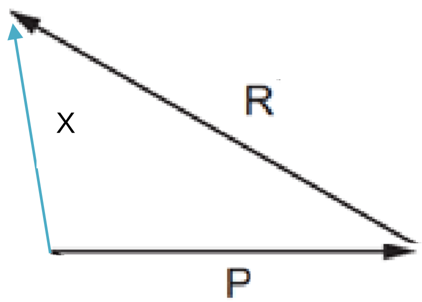
H2 Physics PU3 Preliminary Examination Paper 1 Answers

1	A	**6**	B	**11**	C	**16**	B	**21**	C	**26**	B
2	C	**7**	B	**12**	A	**17**	D	**22**	A	**27**	C
3	B	**8**	C	**13**	A	**18**	C	**23**	A	**28**	B
4	B	**9**	D	**14**	B	**19**	D	**24**	D	**29**	D
5	D	**10**	D	**15**	A	**20**	C	**25**	B	**30**	C

<table>
<tr><td>1</td><td>A</td><td>X = P – R = P + (–R)

Hence vector R needs to change to the opposite direction before adding to P


</td></tr>
<tr><td>2</td><td>C</td><td>The object dropped from a great height will be experiencing a decreasing acceleration due to to increase in air resistance acting on it.

As a result, the velocity will be increasing at a decreasing rate until it reaches a constant value.</td></tr>
<tr><td>3</td><td>B</td><td>$\Delta p = \text{impulse}$
$p_f - p_i = \text{area under F-t graph}$
$m(v_f - v_i) = 10(0.5) + 5(0.5)$
$3(v_f - 0.50) = 7.5$
$v_f = 3.0 \text{ m s}^{-1}$</td></tr>
<tr><td>4</td><td>B</td><td>Since no net external force acts on the system of 2 particles, final momentum = initial momentum

Considering vertical momentum,

$p_X \sin\theta + (-p_Y \sin\alpha) = 0$

$p_X \sin\theta = p_Y \sin\alpha$</td></tr>
</table>

5	**D**	Let *L* be the distance from hip joint pivot to centre of mass. Applying principle of moment at the hip joint pivot, $TL\sin 8^o = WL\sin 70^o$ $T = W\dfrac{sin70^o}{sin8^o}$ $= 400 \times 6.752$ $= 2700$ N
6	**B**	Upthrust $= V\rho g = \left(2.0\times10^{-4}\right)(800)(9.81) = 1.6$ N The spring balance will read = 8.0 1.6 $=$ 6.4 N
7	**B**	By conservation of energy, Loss in GPE = Gain in KE + W.D by resistive force (600)(80 – *h*)(9.81) = [½ (600)(12.0)^2 – 0] + (200)(1500) *h* = 22 m
8	**C**	The resultant of 160 N and 120 N should provide the horizontal centripetal force. Resultant force = (160^2 – 120^2) =105.8 N Resultant force = ma 105.8 = (120/9.81) a ® a = 8.65 ms^{-2}
9	**D**	g = $\frac{GM}{r^2}$ = $GM\frac{1}{r^2}$ The gradient is "*GM*", where *M* is the mass of the planet.
10	**D**	v = rw = r $\frac{2\pi}{T}$ $= (36000 + 6400) \times 10^3 \times \frac{2\pi}{24\times60\times60}$ = 3100 m s^{-1}
11	**C**	total kinetic energy = $\frac{3}{2}nRT = \frac{3}{2}pV = \frac{3}{2}(1.0\times10^{-5}\times0.010) = 1500\,J$ Total KE is the same for the same T.
12	**A**	$\frac{1}{2}m\langle c^2\rangle = \frac{3}{2}kT$ ▯ $c_{\text{rms}} = \sqrt{\dfrac{3kT}{m}}$ $\dfrac{c'_{rms}}{c_{rms}} = \sqrt{\dfrac{T'}{T}}$ ▯ $\dfrac{0.8c_{rms}}{c_{rms}} = \sqrt{\dfrac{T'}{295}}$ *T'* = 188.8 K = 84.4 °C

13	**A**	Total heat supplied by the potatoes = heat for calorimeter + heat for water = *C*(+ *mc*(= 200*12 + (2000)*(4.18)*12 = 102720 J Hence heat supplied per gram of potato = *Q/m* = 102720/75 =1369.6 J per gram
14	**B**	a_{max} = $\omega^2 x_o$ ------- (1) where x_o = 0.30 cm $\omega = \frac{2\pi}{T_{shm}}$ -------- (2) T_{shm} = twice the period of E_k – t graph [Remember this!] = 2 × 0.20 s = 0.4 s a_{max} = $(\frac{2\pi}{0.40})^2(0.30 \times 10^{-2}) = 0.74\ m\ s^{-2}$
15	**A**	With increased damping, the initial amplitudes are the same, the maximum amplitude is reduced and resonance occurs at a frequency slightly lower than natural frequency.
16	**B**	Using Malus' Law, $I_p = I_o \cos^2$ (= 2.0 ($\cos^2 60^o$) = 0.5 W m^{-2}
17	**D**	The wave is reflected from the surface of the water and then interferes with the incident wave to form the stationary wave.
18	**C**	$x = \frac{\lambda D}{a} \Rightarrow \lambda = \frac{ax}{D} = \frac{(0.1 \times 10^{-3})(8.0 \times 10^{-3})}{2.0} = 4.0 \times 10^{-7}\ m$ At the second order dark fringe, the path difference will be 1.5 times of the wavelength, $6.0 \times 10^{-7}\ m$
19	**D**	At point A, the resultant electric field is pointing towards the left. At points B and C, the resultant electric field is pointing towards the right.

		At point D, the electric field due to $+4Q$ is pointing towards the right and that due to $-Q$ is pointing towards the left. Considering the magnitude of $\frac{Q}{r^2}$ for both charges at point D, it is possible for the resultant electric field to be zero.
20	**C**	The electric force on the positive charge is pointing in the direction of the E-field. So the external force exerted to move the charge is pointing in the opposite direction to the E-field. Work done by external force, $W = F\,s \cos (= qEs \cos 0°$ $= (2.6 \cdot 10^{8})(3.0 \cdot 10^{5})(4.0 \cdot 10^{3})$ $= + 3.1 \cdot 10^{5}$ J
21	**C**	E=Pt=40x3=120 J
22	**A**	Characteristics of (1) NTC: when the temperature is high, the resistance of a thermistor decreases. (2) LDR: when light intensity is high, the resistance of the LDR decreases For lamp to glow more brightly, LDR must have lower resistance (to increase the overall supply current) and NTC with a higher resistance (so that more current will pass through lamp in the parallel branch). To achieve this, the light intensity on the LDR must increase while the NTC temperature must decrease.
23	**A**	The point charge's velocity is parallel to resultant magnetic flux density at the centre of the two wires. Thus magnetic force is zero.
24	**D**	The change in C will result in an increase in magnetic field hence, an increase in the balancing force required. With a larger moment, a larger mass of the rider had to be used to rebalance.
25	**B**	$\lvert\varepsilon\rvert = \left\lvert\frac{\Delta BAN}{\Delta t}\right\rvert$ $= \left\lvert\frac{(0-0.15)\times 0.050\times 0.080\times 40}{3.0}\right\rvert$ $= 0.0080$ V
26	**B**	On the secondary side, $I_{S\,rms} = \frac{\langle P\rangle}{V_{S\,rms}} = \frac{12}{6.5} = 1.8462\,A$ There using $\frac{I_P}{I_S} = \frac{N_S}{N_P}$ $I_{P\,rms} = \frac{40}{1000} \times 1.8462 = 0.0738 = 0.074\,A$

27	**C**	Option A : Incorrect. If the frequency of light is sufficiently high, even at extremely low intensities there will be emission of photoeelectrons. Option B : Incorrect. From Einstein's photoelectric effect equation, the relationship between frequency and stopping potential is not directly proportional. Option D: Increasing the intensity of the incident photons will not change the energy of each photon, it just increases the no. of photons per unit time incident on the metal. Hence, the energy of the photoelectrons emitted will not change as the interaction between each photon and electron remains the same.
28	**B**	K_{max} = 0 eV occurs when λ = 300 nm. Therefore, the threshold wavelength is 300 nm. By photoelectric equation, $\Phi = \frac{hc}{\lambda} - E_k\text{max}$ $= \frac{6.63\times10^{-34}(3.0\times10^{8})}{300\times10^{-9}} - 0$ $\Phi = 6.63\times10^{-19}$ J $=$ 4.14 eV
29	**D**	Total BE before reaction = 7.59 (235) = 1783. 65 Mev Total BE after reaction = (8.26 x 121) + (8.52 x 113) = 1962 MeV Change in BE = +179 MeV, manifested as the energy released (products are more stable)
30	**C**	For sample X: $A = \lambda_A N$ For sample Y: $3A = \lambda_Y N$ and since for half life $\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$ we can combine the equations as follows:

		$A = \frac{\ln 2}{t_{1/2(X)}} N$ $3A = \frac{\ln 2}{t_{1/2(Y)}} N$ $\frac{3A}{A} = \frac{\frac{\ln 2}{t_{1/2(Y)}} N}{\frac{\ln 2}{t_{1/2(X)}} N}$ $3 = \frac{t_{1/2(X)}}{t_{1/2(Y)}}$