

---

**PHYSICS**

**9702/22**

Paper 2 AS Structured Questions

**October/November 2016**

MARK SCHEME

Maximum Mark: 60

---

**Published**

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.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2016 series for most Cambridge IGCSE<sup>®</sup>, Cambridge International A and AS Level components and some Cambridge O Level components.

Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9702	22

- 1 (a) (i) force / area (normal to the force) B1 [1]
- (ii) ( $p = F/A$  so) units:  $\text{kg m s}^{-2} / \text{m}^2 = \text{kg m}^{-1} \text{s}^{-2}$  A1 [1]
- allow use of other correct equations:  
e.g. ( $\Delta p = \rho g \Delta h$  so)  $\text{kg m}^{-3} \text{m s}^{-2} \text{m} = \text{kg m}^{-1} \text{s}^{-2}$   
e.g. ( $p = W/\Delta V$  so)  $\text{kg m s}^{-2} \text{m} / \text{m}^3 = \text{kg m}^{-1} \text{s}^{-2}$
- (b) units for  $m$ : kg,  $t$ : s and  $\rho$ :  $\text{kg m}^{-3}$  C1
- units of  $C$ :  $\text{kg/s}$  ( $\text{kg m}^{-3} \text{kg m}^{-1} \text{s}^{-2}$ )<sup>1/2</sup>  
or  
units of  $C^2$ :  $\text{kg}^2 / \text{s}^2 \text{kg m}^{-3} \text{kg m}^{-1} \text{s}^{-2}$  C1
- units of  $C$ :  $\text{m}^2$  A1 [3]
- 2 (a)  $\Delta E = mg\Delta h$  C1
- $= 0.030 \times 9.81 \times (-)0.31$
- $= (-)0.091 \text{ J}$  A1 [2]
- (b)  $E = \frac{1}{2}mv^2$  C1
- (initial)  $E = \frac{1}{2} \times 0.030 \times 1.3^2 (= 0.0254)$  C1
- $0.5 \times 0.030 \times v^2 = (0.5 \times 0.030 \times 1.3^2) + (0.030 \times 9.81 \times 0.31)$  so  $v = 2.8 \text{ ms}^{-1}$   
or  
 $0.5 \times 0.030 \times v^2 = (0.0254) + (0.091)$  so  $v = 2.8 \text{ ms}^{-1}$  A1 [3]
- (c) (i)  $0.096 = 0.030(v + 2.8)$  C1
- $v = 0.40 \text{ ms}^{-1}$  A1 [2]
- (ii)  $F = \Delta p / (\Delta)t$  or  $F = ma$   
 $= 0.096 / 20 \times 10^{-3}$  or  $0.030 (0.40 + 2.8) / 20 \times 10^{-3}$  C1
- $= 4.8 \text{ N}$  A1 [2]
- (d) kinetic energy (of ball and wall) decreases/changes/not conserved, so inelastic  
or  
(relative) speed of approach (of ball and wall) not equal to/greater than (relative) speed of separation, so inelastic. B1 [1]
- (e) force = work done / distance moved  
 $= (0.091 - 0.076) / 0.60$  C1
- $= 0.025 \text{ N}$  A1 [2]

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9702	22

- 3 (a) resultant force (in any direction) is zero B1  
 resultant moment/torque (about any point) is zero B1 [2]
- (b) (i) force =  $33 \sin 52^\circ$  or  $33 \cos 38^\circ$   
 = 26 N A1 [1]
- (ii)  $26 \times 0.30$  or  $W \times 0.20$  or  $12 \times 0.40$  C1  
 $26 \times 0.30 = (W \times 0.20) + (12 \times 0.40)$  C1  
 $W = 15 \text{ N}$  A1 [3]
- (c) (i)  $E = \Delta\sigma / \Delta\varepsilon$  or  $E = \sigma / \varepsilon$  C1  
 $\Delta\sigma = 2.0 \times 10^{11} \times 7.5 \times 10^{-4}$   
 $= 1.5 \times 10^8 \text{ Pa}$  A1 [2]
- (ii)  $\Delta\sigma = \Delta F / A$  or  $\sigma = F / A$  C1  
 $A = 78 / 1.5 \times 10^8 (= 5.2 \times 10^{-7} \text{ m}^2)$  C1  
 $5.2 \times 10^{-7} = \pi d^2 / 4$   
 $d = 8.1 \times 10^{-4} \text{ m}$  A1 [3]
- 4 (a) wave incident on/passes by or through an aperture/edge B1  
 wave spreads (into geometrical shadow) B1 [2]
- (b) (i) waves (from slits) overlap (at point X) B1  
 path difference (from slits to X) is zero/  
 phase difference (between the two waves) is zero  
 (so constructive interference gives bright fringe) B1 [2]
- (ii) difference in distances =  $\lambda / 2 = 580 / 2$   
 = 290 nm A1 [1]
- (iii)  $\lambda = ax / D$  C1  
 $D = [0.41 \times 10^{-3} \times (2 \times 2.0 \times 10^{-3})] / 580 \times 10^{-9}$  C1  
 = 2.8 m A1 [3]
- (iv) same separation/fringe width/number of fringes  
 bright fringe(s)/central bright fringe/(fringe at) X less bright  
 dark fringe(s)/(fringe at) Y/(fringe at) Z brighter  
 contrast between fringes decreases  
 Any two of the above four points, 1 mark each B2 [2]



Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9702	22

- 6 (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)  ${}^0_1\text{e}^{(+)}$  or  ${}^0_1\beta^{(+)}$  B1
- ${}^0_0\nu_{(\text{e})}$  B1 [2]
- (ii) weak (nuclear force / interaction) B1 [1]
- (iii) • mass-energy  
• momentum  
• proton number  
• nucleon number  
• charge
- Any three of the above quantities, 1 mark each* B3 [3]
- (c) (quark structure of proton is) up, up, down or uud B1
- up/u (quark charge) is  $(+)\frac{2}{3}(\text{e})$ , down/d (quark charge) is  $-\frac{1}{3}(\text{e})$  C1
- $\frac{2}{3}\text{e} + \frac{2}{3}\text{e} - \frac{1}{3}\text{e} = (+)\text{e}$  A1 [3]