

**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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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9702	22

1	(a) micrometer/screw gauge/digital callipers	B1	[1]
	(b) (i) look/check for zero error	B1	[1]
	(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 kind	A1	[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 <u>and</u> antinodes neighbouring points (in inter-nodal loop) vibrate in phase, etc. (any two, 1 mark each to max 2	B2	[2]

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
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(b)	(i)	$\lambda = (330 \times 10^2)/550$	M1		
		$\lambda = 60 \text{ cm}$	A0	[1]	
	(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)	<i>either</i> $P \propto V^2$ <i>or</i> $P = V^2/R$	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</i> $\pm 0.005\text{A}$)	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 $\times R$ any 2 statements	B1	[2]	

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
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- 7 (a) (i) *either* helium nucleus
or contains 2 protons and 2 neutrons B1 [1]
- (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