

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

**9702 PHYSICS**

**9702/23**

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	(a) (i) 1% of $\pm 2.05$ is $\pm 0.02$	A1	[1]
	(ii) max. value is 2.08 V	A1	[1]
	(b) there may be a zero error/calibration error/systematic error which makes all readings either higher or lower than true value	M1 A1	[2]
2	(a) no resultant force/sum of forces zero no resultant moment/torque/sum of moments/torques zero	B1 B1	[2]
	(b) (i) each force is represented by the side of a triangle/by an arrow in magnitude and direction arrows joined, head to tail (could be shown on a sketch diagram)	M1 A1 B1	[3]
	(ii) if the triangle is 'closed' (then the forces are in equilibrium)	B1	[1]
	(c) triangle drawn with correct shape (incorrect arrows loses this mark) $T_1 = 5.4 \pm 0.2 \text{ N}$ $T_2 = 4.0 \pm 0.2 \text{ N}$	B1 B1 B1	[3]
	(d) forces in strings would be horizontal (so) no vertical force to support the weight	B1 B1	[2]
3	(a) evidence of use of area below the line distance = 39 m (allow $\pm 0.5 \text{ m}$ ) (if $> \pm 0.5 \text{ m}$ but $\leq 1.0 \text{ m}$ , then allow 1 mark)	B1 A2	[3]
	(b) (i) 1 $E_K = \frac{1}{2}mv^2$ $\Delta E_K = \frac{1}{2} \times 92 \times (6^2 - 3^2)$ $= 1240 \text{ J}$	C1 A1	[2]
	2 $E_P = mgh$ $\Delta E_P = 92 \times 9.8 \times 1.3$ $= 1170 \text{ J}$	C1 A1	[2]
	(ii) $E = Pt$ $E = 75 \times 8$ $= 600 \text{ J}$	C1 A1	[2]
	(c) (i) energy = $(1240 + 600) - 1170$ $= 670 \text{ J}$	M1 A0	[1]
	(ii) force = $670/39 = 17 \text{ N}$	A1	[1]
	(d) frictional forces include air resistance air resistance decreases with decrease of speed	B1 B1	[2]

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4	(a) (i) solid has fixed volume and fixed shape/incompressible	B1	[1]
	(ii) gas fills any space into which it is put	B1	[1]
	(b) atoms/molecules have (elastic) collisions with the walls (of the vessel) momentum of atom/molecule changes <u>so</u> impulse (on wall)/force on wall random motion/many collisions (per unit time) gives rise to (constant) force/pressure	B1 B1 B1 B1	[4]
4	(c) spacing (much) greater in gases than in liquids/about ten times <i>either</i> spacing depends on $1/\sqrt[3]{\rho}$ <i>or</i> ratio of spacings is about 8.8	C1 A1	[2]
	5	(a) (i) 1 number of oscillations per unit time (not per second) 2 $n\lambda$	B1 A1
5	(ii) $v = \text{distance} / \text{time} = n\lambda/t$ $n/t = f$ hence $v = f\lambda$ <i>or</i> $f$ oscillations per unit time so $f\lambda$ is distance per unit time distance per unit time is $v$ so $v = f\lambda$	M1 A1 M1 A1	[2]
	5	(b) (i) 1.0 period is $3 \times 2 = 6.0$ ms frequency = $1/(6 \times 10^{-3}) = 170$ Hz	C1 A1
(ii) wave (with approx. same amplitude and) with correct phase difference		B1	[1]
6	(a) (i) movement/flow of charged particles	B1	[1]
	(ii) work done per unit charge (transferred)	B1	[1]
6	(b) straight line through origin resistance = $V/I$ , with values for $V$ and $I$ shown = $20 \Omega$ (using the gradient loses the last mark)	B1 M1 A0	[2]
	6	(c) (i) 0.5 A	A1
(ii) <i>either</i> resistance of each resistor is $20 \Omega$ <i>or</i> total current = 0.8 A <i>either</i> combined resistance = $10 \Omega$ <i>or</i> $R = E/I = 10 \Omega$		C1 A1	[2]
6	(d) (i) 10 V	A1	[1]
	(ii) power = $EI$ = $10 \times 0.2 = 2.0$ W	C1 A1	[2]

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- 7 (a) (i) *either* helium nucleus  
or particle containing two protons and two neutrons B1 [1]
- (ii) allow any value between 1 cm and 10 cm B1 [1]
- (b) (i) energy =  $(8.5 \times 10^{-13}) / (1.6 \times 10^{-13})$   
= 5.3 MeV M1  
A0 [1]
- (ii) number =  $(5.3 \times 10^6) / 31$   
=  $1.7 \times 10^5$  (*allow 2 s.f. only*) C1  
A1 [2]
- (iii) number per unit length =  $(1.7 \times 10^5) / \text{(a)(ii)}$   
correct numerical value A1  
correct unit B1 [2]