HKDSE MOCK EXAMINATION 2024

Physics

Marking Scheme

Marking Scheme

Paper I Section A

Question No.	Key	Question No.	Key
1.	C	26.	C
2.	B	27.	C
3.	A	28.	B
4.	B	29.	A
5.	A	30.	A
6.	D	31.	D
7.	C	32.	C
8.	A	33.	D
9.	A		
10.	D		
11.	D		
12.	D		
13	C		
14.	B		
15.	B		
16.	B		
17.	A		
18.	B		
19.	A		
20.	A		
21.	B		
22.	B		
23.	A		
24.	B		
25.	D		

,

Paper I Section B

Marks

1. (a) By $pV = nRT$ — 1 M

$$n = \frac{pV}{RT} = \frac{(10^5)(1200\times10^{-6})}{(8.31)(27+273)} = \underline{\underline{0.0481 \text{ mol}}}$$ 1 A

(b) Total amount of gas molecules before the tap is opened = Total amount of gas molecules after the tap is opened — 1 M

$$\frac{(10^5)(1200\times10^{-6})}{(8.31)(27+273)} + 0 = \frac{p'(1200\times10^{-6})}{(8.31)(27+273)} + \frac{p'(400\times10^{-6})}{(8.31)(127+273)}$$ 1 M

$$\therefore p' = \underline{\underline{7.99\times10^4 Pa}}$$ 1 A

2. (a)

$$E_{stored} = \frac{1}{2}mu^2 = \frac{1}{2}(0.5)(0.8)^2$$ 1 M

$$= \underline{\underline{0.16 \text{ J}}}$$ 1 A

(b) $W = Fs \quad \Rightarrow \quad 0.16 = F(0.05)$ — 1 M

$$\therefore F = \frac{0.16}{0.05} = \underline{\underline{3.2 \text{ N}}}$$ 1 A

<u>No</u>, the maximum compression of the spring should be <u>larger than 5 cm</u> — 1 M

It is because the <u>total mechanical energy is larger</u>. The height of the trolley drops when the spring is compressed. Therefore, more kinetic energy and gravitational potential energy converts to elastic potential energy at the spring. — 1 M

(Another answer is also acceptable)

Yes, the maximum compression of the spring is equal to 5 cm. — 1 M

Although the trolley is on an inclined runway, the speed of the trolley is also 0.8 m s^{-1} during the collision, which means the energy transferred from the trolley to the spring is still the same. (The height difference caused by spring's compression is neglected) — 1 M

('compression less than 5 cm' is **NOT** accepted)

3 (a)

$$F_C = \frac{mv^2}{r} = \frac{(5\times10^4)(240)^2}{45\times10^3}$$ 1 M

$$= \underline{\underline{64000 \text{ N}}}$$ 1 A

(b)

$$\tan\theta = \frac{v^2}{gr} = \frac{(240)^2}{(9.81)(45\times10^3)}$$ 1 M

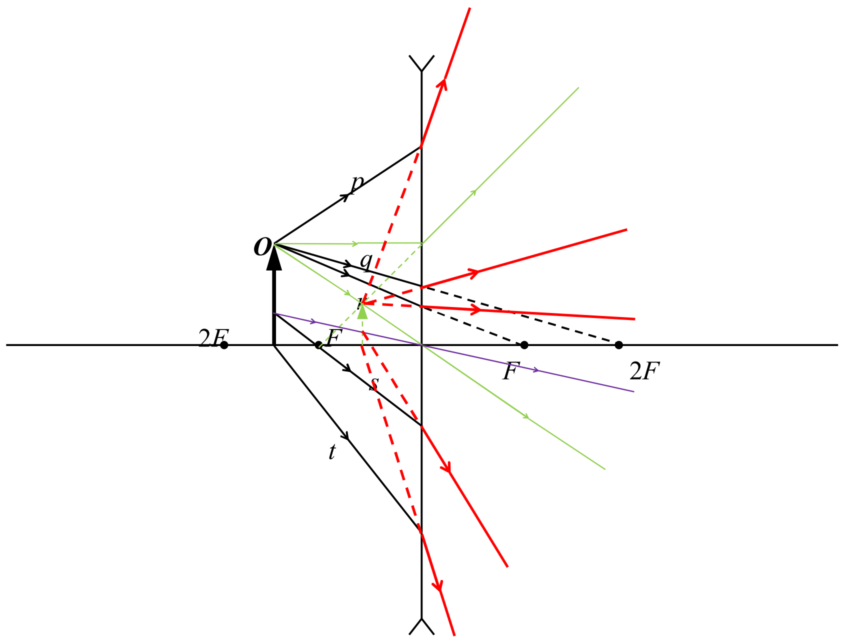
$$\therefore \theta = \underline{\underline{7.43°}}$$ 1 A

(c)

$$F_L \cos\theta = mg \quad \Rightarrow \quad F_L = \frac{mg}{\cos\theta} = \frac{(5\times10^4)(9.81)}{\cos 7.43°}$$ 1 M

$$\therefore F_L = \underline{495000 N}$$ 1 A

4.



5 A

(1 mark for each correct ray)

5. (a) Take moment at O,

$T(0.8)\sin 30° = (50\times 9.81)(0.4) + (2000)(1.2+0.4)$ 1 M

$\therefore T = \underline{\underline{8490\text{ N}}}$ 1 A

(b) $\begin{cases} R\sin\phi = T\cos 30° & ...(1) \\ R\cos\phi = T\sin 30° + 50\times 9.81 + 2000 & ...(2) \end{cases}$ 1 M

Solving above equations, we have

$R = \sqrt{(T\cos 30°)^2 + (T\sin 30° + 50\times 9.81 + 2000)^2}$

$= \sqrt{(8490\cos 30°)^2 + (8490\sin 30° + 50\times 9.81 + 2000)^2}$ 1 M

$= \underline{\underline{9970\text{ N}}}$ 1 A

6. (a) By conservation of mass and energy,

$4m_p = m_{He} + \Delta E$

$4(1.007279u) = m_{He} + \dfrac{(4.28\times 10^{-12})}{(3\times 10^8)^2}\left(\dfrac{1}{1.661\times 10^{-27}}\right)$ 1 M

$\therefore m_{He} = \underline{\underline{4.000473u}}$ 1 A

(b) According to $P = \dfrac{E}{t} = \dfrac{N(\Delta E)}{t}$,

number of fusion occurs per second： $\dfrac{N}{t} = \dfrac{P}{\Delta E} = \dfrac{3.68\times 10^{26}}{4.28\times 10^{-12}} = 8.598\times 10^{37}\text{ s}^{-1}$ 1 M

Mass of the helium produced per second：

$\dfrac{M}{t} = \dfrac{N}{t}\times m_{He} = (8.598\times 10^{37})\times(4.000473\times 1.661\times 10^{-27}) = \underline{\underline{5.71\times 10^{11}\text{ kg s}^{-1}}}$ 1 M + 1A

Marks

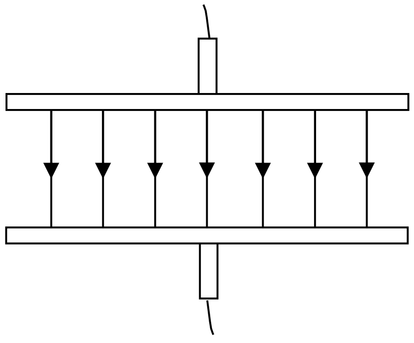
7. (a) The impact force is equal to the rate of change of momentum during a collision. — 1 M

The airbags decrease the rate of change of momentum (i.e. impact force) by increasing the time of the collision, which protect passengers from getting injured. — 1 M

(b) Seat-belt / crumple zones of vehicles / other reasonable answers — 1 A + 1A

8.

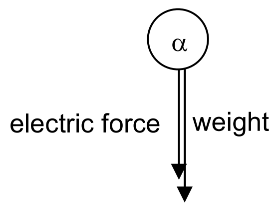
(a)



(Parallel and evenly spaced field lines) — 1 A

(Correct direction) — 1 A

(b) — 1 A+1 A



(2 correct labeled forces)

(c) The polarities of the parallel plates are reversed. — 1 A

9. (a) Radio waves — 1 A

(b) A cell typically uses a different set of frequencies from neighboring cells, to avoid interference within each cell. — 1 A

Signal from the cell towers blocked by the construction materials such as brick, steel bar inside concrete wall, etc. — 1 M

Cell signal may enter a building through windows. However, going outside should allow cell phones to receive a stronger signal from the local cell towers. — 1 M

10. (a) reflection — 1 A

(b) Orientation 1 — 1 A

(c) The wave travels slower in region B. — 1 M

$$\frac{v_A}{v_B} = \frac{\lambda_A}{\lambda_B} \Rightarrow \frac{v_A}{1} = \frac{3}{2}$$ — 1 M

$$\therefore v_A = 1.5 \text{ m s}^{-1}$$ — 1 A

				Marks
10.	(b)	(i)	Electric force = weight	
			$Eq = mg$	1 M
			$E = \dfrac{mg}{q}$	
			$= \dfrac{10^{-27} \times 9.81}{2 \times 1.60 \times 10^{-19}}$	
			$= 3.066 \times 10^{-8}$ N C^{-1}	
			$= 3.07 \times 10^{-8}$ N C^{-1}	1 A
			The electric field strength needed is about 3.07×10^{-8} N C^{-1}.	
		(ii)	By $E = \dfrac{V}{d}$	
			$V = Ed = 3.066 \times 10^{-8} \times 0.005 = 1.53 \times 10^{-10}$ V	1 M +1 A
			The potential difference between the plates required is about 1.53×10^{-10} V.	
		(iii)	The EHT power supply is not suitable for the experiment	1 A
			since it is unable to provide such a small voltage output.	1 A
11.	(a)		The electric field points upwards.	1 M
			$E = \dfrac{V}{d} = \dfrac{4.68 \times 10^3}{0.5 \times 10^{-2}} = 936000$ N C^{-1}	1 A
	(b)		The magnetic force points downwards.	1 M
			$F_B = F_E = qE = (3.2\times10^{-19})(936000) = 3.00\times10^{-13}$ N	1 A
	(c)		$F_B = qvB \sin\theta$	
			$3.00\times10^{-13} = (3.2\times10^{-19})v(1.8) \sin 90^\circ$	1 M
			$\therefore\ v = 5.20\times10^5$ m s^{-1}	1 A
	(d)		$F_C = F_B \quad \Rightarrow \quad \dfrac{mv^2}{r} = qvB$	
			$\Rightarrow \quad r = \dfrac{mv}{Bq} = \dfrac{(6.64\times10^{-27})(5.2\times10^5)}{(2)(3.2\times10^{-19})} = 0.005395\text{ m}$	1 M
			$\therefore\ d = 2r = 0.0108\text{ m}$	1 A
	(e)	(i)	There are two forces, electrostatic force F_E and the induced magnetic force F_B, which are in opposite direction acts on the electron.	
			$F_E = F_B \quad \Leftrightarrow \quad qE = qvB \quad \Leftrightarrow \quad v = \dfrac{E}{B}$	
			When an electron is projected to the selector at the speed in (c), that means net force on it is zero since F_E and F_B equals and in opposite. So, the electron can pass without deflection.	1 M+1 M
		(ii)	The radius of circular path / the rotating direction / period of the circular motion (any two)	1 M+1 M

Marks

12. (a) $\lambda = \frac{v}{f} = \frac{340}{3000} = \underline{\underline{0.113\text{ m}}}$ — 1 M+1 A

(b) (i) Constructive and destructive <u>interference</u> occurs alternatively along PQ. — 1 A

(ii) <u>Loud sound</u> is detected at O. — 1 A

(iii) - There is a background noise. — 1 A

- <u>Intensity/amplitude</u> of sound wave from slits S_2 and S_3 have <u>slightly difference</u> due to the path differences. — 1 A

(c) $\lambda' = \frac{v}{f'} = \frac{340}{30000} = 0.0113\text{ m} = 1.13\text{ cm} << 10\text{cm}$

<u>Degree of diffraction is too small at slit S_1</u> since wavelength becoming shorter.

(d) Path difference： $\Delta x = n\lambda$

$$S_3R - S_2R = n(\frac{v}{f})$$

$$\sqrt{(S_2R)^2 + (S_2S_3)^2} - S_2R = n(\frac{v}{f})$$

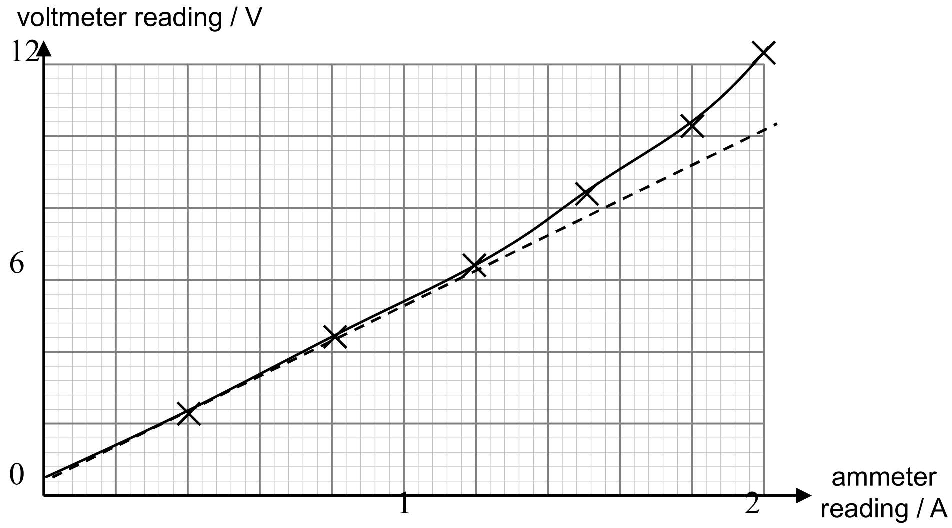
$$\sqrt{(\frac{300}{100})^2 + (\frac{40}{100})^2} - \frac{300}{100} = 5\left(\frac{340}{f}\right)$$ — 1 M

$$\therefore f = 5\left(\frac{340}{\sqrt{3^2 + 0.4^2} - 3}\right) = \underline{\underline{64000\text{ Hz}}}$$ — 1 A

(e) Only two bright projections form S_2 and S_3 can be observed. i.e. <u>No interference pattern is observed</u> since wavelength of visible light is much shorter than the width of the slits. — 1 A

13. (a) Both readings <u>decrease</u>. — 1 A

(b)



1 A+1 A

Marks

13. (b) (ii) $R = \frac{V}{I} = \frac{4}{0.8} = \underline{\underline{5\ \Omega}}$ 1 M+1 A

(iii) Resistance increases with temperature of the resistor increases due to the heating effect of current. 1 A+1 A

(c) (i) The ammeter is connected in series to the resistor which means the reading of ammeter is same as the current through the resistor. 1 A

However, the voltmeter is connected in parallel across the resistor and ammeter. Therefore, the reading of voltmeter is larger than the potential difference across the resistor. 1 A

So, the measured value of the resistance, (in other words, the ratio of readings of voltmeter and ammeter) is larger than the actual resistance of the resistor. 1 A

(ii) $V = I(R + R_A)$

$4 = 0.8(R + 2)$ 1 M

$\therefore R = \underline{\underline{3\ \Omega}}$ 1 A

Paper II

Section A: Astronomy and Space Science

1.	2.	3.	4.	5.	6.	7.	8.
B	C	C	B	B	B	A	A

Marks

1. (a) S rises and sets everyday as seen from the Earth, and so it cannot always be observed. 1 A

(b) The relative motion between the source (i.e. the star) and the observer on the Earth gives rise to the Doppler effect. 1 A

(c) (i) From the plot, the peak values of the graph correspond to the speeds of S when it is moving directly towards or away from the Earth. 1 A

Orbital speed of *S*

$$v_S = c\left|\frac{\Delta\lambda}{\lambda}\right| = (3\times10^8)\times\left|\frac{0.13\times10^{-12}}{656.3\times10^{-9}}\right| = 59.42 \approx 59.4\ \text{m s}^{-1}$$ 1 M + 1 A

Orbital radius of *S*

$$R_S = \frac{v_S}{\omega_S} = \frac{v_S T_S}{2\pi} = \frac{59.4\times(60\times60\times100)}{2\pi} = 3.4047\times10^6 \approx 3.40\times10^6\ \text{m}$$ 1 M + 1 A

(d) By Kepler's third law of planetary motion, $T^2 = \frac{GM}{4\pi^2}R^3$

Orbital radius of *P*

$$R_P = \left(\frac{GM_S T_P^2}{4\pi^2}\right)^{\frac{1}{3}} = \left[\frac{(6.67\times10^{-11})\times(2.10\times10^{30})\times(60\times60\times100)^2}{4\pi^2}\right]^{\frac{1}{3}}$$ 1 M

$$= 7.718\times10^9 \approx 7.72\times10^9\ \text{m}$$ 1 A

(e) The curve of the graph will shift upwards. 1 A

Section B: Atomic world

1.	2.	3.	4.	5.	6.	7.	8.
B	B	D	A	B	B	C	B

Marks

2. (a) (i) Feature 1: There is a threshold frequency for the incident radiation below which no photoelectron is emitted irrespective of the radiation intensity.

Feature 2: The maximum kinetic energy of the photoelectrons depends only on the frequency and not the intensity of the incident radiation.

Feature 3: No time delay occurs during the emission of photoelectrons.

(Any Two of above / other reasonable answers) 1 M + 1 M

(ii) Explanation 1: The energy carried by a photon is hf and so the electrons cannot acquire enough energy to escape from the metal surface.

Explanation 2: By Einstein's photoelectric equation K.E.max = hf − φ, the maximum kinetic energy depends only on the frequency of the incident photons.

Explanation 3: The incident photons transfer energy to an electron once it is absorbed.

(Any Two of above / other reasonable answers) 1 M + 1 M

(b) (i) Work function is the minimum amount of energy required to remove an electron from a metal surface. 1 A

(ii) Threshold frequency of the alloy : $f_0 = \frac{\phi}{h} = \frac{(1.8)(1.60\times10^{-19})}{6.63\times10^{-34}} = 4.34\times10^{14}\text{ Hz}$ 1 M

Frequency of the infrared radiation : $f = \frac{c}{\lambda} = \frac{3\times10^{8}}{1000\times10^{-9}} = 3\times10^{14}\text{ Hz} < f_0$ 1 M

Hence the photomultiplier tube does not work with the infrared radiation. 1 A

Alternative:

Energy of the infrared photon:

$$E = hf = \frac{hc}{\lambda} = \left[\frac{\left(6.63\times10^{-34}\right)\left(3\times10^{8}\right)}{1000\times10^{-9}}\right]\frac{1}{1.60\times10^{-19}} \approx 1.24\text{ eV} < 1.8\text{ eV}$$

Hence the photomultiplier tube does not work with the infrared radiation.

(iii) The more intense is the incident light, the more photons reach the photocathode. 1 A

Since each photoelectron has to absorb one photoelectron before it is emitted, more photos reaching the photocathode results in more electrons to be emitted. 1 A

So, Derek's claim is correct.

Section C: Energy and Use of energy

1.	2.	3.	4.	5.	6.	7.	8.
A	B	C	B	B	C	C	A

				Marks
3.	(a)		Solar panels are portable, so they can be easily transported to remote areas.(Or other reasonable answers)	1 A
	(b)		Maximum energy stored = $Pt = 7 \times 60 \times 60 \times 24 \times 3$	1 M
			$= \underline{\underline{1.81 \times 10^6 \text{ J}}}$	1 A
	(c)		$1000 \times A \times 18\% = 45$	1 M
			$A = \underline{\underline{0.25 \text{ m}^2}}$	1 A
	(d)		There is an extended period of rainy (or cloudy) weather.	1 A
	(e)	(i)	By $P_{最大} = \frac{1}{2}\rho A v^3 = \frac{1}{2} \times 1.2 \times (\pi \times 0.8^2) \times \left(\frac{20 \times 10^3}{3600}\right)^3$	1 M
			$= \underline{\underline{207 \text{ W}}}$	1 A
		(ii)	Air does not stop after passing through the turbine.	1 A
			The generator in the turbine is not 100% efficient.	1 A
			(Or other reasonable answers)	

Section D: Medical Physics

1.	2.	3.	4.	5.	6.	7.	8.
A	A	A	D	B	A	A	D

				Marks
4.	(a)		The result does not tell which kidney is not working normally.	1 A
	(b)	(i)	Only a few radionuclides are accumulated in the kidneys.	1 A
		(ii)	More radionuclides are accumulated in the kidneys.	1 A
			The kidney appearing whiter absorbs fewer radionuclides.	1 A
		(iii)	Most radionuclides have decayed / been removed from the body by biological processes.	1 A

(c) (i) By $\frac{1}{t_{eff}} = \frac{1}{t_{phy}} + \frac{1}{t_{bio}}$,

$$t_{eff} = \left(\frac{1}{t_{phy}} + \frac{1}{t_{bio}}\right)^{-1} = \left(\frac{1}{6} + \frac{1}{4}\right)^{-1} = \underline{\underline{2.4 \text{ hours}}}$$ 1 M

Decay constant $k = \frac{\ln 2}{t_e} = \frac{\ln 2}{2.4} = 0.289 \text{ h}^{-1}$

By $A = A_0 e^{-kt}$, 1 M

$$t = \frac{-1}{k} \ln \frac{A}{A_0} = \frac{-1}{0.289} \ln 0.1 = \underline{\underline{7.97 \text{ h}}}$$ 1 A

<u>Or</u> By $A = A_0 \left(\frac{1}{2}\right)^{\frac{t}{t_e}}$, 1 M

$$t = t_e \frac{\ln \frac{A}{A_0}}{\ln 0.5} = 2.4 \times \frac{\ln 0.1}{\ln 0.5} = 7.97 \text{ h}$$ 1 A

(ii) Any two of the following: 1 A + 1 A

-Emit γ radiation only

-Non-toxic / no pharmacological effect

-Decay to a stable nuclide

(Accept other reasonable answers.)