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Cambridge Pre-U Certificate

PHYSICS **9792/02**

Paper 2 Written Paper **May/June 2017**

MARK SCHEME

Maximum Mark: 100

Published

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Section A

Question	Answer	Marks
1(a)	(gravitational) force per unit mass **or** force / mass	**1**
1(b)(i)	at least 5 vertical lines equally spaced (by eye)	**1**
	arrowheads downwards	**1**
1(b)(ii)	one dashed, horizontal line	**1**
1(c)(i)	($\Delta V = g\Delta h$ = 9.81 × 15.5 =)152 (J kg^{-1})	**1**
1(c)(ii)	(v =) $\sqrt{2g\Delta h}$ **or** $\sqrt{2as}$ **or** $\sqrt{(2 \times 152(.055))}$	**1**
	17.4 (m s^{-1})	**1**

Question	Answer	Marks
2(a)(i)	when force is removed **and** the material returns to its original size and shape	**1**
2(a)(ii)	1 sensible suggestion e.g. ceramic, glass, concrete	**1**
	2 sensible suggestion e.g. any metal, copper	**1**
	3 sensible suggestion e.g. clay, plasticine, putty, plastic	**1**
2(b)(i)	(x =)Fl / EA **or** 12.8 × 9.81 × 7.65 / (3.51 × 10^{-2} × 1.86 × 10^{11})	**1**
	12.8 × 9.81 × 7.65 / (3.51 × 10^{-6} × 1.86 × 10^{11}) **or** 1.47 × 10^{-7} (m)	**1**
	1.47 × 10^{-3} (m) **or** 1.47 mm	**1**

Question	Answer	Marks
2(b)(ii)	(energy =)½*Fx* **or** ½ × 12.8 × 9.81 × 1.47 × 10^{-3}	**1**
	0.0924 (J)	**1**

Question	Answer	Marks
3(a)(i)	(momentum =) mass × velocity	**1**
3(a)(ii)	change in momentum **or** force × time	**1**
3(b)(i)	any **two** from air resistance <u>varies</u> (with speed) **or** flaps moved friction (with ground / runway / tarmac) <u>varies</u> thrust / (resultant) force varies mass of fuel decreases / fuel used up	**2**
3(b)(ii)	mentions area <u>under</u> graph	**1**
	(½ × 5 × 1.13 × 10^5) + (20 × 1.13 × 10^5) **or** 2.54 × 10^6	**1**
	(30 × 1.05 × 10^5 =)3.15 × 10^6	**1**
	(2.54 × 10^6 + 3.15 × 10^6 =)5.69 × 10^6 (N s)	**1**
3(b)(iii)	(*v* = *p* / *m* **or** 5.69 x 10^6 / 7.31 × 10^4) 77.9 (m s^{-1})	**1**
3(b)(iv)	curve of increasing gradient from origin	**1**
	line of constant gradient **and** decreasing positive gradient after 25.0 s	**1**
	gradient at 5.0 s remains constant	**1**
3(b)(v)	area under graph **or** (candidate's **(b)(iii)** / 2) × 55.0	**1**
	2000–3200 (m)	**1**

Question	Answer	Marks
4(a)(i)	at a junction, the algebraic sum of the currents is zero	**1**
4(a)(ii)	<table><tr><td>current / A</td><td>I_1</td><td>I_2</td><td>I_3</td><td>I_4</td><td>I_5</td><td>I_6</td><td>I_7</td></tr><tr><td></td><td>**3.25**</td><td>2.15</td><td>1.10</td><td>**0.25**</td><td>1.90</td><td>**1.35**</td><td>**3.25**</td></tr></table>	
	I_1 = 3.25 **and** I_7 = 3.25 **cao**	**1**
	I_4 = 0.25 **and** I_6 = 1.35 **cao**	**1**
4(b)(i)	in a closed loop, the sum of the emfs equals the sum of the pds	**1**
4(b)(ii)	V_1 = 2.4 (V) **and** V_3 = 8.0 (V) **cao**	**1**
	V_2 = 1.6 (V) **cao**	**1**
4(b)(iii)	B to A **or** upwards	**1**
	potential of A is 8.0 V **and** potential of B is 9.6 V	**1**
4(c)	first law: charge (conserved)	**1**
	second law: energy (conserved)	**1**

Question	Answer	Marks
5(a)	(sin r = sin 60.0° / 1.54); (r =)34.2(°)	**1**
	(length of ray in glass = 8.85 / cos 34.2° =)10.7 (cm)	**1**
	(60.0° – 34.2° =) 25.8(°)	**1**
	(displacement = 10.7 × sin (25.8°) =) 4.65 (cm)	**1**

Question	Answer	Marks
5(b)	ray with a smaller value of r **and** $r > 0$	**1**
	emerging parallel to the incident ray	**1**

Question	Answer	Marks
6(a)	two sine waves in antiphase	**1**
	intermediate sine waves	**1**
6(b)	a second sine wave of same wavelength on same axis	**1**
	separated by a quarter of the wavelength	**1**
6(c)	plane parallel wavefronts before the opening	**1**
	three (or more) wavefronts showing substantial diffraction after the opening	**1**
	same wavelength **and** greater than gap width	**1**

Question	Answer	Marks
7(a)	$^{235}_{92}U + {}^{1}_{0}n \rightarrow (^{236}_{92}U \rightarrow) {}^{143}_{54}Xe + {}^{90}_{38}Sr + 3\,{}^{1}_{0}n$ (+ energy)	
	left-hand side correct	**1**
	three neutrons on right	**1**
	rest of right-hand side correct	**1**
7(b)(i)	more than one neutron is produced	**1**
	more reactions started	**1**

Question	Answer	Marks
7(b)(ii)	to prevent the reaction rate/energy released/temperature increasing continuously **or** to prevent meltdown **or** to absorb neutrons	**1**
7(c)	(energy released =) $2.15 \times 10^{8} \times 1.60 \times 10^{-19}$ **or** 3.44×10^{-11} (J)	**1**
	(energy required =)$25.6 \times 4190 \times 42.0$ **or** 4.51×10^{6} (J)	**1**
	(number required =)$4.51 \times 10^{6} / 3.44 \times 10^{-11}$	**1**
	1.31×10^{17}	**1**
7(d)	720 / 28.8 **or** 25 (half-lives) **or** (A =) $4.93 \times 10^{8} \times e^{-0.0241 \times 720}$	**1**
	$4.93 \times 10^{8} / 2^{25}$ **or** (λ =)ln(2) / 28.8 **or** 0.693 / 28.8 **or** 0.0241 (yr^{-1})	**1**
	14.7 (Bq)	**1**

Question	Answer		Marks
8(a)(i)(ii)	**(i)** any **two** of:	**(ii)** explanation to match **(i)**	**2 + 2**
	immediate emission (even with weak illumination)	electron emitted when one photon absorbed	
	existence of threshold frequency	photon energy depends on frequency	
	(maximum) KE not influenced by intensity	all photons have the same energy (and only one is absorbed)	
	(maximum) KE depends on frequency	photon energy depends on frequency **or** only one photon absorbed	
	photoelectric current is (directly) proportional to intensity	number of photons is (directly) proportional to intensity	
	existence of stopping potential / maximum KE value	no more energy absorbed than that of one photon	
8(b)(i)	vary position of sliding contact		**1**
	measure V when $I = 0$		**1**

Question	Answer	Marks
8(b)(ii)	vary frequency (and measure stopping voltage)	**1**
	plot stopping voltage against frequency **or** use of $hf = \Phi + eV_S$	**1**
	(Planck constant =)$e \times$ gradient **or** eliminate Φ **and** find h	**1**

Question	Answer	Marks
9(a)	(600 / 120 =) 5.0 (hours)	**1**
9(b)(i)	any **three** points: increases quickly at first increases quickly until 10–15% charge rate of increase decreases between 15 and 50% charge then increases more slowly after 50% charge	**3**
9(b)(ii)	large increase in temperature / overheating	**1**
	large increase in pressure	**1**
	deposit of electrolyte at vent	**1**
9(c)(i)	substitution of E_{net} and r_{net} in $E=I(R+r)$ $3.72 = I(4.3 + 2.7)$	**1**
	(I =)0.53 (A)	**1**
9(c)(ii)	clockwise arrow drawn on Fig. 9.2	**1**

Question	Answer	Marks
9(c)(iii)	(V =)$4E - 4Ir$ **or** $(4 \times 1.24) - (0.53 \times 4 \times 0.54)$	**1**
	3.81 (V)	**1**
	or ($V = E + I(R + r)$ =) 1.24 + 0.53(4.3+0.54)	**(1)**
	3.81 (V)	**(1)**
9(d)(i)	when top / M is positive the current direction is MOP(N) **or** in W, left to right in cell (and in Z)	**1**
	when bottom / N is positive the current direction is NOP(M) or in Y, left to right in cell (and in X)	**1**
9(d)(ii)	**1** (the supply) voltage is less than voltage of cell / 1.24 V **or** less then the voltage needed across diodes / 1.4 V	**1**
	2 150 – 175 (2 mm) squares **or** $3.75 - 4.35 \times 10^{-4}$ (C)	**1**
	$3.90 - 4.20 \times 10^{-4}$ (C)	**1**
9(d)(iii)	2160 (C) **or** 21.6 / candidate's **(ii)2**	**1**
	51 400–55 400 s **or** 14.3–15.4 hours	**1**
9(e)(i)	voltage across capacitor increases (as it charges)	**1**
	decrease in pd across resistor reduces the current	**1**
	zero when the two pds are equal	**1**
9(e)(ii)	(calculation of time constant $CR = 6.25 \times 10^{-5} \times 0.54$ =) $3.37 / 8 \times 10^{-5}$ (s)	**1**
	$2.0 \times 10^{-4} / 3.38 \times 10^{-5} \approx 6$ **or** calculation of Q after 0.20 ms **or** 7.729×10^{-5} (C)	**1**
	correct conclusion (almost fully charged)	**1**