CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

MARK SCHEME for the October/November 2013 series

9792 PHYSICS

9792/02 Paper 2 (Written Paper), maximum raw mark 100

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.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Section A [75 marks]

Q	Marking Points	Marks	Totals	
1 (a)	(In Fig. 1.2) weight vertically down **and** (tension) force in string force of wind on kite upwards and to right three forces shown in equilibrium	1 1 1	3	
(b)	(In Fig. 1.3) weight and force of wind only shown explanation of how these two forces cannot be in equilibrium	1 1	2	**5**

2 (a) (i)	(pressure) = $h\rho g$ = 1.4 × 1000 × 9.8 13700 **or** 1.37×10^4 (Pa)	1 1		
(ii)	(3.2 × 1000 × 9.8) = 31400 **or** 3.14×10^4 (Pa)	1	3	
(b)	pressure difference = 31400 –13700 = 17700 **or** 1.77×10^4 (Pa) **ecf from (a)(i) and (a)(ii)** resultant force = 17700 × 0.45 = 7970 **or** 7.97×10^3 (N)	1 1	2	
(c)	volume of cylinder = 0.45 × 1.8 = 0.81 (m^3) mass of cylinder = 0.81 × 2400 = 1944 **or** 1.944×10^3 (kg) weight of cylinder = 1944 × 9.8 = 19050 **or** 1.905×10^4 (N) force on rod = 19050 – 7970 = 11100 **or** 1.11×10^4 (N) **ecf from 2(b)**	1 1 1	3	**8**

3 (a) (i)	<u>brittle</u>: a material that has (almost) zero plastic behaviour e.g. cast iron, ceramic, brick	1 1		
(ii)	<u>tough</u>: a material with a high resistance to breaking **or** large plastic deformation e.g. copper, mild steel, epoxy resin, (some) plastics	1 1		
(iii)	<u>ductile</u>: a material that can be plastically extended (drawn) <u>into a wire</u> e.g. copper (wire), (mild) steel **not just metal**	1 1	6	
(b) (i)	Young modulus = stress / strain values taken near end of straight line region of graph e.g. stress = 4×10^9 Pa; strain = 0.024 ± 0.001 E = $4 \times 10^9 / 0.024 = 1.7 \times 10^{11}$ (Pa)	1 1 1		
(ii)	5.9×10^9 (Pa)	1	4	
(c)	$5.9 \times 10^9 \times 4.2 \times 10^{-7}$ = 2480 **or** 2.48×10^3 (N)	1	1	
(d)	(as the sample is stretched) the cross-sectional area is not constant cross-sectional area <u>decreases</u>	1 1	2	**13**

4 (a)	same shape graph displaced <u>forwards</u> by between one and two months maximum at 20.5 °C <u>and</u> minimum at 7.5 °C <u>reason</u>: high thermal capacity (or equivalent) of the sea	1 1 1	3	
4 (b) (i)	energy supplied = 0.6 × 6.7 × 1000 × 3600 = 1.45 × 10^7 (J) **ecf from reading from graph** = $mc\Delta\theta$ = 1000 × 4200 × $\Delta\theta$ $\Delta\theta$ = 1.45 × 10^7/4.2 × 10^6 = 3.5 (°C)	1 1 1		
(ii)	during the night (a lot of) thermal energy (heat) will be lost (to the air) by radiation and/or convection **plus another valid reason** e.g. mixing effect of waves will distribute energy (over a larger volume) e.g. variable cloud cover will affect (rise and) fall of temperature	1 1 1	6	**9**

5 (a)	<u>emf</u>: energy per unit charge converted from other forms of energy into electrical energy from the supply <u>terminal pd</u>: energy per unit charge available at the terminals of the supply for conversion from electrical energy into other forms of energy	1 1 1	3	
(b) (i)	9.6 (V) (pd AB = 4.8 mA × 2.0 kΩ)	1		
(ii)	3.2 (mA) (current A to C = 8.0 mA – 4.8 mA)	1		
(iii)	12.8 (V) (pd AC = 3.2 mA × 4.0 kΩ) **ecf from (b)(ii)**	**both** 1		
(iv)	3.2 (V) (pd BC = 12.8 V – 9.6 V) **ecf from (b)(i) and (b)(iii)**			
(v)	0.4 (mA) (current BC = 3.2 V/8.0 kΩ) **ecf from (b)(iv)**	1		
(vi)	4.4 (mA) (current BD = 4.8 mA – 0.4 mA) **ecf from (b)(v)**	**all three** 1		
(vii)	3.6 (mA) (current CD = 8.0 mA – 4.4 mA) **ecf from (b)(vi)**			
(viii)	7.2 V (pd CD = 20 V – 12.8 V) **ecf from (b)(iii)**			
(ix)	2.0 (kΩ) (Resistance R_2 = 7.2 V / 3.6 mA) **ecf from (b)(vii) and (b)(viii)**	1		
(x)	8.0(mA) (current from D to battery)	1	7	
(c)	for series addition the current through each resistor must be the same and for parallel condition the potential difference across the resistors must be the same neither is true in this case	1 1	2	
(d)	(R =) 20 V / 8.0 mA = 2500 Ω **or** 2.5 kΩ	1 1	2	**14**

6 (a)	(wavelength =) 340 / 12000 = 2.83 × 10^{-2} (m) **or** 2.83 cm **or** 28.3 mm	1	1	
(b) (i)	at least a double wave drawn with obvious nodes and antinodes only three antinodes shown or labelled	1 1		
(ii)	wavelength (= 2.83 cm) correctly shown	1	3	
(c)	particles either side of a node are moving in opposite directions so at one moment they increase the pressure (at a node) and the next moment they reduce the pressure	1 1	2	
(d)	time for S–waves = 3300 / 2.7 = 1220 s **or** 1.22 × 10^{3} s time for P–waves = 3300 / 4.3 = 770 s time interval = 1200 –770 = 450 (s)	1 1	2	**8**

7 (a)

	alpha	beta	gamma		
nature	**particle**	particle	**electromagnetic**	both	1
charge	+2*e*	**– e**	**zero**		2
mass	**4u**	5.44 × 10⁻4 u	**zero**	both	1
penetrating power	stopped by a piece of paper	**stopped by thin aluminium (1 – 5 mm)**	**Stopped by thick lead**		2
ionising ability	**high**	**some**	small		2

(a) total: 8

(b)	<u>sources</u>: cosmic rays from space / medical procedures / fertilisers / food (and/or drink) / air / fall-out from Chernobyl / Fukushima / nuclear incidents / nuclear power / radon gas (from the ground) / rocks / air travel / luminous watches **any two** <u>how reduced</u>: shielding / moving (away from sources) / limiting air travel / insulating houses (against radon gas) / ventilating basements / safe disposal of nuclear waste / not trapping fertiliser particles / reducing unnecessary exposure **any two relevant to sources**	2 2	4	
(c) (i)	<u>random</u>: (slight) variation in counts per second / count rate in a given time interval	1		
(ii)	<u>spontaneous</u>: pressure / temperature / chemical reactions have no effect on the rate of decay	1	2	**14**

8 (a)	(wavelength =) $h/p = h/mv$ $= 6.63 \times 10^{-34}/(9.11 \times 10^{-31} \times 3.0 \times 10^{7}) = 2.43 \times 10^{-11}$ (m)	1 1	2	
(b)	idea of a diffraction pattern (on screen) circular pattern	1 1	2	**4**
		Section A total 75		

Section B [25 marks]				
Q	**Marking Points**	**Marks**	**Totals**	
9 (a) (i)	wavelength = 505 (seen) **or** f = c/λ **or** 5.05×10^{-7} m **or** 4.30×10^{-7} m (i.e. conversion from nm to metres) $3.00 \times 10^{8}/5.05 \times 10^{-7}$ 5.94×10^{14} (Hz)	1 1 1		
(ii)	(E =) hf **or** $6.63 \times 10^{-34} \times 5.94 \times 10^{14}$ 3.94×10^{-19} (J) **ecf from (a)(i)**	1 1		
(iii)	$3.94 \times 10^{-19}/1.60 \times 10^{-19}$ 2.46 (eV) **ecf from (a)(ii)**	1 1	7	
(b) (i)	Below this voltage not enough energy is supplied to an electron to promote it to the appropriate energy level	1		
(ii)	For the blue LED the energy of the photons/band gap is greater and so more energy (pd is energy/unit charge) is required **or *vice versa* for red LED**	1	2	
(c) (i)1	$v = c/n$ **or** $3.00 \times 10^{8}/4.24$ 7.08×10^{7} (m s^{-1})	1 1		
(i)2	$n = 1/\sin c$ **or** $c = \sin^{-1}(1/n)$ **or** $\sin c = 1/4.24$ 13.6°	1 1		
(ii)	reflection enables more light to emerge in the forward direction total internal reflection (TIR) can be used to do this **or** the critical angle can be chosen to get the maximum emission where it is required **or** it increases the critical angle	1 1	6	
(d) (i)	(P =) IV **or** 0.44 × 4.50 1.98 (W)	1 1		
(ii)	(3.35/1.98) = 1.69 (lm W^{-1}) **ecf from (d)(i)**	1	3	

(e)	domestic: use as indicator lights small domestic lighting efficient / low energy consumption / powered by dynamo (wind-up) white light source torches (large screen) TV / monitors no vacuum tube / thin / bright Christmas tree lights etc. low voltage device powered by batteries / portable / used outside remote control IR LED used Industrial: traffic lights motorway information directional display (e.g. ATM) light emitted in one direction cheap lightweight used in vehicles d.c. device UV LED used in sanitation / sterilisation used in medicine / for dermatitis technological: light source for fibre optic cables / cable TV / phones no warming up / immediate illumination HDTV headlamps / fog lamps etc. any sensible future use reason for sensible future use **Maximum 7 marks**	7		**25**

Section B total 25

Paper total 100