

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**GCE Advanced Subsidiary Level and GCE Advanced Level****MARK SCHEME for the May/June 2010 question paper
for the guidance of teachers****9702 PHYSICS****9702/21**

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

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	GCE AS/A LEVEL – May/June 2010	9702	21
1	10^9 B1 c B1 mega B1 tera B1 [4]		
2	(a) scalar B1 scalar B1 vector B1 [3]		
	(b) (i) 1 gradient (of graph) is the speed/velocity (<i>can be scored here or in 2</i>)..... B1 initial gradient is zero B1 [2]		
	2 gradient (of line/graph) becomes constant B1 [1]		
	(ii) speed = $(2.8 \pm 0.1) \text{ m s}^{-1}$ A2 [2] (<i>if answer $> \pm 0.1$ but $\leq \pm 0.2$, then award 1 mark</i>)		
	(iii) curved line never below given line and starts from zero B1 continuous curve with increasing gradient B1 line never vertical or straight B1 [3]		
3	(a) <i>either</i> energy (stored)/work done represented by area under graph B1 or energy = <u>average</u> force $\times$ extension C1 energy = $\frac{1}{2} \times 180 \times 4.0 \times 10^{-2}$ A1 [3] = 3.6 J		
	(b) (i) <i>either</i> momentum before release is zero M1 so sum of <u>momenta</u> (of trolleys) after release is zero A1 or force = rate of change of momentum (M1) force on trolleys equal and opposite (A1) or impulse = change in momentum (M1) impulse on each equal and opposite (A1) [2]		
	(ii) 1 $M_1 V_1 = M_2 V_2$ B1 [1]		
	2 $E = \frac{1}{2} M_1 V_1^2 + \frac{1}{2} M_2 V_2^2$ B1 [1]		
	(iii) 1 $E_K = \frac{1}{2} m v^2$ and $p = m v$ combined to give M1 $E_K = p^2 / 2m$ A0 [1]		
	2 m smaller, E_K is larger because p is the same/constant M1 so trolley B A0 [1]		

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- 4 (a) when a wave (front) passes by/incident on an edge/slit M1
 wave bends/spreads (into the geometrical shadow) A1 [2]
- (b) $\tan \theta = \frac{38}{165}$
 $\theta = 13^\circ$ C1
 $d \sin \theta = n\lambda$ C1
 $d = 2.82 \times 10^{-6}$ C1
 number = $(1/d) = 3.6 \times 10^5$ A1 [4]
- (c) P remains in same position B1
 X and Y rotate through 90° B1 [2]
- (d) *either* screen not parallel to grating
or grating not normal to (incident) light B1 [1]
- 5 (a) region/area where a charge experiences a force B1 [1]
- (b) (i) left-hand sphere (+), right-hand sphere (–) B1 [1]
- (ii) 1 correct region labelled C within 10 mm of central part of plate
 otherwise within 5 mm of plate B1 [1]
- 2 correct region labelled D area of field not included for (b)(ii)1 B1 [1]
- (c) (i) arrows through P and N in correct directions B1 [1]
- (ii) torque = force $\times$ perpendicular distance (between forces) C1
 $= 1.6 \times 10^{-19} \times 5.0 \times 10^4 \times 2.8 \times 10^{-10} \times \sin 30$
 $= 1.1 \times 10^{-24} \text{ N m}$ A1 [2]
- 6 (a) (i) $P = VI$ C1
 $60 = 12 \times I$
 $I = 5.0 \text{ A}$ A1 [2]
- (ii) *either* $V = IR$ *or* $P = I^2 R$ *or* $P = V^2 / R$ C1
either $12 = 5 \times R$ *or* $60 = 5^2 \times R$ *or* $60 = 12^2 / R$ M1
 $R = 2.4 \Omega$ A0 [2]
- (b) $R = \rho L / A$ C1
 $A = \pi \times (0.4 \times 10^{-3})^2 (= 5.03 \times 10^{-7})$ C1
 $L = (2.4 \times 5.03 \times 10^{-7}) / (1.0 \times 10^{-6})$
 $= 1.2 \text{ m}$ A1 [3]
- (c) resistance is halved M1
either current is doubled *or* power $\propto 1/R$ M1
 power is doubled A1 [3]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
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- 7 (a) nuclei/atoms with same proton number/atomic number B1
nuclei/atoms contain different numbers of neutrons/different atomic mass B1 [2]
- (b) (i) 92 A1 [1]
(ii) 146 A1 [1]
- (c) (i) mass = $238 \times 1.66 \times 10^{-27}$ C1
= 3.95×10^{-25} kg A1 [2]
- (ii) volume = $\frac{4}{3} \pi \times (8.9 \times 10^{-15})^3$ (= 2.95×10^{-42}) C1
density = $(3.95 \times 10^{-25}) / (2.95 \times 10^{-42})$
= 1.3×10^{17} kg m⁻³ A1 [2]
- (d) nucleus contains most of mass of atom B1
either nuclear diameter/volume very much less than that of atom
or atom is mostly (empty) space B1 [2]