1. **b)** $\sqrt{2}$

Kinetic energy + Potential energy = Total energy

De-Broglie wavelength $\lambda = \frac{h}{\sqrt{2mK}}$

2. **d) the intensities of light incident on a, b and c are all different**

Intensity $= \frac{\text{no of photnsincident}}{\text{second} \times \text{Area}}$

$\text{current } \alpha \frac{\text{no ; of photons incident}}{\text{seconds}}$

3. **c) 1**

From conservation of linear momentum both the particles will have equal
and opposite momentum.
The de-Broglie wavelength is given by

$\lambda = \frac{h}{p} \qquad \therefore \frac{\lambda_1}{\lambda_2} = 1$

4. **b)** $E = 3.4$ **eV,** $\lambda \approx 6.6 \times 10^{-10}$ **m**

The potential energy $= -2 \times \text{kinetic energy} = -2E$

$\therefore$ total energy $= -2E + E = -E = -3.4$ eV

or $E = 3.4$ eV.

Let p = momentum and $m =$ mass of the electron.

$\therefore E = \frac{p^2}{2m} \qquad or \qquad p = \sqrt{2mE}.$

De Broglie wavelength, $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}} \approx 6.6 \times 10^{-10} m.$

5. **a)** $2.176 \times 10^{-18} J$

$E_{(n_1 \to n_2)} = \frac{A}{n_2^2} - \frac{A}{n_2^2}$

$E = \frac{hc}{\lambda}$ so, $\frac{\lambda_{n_1 \to n_2}}{\lambda_{n_1 \to n_2 + 1}} = \frac{\frac{1}{n_1^2} - \frac{1}{(n_2+1)^2}}{\frac{1}{n_1^2} - \frac{1}{n_2^2}} = \frac{1028}{975} = 1.054$

or , $\frac{0.054}{n_1^2} = \frac{1.054}{n_2^2} - \frac{1}{(n_2+1)^2}$

so, taking $n_2 = 2,3,4........$ so an find integral value of $n_2 = 2,3,4........n_1$ we find, $n_2 = 3$ gives $n_1 \simeq 1$

so, $A = \frac{hc}{\lambda}\left(\frac{1}{1} = \frac{1}{9}\right)^{-1} J \simeq 2.176\times10^{-18} J$

6. **a)** $\frac{h}{mA}$

a = A cost t, ω = 1

v = A sin t at t = π/2; v = A

∴ λ = h/mA

7. **b)** $\frac{9a^2I}{4c}$

Radiation pressure = $P = \frac{I}{c}$

Area of hexagon = $\left(\frac{1}{2}a.\frac{a\sqrt{3}}{2}\right)\times 6$

$F = PA\cos\theta = \frac{I}{c}.\frac{3a^2\sqrt{3}}{2}.\frac{\sqrt{3}}{2} = \frac{9a^2I}{4c}$

8. **a)** $\frac{2mc\lambda^2}{h}$

$P = \frac{h}{\lambda}$ $\qquad kE = \frac{P^2}{2m} = \frac{h^2}{2m\lambda^2} = \frac{hc}{\lambda_0}$

9. **a)** $\frac{1}{e}$

$\frac{N(t)}{N_o}$ = $\frac{N_o e^{-\lambda t}}{N_o}$ $\qquad$ Probability $= e^{-\lambda\frac{1}{\lambda}} = e^{-1} = \frac{1}{e}$

∴ (a) is correct.

10. **d) two or three atoms**

An excited H-atom cannot emit 1.9ev, 10.2ev and 12.1ev simultaneously

11. **b) Targets of high atomic numbers have smaller energy differences as compared with targets of low atomic numbers.**

$|E| \propto Z^2$

So targets of higher atomic numbers have higher energy differences.

12. **b) 41 kV**

For shortest wavelength, maximum K.E of electron is converted to X-ray

$\frac{hc}{\lambda} = eV_o$ ...(1)

Let V_o be initial voltage

$\frac{hc}{\lambda - 20} = e(3V_o)$ ...(2)

$\frac{1}{2}$ $\frac{\lambda - 20}{\lambda} = \frac{1}{3}$ $\Rightarrow 3\lambda - 60 = \lambda$

$\lambda = 30\,pm$

$V_o - 41kV$

13. **c)** $\frac{25}{9}v$

$\sqrt{v} = a(Z - b)$

14. **b) product of slope of the line and charge on the electron**

$e V_0 = h\upsilon - W$ Where V_0 is the stopping potential

15. **d) doubly ionized lithium**

16. **d)** $\frac{nh}{2\pi\sqrt{mK}}$

$F = -\frac{dU}{dr} = -\frac{K}{r}$

Force $F = \frac{mv^2}{r}$ also $mvr = \frac{nh}{2\pi}$

17. **b) photon of energy 10.2eV and electron of energy 1.4eV**

18. **b)** $Z_A < Z_B; V_A > V_B$

$\lambda_{\min} \alpha \frac{1}{V}$ and $\sqrt{\frac{C}{\lambda}} = a(Z - b)$

19. **a) 1.51 eV**

Angular momentum $= \frac{nh}{2\pi}$ $\therefore n = 3$

20. **c) both a and b are independent of target material**

21. **d) None**

$\phi \Rightarrow eb$ (where e $\rightarrow$ electronic charge)

22. **d)** $e^{\lambda(t_1-t_2)}$

Conceptual

23. **a) 30**

$\ln\left|\frac{6}{100}\right| = -\lambda t = \frac{-0.693(120)}{T}$ (or) t = 30 min.

24. **d)** $\frac{3}{8}s$

$$\frac{N}{N_o} = \left(\frac{1}{2}\right)^{\frac{t}{T}} = \frac{1}{4}$$

$$\frac{t}{T} = 2 \ \ or \ \ T = \frac{t}{2} = \frac{3}{4\times 2} = \frac{3}{8}S.$$

25. **b) 3 : 2**

Since, $\frac{\lambda_x}{\lambda_y} = \frac{2}{3}$

$$N_x\lambda_x = N_y\lambda_y \Rightarrow \frac{N_x}{N_y} = \frac{3}{2}$$

26. **d) 8 × 10⁹ years**

Let the initial no be N_o

For X, $\lambda_x = \frac{0.693}{T_x}$, $\lambda_y = \frac{0.693}{T_y}$

$$N_x = N_o e^{-\lambda xt}, \ \ N_y = N_o e^{-\lambda yt}, \ \ \frac{N_x}{N_y} = \frac{20}{80} = \frac{1}{4}$$

27. **a) 4.95 Mev**

Total B.E. of C^{13}- Total B.E. of C^{12} = (13 x 7.47) – 12 x 7.68

28. **b) 180 MeV**

$$\varnothing = B.E_{products} - B.E_{reactants}$$

29. **b) 6.5 MeV**

Mass of one atom of U^{235} is

235.121420 a.m.u.

Mass of one neutron = 1.008665 a.m.u.

Sum of the masses of U^{235} and neutron

=236.130085 = 236.130 a.m.u.

Mass of one atom of U^{236} is

236.123050 a.m.u. = 236.123 a.m.u.

Mass defect = 236.136 – 236.123

= 0.007 a.m.u.

Therefore, energy required to remove one neutron is

0.007 × 931 MeV = 6.517 MeV = 6.5 Mev

30. **b)** $\frac{3 \ln 2}{2t}$

Probability that either decrees

$$\lambda dt = \lambda_1 dt + \lambda_2 dt$$

$$\lambda = m^2 \left[\frac{1}{T_1} + \frac{1}{T_2} \right]$$