

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	
	<u>initial gradient</u> is zero	B1	[2]
	2 gradient (of line/graph) becomes constant	B1	[1]
	(ii) speed = (2.8 ± 0.1) m s ⁻¹	A2	[2]
	(<i>if answer > ±0.1 but ≤ ±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		
	or energy = <u>average</u> force × extension	B1	
	energy = ½ × 180 × 4.0 × 10 ⁻²	C1	
	= 3.6 J	A1	[3]
	(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 $\underline{E} = \frac{1}{2} M_1 V_1^2 + \frac{1}{2} M_2 V_2^2$	B1	[1]
	(iii) 1 E _K = ½mv ² and p = mv 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]

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
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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]

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