Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/21**

Paper 2 AS Level Structured Questions **October/November 2019**

MARK SCHEME

Maximum Mark: 60

Published

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Question	Answer	Marks
2(a)	the (two) plates are <u>vertical</u> (and separated)	**B1**
	left plate positively charged **and** right plate negatively charged/earthed **or** right plate negatively charged **and** left plate positively charged/earthed	**B1**
2(b)	$F = Eq$	**C1**
	$= 1.3 \times 10^4 \times 3.7 \times 10^{-9}$ $= 4.8 \times 10^{-5}$ N	**A1**
2(c)	$F^2 = (4.8 \times 10^{-5})^2 + (5.4 \times 10^{-5})^2$ so $F = 7.2 \times 10^{-5}$ N **or** $F = [(4.8 \times 10^{-5})^2 + (5.4 \times 10^{-5})^2]^{0.5}$ so $F = 7.2 \times 10^{-5}$ N	**A1**
2(d)	electric force is constant (because field strength/E is constant)	**B1**
	weight is constant (and so resultant force constant)	**B1**
2(e)(i)	$m = 5.4 \times 10^{-5} / 9.81$ $(= 5.5 \times 10^{-6})$	**C1**
	$a = 7.2 \times 10^{-5} / (5.5 \times 10^{-6})$ $= 13$ m s^{-2}	**A1**
2(e)(ii)	$v^2 = u^2 + 2as$ $v^2 = 2 \times 13 \times 0.58$	**C1**
	$v = 3.9$ m s^{-1}	**A1**

Question	Answer	Marks
3(a)	$\rho = m / V$	C1
	$V = \pi \times (0.16 / 2)^2 \times 7.6 \times 3.0$ (= 0.458 m^3)	C1
	$m = \pi \times (0.16 / 2)^2 \times 7.6 \times 3.0 \times 1.2 = 0.55$ kg	A1
3(b)(i)	$\Delta p = 0.55 \times 7.6$ = 4.2 N s	A1
3(b)(ii)	$F = 4.2 / 3.0$ **or** $0.55 \times 7.6 / 3.0$ = 1.4 N	A1
3(c)(i)	F = 1.4 N	A1
3(c)(ii)	Newton's third law (of motion)	B1
3(d)	$2 \times 1.4 = m \times 9.81$ m = 0.29 kg	A1
3(e)	the density of air is less at high altitude	B1
3(f)	$f_o = f_s v / (v - v_s)$ $= 3000 \times 340 / (340 - 22)$	C1
	= 3200 Hz	A1

Question	Answer	Marks
4(a)	$k = F / x$ **or** k = gradient	**C1**
	e.g. $k = 4.0 / 0.050$ $k = 80\ \text{N m}^{-1}$	**A1**
4(b)	$E = ½Fx$ **or** $E = ½kx^2$ **or** E = area under graph	**C1**
	$(\Delta)E = (½ \times 3.2 \times 0.040) – (½ \times 1.2 \times 0.015) = 0.055\ \text{J}$ **or** $(\Delta)E = (½ \times 80 \times 0.040^2) – (½ \times 80 \times 0.015^2) = 0.055\ \text{J}$ **or** $(\Delta)E = ½ \times (1.2 + 3.2) \times 0.025 = 0.055\ \text{J}$	**A1**
4(c)	$(\Delta)E\ = mg(\Delta)h$	**C1**
	$= 0.122 \times 9.81 \times (0.120 – 0.095)$ $= 0.030\ \text{J}$	**A1**
	or	
	$(\Delta)E\ = W \times (\Delta)h$	**(C1)**
	$= 1.2 \times 0.025$ $= 0.030\ \text{J}$	**(A1)**

Question	Answer	Marks
4(d)(i)	$E = 0.055 – 0.030$ $= 0.025$ J	A1
4(d)(ii)	$E = ½mv^2$	C1
	$v = [(2 \times 0.025) / 0.122]^{0.5}$ $= 0.64$ m s^{-1}	A1

Question	Answer	Marks
5(a)(i)	the dippers are connected to the same vibrator/motor	B1
5(a)(ii)	(the overlapping waves have) similar/same amplitude	B1
5(b)	any means of 'freezing' the pattern e.g. use a stroboscope/strobe	B1
5(c)	$vT = \lambda$ **or** $v = f\lambda$ **and** $f = 1 / T$	C1
	$T = 0.060 / 0.40$ $= 0.15$ s	A1
5(d)(i)	path difference = 3.0 cm	A1
5(d)(ii)	phase difference = 180°	A1
5(e)	line drawn joining points where only maxima are observed (i.e. through points where wavefronts intersect) of length at least 4 cm	B1

Question	Answer	Marks
6(a)	work done / charge **or** energy (transferred from electrical to other forms) / charge	**B1**
6(b)	for $V < 0.25$ V resistance is infinite/very high (as current is zero)	**B1**
	for $V > 0.25$ V resistance decreases (as V increases)	**B1**
6(c)(i)	$R = V / I$	**C1**
	$= 0.75 / (15 \times 10^{-3})$	**C1**
	$= 50\ \Omega$	**A1**

Question	Answer	Marks
6(c)(ii)	**1.** $V_Y = 15 \times 10^{-3} \times 60$ (= 0.90 V)	C1
	$V_X = 2.0 - 0.90 - 0.75$ (= 0.35 V)	C1
	$R_X = 0.35 / (15 \times 10^{-3})$ $= 23\ \Omega$	A1
	or	
	total $R = 60 + 50 + R_X$	(C1)
	$60 + 50 + R_X = 2.0 / (15 \times 10^{-3})$	(C1)
	$R_X = 23\ \Omega$	(A1)
	2. $P = VI$ **or** $P = EI$ **or** $P = I^2R$ **or** $P = V^2 / R$	C1
	ratio $= \dfrac{(15 \times 10^{-3})^2 \times 60}{2.0 \times 15 \times 10^{-3}}$ **or** $\dfrac{0.90 \times 15 \times 10^{-3}}{2.0 \times 15 \times 10^{-3}}$ **or** $\dfrac{(0.90^2 / 60)}{2.0 \times 15 \times 10^{-3}}$ $= 0.45$	A1

Question	Answer	Marks
7(a)(i)	proton number = 17 **and** nucleon number = 35	**A1**
7(a)(ii)	(electron) neutrino	**B1**
7(b)	d/down (quark charge) is $-\frac{1}{3}$(e) **or** two d/down (quark charges) is $-\frac{2}{3}$(e) **or** s/strange (quark charge) is $-\frac{1}{3}$(e)	**C1**
	charge = $-\frac{1}{3}(e) - \frac{1}{3}(e) - \frac{1}{3}(e)$ $= -1(e)$	**A1**