very small) nucleus/small region/small volume/small core  
*or*  
 the majority of mass in (very small) nucleus/small region/small volume/small core B1 [2]