MARK SCHEME for the May/June 2008 question paper

9702 PHYSICS

9702/02

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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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

• CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the May/June 2008 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



UNIVERSITY of CAMBRIDGE International Examinations

Page 2		2	Mark Scheme	Syllabus	Paper	
			GCE A/AS LEVEL – May/June 2008 9702		02	
(a)	allo	w any	ything in range 20 Hz \rightarrow 20 kHz		B1	[1]
(b)	allo	w any	ything in range 10 nm \rightarrow 400 nm		B1	[1]
(c)	allo	w any	ything in range 10 g \rightarrow 100 g		B1	[1]
(d)	allo	allow anything in range 0.1 kg m ⁻³ \rightarrow 10 kg m ⁻³			B1	[1]
(a)	(i)				C1 A1	[2]
	(ii)	<i>or</i> a ener	area under graph line gy = ½ × 800 × (3.5 × 10 ⁻²) ² or ½ × 28 × 3.5 × 10 ⁻	2	C1 M1 A0	[2]
(b)	(i)	0 =	$2400 \times V - 800 \times V$		C1 M1 A0	[2]
	(ii)	0.49	$= \frac{1}{2} \times 2.4 \times (\frac{1}{3}v)^2 + \frac{1}{2} \times 0.8 \times v^2$		C1 C1	
				max 1 mark)	A1	[3]
(a)	(i)	1.2 ²	= 2 × <i>a</i> × 1.9		M1 A1	[2]
	(ii)	=	42 × 0.38		M1 A0	[1]
(b)	pov				C1	
					A1	[2]
(c)	(i)	com	ponent = 42 × 9.8 × sin2.8 = 20.1 N		C1 A1	[2]
	(ii)	acce	eleration of trolley = $4.1 / 42 = 0.098 \text{ m s}^{-2}$		C1 C1	
		3.5	$= \frac{1}{2} \times 0.098 \times t^2$		C1 A1	[4]
	(a) (b) (c) (d) (a) (b)	(a) allo (b) allo (c) allo (c) allo (a) (i) (ii) (ii) (ii) (ii) (ii) (ii) (ii) (ii)	(a) allow any (b) allow any (c) allow any (c) allow any (d) allow any (a) (i) k is indicated (ii) $either or a energination (iii) either or a energination (iii) energination (iii) either or a energination (iii) either (iii) eithe$	GCE A/AS LEVEL - May/June 2008(a) allow anything in range 20 Hz \rightarrow 20 kHz(b) allow anything in range 10 nm \rightarrow 400 nm(c) allow anything in range 10 g \rightarrow 100 g(d) allow anything in range 0.1 kg m ⁻³ \rightarrow 10 kg m ⁻³ (a) (i) k is the reciprocal of the gradient of the graph $k = \{32 / (4 \times 10^{-2}) = \} 800 \text{ Nm}^{-1}$ (ii) either energy = average force × extension or $\frac{1}{2}kx^2$ or area under graph line energy = $\frac{1}{2} \times 800 \times (3.5 \times 10^{-2})^2$ or $\frac{1}{2} \times 28 \times 3.5 \times 10^{-2}$ energy = 0.49 J(b) (i) momentum before cutting thread = momentum after $0 = 2400 \times V - 800 \times v$ $v / V = 3.0$ (ii) energy stored in spring = kinetic energy of trolleys $0.49 = \frac{1}{2} \times 2.4 \times (\frac{1}{3}v)^2 + \frac{1}{2} \times 0.8 \times v^2$ $v = 0.96 \text{ m s}^{-1}$ (if only one trolley considered, or masses combined, allow(a) (i) $v^2 = 2as$ $1.2^2 = 2 \times a \times 1.9$ $a = 0.38 \text{ m s}^{-2}$ (ii) $F = ma$ $= 42 \times 0.38$ $= 16 \text{ N}$ (b) power = Fv $= 16 \times 1.2$ $= 19 \text{ W}$ (c) (i) component = $42 \times 9.8 \times \sin 2.8$ $= 20.1 \text{ N}$	GCE A/AS LEVEL - May/June 2008 9702 (a) allow anything in range 20 Hz → 20 kHz (b) allow anything in range 10 nm → 400 nm (c) allow anything in range 10 g → 100 g (d) allow anything in range 0.1 kg m ⁻³ → 10 kg m ⁻³ (a) (i) k is the reciprocal of the gradient of the graph $k = \{32/(4 \times 10^{-2}) = \} 800 \text{ Nm}^{-1}$ (ii) either energy = average force × extension or $\frac{1}{2}kx^2$ or area under graph line energy = $\frac{1}{2} \times 800 \times (3.5 \times 10^{-2})^2$ or $\frac{1}{2} \times 28 \times 3.5 \times 10^{-2}$ energy = 0.49 J (b) (i) momentum before cutting thread = momentum after $0 = 2400 \times V - 800 \times v$ $v / V = 3.0$ (ii) energy stored in spring = kinetic energy of trolleys $0.49 = \frac{1}{2} \times 2.4 \times (\frac{3}{4}v)^2 + \frac{1}{2} \times 0.8 \times v^2$ $v = 0.96 \text{ m s}^{-1}$ (if only one trolley considered, or masses combined, allow max 1 mark) (a) (i) $v^2 = 2as$ $1.2^2 = 2 \times a \times 1.9$ $a = 0.38 \text{ m s}^{-2}$ (ii) $F = ma$ = 42×0.38 = 16 N (b) power = Fv = 16×1.2 = 19 W (c) (i) component = $42 \times 9.8 \times \sin 2.8$ = 20.1 N (ii) accelerating force = $20.1 - 16 = 4.1 \text{ N}$ acceleration of trolley = $4.1/42 = 0.098 \text{ m s}^{-2}$ $s = \frac{3}{2}a^2t$ (ii) accelerating force = $20.1 - 16 = 4.1 \text{ N}$ acceleration of trolley = $4.1/42 = 0.098 \text{ m s}^{-2}$ $s = \frac{3}{2}a^2t$	GCE A/AS LEVEL - May/June 2008970202(a) allow anything in range 20 Hz \rightarrow 20 kHzB1(b) allow anything in range 10 m \rightarrow 400 nmB1(c) allow anything in range 10 g \rightarrow 100 gB1(d) allow anything in range 0.1 kg m ⁻³ \rightarrow 10 kg m ⁻³ B1(a) (i) k is the reciprocal of the gradient of the graph k = $\{32/(4 \times 10^{-2}) = \}$ 800 N m ⁻¹ C1(ii) either energy = average force × extension or ½kx²C1(iii) either energy = average force × extension or ½kx²C1(iii) energy = 0.49 JA0(b) (i) momentum before cutting thread = momentum after 0 = 2400 × V - 800 × v v / V = 3.0C1(ii) energy stored in spring = kinetic energy of trolleys (if only one trolley considered, or masses combined, allow max 1 mark)C1(ii) $v^2 = 2as$ 1 $2^2 = 2 \times a \times 1.9$ a = 0.38 m s ² M1 A1(iii) $F = ma$ $= 42 \times 0.38$ $= 16 N$ M1 A0(b) (i) component = 42 × 9.8 × sin2.8 $= 16 N$ C1 $= 20.1 N$ (c) (i) component = 42 × 9.8 × sin2.8 $= 20.1 N$ C1 $= 20.1 - 16 = 4.1 N$ $= 20.1 - 16 = 4.1 N$ $= 5 \frac{12}{3} \times 10^{2}$ C1 $= 1.2 \frac{12}{3} = 1.2 \frac{13}{3} = 1.2 \frac{13}{3} = 1.2 \frac{13}{3} = 1.2 \frac{13}{3} = 1.2 \frac{1.2}{3} = 1.2 $

	Page 3			Syllabus	Paper	
			GCE A/AS LEVEL – May/June 2008 9702		02	
(d) either or or (answer		or or	allows plenty of time to stop runaway trolley speed of trolley increases gradually trolley will travel faster r must be unambiguous when read in conjunction with ques	tion)	B1	[1]
4	(a)				B1 B1 B1	[1] [1] [1]
		(ii) eith or or	ner fluids cannot be deformed in one direction / cannot be fluids can only have volume change no fixed shape	stretched	B1	[1]
	(b)	either	unless Δp is very large or 2.2 × 10 ⁹ is a large number ΔV is very small or $\Delta V/V$ is very small, (so 'incompressil	ole')	M1 A1	[2]
	(c)	h = 9.8 $\Delta h / h = 0.8$	$10^5 = h \times 1.08 \times 10^3 \times 9.81$		C1 C1 A1	[3]
5	(a)	(i) free (ii) spe	quency: number of oscillations <u>per</u> unit time of the source / of a point on the wave speed at which energy is transferred / speed of w	ave <u>front</u>	M1 A1 B1	[2] [1]
		(ii) pos	es not transfer energy (along the wave) sition (along wave) where amplitude of vibration is a maximu three positions marked	um	B1 B1 B1	[1] [1] [1]
	(c)	$v = f\lambda$ $v = 12$ $= 44$ $44.5^{2} =$	ngth = 2×17.8 = 35.6 cm 25 × 0.356 4.5 m s ⁻¹ = 4.00 / m 0 × 10 ⁻³ kg m ⁻¹		C1 C1 C1 C1 A1	[5]

GCE A/AS LEVEL - May/June 20089702026(a) either $P = VI$ and $V = IR$ or $P = V^2/R$ C1resistance = 38.4 Ω A1(b) zeroB11.5 kWB13.0 kWB10.75 kWB12.25 kWB17(a) α -particle: either helium nucleus or contains 2 protons + 2 neutronsor $\frac{4}{2}$ HeB1 β -particle: either electron or $\frac{0}{-1}$ eB1 α speed < β speed(1) α discrete values of speed/energy, β continuous spectrum(1)either α ionising power >> β ionising power(1)or α range << β range(1) α positive, β negative (only if first two B marks not scored)(1) α mass > β mass (only if first two B marks not scored)(1) $(any two sensible pairs of statements relevant to differences,- do not allow statements relevant to only \alpha or \beta, 1 each, max 2)B2(b) (i) \frac{236}{92}U \rightarrow \frac{232}{90}Th+ \frac{4}{2}HeM1$	Page 4		ge 4	Mark Scheme	Syllabus	Paper	
The resistance = 38.4Ω A1(b) zeroB1 1.5 kW B1 3.0 kW B1 0.75 kW B1 2.25 kW B17 (a) α -particle: either helium nucleus or contains 2 protons + 2 neutronsB1 $\sigma r \frac{4}{2} \text{He}$ B1 β -particle: either helium nucleus or contains 2 protons + 2 neutronsB1 $\sigma r \frac{4}{2} \text{He}$ B1 β -particle: either electron or $-1e$ B1 α speed < β speed(1) α discrete values of speed/energy, β continuous spectrum(1) $either \alpha$ ionising power >> β ionising power(1) $\sigma r \alpha$ range << β range(1) α mass > β mass (only if first two B marks not scored)(1) $(\alpha ny two sensible pairs of statements relevant to differences,(1)- do not allow statements relevant to only \alpha or \beta, 1 each, max 2)B2(b) (i) \frac{236}{92}U \rightarrow \frac{232}{90}ThM1$				GCE A/AS LEVEL – May/June 2008	9702	02	
(c) 1.5 kW 3.0 kW 0.75 kW 2.25 kW (a) α -particle: either helium nucleus or contains 2 protons + 2 neutrons or $\frac{4}{2}$ He β -particle: either helium nucleus or contains 2 protons + 2 neutrons or $\frac{4}{2}$ He β -particle: either electron or $\frac{0}{-1}$ e α speed < β speed (1) α discrete values of speed/energy, β continuous spectrum (1) either α ionising power >> β ionising power or α range << β range (1) α positive, β negative (only if first two B marks not scored) (1) α mass > β mass (only if first two B marks not scored) (1) (any two sensible pairs of statements relevant to differences, - do not allow statements relevant to only α or β , 1 each, max 2) B2 (b) (i) $\frac{236}{92}$ U $\rightarrow \frac{232}{90}$ Th M1	6	(a)					[2]
$or \ {}^{4}_{2}He \qquad B1$ β -particle: <i>either</i> electron or ${}^{0}_{-1}e \qquad B1$ $\alpha \text{ speed } < \beta \text{ speed} \qquad (1)$ $\alpha \text{ discrete values of speed/energy, } \beta \text{ continuous spectrum } (1)$ <i>either</i> α ionising power >> β ionising power <i>or</i> $\alpha \text{ range } << \beta \text{ range} \qquad (1)$ $\alpha \text{ positive, } \beta \text{ negative } (only \text{ if first two B marks not scored}) \qquad (1)$ $\alpha \text{ mass } > \beta \text{ mass } (only \text{ if first two B marks not scored}) \qquad (1)$ $(any two sensible pairs of statements relevant to differences, - do not allow statements relevant to only \alpha \text{ or } \beta, 1 each, max 2) B2 $ (b) (i) ${}^{236}_{92}U \rightarrow {}^{232}_{90}Th$ M1		(b)	1.5 kW 3.0 kW 0.75 kW			B1 B1 B1	[5]
	7	(a)	β -particle α speed α discret <i>either</i> <i>or</i> α positiv α mass = <i>(any two</i>)	or ${}^{4}_{2}$ He e: either electron or ${}^{0}_{-1}$ e < β speed e values of speed/energy, β continuous spectrum α ionising power >> β ionising power α range << β range e, β negative (only if first two B marks not scored) > β mass (only if first two B marks not scored) sensible pairs of statements relevant to differences,	(1) (1) (1) (1) (1)	B1	[4]
		(b)	(i) ²³⁶ ₉₂ U				[2]

(ii) 1. correct position for U at Z = 92, N = 1452. correct position for Np relative to U i.e. Z + 1 and N - 1B1 [2]