

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

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MARK SCHEME for the May/June 2013 series

9792 PHYSICS

9792/02

Paper 2 (Part A Written), maximum raw mark 100

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

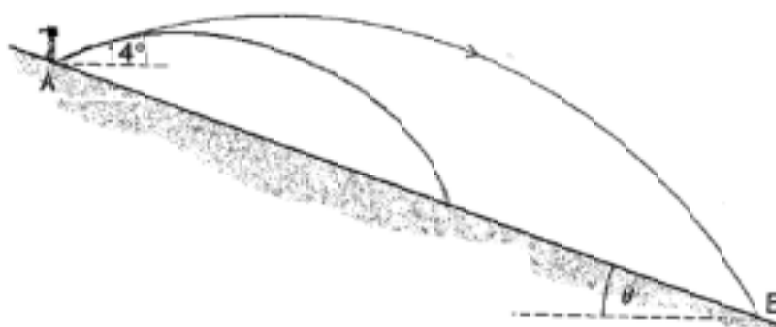
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- 1 (a) (i) horizontal component at A = $63 \cos 14 = 61.1 \text{ (ms}^{-1}\text{)}$ (1)
vertical component at A = $63 \sin 14 = 15.2 \text{ (ms}^{-1}\text{)}$ (1) [2]
- (ii) horizontal displacement = $61.1 \times 4.9 = 300 \text{ (m)}$ (1)
accept 299 (m) [1]
- (iii) vertical displacement = $ut + \frac{1}{2}at^2 = (15.2 \times 4.9) - (\frac{1}{2} \times 9.81 \times 4.9^2)$ (1)
= $74.5 - 117.8 = (-)43.0$ to 43.3 (m)
accept 44 (m), **ignore** sign (1) [2]
- (iv) the angle of the slope $\tan \theta = 43.3/300$ (1)
 $\theta = 8.2^\circ$ (1) [2]

(b) (i)



at least 3 mm along original path **and** then new path under present curve (1) [1]

- (ii) 1. path determined by movement of club **or** caused by same force in same direction **or** air resistance has acted for short time (1)
not if path stated to be different [1]
2. (air resistance) reduces upward velocity / deceleration (1)
allow WD against air resistance; **not** if height is greater (1)
(air resistance) reduces forward velocity (1)
not if maximum height is later (1)
3. forward/horizontal velocity (much) reduced (1)
not if angle smaller [4]

[Total: 12]

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- 2 (a) (i) $mgh = 6.0 \times 9.81 \times 1.64$ (1)
96.5(J) (1)
kinetic energy = $96.5 + 134 = 231$ (J) (1) [3]
- (ii) $\frac{1}{2}mv^2 = 231$ so $v^2 = 461/6$ (1)
 $v = \sqrt{460/6.0} = 8.77$ (ms⁻¹) (1)
momentum = $8.77 \times 6 = 52.6$ (52.596)(Ns) (1) [3]
- (b) force = momentum/time = (1)
= $52.6/0.013 = 4046$ (N) (1)
accept 4050/4060 (1) [2]
- (c) (because of the small time) the force is very large (1)
constant impulse/ change of momentum **or** greater rate of change of momentum (1) [2]

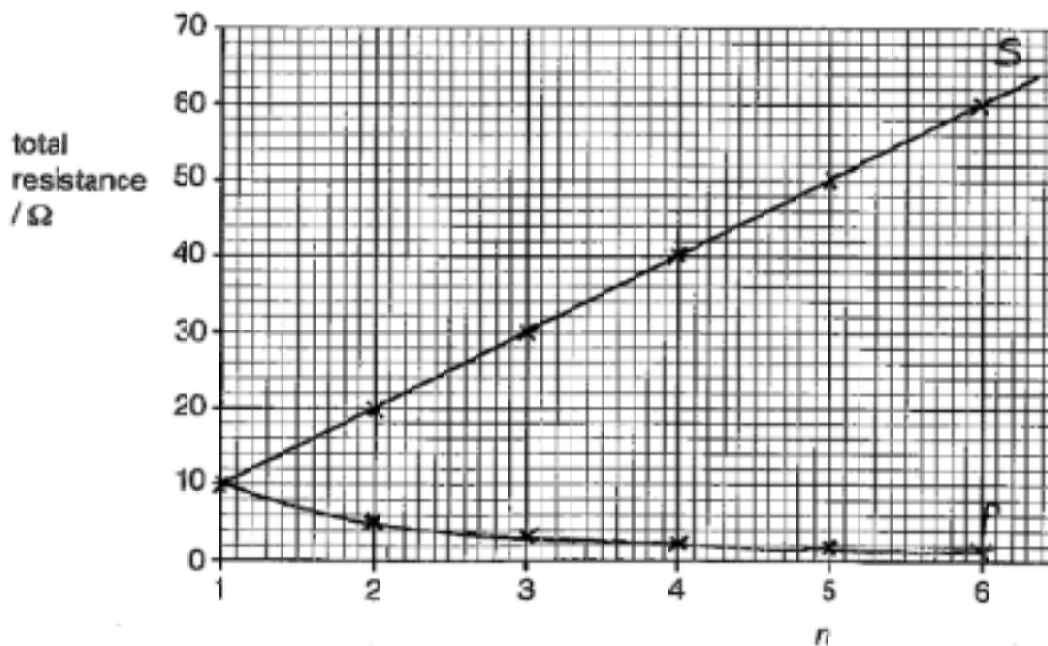
[Total: 10]

- 3 (a) (i) heat energy for raising temperature = $mc\Delta\theta = 65 \times 4200 \times 77$ (1)
= 2.10×10^7 (J) (1)
heat energy for conversion to steam = $65 \times 2.26 \times 10^6 = 1.47 \times 10^8$ (J) (1)
total heat required = 1.68×10^8 (J) (1) [4]
- (ii) power = 1.68×10^8 /time (1)
= $1.68 \times 10^8/1200 = 140\,000$ (W) (1) [2]
- (b) (i) power output = force x speed (1)
= $1800 \times 3.2 = 5760$ (W) (1) [2]
- (ii) efficiency = $5760/140000 = 4.1$ (%) **or** 0.041 (1)
NOT 0.041% (1) [1]

[Total: 9]

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- 4 (a) (i) electromotive force is the energy per unit charge (or power per unit current) (converted from other forms of energy or power) into electrical energy (or power) (1) [2]
- (ii) resistance is potential difference per unit current (1) [1]
- (b) (i) 1. total resistance = $10n$ (Ω) (1) [1]
 2. resistances 10, 20, 30, 40, 50 and 60Ω plotted as straight line graph (1) [2]



- (ii) 1. resistance = $10/n$ (Ω) (1)
 2. resistances = 10, 5, 3.3, 2.5, 2.0 and 1.7Ω graph plotted correctly (for values stated) (1) [3]
- (c) (i) 4 lines of 40Ω (1)
 total resistance 10Ω (1) [2]
- (ii) (always) 10Ω (1) [1]
- (iii) smaller current through each resistor (1) so capable of handling more power output (1)
 if one resistor faulty/inaccurate (1), total resistance close to 10Ω (1)
 (R unchanged 1/2 only)
 basic sensible suggestion (1); elaboration (1) (2) [2]

[Total: 14]

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- 5 (a) radio waves, microwaves and UV are transverse waves **and** ultrasound is a longitudinal wave (-1 e.e.o.o.) (2) [2]
- (b) a (transverse) wave in which all the oscillations take place in one plane
ignore direction (1)
 diagram showing this (in contrast to a non-polarised wave) (1) [2]
- (c) (i) amplitude = $A \cos 30 = 0.87 A$
ignore $\sqrt{3}/2$ (1) [1]
- (ii) 30° to the vertical (1) [1]
- (iii) amplitude = $A \cos 30 \times \cos 30 = 0.75 A$ (1)
 intensity \propto amplitude² (1)
 intensity = $I \times 0.75^2 = 0.56(25) I$
not A^2
 penalise fractions only once (1) [3]
- [Total: 9]**
- 6 (a) (i) 132 to 135 mm (1) [1]
- (ii) phase difference = 180 degrees or π radians (1) [1]
- (iii) actual value of $s = 2 \times 25 \text{ mm} = 49$ to 51 mm (1)
 ($D = 132 \text{ mm}$, $a = 22 \text{ mm}$, $s = 8 \times 132/22 =$) 48.4 mm (1)
 percentage difference = $(1.6 \text{ in } 50 \times 100 =)$ 3.2% (1) [3]
- (iv) any **two** from:
 the intensity of the wave from B will be less than that from A
 B is further from X than A
 the slit widths are not negligible (so situation is more complex than assumed)
 small angle approximation has been made **or** $\sin \theta \approx \theta$ (2) [2]
- (b) the amplitude of one high frequency wave, the carrier, varies in a manner determined by the amplitude of another wave (the modulating wave, the signal) (1)
 constant period of carrier wave **or** period much less for carrier wave (1)
 modulated amplitude (1) [3]
- (c) lowest frequency = 200 Hz (1)
 middle frequency = 3 times lowest frequency (allow 4 times / 800 Hz)
 = 600 Hz (1)
 highest frequency = 11 – 14 times lowest frequency
 = $2500 \pm 300 \text{ Hz}$ (1) [3]
- [Total: 13]**

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- 7 (a) (i) $E = hc/\lambda$ (and knowing what the terms mean) (1)
 $= 6.63 \times 10^{-34} \times 3.0 \times 10^8 / 6.44 \times 10^{-7} = 3.09 \times 10^{-19} \text{ (J)}$ (1) [2]
 $= 3.09 \times 10^{-19} / e$ (1)
 $= 3.09 \times 10^{-19} / 1.60 \times 10^{-19} = 1.93 \text{ (eV)}$ (1) [2]
- (ii) $7.87 \text{ W} / 3.09 \times 10^{-19} \text{ (J)}$ (1)
 $2.55 \times 10^{19} \text{ (s}^{-1}\text{)}$ (1) [2]
- (b) (too) low energy photons / (too) long wavelength / (too) low frequency (1)
electrons in most metals (except sodium and potassium) require UV radiation / work
function in metals high / work function low / below threshold frequency (1) [2]
- [Total: 8]**
- 8 (a) (i) (total no. of atoms =) number of atoms of isotope / abundance ratio (1)
or $1.82 \times 10^{22} / 0.00718$ **or** $1.82 \times 10^{22} / 0.0000718$ **or** $2.53 (4818942) \times 10^n$ (1)
 $2.53 (4818942) \times 10^{24}$ (1)
- (ii) $2.13 \times 10^9 / 7.10 \times 10^8$ **or** 3 half-lives **or** 2^3 **or** $1/2^3$ **or** $8 \times 1.82 \times 10^{22}$ (1)
 $1.46 (1.456) \times 10^{23}$ (1)
- (iii) $0.039890410964.00$ **or** 0.0400 **or** 3.989041096% **or** 4.00% (1)
allow 0.04 from $1.46 \times 10^{23} / 3.65 \times 10^{24}$ (1)
- (iv) too few uranium-235 atoms (in naturally occurring uranium) **or**
atomic abundance ratio too low (in naturally occurring uranium) (1)
chance of further fission, 1 **or** chance of 1 neutron hitting another (U-235)
nucleus too low **or** not enough neutrons emitted (1) [7]
- (b) (i) at least one β emission **or** ${}_{91}^{234}\text{X}$ **or** ${}_{91}^{234}\text{Pa}$ (1)
two β emissions (1)
- (ii) new uranium-234 **atoms** created (somehow/by decaying uranium-238) (1)
in equilibrium with uranium-238 **or** decay at same rate as produced **or**
as number of uranium-238 atoms decreases, so does number of uranium-234
atoms (1) [4]
- (c) (i) 1. 57 (1)
2. 89 (1)
- (ii) 1. $0.181 \times 1.66 \times 10^{-27} \times (3.00 \times 10^8)^2$ **or** $0.181 \times (3.00 \times 10^8)^2$ **or**
 $1.63 / 1.629 \times 10^{16}$ (1)
 $2.70(414) \times 10^{-11} \text{ (J)}$ (1)
2. $4.92(15348) \times 10^{11} \text{ (J)}$ (1)
(do not penalise J/kg as wrong unit) (1) [5]

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- (d) (i) all uranium atoms undergo the same chemical reactions/behaviour/properties
ignore chemical means (1)
- (ii) more liberated neutrons can escape through the sides of the rod before hitting
another uranium-235 nucleus **or** large surface area to volume ratio (1) [2]
- (e) **social**
- political/‘nimby’ opposition (1)
 - terrorist target/dirty bomb (1)
 - accidents unlikely (1)
 - built away from population centres (1)
 - unattractive (in rural/coastal areas) (1)
 - jobs created (1)
 - operate continuously (1)
 - large power output (1)
 - (public perception of) leading to nuclear weapons (1)
- environmental**
- no CO₂ emitted/small carbon footprint/no greenhouse gases emitted/ less global warming (1)
 - radioactive waste long lasting (1)
 - radioactive waste dangerous (1)
 - land uninhabitable due to accidents (1)
 - radiation escape to surroundings (1)
 - danger of tsunami/ earthquake (1)
 - volume of waste small (1)
 - small area (1)
 - mining for uranium dirty (1)
 - long term storage needed (1)
- economic**
- expensive to build (1)
 - expensive maintenance (1)
 - difficult/expensive disposal of waste (1)
 - not easily switched on/off (1)
 - creates jobs (do not credit twice) (1)
 - decommissioning costs (1)
 - fuel cheap/power station cheap to run (1)
 - fuel abundant (1)
 - easy to transport (1)
- at least two from each category [max 7]

[Total: 25]