

**MARK SCHEME for the May/June 2010 question paper
for the guidance of teachers**

9702 PHYSICS

9702/22

Paper 2 (AS Structured Questions)

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 must be read in conjunction with the question papers and the report on the examination.

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- 1 (a) micrometer/screw gauge/digital callipers B1
- (b) (i) look/check for zero error B1
- (ii) take several readings M1
- around the circumference/along the wire A1 [2]
- 2 (a) e.g. initial speed is zero
constant acceleration
straight line motion
(any two, one mark each)B2 [2]
- (b) (i) $s = \frac{1}{2}at^2$
 $0.79 = \frac{1}{2} \times 9.8 \times t^2$ C1
 $t = 0.40$ s allow 1 SF or greater A1
2 or 3 SF answer A1 [3]
- (ii) distance travelled by end of time interval = 90 cm C1
 $0.90 = \frac{1}{2} \times 9.8 \times t^2$
 $t = 0.43$ s allow 2 SF or greater C1
time interval = 0.03 s A1 [3]
- (c) (air resistance) means ball's speed/acceleration is less M1
length of image is shorter A1 [2]
- 3 (a) (i) force is rate of change of momentum B1 [1]
- (ii) force on body A is equal in magnitude to force on body B (from A)M1
forces are in opposite directions A1
forces are of the same kindA1 [3]
- (b) (i) 1 $F_A = -F_B$ B1 [1]
2 $t_A = t_B$ B1 [1]
- (ii) $\Delta p = F_A t_A = -F_B t_B$ B1 [1]
- (c) graph: momentum change occurs at same times for both spheres B1
final momentum of sphere B is to the right M1
and of magnitude 5 N s A1 [3]
- 4 (a) e.g. no energy transfer
amplitude varies along its length/nodes and antinodes
neighbouring points (in inter-nodal loop) vibrate in phase, etc.
(any two, 1 mark each to max 2B2 [2]

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(b)	(i)	$\lambda = (330 \times 10^2)/550$	M1	
		$\lambda = 60 \text{ cm}$	A0	
	(ii)	node labelled at piston	B1	
		antinode labelled at open end of tube	B1	
		additional node and antinode in correct positions along tube	B1	[3]
(c)		at lowest frequency, length = $\lambda/4$	C1	
		$\lambda = 1.8 \text{ m}$		
		frequency = $330/1.8$	C1	
		= 180 Hz	A1	[3]
5	(a)	(i)	Young modulus = stress/strain	C1
			data chosen using point in linear region of graph	M1
			Young modulus = $(2.1 \times 10^8)/(1.9 \times 10^{-3})$	
			= $1.1 \times 10^{11} \text{ Pa}$	A1
				[3]
		(ii)	This mark was removed from the assessment, owing to a power-of-ten inconsistency in the printed question paper.	
	(b)	area between lines represents energy/area under curve represents energy ..	M1	
		when rubber is stretched and then released/two areas are different	A1	
		this energy seen as thermal energy/heating/difference represents energy		
		released as heat	A1	[3]
6	(a)	either $P \propto V^2$ or $P = V^2/R$	C1	
		reduction = $(230^2 - 220^2)/230^2$		
		= 8.5 %	A1	[2]
	(b)	(i) zero	A1	[1]
		(ii) 0.3(0)A	A1	[1]
	(c)	(i) correct plots to within $\pm 1 \text{ mm}$	B1	[1]
		(ii) <u>reasonable line/curve</u> through points giving current as 0.12 A		
		<i>allow $\pm 0.005\text{A}$</i>	B1	[1]
		(iii) $V = IR$	C1	
		$V = 0.12 \times 5.0$		
		= 0.6(0)V	A1	[2]
	(d)	circuit acts as a potential divider/current divides/current in AC not the same as		
		current in BC	B1	
		resistance between A and C not equal to resistance between C and B	B1	
		or current in wire AC $\times R$ is not equal to current in wire BC $\times R$	B1	
		any 2 statements		[2]

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- 7 (a) (i) *either* helium nucleus
or contains 2 protons and 2 neutrons B1
- (ii) e.g. range is a few cm in air/sheet of thin paper
 speed up to 0.1 c
 causes dense ionisation in air
 positively charged or deflected in magnetic or electric fields
 (any two, 1 each to max 2) B2 [2]
- (b) (i) ${}^4_2\alpha$ B1
either ${}^1_1\text{p}$ or ${}^1_1\text{H}$ B1 [2]
- (ii) 1 initially, α -particle must have some kinetic energy B1 [1]
- (ii) 2 $1.1 \text{ MeV} = 1.1 \times 1.6 \times 10^{-13} = 1.76 \times 10^{-13} \text{ J}$ C1
 $E_K = \frac{1}{2}mv^2$ C1
 $1.76 \times 10^{-13} = \frac{1}{2} \times 4 \times 1.66 \times 10^{-27} \times v^2$ C1
 $v = 7.3 \times 10^6 \text{ m s}^{-1}$ A1 [4]
 use of $1.67 \times 10^{-27} \text{ kg}$ for mass is a maximum of 3/4