9749/01 H2 Physics
Multiple Choice

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

Question Number	Key	Solution
1	C	Option A is the approximate mass of one paper clip. Option B is the approximate mass of one coin. Option D is an unreasonable estimate.
2	D	Volume = $\pi\left(\frac{d}{2}\right)^2(h)$ Density, ρ = mass/volume = $\frac{4m}{\pi h d^2}$ $\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + \frac{\Delta h}{h} + 2\frac{\Delta d}{d}$ = 10 + 2(3) + 2 = 18%
3	B	$s = (15.0)(2.00) + \frac{1}{2}(-9.81)(2.00)^2 = 10.4\text{ m}$
4	A	Vertical component of 9.0 N force = 9.0 sin45° = 6.36 N < weight of crate (19.6 N), so no lifting of crate above the ground. $F_{\text{net}} = \text{horizontal component of 9.0 N force} - \text{frictional force}$ $= 9.0\cos 45° - 2.0 = 4.36\text{ N}$ $a = \frac{F_{\text{net}}}{m} = \frac{4.36}{2}$ = <u>2.2 m s^{-2}</u>
5	B	By COLM, $m_1u_1 + m_2u_2 = (m_1 + m_2)v$ $(5.0)(4.0) + (2.0)(-3.0) = (5.0 + 2.0)v$ $v = \frac{20.0-6.0}{7.0}$ = 2.0 m s^{-1} Total final kinetic energy = $\frac{1}{2}(m_1 + m_2)v^2 = \frac{1}{2}(5.0 + 2.0)(2.0)^2$ = 14 J

Question Number	Key	Solution
6	**C**	(subscript *s* denotes stationary train and *a* denotes accelerating train) $F_s = \text{weight of mass} = 1.2 \times 9.81 = 11.772$ N When train is accelerating, the spring settles at angle to the vertical so that the horizontal component of the tension provides the resultant force for the train to accelerate. $F_a = \sqrt{11.772^2 + (1.2 \times 5.0)^2} = 13.213$ N Since force is proportional to extension, $\frac{F_s}{F_a} = \frac{x_s}{x_a}$ $x_a = \frac{F_a}{F_s}(x_s) = \frac{13.213}{11.772}(2.4) = \underline{2.7\text{ cm}}$
7	**B**	Minimum force needed to lift weight = 900 N Hence minimum torque needed to lift weight = 900 × 0.20 = 180 N m This torque is provided by the couple of forces *F* on the lever. Minimum force *F* = 180 / 1.20 = <u>150 N</u>
8	**B**	Useful power $= 0.9 \times mgh = 0.9 \times \left(\frac{\rho V g h}{t}\right) = 0.9 \times \left(\frac{V}{t}\right) \rho g h$ $= 0.9 \times (5.7)(1000)(9.81)(30)$ $= 1.5\text{ MW}$
9	**C**	Frictional force provide the centripetal force 0.2 = 0.01(0.05) ω^2 ω = 20 rad s^{-1}
10	**B**	Immediately after launch, spacecraft is still at/near Earth's surface, so gravitational field strength remains as *g*.
11	**C**	$g_E = \frac{GM_E}{r_E^2} \ldots (1)$ $g_N = \frac{GM_N}{r_N^2} \ldots (2)$ (2)/(1): $\frac{r_N}{r_E} = \sqrt{\frac{M_N(g_E)}{M_E(g_N)}} = \sqrt{17} = 4.1$
12	**D**	Loss in thermal energy of water = 0.160 × 4200 × 100 = 67200 J Mass of ice melted = 67200 / 336000 = 0.200 kg Total mass of water = 200 + 160 = 360 g
13	**B**	increase in internal energy = 80 + (−100) = −20 J
14	**D**	For the 4 options, ke and total energy are similar. gpe increases linearly with height (*mgx*). epe decreases as height increases (smaller extension) and quadratic $E_{el} = \frac{1}{2}kx^2$

Question Number	Key	Solution
15	D	Lower amplitude throughout. Peak shifts to a slightly lower frequency with more damping
16	B	Obtain from Malus's law $I = I_0 \cos^2 \theta$ and $I \propto A^2$ that $kA^2 = k(A_0)^2 \cos^2 \theta$ So, $A = A_0 \cos \theta$ Alternatively, resolve amplitude to the plane of polarisation of filter = $E_0 \cos \theta$
17	C	The narrower the slit, the higher the amount of spreading The longer the wavelength, the higher the amount of spreading.
18	C	d$\sin\theta$ = nλ $\frac{0.001}{400} \sin \theta_2 = 2(567 \times 10^{-9}) \Rightarrow \theta_2 = 27.00°$ $\frac{0.001}{400} \sin \theta_3 = 3(567 \times 10^{-9}) \Rightarrow \theta_3 = 42.87°$ The angle between is 42.87 – 27.00 = 15.87°
19	A	From Coulomb's law, $F \propto \frac{1}{r^2}$ $\frac{F'}{F} = \left(\frac{200}{600}\right)^2 = \frac{1}{9}$ $F' = \frac{1}{9} \times 180 = 20\ \mu\text{N}$
20	C	Loss of kinetic energy = Gain in electric potential energy $9.0 \times 10^{-13} = \frac{79 \times 2 \times (1.6 \times 10^{-19})^2}{4\pi\varepsilon_o r}$ $r = 4.0 \times 10^{-14}$ m
21	A	$I = Anqv \Rightarrow v = \frac{I}{Anq}$ $v = \frac{0.30}{[1.0\times(10^{-3})^2](8.5\times10^{28})(1.60\times10^{-19})} = 2.2 \times 10^{-5}$ m s^{-1}
22	B	When XJ is 0.50 m, R_{XJ} = 20 / 100 × 50 = 10 Ω V of lamp = 1.5 × (10/20) = 0.75 V $P = V^2/R$ $P'/P = V'^2/V^2$ $P' = (0.75/1.5)^2 P = 0.25P$
23	B	$F = BIL$ $F + 3.6 \times 10^{-3} = B(I + 4)(0.15)$ $F + 3.6 \times 10^{-3} = F + 0.6B$ $B = 0.006$ T

<table>
<tr><th>Question Number</th><th>Key</th><th>Solution</th></tr>
<tr><td>24</td><td>B</td><td>Option A: Force on each isotope is same, $F_B = Bqv$ (same value of force)

Option B: The isotopes have different masses.
$Mv^2 / r = Bqv$
$r = Mv / Bq$

Option C: Uniform circular motion in magnetic field, so speed and k.e. remains constant for each isotope.
Option D: Acceleration $ma = Bqv$
$a = Bqv/m$ (the isotope has different mass)</td></tr>
<tr><td>25</td><td>D</td><td>$\omega = \frac{2\pi}{T} = \frac{2\pi}{\frac{1}{50}} = 100\pi$
Maximum magnetic flux linkage = NBA

Max Induced emf = ωNBA = $(100\pi)(200)(0.20)[\pi(0.1)^2]$ = 395 V</td></tr>
<tr><td>26</td><td>A</td><td>I^2_{peak} = 10 A^2
P_{mean} = ½ Peak = ½ $I^2_{peak} R$
I^2_{dc} (R) = ½ (10) R
I = 2.23 A</td></tr>
<tr><td>27</td><td>C</td><td>$\phi = \frac{hc}{\lambda_0}$ (This wavelength just causes photoemission of electrons at zero kinetic energy)
$\lambda_0 = \frac{6.63 \times 10^{-34} \times 3.00 \times 10^{8}}{2.3 \times 1.60 \times 10^{-19}} = 5.4 \times 10^{-7}\ \mathrm{m}$</td></tr>
<tr><td>28</td><td>C</td><td>$p = \frac{h}{\lambda} = \frac{6.63 \times 10^{-34}}{2.0 \times 10^{-12}} = 3.32 \times 10^{-22}\ \mathrm{kg\ m\ s^{-1}}$
$E_k = \frac{p^2}{2m} = \frac{(3.32 \times 10^{-22})^2}{2 \times 9.11 \times 10^{-31}} = 6.0 \times 10^{-14}\ \mathrm{J}$</td></tr>
<tr><td>29</td><td>B</td><td>The sequence of decay is not important. Deduce the total change in the proton and neutron number after the series of decay.

<table><tr><th>decay</th><th>proton</th><th>neutron</th></tr><tr><td>$\alpha\beta\beta$</td><td>0</td><td>–4</td></tr></table></td></tr>
<tr><td>30</td><td>C</td><td>Total number of antimony nuclei at t = 0 is N_0

After time t, $\frac{N}{N_0} = \frac{1}{3}$ which is smaller than $\frac{1}{2}$ (one half-life) and larger than $\frac{1}{4}$ (two half-lives).</td></tr>
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