

**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

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.

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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]

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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
 $= 1.6 \times 10^{-19} \times 5.0 \times 10^4 \times 2.8 \times 10^{-10} \times \sin 30$
 $= 1.1 \times 10^{-24}$ N m A1 [2]
- 6 (a) (i) $P = VI$ C1
 $60 = 12 \times I$
 $I = 5.0$ A A1 [2]
- (ii) *either* $V = IR$ or $P = I^2R$ 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
 $L = (2.4 \times 5.03 \times 10^{-7}) / (1.0 \times 10^{-6})$
 $= 1.2$ 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]