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PHYSICS **9702/21**

Paper 2 AS Level Structured Questions **October/November 2017**

MARK SCHEME

Maximum Mark: 60

Published

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Question	Answer	Marks
1(a)	units of F: kg m s^{-2}	C1
	units of ρ: kg m^{-3} **and** units of v: m s^{-1}	C1
	units of K: kg m s^{-2} / [kg m^{-3} (m s^{-1})^2] = m^2	A1
1(b)(i)	$K\rho$ = 1.5 / 33^2	C1
	= 1.38 × 10^{-3} F_D = 1.38 × 10^{-3} × 25^2 **or** F_D / 1.5 = 25^2 / 33^2 F_D = 0.86 N	A1
1(b)(ii)	a = (1.5 – 0.86) / (1.5 / 9.81) **or** a = 9.81 – [0.86 / (1.5 / 9.81)]	C1
	a = 4.2 m s^{-2}	A1
1(c)	initial acceleration is g/9.81 (m s^{-2})/acceleration of free fall	B1
	acceleration decreases	B1
	final acceleration is zero	B1

Question	Answer	Marks
2(a)	$30\,\text{m s}^{-1} = 108\,\text{km h}^{-1}$ **or** $100\,\text{km h}^{-1} = 28\,\text{m s}^{-1}$ **and** so exceeds speed limit	**B1**
2(b)	acceleration = gradient **or** $\Delta v/(\Delta)t$ **or** $(v - u)/t$	**C1**
	e.g. acceleration = (24 – 20) / 12 [other points on graph line may be used] $= 0.33\,\text{m s}^{-2}$	**A1**
2(c)	distance travelled by Q = ½ × 12 × 30 (= 180 m)	**C1**
	distance travelled by P = ½ × (20 + 24) × 12 (= 264 m)	**C1**
	distance between cars = 264 – 180 = 84 m	**A1**
2(d)	$30 - 24 = 6\,\text{m s}^{-1}$ 'extra' time $T = 84/6$ (= 14 s) **or** $180 + 30T = 264 + 24T$ 'extra' time $T = 84/6$ (= 14 s)	**C1**
	$t = 12 + 14 = 26$ s	**A1**

Question	Answer	Marks
3(a)(i)	in a stationary wave energy is not transferred **or** in a progressive wave energy is transferred	**B1**
3(a)(ii)	in a stationary wave (adjacent) particles are in phase **or** in a progressive wave (adjacent) particles are out of phase/have a phase difference/not in phase	**B1**
3(b)(i)	(position where) maximum amplitude	**B1**
3(b)(ii)	distance = 0.10 m	**B1**
3(b)(iii)	**1.** λ = 0.60 / 1.5 = 0.40 m	**A1**
	2. $v = f\lambda$	**C1**
	f = 340 / 0.40 = 850 Hz	**A1**
3(b)(iv)	$\lambda = 2 \times 0.60$ **or** $\lambda = 3 \times 0.40$ **or** $f = 850/3$	**C1**
	f = 280 (283) Hz	**A1**

Question	Answer	Marks
4(a)	(strain =) extension / original length	B1
4(b)(i)	$E = \sigma / \varepsilon$	C1
	maximum stress $= 2.1 \times 10^{11} \times 4.0 \times 10^{-4}$ $= 8.4 \times 10^{7}$ Pa	A1
4(b)(ii)	$\sigma = F / A$	C1
	minimum area $= 8.0 \times 10^{3} / 8.4 \times 10^{7}$ $= 9.5 \times 10^{-5}$ m^2	A1

Question	Answer	Marks
5(a)	$I_1 + I_2 = I_3$ [any subject]	B1
5(b)	$E_1 + E_3 = I_1R_1 + I_3R_3 + I_3R_4$ [any subject]	B1
5(c)	$E_1 - E_2 = I_1R_1 - I_2R_2$ [any subject]	B1

Question	Answer	Marks
6(a)	force per unit positive charge	B1
6(b)(i)	$E_K = ½mv^2$	C1
	$2.4 \times 10^{-16} = ½ \times 1.7 \times 10^{-27} \times v^2$ $v = 5.3 \times 10^5\,\text{m s}^{-1}$	A1
6(b)(ii)	work done = 2.4×10^{-16} J	A1
6(b)(iii)	$W = Fs$	C1
	$F = 2.4 \times 10^{-16} / 15 \times 10^{-3}$ $= 1.6 \times 10^{-14}$ N	A1
6(b)(iv)	$V = Fd / Q$ **or** $V = W / Q$ **or** $E = V / d$ **and** $E = F / Q$	C1
	$V = (1.6 \times 10^{-14} \times 15 \times 10^{-3}) / 1.6 \times 10^{-19}$ **or** $2.4 \times 10^{-16} / 1.6 \times 10^{-19}$	C1
	= 1500 V	A1
6(b)(v)	straight line with positive gradient starting at the origin and going as far as x = 15 mm	B1

Question	Answer	Marks
7(a)	(the ohm is) volt / ampere	**B1**
7(b)(i)	$R = \rho L / A$	**C1**
	ratio = $[\rho L / (\pi d^2 / 4)] / [0.028\rho \times 7.0L / \{\pi(14d)^2 / 4\}] = 1000$ **or** ratio = $14^2 / (0.028 \times 7) = 1000$	**A1**
7(b)(ii)	same current (in connecting and filament wires) **and** the lamp/filament (wire) has greater resistance	**B1**
7(b)(iii)	$P = V^2 / R$ **or** $P = VI$ **or** $P = I^2R$	**C1**
	(for filament wire) $R = 12^2/6.0$ **or** $R = 6.0/0.50^2$ **or** $R = 12/0.50$	**C1**
	(for filament wire) $R = 24\,\Omega$ (for connecting wire) $R = 24 / 1000$ $= 2.4 \times 10^{-2}\,\Omega$	**A1**
7(b)(iv)	resistance of connecting wire increases	**B1**
	current in circuit/lamp/filament (wire) decreases **or** potential difference across lamp/filament (wire) decreases	**M1**
	(so) resistance of lamp/filament (wire) decreases	**A1**

Question	Answer	Marks
8(a)	(quark structure is) up, down, down/udd	**B1**
	up/u has charge +⅔(*e*), down/d has charge –⅓(*e*)	**C1**
	+⅔*e* –⅓*e* –⅓*e* = 0	**A1**
8(b)	charge: p +1.6(0) × 10^{-19} (C) **or** +*e* β^- –1.6(0) × 10^{-19} (C) **or** –*e* $\bar{\nu}$ zero/0	**B1**
	mass: p 1.67 × 10^{-27} (kg)/1.7 × 10^{-27} (kg) β^- 9.1(1) × 10^{-31} (kg) $\bar{\nu}$ very small/zero/0	**B1**