# Physics H2 Prelim Papers 2007

## Solutions

| Q | ACJC | AJC | CJC | HCI | MJC | NJC | NYJC | RJC | SAJC | TJC | VJC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A | D | C | D | A | A | D | B | A | A | D |
| 2 | C | D | C | D | A | B | C | D | C | C | D |
| 3 | C | B | C | C | B | C | A | D | B | B | C |
| 4 | A | C | B | A | A | B | C | A | B | A | C |
| 5 | D | A | B | B | B | D | A | D | C | B | A |
| 6 | B | C | D | D | A | D | A | C | B | D | C |
| 7 | C | D | C | B | B | C | A | C | C | B | B |
| 8 | C | C | D | A | A | A | D | D | B | C | D |
| 9 | D | C | B | D | A | B | B | A | D | B | D |
| 10 | A | D | B | B | B | A | D | B | D | A | B |
| 11 | B | C | D | A | D | A | B | D | C | D | A |
| 12 | B | B | A | D | A | C | C | C | C | C | A |
| 13 | A | B | A | A | A | D | B | A | A | C | C |
| 14 | D | B | C | A | D | D | A | B | A | A | B |
| 15 | C | A | D | A | B | B | B | C | B | C | D |
| 16 | B | C | A | C | B | B | D | B | B | D | C |
| 17 | D | D | B | C | B | D | B | C | D | A | B |
| 18 | B | B | B | B | D | B | D | D | A | A | C |
| 19 | B | C | A | B | C | D | B | A | A | D | C |
| 20 | D | C | C | C | A | B | C | A | A | D | D |
| 21 | A | B | D | C | A | C | B | C | D | B | A |
| 22 | A | D | D | D | B | C | C | B | D | A | D |
| 23 | A | D | D | B | D | C | C | D | D | C | A |
| 24 | A | B | D | D | C | C | D | B | C | A | B |
| 25 | B | D | B | D | D | A | B | A | B | D | B |
| 26 | A | B | D | C | C | B | D | A | B | A | D |
| 27 | B | A | A | C | A | C | C | B | C | D | D |
| 28 | A | D | A | A | C | D | B | D | B | B | A |
| 29 | C | C | C | D | A | C | A | D | D | A | C |
| 30 | A | A | C | B | C | B | C | C | B | B | B |
| 31 | C | B | A | B | A | A | D | C | A | B | A |
| 32 | A | B | B | B | B | C | C | A | B | A | B |
| 33 | B | A | C | D | D | D | B | A | B | D | C |
| 34 | C | B | B | C | B | C | C | C | D | C | D |
| 35 | A | A | A | B | B | D | A | C | A | D | C |
| 36 | D | D | D | C | C | A | A | C | B | C | B |
| 37 | C | B | C | C | D | D | C | A | B | C | C |
| 38 | A | C | C | A | C | A | D | A | B | D | C |
| 39 | C | C | D | C | B | A | B | B | A | B | B |
| 40 | C | A | B | A | D | A | D | B | C | D | B |

| P2 | Part | ACJC | AJC | |
|---|---|---|---|---|
| 1 | ai | Position B (bottom/lowest point of loop) | Apple's speed at moment of release = 2.0 $ms^{-1}$ | |
| | aii | If speed uniform, speed throughout is the same so neither max. nor min.<br>OR<br>Not comfortable if N too high, hence speed should be as low as possible (min.) or there is a max. allowed speed. | Acceleration = 9.81 $ms^{-1}$ | |
| | aiii | - | $s = ut + \frac{1}{2}at^2$ , $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$<br>t = 6.59 s or -6.18 s (NA) | |
| | bi | At B, $N_B \leq 1.05mg$<br>$mv^2/r = N_B - mg$<br>$v_B = 4.95\ ms^{-1}$ ( 4.9 possible, reject 5.0 because $N_B \leq 1.05mg$) | Weight of object = resistive F<br>k = 0.199<br>base units of k = kg $m^{-1}$ | |
| | bii | Smallest force occurs at the top (position T)<br>$mv^2/r = mg - N_T$<br>If $v_T = v_B \rightarrow N_T = 559$ N | | |
| 2 | a | V = 0.23V | - | |
| | bi | $V_R = V_B\left(\frac{100}{100+10}\right)$ and $V_R = V$ | (scan in picture) | |
| | bii | $R = 22k\Omega$ | Resultant F = centripetal F<br>= 1.3 x $10^5$ N<br>Direction = towards center of | |

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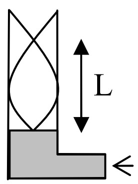
| | | | (horizontal) circle. | |
| | ci | M to X and N to Y | - | |
| | cii | When dark $V_{LDR}$ = 5.45 V<br>$V_Y - V_X \geq 5.0$ V OR $V_N - V_M \geq 5.0$ V<br>→ then lamp lights up<br>$V_R = V_{LDR} - 5.0$<br>R = 180 Ω | - | |
| 3 | ai | 1st resonance | Refer to notes. | |
| | aii | 2nd resonance occurs.<br>Length of water column = 0.833 m<br>$\frac{1}{2}\lambda = L$ (1/2) → $\lambda = 1.67m$ | | |
| | bi | $f_2 = 420Hz$ $f_1 = 315Hz$<br>$n\lambda_1 = (n+1)\lambda_2$ $\lambda = \frac{v}{f}$<br>$n = 3$ v=157.5ms$^{-1}$<br>$f_0 = \frac{v}{2L} = 105Hz$ | Slit separation < 1.0 mm<br>Fringe separation, $x = \lambda D/d$<br>x = 1.04 mm | |

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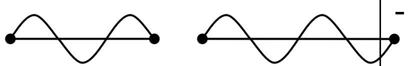
| | bii | (?) | 1. bright fringes less intense.<br>2. bright fringes less intense, dark fringes not be completely dark.<br>3. fringe pattern will appear and disappear at every half cycle of rotation.<br>4. fringe separation would be reduced, color of fringes would be yellow. | |
| | biii | <br>3 loops 4 loops | - | |
| 4 | a | Refer to notes | I = 0.33 A | |
| | bi | (scan picture) | $V_{XY}$ = 1.67 V<br>XP = 0.90 m | |
| | bii | 1. Wire X:<br>$B=\frac{\mu_0 I}{2\pi r}=2.0\times10^{-5}T$<br>Wire Y:<br>$B=\frac{\mu_0 I}{2\pi r}=1.2\times10^{-5}T$<br>$B_{result}=B_x+B_y$<br>2.<br>$B_{result}=(2.0+1.2)\times10^{-5}$<br>$=3.2\times10^{-5}T$ (Upwards) | $V_{10\Omega}=\frac{15}{10+r}$<br>$\frac{V_{XY}}{V_{10\Omega}}=\frac{1.0}{0.75}$<br>$r=1.97\Omega=2.0\Omega$ | |

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| 5 | ai | Refer to notes | (scan graph)<br>$\Phi = 0.1t$<br>Max $\Phi$ reached when t = 0.10 s<br>$\Phi_{\max} = 0.1\left(\frac{a}{v}\right) = 0.01wb$<br>Time interval for constant magnetic flux = 0.05s | |
| | aii | | (scan graph)<br>E = 0.1 V | |
| | bi | Refer to notes | When rod QR cuts the B field, an induced I flows in it.<br>The magnetic F on QR is in opp. Direction (by FLHR) and equal in magnitude to the applied F. | |
| | bii | Refer to notes | | |
| | biii | (scan picture) | | |
| | c | - | $F_{ext} = F_B = BIL$<br>$I = 0.00625A$<br>$F_{ext} = 6.3\times10^{-4}N$ | |
| 6 | a | 135, 142 or 143, 92 or 93 | A quantum of EM energy. | |
| | b | a = 135, b = 52 | Not traveling in direction of crystal.<br>Some pass through the crystal.<br>Any sensible suggestion. | |
| | ci | $\Delta m = 0.19738u$<br>$E = mc^2 = 2.94886\times10^{-11}J$ | 1. 1.3 - 1.5 cm<br>2. gradient = $(0.07\pm0.01)$cm$^{-1}$ | |
| | cii | | Q takes the same distance to halve in value. | |
| | di | 1 kg will give $7.5578\times10^{13}J$ | Fraction of total no. of photons directed towards crystal becomes | |

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| | | | smaller as x increases. | |
| | dii | $7.5578 \times 10^{13} J$ needed<br>$2.29 \times 10^{6} kg$ of coal | For low photon E, all photons directed towards crystal are absorbed, high energy photons can penetrate crystal. | |
| | ei | Total output per day E = $8.64 \times 10^{13} J$<br>Mass needed = 4.57 kg | When S is in contact with crystal, only half of all emissions move towards the crystal. | |
| | eii | | If S is at the bottom of the well, some photons directed 'backwards' will be detected so efficiency will increase. | |
| | f | Can be stopped by paper hence not hazardous, highly ionizing so hazardous, half life long (emission rate is low so not hazardous), depends on intensity (high intensity is hazardous, low intensity is not), and any other appropriate answer. | - | |

- : Question does not exist in the paper or no numerical answer
Refer to notes: answers are to be memorized and can be found directly from the notes

| Question | Part | CJC | HCI | MJC |
|---|---|---|---|---|
| 1 | ai | t = 2.45 s | - | t = 5.00 s |
| | aii | h = 2.52 m | | |
| | aiii | h = 0.158 m | | |
| | bi | t = 0.0816 R | $F = mg\left(1-\frac{d}{D}\right)$ | $\theta = 59.4^o$ |
| | bii | R = 21.2t-9.81t$^2$ | | |
| | biii | R = 0 (NA) or 11.2m | | |
| | ci | - | $m_{sample} = 0.17873kg$ | Total time = 6.54 s |
| | cii | | 0.123% | |
| 2 | ai | $W = \rho_{sea\ water} Ayg$ | - | P = Fv |
| | aii | $W = \rho_{fresh\ water} Azg$ | | |
| | aiii | $\frac{\rho_{sea\ water}}{\rho_{fresh\ water}} = \frac{z}{y}$ | | |
| | aiv | - | | |
| | bi | - | $W = -\frac{GMm}{R+h} - \left(-\frac{GMm}{R}\right)$<br>$W = 8.43\times10^8\ J$ | F = 1460 or 1500 N |
| | bii | R = 5 N<br>$T\cos\theta = 2g$<br>$T\sin\theta = F - R$<br>$F = 8.32N$ | | P = 17500 W |
| | biii | - | - | - |
| | ci | - | 12hr → $3\pi\ rad$<br>T = 8 h | - |
| | cii | | $r = 2.03\times10^7\ m$ | |
| 3 | ai | Longitudinal | $A = 1.26\times10^3\ Pa\ m^3$<br>$B = -1.0\times10^{-5}$ | $x = \lambda D/a = 1.84mm$ |
| | aii | 1. 0.5m<br>2. 0.5mm | | |

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| | | 3. v = 330 $ms^{-1}$ | | |
| | bi | - | B = 0 | $\lambda$ increases hence x increases. |
| | bii | - | | - |
| | biii | $\lambda = 2L$<br>$L = 0.317m$ | | - |
| | biv | - | | - |
| | c | - | Horizontal line at<br>$PV = 1.26\times10^{3}\,Pa\,m^{3}$ | - |
| | di | - | $PV = 660 Pa\,m^{3}$ | - |
| | dii | | 600 Nm | |
| 4 | ai | - | $E \cong \frac{\Delta V}{\Delta d} = 1.0\times10^{4} V\,m^{-1}$ | 1.6 V |
| | aii | $hf = \Phi + eV$<br>$\Phi = 2.3\times10^{-19} J$ | - | |
| | bi | | - | Ir = E-V<br>r = 0.80 $\Omega$ |
| | bii | | qE = mg = 4.11x10-12 C | |
| | biii | | - | |
| | ci | | At $\Delta V = 4.0MV$, $Q = 475mC$<br>$\Delta V' = 1500MV, Q = 142.5mC$<br>Mean discharge current<br>= $1.19\times10^{6} A$ | V = 0.24V |
| | cii | | | V = 1.36 V |
| | d | | | Y : $P = 0.408W, P_s = 0.48W, 85\%$<br>X : $P = 0.60W, P_s = 0.80W, 75\%$ |
| 5 | a | $P_1 = 2600Pa$<br>$P_2 = 650Pa$ | - | - |
| | bi | After process 1, | - | - |

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| | | $\Delta U = 0J$ | | |
| | bii | For one cycle,<br>$\Delta U = 0J$ | - | |
| | ci | Total work done<br>= 1660 J | - | - |
| | cii | | | - |
| | d | U = Q+W = 0<br>Q = +1660 J | - | - |
| 6 | a | - | - | - |
| | bi | - | - | Temperature OR pressure. |
| | bii | $R_0 = 3820\Omega$<br>$R_{100} = 2620\Omega$ | | |
| | ci | - | - | 1. $A_C >> A_N$ , PQ is a straight line. $A_{mix} \approx A_C = A_{oC}e^{-\lambda ct}$ , $\ln A_{mix}$ against t should give a straight line.<br>2. $A_{mix} \approx A_N = A_{oN}e^{-\lambda nt}$ , $\ln A_{mix}$ against t should give a straight line.<br>3. $A_{mix} = A_N + A_C$ $\ln A_{mix}$ against t should give a curve. |
| | cii | | | 1. -0.124 $yr^{-1}$<br>2. -0.00775 $yr^{-1}$ |
| | ciii | | | $\ln A = \ln A_0 - \lambda t$ |

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| | | | | $\lambda_C = 0.124 yr^{-1}$<br>$\lambda_N = 0.00775 yr^{-1}$ |
| | civ | | | $T_{1/2} = 5.59 yr$ |
| | di | $6.3^oC$ | - | - |
| | dii | $1.1^o C, 21.1\%$ | | |
| | ei | - | - | - |
| | eii | - | | |
| 7 | a | - | $\ln A = \ln A_0 - \lambda t$<br>Plot $\ln\left(A/s^{-1}\right)$ against t to get $\lambda$.<br>$\ln\left(A/s^{-1}\right)$ in 1990 = 16.80<br>$\ln\left(A/s^{-1}\right)$ in 1997 = 16.20<br>$\lambda = 2.72 \times 10^{-9} s^{-1}$ | - |
| | b | | $T_{1/2} = 8.1 yr$ | |
| | c | | $A = 1.10 \times 10^7 s^{-1}$<br>$N_1 = 4.05 \times 10^{15}$ | |
| | d | | $N_2 = 3.27 \times 10^{15}$<br>No. of stolen nuclei<br>$= 0.78 \times 10^{15}$ | |
| | e | | - | |

# H2 Physics Prelim Paper 2 – NJC

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|---|---|---|---|
| 1a | $kgm^{-1}s^{-2}$ | 6a | $W_{AB} = 1.00\times10^{-8} J$ , $W_{AC} = 0J$<br>$W_{AD} = 1.00\times10^{-8} J$ |
| 1b | $10^{-5}\ to 10^{-6}, T$<br>$10^{3}, \Omega \quad 10^{-7}, m$ | 6b | $V_{AB} = 400V, V_B = 600V$<br>$V_C = V_A = 200V, V_D = V_B = 600V$ |
| 2ai | $F\Delta t = \Delta p = 17667 Ns$ | 6c | - |
| 2aii | F = 92982 N<br>$k = 58114 Nm^{-1}$ | 6d | - |
| 2aiii | - | 7ai | n=1 (-13.6eV), n=2 (-3.40eV),<br>n=3 (-1.51eV), n=4 (-0.85eV),<br>n=5 (-0.54eV), n=6 (-0.35eV). |
| 2bi | $v = 25kmh^{-1}$ to the left | 7aii | - |
| 2bii | $KE_{ini} = 298534J$<br>$KE_{fin} = 51119J$<br>Lost KE=247415J | 7b | n=4→3, $\lambda = 1.88\times10^{-6} m$ OR<br>n=5→3, $\lambda = 1.28\times10^{-6} m$ OR<br>n=6→3, $\lambda = 1.07\times10^{-6} m$<br>Wavelength lies in the IR region. |
| 2biii | - | 7ci | - |
| 3a | P = Fv | 7cii | $d\sin\theta = 2\lambda, \lambda = 6.56\times10^{-7} m$ |
| 3b | - | 7ciii | $E = 1.9eV$, $E_3 - E_2 = 1.9eV$ |
| 3c | $F_D = 40N$ 40 N | | |
| 3d | $P = kv^2$ | | |
| 3e | $P' = 288W$ | | |
| 3f | P = 363 W | | |
| 4a | H = 7.92 km | | |
| 4b | $\rho_{wood} = 741kgm^{-3}$ | | |
| 4ci | $\Sigma F = 0$ : $T_1 = 1.33T_2$ | | |
| 4cii | $1.664T_2 = mg$<br>$\Sigma\tau = 0$ (left end)<br>$mgx = T_2 cos 53.1\times6.10,\ x = 2.20m$ | | |
| 5a | - | | |
| 5bi | - | | |
| 5bii | F=-kx, ma=-kx, a=-kx/m=-$\omega^2$x<br>Hence $\omega^2$ = k/m | | |
| 5biii | T = 0.51 s | | |
| 5biv | Equilibrium length = 0.065 m | | |

# H2 Physics Prelim Paper 2 – NYJC

| | | | |
|---|---|---|---|
| 1a | 5.0 m | 5a | - |
| 1b | 800 N, 800 N | 5b | - |
| 1c | GPE of A: 16000J, GPE of B: 4000J | 5c | - |
| 1d | -12000J | 6a | Solar power collected = 6930 W<br>Time taken = $1.07\times10^{4}s$<br>Energy collected = $7.45\times10^{7}J$ |
| 1e | $GPE_A + KE_A = GPE_B + KE_B$<br>$v_B = 26.5ms^{-1}$ | 6b | $1.94\times10^{7}J$ |
| 2ai | - | 6c | 1.2 kW |
| 2aii | Resonance. | 6d | No. of solar cells required, N = $1.2\times10^{3}$<br>Energy collected by each cell = $6.2\times10^{4}J$ |
| 2bi | 1. $1.2ms^{-1}$<br>2. $9.1ms^{-2}$ | 6e | 59N, 59N |
| 2bii | Time interval = $T/4$=0.021s | 6f | $\frac{P_{peak}}{P_{ave}} = \left(\frac{v_{peak}}{v_{ave}}\right)^3, v_{peak} = 107km\,h^{-1}$ |
| 3a | $F_B = BIL\sin\theta, a = F_B/m, v = u + at$ | 6g | P=IV, 24A |
| 3b | Towards the left, away from the cell. | 6h | Q=It, 2.5hr |
| 3c | $V = \frac{\pi d^2}{4}\times L \rightarrow V \propto d^2,\ R = \frac{\rho l}{A} \rightarrow R \propto \frac{1}{d^2}$<br>$I = V/R,\ a = F_B/m$<br>Current increase by 4 times, $F_B$ increase by 4 times, acceleration not affected. Wire speed not affected at t=2.0s. | 6i | - |
| 4a | $3.35\times10^{-4}V$ | | |
| 4b | $1.67\times10^{-4}A$ | | |
| 4c | Clockwise. | | |
| 4d | $1.0\times10^{-5}N$ | | |
| 4e | $mg\sin\theta = BIL\cos\theta,\ v_t = 0.0308ms^{-1}$ | | |

# H2 Physics Prelim Paper 2 – RJC

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|---|---|---|---|
| 1a | Units of $kgm^{-1}s^{-2}$ for both sides → equation is dimensionally consistent. | 5bii | - |
| 1b | $\Delta E \simeq 0.1\times10^{11}Pa$<br>$E=(2.0\pm0.1)\times10^{11}Pa$ | 6ai | The two E levels are the conduction and valence E bands of the GaAs layer. |
| 2ai | Impulse, Ft = mv-mu, t = 0.043 s | 6aii | $E_g = hf = \frac{hc}{\lambda} \rightarrow \lambda = \frac{hc}{E_g}$ |
| 2aii | $t \simeq 0.232s$<br>$s_y = u_t t + \frac{1}{2}at^2$, $s_y = 1.88m$ | 6b | - |
| 2b | 0.197 m | 6c | - |
| 3ai | 24 mA | 6d | Minimal length corresponds to half the wavelength ~ 1.15x$10^{-7}$ m. |
| 3aii | 7.2 V | 7a | Resultant motion is a spiral about *B*. |
| 3b | - | 7bi | - |
| 3ci | P=0.48W at 25°C, P=2.62W at 45°C | 7bii | $F = Bqv\sin\theta$, $F = 5.0\times10^{-18}N$ and is directed perpendicularly into the page. |
| 3cii | E = 930 J | 7biii | $\frac{v_{\parallel}}{v_{\perp}} = \sqrt{\frac{B_{\max}}{B_{\min}}-1}$, $\tan\theta = \frac{v_{\perp}}{v_{\parallel}}$<br>$\theta = 51^o$ |
| 3ciii | - | 7biv | - |
| 4a | Period = 10 ms, f = 100Hz | 7c | Mass change per reaction = 0.013805u<br>Total energy released = $2.06\times10^{14}J$ |
| 4b | $V_{rms} = 0.573V$ | 7di | $\frac{1}{2}mv^2 = 52.5eV$<br>→ excitation is possible.<br>(KE of protons is higher than excitation energy of oxygen atoms) |
| 4c | Mean power = $6.56\times10^{-4}W$ | 7dii | $E = \frac{hc}{\lambda} \rightarrow \lambda = 5.57\times10^{-7}m$<br>Colour: green or greenish yellow. |
| 5ai | - | | |
| 5aii | $a = -\omega^2 x$, Gradient = $-\omega^2$=-55<br>$\omega = \frac{2\pi}{T} \rightarrow T = 0.85s$ | | |
| 5bi | $KE_{\max} = 0.011J$ | | |

# H2 Physics Prelim Paper 2 – SAJC

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|---|---|---|---|
| 1a | - | 4ciii | - |
| 1bi | t = $2.22\times10^{-9}s$ | 5a | $K_0 - K_1 = \frac{hc}{\lambda}, K_1 = \frac{1}{2}K_0$<br>$\lambda = 4.97\times10^{-11}m$ |
| 1bii | $a = 1.41\times10^{15}ms^{-2}$ | 5bi | $k = \sqrt{\frac{8\pi^2 m(U-E)}{h^2}} = 6.67\times10^{9}m^{-1}$ |
| 1biii | $s = 3.47\times10^{-3}m$ | 5bii | Probability is smaller because proton is much more massive. |
| 1biv | - | 6a | Cells could be killed, damaged, mutated or heated up (any two). |
| 2a | $a = 4.49ms^{-2}$ | 6b | - |
| 2b | 94.75kg | 6c | Beta particles have lower penetrative power. |
| 2c | 1716 $ms^{-1}$ | 6d | Cancer cells divide very rapidly, sot hey are much more likely to be killed by radiation treatment. |
| 2d | $V_f = 2U + v$ | 6e | 28 p, 32 n |
| 3a | - | 6f | Rest mass = 59.93025 u |
| 3bi | Light waves are transverse waves. | 6g | BE per nucleon = 8.74 MeV |
| 3bii | - | 6h | - |
| 3biii | $d\sin\theta = n\lambda, d = 1/N$<br>$N = 7.89\times10^{5}lines/m$ | 6i | $A = A_0 e^{-\frac{\ln 2}{t_{1/2}}\times t}$ , $A_0 = 4.75\times10^{12}Bq$<br>$A = \lambda N$, $N = 1.138\times10^{21}$<br>Mass of nuclides $= 1.13\times10^{-4}kg$ |
| 4a | - | 6j | - |
| 4b | $4.00\Omega$ | | |
| 4ci | $V_{XP} = 0.762V$ | | |
| 4cii | $V_{XP} = V_{2\Omega} = \frac{2}{3+2}E_Q$, $E_Q = 1.90V$ | | |

# H2 Physics Prelim Paper 2 – TJC

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|---|---|---|---|
| 1a | $17.1ms^{-1}$ | 6bi | KE or products = $(m_{Pu} - m_u - m_\alpha)c^2$<br>$m_u = 234.0409u$ |
| 1b | - | 6bii | COLM: $\frac{v_\alpha}{v_u} = -\frac{m_u}{m_\alpha}$<br>$\frac{T_\alpha}{T_u} = \frac{m_u}{m_\alpha} = 58.47$ |
| 1c | 19.6 m | 6biii | T=5.554 MeV |
| 2a | - | 7a | $15ms^{-1}$ |
| 2bi | 1. $T = \frac{24\times60\times60}{14} = 6170s$<br>2. $\frac{GM}{r^2} = r\omega^2 = r\left(\frac{2\pi}{T}\right)^2$,<br>$r = 7.27\times10^6 m$ | 7bi | $90ms^{-2}$ |
| 2bii | - | 7bii | 0.17 s |
| 3a | 0.20 m, 1.33 Hz | 7ci | 1.08 N |
| 3b | 0.09 m | 7cii | $9.0ms^{-2}$ |
| 3c | - | 7d | $p_1V = p_2V_2$, $p_2 = 5.0\times10^7 Pa$ |
| 4a | - | 7e | $\Delta pV = \Delta N\,kT$, $\Delta N = 7.50\times10^{23}$<br>No. of gas molecules leaving per second = $3.1\times10^{17} s^{-1}$ |
| 4bi | $F = \sqrt{5}EQ$ | 7fi | $R = \frac{\rho l}{A} = 1.2\Omega$ |
| 4bii | - | 7fii | $Q = \left(\frac{V^2}{R}\right)t$, $t = 8.0\times10^{-3}s$ |
| 4biii | - | | |
| 5a | $\langle P\rangle = V_{rms}I_{rms}$, $I_{rms} = 1.03A$ | | |
| 5b | $P_0 = 2\langle P\rangle = 160W$ | | |
| 5c | - | | |
| 6a | ${}^{238}_{94}Pu \rightarrow {}^{234}_{92}U + {}^{4}_{2}He$ | | |

# H2 Physics Prelim Paper 2 – VJC

<table>
<tr><td>1a</td><td>Point A has the highest potential. The farther a point is away from the earth, the higher the potential.</td><td>5bi</td><td>$ME_0 = Pt$<br>$2000kgs^{-1}$</td></tr>
<tr><td>1bi</td><td>$5.0\times10^{10}\,J$</td><td>5bii</td><td>$4.44\times10^{-7}\,kg$</td></tr>
<tr><td>1bii</td><td>No work is done by gravitational field as C and D are at the same potential.</td><td>5biii</td><td>Power input = $2.0\times10^{11}W$<br>Mass burnt per sec = 10 000$kgs^{-1}$<br>Extra coal needed = $8\,000kgs^{-1}$</td></tr>
<tr><td>1c</td><td>g decreases as one goes away from earth.</td><td>6ai</td><td>$E = I\left(r + R_L\right)$
<table>
<tr><td>$R_L$ / Ω</td><td>I / A</td><td>$\frac{1}{I} / A^{-1}$</td></tr>
<tr><td>2.00</td><td>0.590</td><td>1.69</td></tr>
<tr><td>3.00</td><td>0.420</td><td>2.38</td></tr>
<tr><td>4.00</td><td>0.330</td><td>3.03</td></tr>
<tr><td>5.00</td><td>0.270</td><td>3.70</td></tr>
<tr><td>6.00</td><td>0.230</td><td>4.35</td></tr>
</table>
Gradient E = 1.51 V<br>Negative intercept = 0.563 Ω = r</td></tr>
<tr><td>d</td><td>$8.9\times10^5\,m$</td><td>6aii</td><td>When $R_L$ is dissipating max. power, its R is equal to r=0.563 Ω.<br>$I = \frac{E}{r + R_L}$ = 1.34 A</td></tr>
<tr><td>2a</td><td>$T + mg = \frac{mv^2}{r}$, T = 3.81 N</td><td>6bi</td><td>-</td></tr>
<tr><td>2b</td><td>-</td><td>6bii</td><td>1. $\alpha \approx 4.05\times10^{-3}\left({}^oC\right)^{-1}$<br>2. Graph will cut vertical axis when $R_\theta = R_0$. $R_0 = 27.8\Omega$.<br>3. Negative value for $\alpha$ indicates that the semiconductor resistance decrease with rise in T.</td></tr>
<tr><td>2c</td><td>$R + m_w g = \frac{m_w v^2}{r}$, R=2.64 N<br>R is towards the centre of the circle.</td><td>6c</td><td>-</td></tr>
<tr><td>3a</td><td>$4.6\times10^{-19}\,J$</td><td></td><td></td></tr>
<tr><td>3b</td><td>COM:<br>$m_p v_p = m_\alpha v_\alpha$, $v_\alpha = 5.0\times10^3\,ms^{-1}$</td><td></td><td></td></tr>
<tr><td>3c</td><td>Total KE = $4.2\times10^{-19}\,J$</td><td></td><td></td></tr>
<tr><td>3d</td><td>$KE_1 + PE_1 = KE_2 + PE_2$</td><td></td><td></td></tr>
</table>

| | | | |
|---|---|---|---|
| | separation r = $1.1\times10^{-8}m$ | | |
| 4a | $E_{net}=B\left(\frac{L}{4}\right)v+B\left(\frac{L}{2}\right)v+B\left(\frac{L}{4}\right)v$<br>$=BLv$<br>By RHR, end Q is at higher potential. | | |
| 4bi | - | | |
| 4bii | Net emf is $(B'-B)L_2v$<br>$I=(B'-B)L_2v/R$ | | |
| 4biii | Flux through the coil remains constant and hence no net emf is induced. | | |
| 5a | - | | |