Form 6 PHYSICS 2021 – 2022 Final Examination Paper 1A (Marking Scheme)

Answers:

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

Form 6 PHYSICS 2021 – 2022 Final Examination Paper 1B (Marking Scheme)

Q.1

(a) Use the rubber tube to connect the syringe to the Bourdon gauge. (1)
Slowly push the plunger to decrease the gas volume. (1)
Record the gas volume and pressure. Repeat the experiment to obtain different sets of data (i.e. P & V). (1)
Plot a graph of P against 1/V and a straight line graph is resulted. (1)

(b) n (no of moles of gas molecules) (1)
T (gas temperature) (1)

(c) Gas volume ↓ ➔ gas molecules are closer together ➔ frequency of collision ↑ (1)
➔ force acting on the container's wall ↑ ➔ Pressure ↑ (1)

Q.2

(a) There is <u>air resistance</u> acting on the object. (1)
As mg – f = ma, the <u>influence of air resistance on the lighter object is more significant</u> as it has a smaller mass. (1)

(b) $s = (u + v)t / 2$ ➔ $v = 15.6 \times 2 / 1.79 = 17.4\ m\ s^{-1}$ (1M+1A)
$a = (17.4 – 0) / 1.79 = 9.74\ m\ s^{-2}$

(c) Energy loss = PE↓ - KE↑ = $mgh – 1/2\ m v^2 = (3.58)(9.81)(15.6) – 1/2\ (3.58)\ (17.4)^2 = 4.05\ J$ (1+1)

Q.3

(a) $T \cos 30 – mg \sin 20 – f = ma$ (1)
$T \cos 30 – (3)\ (9.81) \sin 20 – 12 = 3(0.5)$ ➔ $T = 27.2\ N$ (1)

(b) $N + T \sin 30 = mg \cos 20$ (1)
$N = (3)\ (9.81) \cos 20 – (27.2) \sin 30 = 14.0\ N$ (1)

(c) $v = u + at = 0 + 0.5\ (5) = 2.5\ m\ s^{-1}$ (1+1)

(d) The block continues to move for a while. (1)
When it reaches its highest position, it stops and stays. (1)

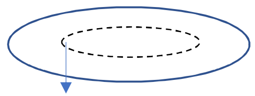
Q.4

(a) $\omega = 5 \times (2\pi/2) = 15.7\ s^{-1}$ (1)
$v = r\ \omega = (1.5)(15.7) = 23.6\ m\ s^{-1}$ (1)

(b) Before breaking,
$T = m v^2 / r = (1+2)\ (23.6)^2 / 1.5 = 1110\ N$ (1)
After breaking,
$T_A = 2T = 2221 = m_A v_A^2 / r$ (1)
➔ $v_A = [(2221)\ (1.5) / (1)]^{1/2} = 57.7\ m\ s^{-1}$ (1)

(c) $m_A u_A + m_B u_B = m_A v_A + m_B v_B$
➔ $(1+2)\ (23.5619) = (1)\ (57.7147) + 2\ v_B$ (1)
➔ $v_B = 6.49\ m\ s^{-1}$ (1)

(d) (1)



Q.5

(a) $GMm/r^2 = mv^2/r$ ➔ $v = \sqrt{(GM/r)}$

Also, $GM/R_E^2 = 9.81$ ➔ $GM = 9.81\ R_E^2$

Thus, $v = \sqrt{((9.81\ R_E^2)/r)}$ $\sqrt{((9.81\ (6400000)^2)/(6370000+1200000))}$ ➔ $v = 7250\ m\ s^{-1}$ (1+1)

(b) $KE = 1/2\ m\ v^2 = 1/2\ (6000)(7251)^2 = 1.58 \times 10^{11}\ J$ (1+1)

(c) $KE = 1/2\ m\ v^2 = 1/2\ m\ (9.81\ R_E^2)/r$ ➔ $KE\ \alpha\ 1/r$ (1)

Thus, r → r/2 ➔ KE → 2 KE

The new KE is $1.58 \times 10^{11}\ J \times 2 = 3.16 \times 10^{11}\ J$ (1)

Q.6

(a)

(i) From the diagram, path diff = $S_1C - S_2C = 2.5\ \lambda$. (1)

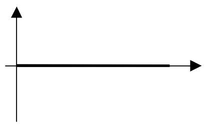
Destructive interference occurs. (1)

(ii) path diff = $S_2D - S_1D = 2\ \lambda$. (1)

➔ $S_1D = 2\ \lambda = 16$ cm (0.5)

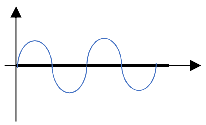
$S_2D = 4\lambda = 32$ cm (0.5)

(b) (i)



(1)

(ii)



(1)

(c) No (1)

The two light sources are not coherent. (1)

(d) $\lambda = v / f = 4.48 \times 10^{-7}$ m (1)

$\Delta y = D\ \lambda / a$ ➔ $a = D\ \lambda / \Delta y = (5)\ (4.48 \times 10^{-7}) / (0.03/8) = 5.97 \times 10^{-4}$ m (1+1)

Q.7

(a) Concave lens (1)

Wider field of vision can be seen. (1)

(b)

(i) m = 0.4 / 1.8 = 0.222 *(or 2/9)*

(ii) (1)

(1)

F

(1)

Focal length = *range : 10 - 12cm* (1)

(c) f↓ → m ↓ → field of vision ↑

Q.8

(a) $E = mc\Delta T + ml = C\Delta T + ml = (0.085)(58\text{-}20) + 20 = 23.23$ J (1+1)

(b) $R = \rho l/A = (2.5 \times 10^{-5})\ (0.012) / [\pi\ (0.5 \times 10^{-3}/2)^2 = 1.53\ \Omega$ (1+1)

(c) $P = I^2R = (5)^2\ (1.53) = 38.1972$ W (1+1)

By E = Pt,

$Pt = mc\Delta T + ml = 23.23$ J ➔ $P = 23.23 / 38.1972 = 0.608$ s (1+1)

Q.9

(a) By $N_S / N_P = V_S / V_P$,

$V_S = (N_S / N_P)\ (V_P) = (200/3000)(220) = 14.7$ V (1)

➔ I = V / R = 14.7 / 20 = 0.733 A (1)

(b) By $I_P\ V_P = I_S\ V_S$,

$I_P\ (220) = (0.733)(14.7)$ ➔ $I_P = 0.0489$A (1+1)

(c) no of bulbs = 2A / 0.0489A = 40.9 (1)

The max no of bulbs connected in parallel is 40. (1)

(d) For minimum current flow in the secondary coil, the max resistance is 20n Ω. (n = no of bulb in series)

Is ≥ 0.08 A ➔ 14.7 V / 20n Ω ≥ 0.08 A ➔ 9.19 ≥ n (1)

The max no of bulbs connected in series is 9.

Q.10

(a) Downward (1)

(b)

(0.5 x 4 = 2)

(c) $f = F_B$ (net force = 0) ➔ $f = B\ I\ l = (0.5)\ (1.2)\ (0.1) = 0.06$ N (1+1)

(d) The magnetic force becomes zero.

The friction is the net force acting on the rod. (1)

The rod decelerates to rest. (1)

(e) X

Q.11

(a) a is 81 b is 206 (0.5 + 0.5)

(b) $\Delta m = E / c2 = 8.49 \times 10^{-13} / (3 \times 10^8)2 = 9.43333 \times 10^{-30}$ kg = 0.00568 u (1)

mass of X = mass of Bi – mass of He – Δm = 209.9841 u – 4.0015 u – 0.00568 u = 205.9769 u (1)

(c) $k = \ln 2 / t_{1/2} = \ln 2 / (5.01 \times 24 \times 3600) = 1.60 \times 10^{-6}\ s^{-1}$ (or 0.138 day^{-1}) (1)

(d) $A_0 = k\ N_0$

➔ $N_0 = A_0 / k = 16800 / 1.60 \times 10^{-6} = 1.05 \times 10^{10}$ (1)

(e) $N = N_0\ (1/2)^n$ ➔ $\Delta N = N_0 - N = (1.05 \times 10^{10})\ [1 - (1/2)^{10/5.01}] = 7.87 \times 10^9$ (1)

Energy released = $\Delta N \times E = (7.87 \times 10^9)\ (8.49 \times 10^{-13}) = 6.68 \times 10^{-3}$ J = 0.00668 J (1)

Final Examination 2020/21 PHYSICS PAPER 2 Marking Scheme

Section B: Atomic World

Q.2: Multiple-choice questions

2.1	B	2.5	A
2.2	C	2.6	D
2.3	B	2.7	A
2.4	C	2.8	D

Q.2: Structured question

(a) The energy of the photons = 2.87 + 0.95 = 3.82 eV **(1A)**

(b) Some of the electrons are not at the surface of the metal so that they don't possess the maximum KE when they are ejected. **(1A)**

(c) (i) Effective area = 0.2 nm^2 = 0.2 (10^{-9} m)^2 = 2 × 10^{-19} m^2

Rate of energy absorbed by each calcium atom

= (2 × 10^{-19})(0.032) = 6.4 × 10^{-21} W

The minimum time required to absorb enough energy

(ii) Photoelectron emission is a one-to-one process, so photoelectrons would be ejected immediately if the energy of the photons absorbed is greater than that of the work function of the metal. **(1A)**

(d) (i) Number of photons falling on the surface

(ii) Maximum photocurrent

= (1.571 × 10^{13})(0.05)(1.6 × 10^{-19}) **(1M)**

= 1.26 × 10^{-7} A **(1A)**

(e) The new I_P–V graph

(2A)

Section C: Energy and Use of Energy

Q.3: Multiple-choice questions

3.1	D	3.5	C
3.2	B	3.6	A
3.3	C	3.7	B
3.4	A	3.8	D

Q.3: Structured question

(a) It can reflect most infrared radiation **(1A)** and allow a high percentage of visible light to pass through. **(1A)**

(b) (i) A large amount of heat from the Sun will be absorbed and conducted through the roof into the warehouse. **(1A)**

(ii) The thermal conductivities of wood and polystyrene are very low. **(1A)** They are the good insulators **(1A)** of heat and thus the rate of heat conduction through the roof will be greatly reduced

(c) (i) Q/t = [(0.9)(360)+(0.3)(216)+(2.5)(36)](35-20) + (100)(36) = 10782 W **(1M+1A)**

(ii) OTTV = 10782 / (360+216+36) = 17.7 **(1A)**

(d) The input power of the air-conditioning system = 10782 / 3.5 = 3080 W **(1A)**

(e) Add some insulating materials to the wall of the warehouse. **(1A)**

Section D: Medical Physics

Q.4: Multiple-choice questions

4.1	C	4.5	B
4.2	A	4.6	C
4.3	A	4.7	D
4.4	B	4.8	D

Q.4: Structured question

(a) $A = A_o e^{-kt}$ ➔ $2 A_o /3 = A_o e^{-k(3)}$ ➔ $\ln(2/3) = -3k$ ➔ $k = 0.135\ h^{-1}$ **(1A)**

$(2A_o/3) = (1/2)^n$ ➔ n = 5.13 hrs **(1A)**

(b) 1/tb + 1/tp = 1/teff **(1A)** ➔ 1/tp = 1/5.13 – 1/12 ➔ 8.96 hrs **(1A)**

(c) $(A_o/100) = (1/2)^{n'}$ **(1A)** ➔ n' = 34.1 hrs **(1A)**

(d) X-ray **(1A)**.

(e) CT Scan **(1A)**

(a) The doctor can have the results within a short period of time. **(1A)**
X-ray radiographic imaging method can show clear image of bones. **(1A)**

Final Examination 2020/21 PHYSICS PAPER 2 Marking Scheme

Answer

Section B: Atomic World

Q.2: Multiple-choice questions

2.1	**B**	**2.5**	**A**
2.2	**C**	**2.6**	**D**
2.3	**B**	**2.7**	**A**
2.4	**C**	**2.8**	**D**

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(c) (i) Effective area = 0.2 nm^2 = 0.2 $(10^{-9}\text{ m})^2 = 2 \times 10^{-19}\text{ m}^2$

Rate of energy absorbed by each calcium atom

$= (2 \times 10^{-19})(0.032) = 6.4 \times 10^{-21}$ W

The minimum time required to absorb enough energy

$$= \frac{\phi}{P} = \frac{(2.87)\,(1.6 \times 10^{-19})}{6.4 \times 10^{-21}} \approx 71.8 \text{ s}$$ (1M+1A)

(ii) Photoelectron emission is a one-to-one process, so photoelectrons would be ejected immediately if the energy of the photons absorbed is greater than that of the work function of the metal. **(1A)**

(d) (i) Number of photons falling on the surface

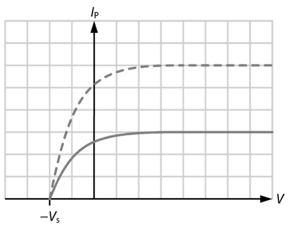
$$= \frac{(0.032)\,(3 \times 10^{-4})}{(3.82)\,(1.6 \times 10^{-19})} = 1.571 \times 10^{13} \approx 1.57 \times 10^{13}$$ (1A)

(ii) Maximum photocurrent

$= (1.571 \times 10^{13})(0.05)(1.6 \times 10^{-19})$ **(1M)**

$= 1.26 \times 10^{-7}$ A **(1A)**

(e) The new I_P–V graph



(2A)

Section C: Energy and Use of Energy

Q.3: Multiple-choice questions

3.1	**D**	**3.5**	**C**
3.2	**B**	**3.6**	**A**
3.3	**C**	**3.7**	**B**
3.4	**A**	**3.8**	**D**

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Section D: Medical Physics

Q.4: Multiple-choice questions

4.1	**C**	**4.5**	**B**
4.2	**A**	**4.6**	**C**
4.3	**A**	**4.7**	**D**
4.4	**B**	**4.8**	**D**

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