Exercise-1

ONLY ONE OPTION CORRECT TYPE

SECTION (A) : PHOTOELECTRIC EFFECT

1. A metal surface is illuminated by a light of given intensity and frequency to cause photoemission. If the intensity of illumination is reduced to one fourth of its original value, then the maximum kinetic energy of the emitted photoelectrons would be :
(1) unchanged (2) 1/16th of original value
(3) twice the original value (4) four times the original value

2. Mark the correct statement: In photo electric effect -
(1) electrons are emitted from metal surface when light falls on it.
(2) the kinetic energy of photo electrons is more for light of longer wavelength in comparison to that due to shorter wavelength.
(3) both of the above (4) none of the above

3. If the threshold wavelength of light for photoelectric effect from sodium surface is 6800 A^o then, the work function of sodium is
(1) 1.8 eV (2) 2.9 eV (3) 1.1 eV (4) 4.7 eV

4. When the distance of a point light source from a photocell is r_1, photoelectric current is I_1, If the distance becomes r_2, then the current is I_2, The ratio ($I_1 : I_2$) is equal to
(1) $r_{22} : r_{21}$ (2) $r_2 : r_1$ (3) $r_{12} : r_{22}$ (4) $r_1 : r_2$

5. The maximum energy of the electrons released in photocell is independent of
(1) Frequency of incident light. (2) Intensity of incident light.
(3) Nature of cathode surface. (4) None of these.

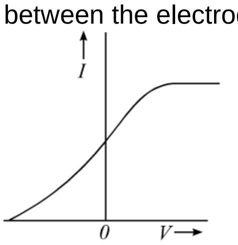
6. In photoelectric effect, we assume the photon energy is proportional to its frequency and is completely absorbed by the electrons in the metal. Then the photoelectric current ($\upsilon > \nu_{th}$)
(1) Decreases when the frequency of the incident photon increases.
(2) Increases when the frequency of the incident photon increases.
(3) Does not depend on the photon frequency but only on the intensity of the incident beam.
(4) Depends both on the intensity and frequency of the incident beam.

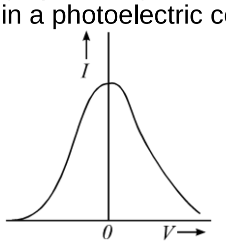
7. When stopping potential is applied in an experiment on photoelectric effect, no photocurrent is observed. This means that
(1) the emission of photoelectrons is stopped
(2) the photoelectrons are emitted but are reabsorbed by the emitter metal
(3) the photoelectrons are accumulated near the collector plate
(4) the photoelectrons are dispersed from the sides of the apparatus.

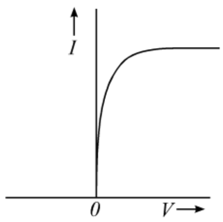
8. If the frequency of light in a photoelectric experiment is doubled then stopping potential will
(1) be doubled (2) be halved
(3) become more than double (4) become less than double

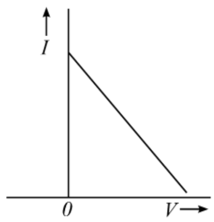
9. The energy of a photon of frequency ν is $E = h\nu$ and the momentum of a photon of wavelength λ is $p = h/\lambda$. From this statement one may conclude that the wave velocity of light is equal to :
(1) $3 \times 10_8\ ms_{-1}$ (2) $\frac{E}{p}$ (3) E p (4) $\left(\frac{E}{p}\right)^2$

10. Which one of the following graphs in figure shows the variation of photoelectric current (I) with voltage (V) between the electrodes in a photoelectric cell ?

(1) 

(2) 

(3) 

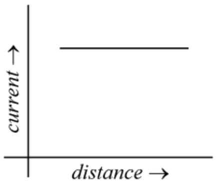
(4) 

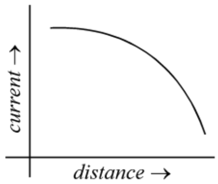
11. The collector plate in an experiment on photoelectric effect is kept vertically above the emitter plate. Light source is put on and a saturation photocurrent is recorded. An electric field is switched on which has vertically downward direction
(1) The photocurrent will increase
(2) The kinetic energy of the electrons will increase
(3) The stopping potential will decrease
(4) The threshold wavelength will increase

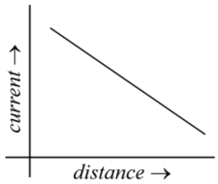
12. The frequency and intensity of a light source are both doubled. Consider the following statements.
(i) The saturation photocurrent remains almost the same.
(ii) The maximum kinetic energy of the photoelectrons is doubled.
(1) Both (i) and (ii) are true
(2) (i) is true but (ii) is false
(3) (i) is false but (ii) is true
(4) both (i) and (ii) are false

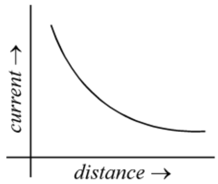
13. A point source of light is used in a photoelectric effect. If the source is removed farther from the emitting metal, the stopping potential
(1) will increase
(2) will decrease
(3) will remain constant
(4) will either increase or decrease

14. A point source causes photoelectric effect from a small metal plate. Which of the following curves may represent the saturation photocurrent as a function of the distance between the source and the metal?

(1) 

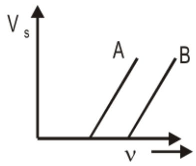
(2) 

(3) 

(4) 

15. The photoelectrons emitted from a metal surface :
(1) Are all at rest
(2) Have the same kinetic energy
(3) Have the same momentum
(4) Have speeds varying from zero up to a certain maximum value

16. The stopping potential as a function of frequency of incident radiation is plotted for two different photo electric surfaces A and B. The graphs show the work function of A is **[CPMT - 92]**



(1) Greater than that of B
(2) Smaller than that of B
(3) Same as that of B
(4) No comparison can be done from given graphs

17. In an electron gun electron are accelerated through a potential difference V. If e = charge of electron and m = mass of electron then maximum electron velocity will be **[MPPET, CPMT -93, RPMT 93]**
(1) 2eV/m
(2) $\sqrt{2eV/m}$
(3) $\sqrt{2m/eV}$
(4) V_2 /2em

18. Light of wavelength 5000 Å falls on a sensitive plate with photoelectric work function of 1.9 eV. The kinetic energy of the photoelectron emitted will be : **[AIPMT-1998]**
(1) 0.58 eV
(2) 2.48 eV
(3) 1.24 eV
(4) 0.58 eV1.16 eV

19. In photo-emissive cell, with exciting wavelength λ, the fastest electron has speed υ. If the exciting wavelength is changed to 3λ/4, the speed of the fastest emitted electron will be : **[AIPMT-1998]**
(1) $\upsilon\ (3/4)_{1/2}$
(2) $\upsilon\ (4/3)_{1/2}$
(3) less than $\upsilon\ (4/3)_{1/2}$
(4) greater than $\upsilon\ (4/3)_{1/2}$

20. When intensity of incident light increases : **[AIPMT-1999]**
(1) photo - current increases
(2) photo - current decreases
(3) kinetic energy of emitted photoelectrons increases
(4) kinetic energy of emitted photoelectrons decreases

21. If wavelenth of photo is 6000 Å, then its energy will be : **[RPMT-2000]**
(1) 0.66 eV (2) 1.66 eV (3) 2.66 eV (4) 3.5 eV

22. Work function a metal is 5.26×10^{-18} then its threshold wavelength will be : **[RPMT-2000]**
(1) 736.7 Å (2) 760.7 Å (3) 301 Å (4) 344.4 Å

23. A radio station is transmitting the waves of wavelength 300 m. Radiation capacity of the transmitter is 10 KW. Find out the number of photons which are emitting in per unit time : **[RPMT-2000]**
(1) 1.5×10^{35} (2) 1.5×10^{31} (3) 1.5×10^{29} (4) 1.5×10^{33}

24. The de-Broglie wavelength of a particle accelerated with 150 volt potential is 10^{-10} m : If it is accelerated by 600 volts p.d. its wavelength will be - **[RPET-88]**
(1) 0.25 Å (2) 0.5 Å (3) 1.5 Å (4) 2 Å

25. The momentum of Photon having energy E is **[RPET -88, RPMT -95]**
(1) E/C (2) 1/E (3) E/C^2 (4) None of the above

26. The accelerating voltage of an electron gun is 50,000 volt. De-Broglie wavelength of the electron will be- **[RPMT- 95]**
(1) 0.55 Å (2) 0.055 Å (3) 0.077 Å (4) 0.095 Å

27. photo-cell is illuminated by a source of light, which is placed at a distance d from the cell, If the sustained become d/2, then number of electrons emitted per second will be :- **[AIPMT-2001]**
(1) Remain same (2) Four times (3) Two times (4) One-fourth

28. Relation between wavelength of photon and electron of same energy is : **[RPMT-2001]**
(1) $\lambda_{ph} > \lambda_e$ (2) $\lambda_{ph} < \lambda_e$ (3) $\lambda_{ph} = \lambda_e$ (4) $\frac{\lambda_e}{\lambda_{ph}}$ = constant

29. The wavelength associated with an electron accelerated through a potential difference of 100 V is nearly **[RPMT-2003]**
(1) 100 Å (2) 123 Å (3) 1.23 Å (4) 0.123 Å

30. The work function of a photometal is 6.63 eV. The threshold wavelength is **[RPMT-2003]**
(1) 3920 Å (2)1866 Å (3) 186.6 Å (4) 18666 Å

31. The speed of an eletron having wavelength of 10^{-10} m is : **[AIIMS 2002]**
(1) 4.24×10^6 m/s (2) 5.25×10^6 m/s (3) 6.25×10^6 m/s (4) 7.25×10^6 m/s

32. Sodium and copper have work functions 2.3 eV and 4.5 eV respectively. Then the ratio of threshold wavelengths is nearest to : **[AIEEE 2002 4/300]**
(1) 1 : 2 (2) 4 : 1 (3) 2 : 1 (4) 1 : 4

33. The de-Broglie wavelength λ : **[RPMT-2004]**
(1) is proportional to mass (2) is proportional to impulse
(3) inversely proportional to impulse (4) does not depend on impulse

34. The minimum wavelength of photon is 5000 Å, its energy will be : **[RPMT-2004]**
(1) 2.5 eV (2) 50 eV (3) 5.48 eV (4) 7.48 eV

35. The wavelength associated with and electron accelerted through a potential difference of 100 V is of the order of : **[RPMT-2005]**
(1) 1.2Å (2) 10.5 Å (3) 100 Å (4) 1000 Å

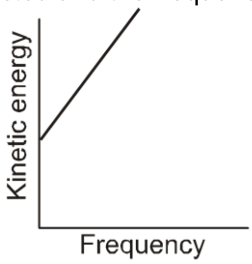
36. The slope of a graph drawn between thershold frequency and stopping potential is : **[RPMT-2005]**
(1) e (2) h (3) $\frac{h}{e}$ (4) he

37. The photoelectric work function of a metal is 3.3 eV. The threshold frequency for this metal is approximately : **[RPMT-2011]**

(1) 3.3×10^{13} Hz (2) 8.0×10^{14} Hz (3) 1.65×10^{15} Hz (4) 9.9×10^{15} Hz

38. A particle of mass 11×10^{-12} kg is moving with a velocity 6×10^{-7} m/s. Its de–Broglie wavelength is nearly : **[RPMT-2011]**
(1) 10^{-20} m (2) 10^{-16} m (3) 10^{-12} m (4) 10^{-8} m

39. According to Eistein's photoelectric equation, the graph between the kinetic energy of photoelectrons ejected and the frequency of incident radiation is **[AIPMT-2004]**

(1)


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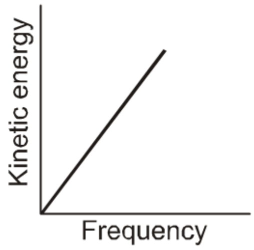

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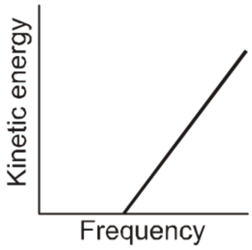

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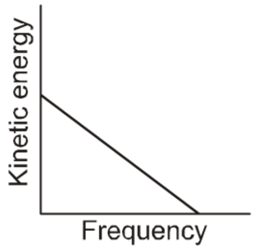


40. A photosensitive metallic surface has work function, h v_0. If photons of energy 2h v_0 fall on this surface, the electrons come, out with a maximum velocity of 4×10^6 m/s. when the photon energy is increased to $5hv_0$, then maximum velocity of photo electrons will be :- **[AIPMT- 2005]**
(1) 2×10^7 m/s (2) 2×10^7 m/s (3) 8×10^5 m/s (4) 8×10^6 m/s

41. When photons of energy hv fal on an aluminium plate (of work function E_0), photoelecrtrons of maximum kinetic energy K are ejected. If the frequency of the radiation is doubled, the maximum kinetic energy of the ejected photoelectrons will be :- **[AIPMT-2006]**
(1) K + E_0 (2) 2K (3) K (4) K + hv

42. The momentum of a photon of energy 1 MeV is kgm/s, will be:- **[AIPMT-2006]**
(1) 0.33×10^6 (2) 7×10^{-24} (3) 10^{-22} (4) 5×10^{-22}

43. A 5 W source emits monochromatic light of wavelength 5000 Å. When placed 0.5 m away, it liberates photoelectrons from a photosensitive metallic surface, When the source is moved to a distance of 1.0 m, the number of photoelectrons liberated will be reduced by a factor of : **[AIPMT-2007]**
(1) 4 (2) 8 (3) 16 (4) 2

44. The work function of a surface of a photosensitive material is 6.2 eV. The wavelength of the incident radiation for which the stopping potential is 5 V lies in the. **[AIPMT-2008]**
(1) ultraviolet region (2) visible region (3) infrared region (4) X-ray region

45. A radiation of energy E falls normally on a perfecting reflecting surface. The momentum transferred to the surface is: **[AIEEE 2004 4/300]**
(1) E/c (2) 2E/c (3) Ec (4) E/c^2

46. According to Einstein's photoelectric equation, the plot of the kinetic energy of the emitted photoelectrons from a metal Vs then frequency, of the incident radiation gives a straight line whose slope : **[AIEEE 2004 4/300]**
(1) depends on the nature of the metal used
(2) depends on the intensity of the radiation
(3) depends both on the intensity of the radiation and the metal used
(4) is the same for all metals and independent of the intensity of the radiation

47. The work function of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately : **[AIEEE 2004 4/300]**
(1) 540 nm (2) 400 nm (3) 310 nm (4) 220 nm

48. If the kinetic energy of a free electron doubles, its de-Broglie wavelength changes by the factor : **[AIEEE 2005 4/300]**

(1) $\frac{1}{2}$ (2) 2 (3) $\frac{1}{\sqrt{2}}$ (4) $\sqrt{2}$

49. The time by a photoelectron to come out after the photon strikes is approximately **[AIEEE 2006 3/180]**

(1) 10^{-1} s (2) 10^{-4} s (3) 10^{-10} s (4) 10^{-16} s

50. Photon of frequency v has a momentum associated with it. If c is the velocity of light, the momentum is: **[AIEEE 2007 3/120, –1]**

(1) v/c (2) hvc (3) h v/c^2 (4) h v/c

51. The threshold frequency for a certain metal is ν_0. When light of frequency $\nu = 2\nu_0$ is incident on it, the maximum velocity of photo electrons is 4 x 10^6 m/s. If the frequency of incident radiation is increased to $5\nu_0$, then the maximum velocity of photo-electrons in m/s will be

(1) (4/5) × 10^6 (2) 2 × 10^6 (3) 8 × 10^6 (4) 2 × 10^7

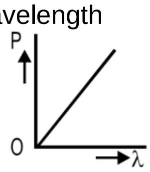
52. If the energy of a photon corresponding to a wavelength of 6000 Aº is 3.32 × 10^{-19} joule, the photon energy (in joule) for a wavelength of 4000 Aº will be

(1) 1.11 × 10^{-19} (2) 2.22 × 10^{-19} (3) 4.44 × 10^{-19} (4) 4.98 × 10^{-19}

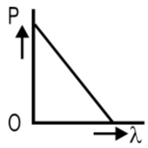
53. Light of frequency 1.5 times the threshold frequency is incident on photo-sensitive material. If the frequency is halved and intensity is doubled, the photo-current becomes

(1) Quadrupled (2) Doubled (3) Halved (4) Zero

54. Which of the following figure, represents the variation of particle momentum and associated de-Broglie wavelength

(1) 

(2) 

(3) 

(4) 

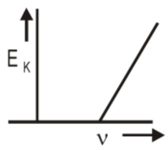
55. Linear momenta of a proton and an electron are equal. Relative to an electron

(1) Kinetic energy of proton is more.
(2) De-Broglie wavelength of proton is more.
(3) De-Broglie wavelength of proton is less.
(4) De-Broglie wavelength of proton and electron are equal.

56. The maximum velocity of an electron emitted by light of wavelength λ incident on the surface of a metal of work function ϕ is **[RPET-88]**

(1) $\left[\frac{2(hc+\lambda\phi)}{m\lambda}\right]^{1/2}$ (2) $\left[\frac{2(hc-\lambda\phi)}{m\lambda}\right]^{1/2}$ (3) $\frac{2(hc-\lambda\phi)}{m\lambda}$ (4) $\frac{2(hc+\lambda\phi)}{m\lambda}$

57. Graph is plotted between maximum kinetic energy of electron with frequency of incident photon in Photo electric effect. The slope of curve will be- **[MP PMT -2001]**



(1) Charge of electron (2) Work function of metal
(3) Planck's constant (4) Ratio of Planck constant and charge of electron

58. Light of frequency ν is incident of photon ν_0. Then work function of device will be - **[MPPMT- 2001]**

(1) hν (2) hν_0 (3) h[ν – ν_0] (4) h[ν_0 – ν]

59. Choose the correct equation **[RPET - 2002]**

(1) $\frac{h\lambda}{c} = E$ (2) $h\lambda = \frac{E}{c}$ (3) $\frac{hc}{E} = \lambda$ (4) none of these

60. The energy of electron with de-Broglie wavelength of 10^{-10} meter, in [ev] is - **[RPMT - 88]**
(1) 13.6 (2) 12.27 (3) 1.27 (4) 150.6

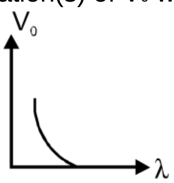
61. If particles are moving with same velocity, then maximum de-Broglie wavelength is for **[CPMT - 2002]**
(1) Proton (2) α-particle (3) Neutron (4) β-particle

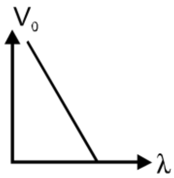
62. Photoelectric effect can be explained by assuming that light
(1) is a form of transverse waves (2) is a form of longitudinal waves
(3) can be polarised (4) consists of quanta

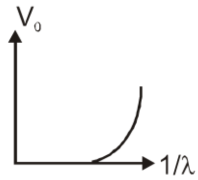
63. A proton and photon both have same energy of E = 100 K eV. The debroglie wavelength of proton and photon be λ_1 and λ_2 then λ_1/λ_2 is proportional to -
(1) $E^{-1/2}$ (2) $E^{1/2}$ (3) E^{-1} (4) E

64. The work functions of Silver and Sodium are 4.6 and 2.3 eV, respectively. The ratio of the slope of the stopping potential versus frequency plot for Silver to that of Sodium is :
(1) 1 (2) 2 (3) 3 (4) 4

65. For photo-electric effect with incident photon wavelength λ, the stopping potential is V_0. Identify the correct variation(s) of V_0 with λ

(1) 

(2) 

(3) 

(4) None of these

66. The work functions for metals A, B and C are respectively 1.92 eV, 2.0 eV and 5eV According to Einsten's's equation, the metals which will emit photo electrons for a radiation of wavelength 4100 Å is /are :- **[AIPMT- 2005]**
(1) None (2) A only (3) A and B only (4) All the three metals

67. When a monochromatic source of light is at a distance of 0.2 m from a photoelectric cell, the cut-off voltage and the saturation current are respectively 0.6 V and 18 mA. If the same source is placed 0.6 m away from the cell, then :
(1) the stopping potential will be 0.2 V (2) the stopping potential will be 1.8 V
(3) the saturation current will be 6.0 mA (4) the saturation current will be 2.0 mA

68. A cesium photo cell, with a steady potential difference of 60 volt across it, is illuminated by a small bright light placed 50 cm away. When the same light is placed one meter away, the photoelectrons emerging from the photo cell: (assume that potential difference applied is sufficient to produce saturation current)
(1) each carry one quarter of their previous energy
(2) each carry one quarter of their previous momentum
(3) are half as numerous
(4) are one quarter as numerous

69. The work function for aluminium surface is 4.2 eV and that for sodium surface is 2.0 ev. The two metals were illuminated with appropriate radiations so as to cause photo emission. Then :
(1) Both aluminium and sodium will have the same threshold frequency
(2) The threshold frequency of aluminium will be more than that of sodium
(3) The threshold frequency of aluminium will be less than that of sodium
(4) The threshold wavelength of aluminium will be more than that of sodium

70. A photoelectric cell is illuminated by a point source of light 1 mm away. When the source is shifted to 2m then **[AIPMT-2003]**
(1) each emitted electron carries one quarter of the initial energy
(2) number of electrons emitted is half the initial number
(3) each emitted electron carries half the initial energy

(4) number of electrons emitted is a quarter of the initial number

71. Light of wavelength 4000 Å is incident on a metal plate whose work function is 2eV. What is maximum kinetic energy of emitted photoelectron ? **[AIIMS-2002]**

(1) 0.5 eV (2) 1.1 eV (3) 2.0 eV (4) 1.5 eV

72. The maximum wavelength of radiation that can produce photoelectric effect in a certain metal is 200 nm. The maximum kinetic energy acquired by electron due to radiation of wavelength 100 nm will be **[RPMT-2009]**

(1) 12.4 eV (2) 6.2 eV (3) manganin (4) aluminium

73. A photoelectric cell is illuminated by a point source of light 1 m away. When the source is shifted to 2 m then- **[CPMT-2003]**

(1) Each emitted electron carries one quarter of the initial energy.
(2) Number of electrons emitted is half the initial number.
(3) Each emitted electron carries half the initial energy.
(4) Number of electrons emitted is a quarter of the initial number.

74. A photon of light enters a block of glass after travelling through vacuum. The energy of the photon on entering the glass block

(1) increases because its associated wavelength decreases
(2) Decreases because the speed of the radiation decreases
(3) Stays the same because the speed of the radiation and the associated wavelength do not change
(4) Stays the same because the frequency of the radiation does not change

75. Two separate monochromatic light beams A and B of the same intensity (energy per unit area per unit time) are falling normally on a unit area of a metallic surface. Their wavelength are λ_A and λ_B respectively. Assuming that all the incident light is used in ejecting the photoelectrons, the ratio of the number of photoelectrons from beam A to that from B is

(1) $\left(\frac{\lambda_A}{\lambda_B}\right)$ (2) $\left(\frac{\lambda_B}{\lambda_A}\right)$ (3) $\left(\frac{\lambda_A}{\lambda_B}\right)^2$ (4) $\left(\frac{\lambda_B}{\lambda_A}\right)^2$

76. A pulse of light of duration 100 ns is absorbed completely by a small object initially at rest. Power of the pulse is 30mV and the speed of light is $3 \times 10\ ms_{-1}$. The final momentum of the object is :

(1) $0.3 \times 10_{-17}$ kg ms_{-1} (2) $1.0 \times 10_{-17}$ kg ms_{-1}
(3) $3.0 \times 10_{-17}$ kg ms_{-1} (4) $9.0 \times 10_{-17}$ kg ms_{-1}

77. When photons of energy hν fall on a photo sensitive metallic surface (work function $h\nu_0$) electrons are emitted from the metallic surface. This is known as photoelectric effect. The electrons coming out of the surface have a K.E. It is possible to say that

(1) All ejected electrons have the same K.E. equal to $h\nu - h\nu_0$
(2) The ejected electrons have a distribution of K.E., the most energetic ones having K.E.equal to $h\nu - h\nu_0$
(3) The most energetic ejected electrons have K.E. equal to hν.
(4) The K.E. of the ejected electrons is $h\nu_0$

78. A photocell is illuminated by a small bright source placed 1 m away. When the same source of light is placed $\frac{1}{2}$ m away, the number of electrons emitted by photocathode would : **[AIEEE 2005 4/300]**

(1) decrease by a factor of 4 (2) increase by a factor of 4
(3) decrease by a factor of 2 (4) increase by a factor of 2

SECTION (B) : DE–BROGLIE WAVE (MATTERWAVES)

1. The ratio of deBroglie wavelengths of a proton and an alpha particle of same energy is .

(1) 1 (2) 2 (3) 4 (4) 0.25

2. The ratio of de broglie wavelengths of a proton and an alpha particle moving with the same velocity is

(1) 1 (2) 2 (3) 4 (4) 0.25

3. The ratio of de Broglie wavelengths of a proton and a neutron moving with the same velocity is nearly
(1) 1 (2) $\sqrt{2}$ (3) $1/\sqrt{2}$ (4) none of the above

4. Two particles have identical charges. If they are accelerated through identical potential differences, then the ratio of their deBroglie wavelength would be
(1) $\lambda_1 : \lambda_2 = 1 : 1$ (2) $\lambda_1 : \lambda_2 = m_2 : m_1$
(3) $\lambda_1 : \lambda_2 = \sqrt{m_2} : \sqrt{m_1}$ (4) $\lambda_1 : \lambda_2 = \sqrt{m_1} : \sqrt{m_2}$

5. If the velocity of a moving particle is reduced to half, then percentage change in its wavelength will be
(1) 100% decrease (2) 100% increase (3) 50% decrease (4) 50% increase

6. Momentum of γ-ray photon of energy 3 keV in kg-m/s will be
(1) 1.6×10^{-19} (2) 1.6×10^{-21} (3) 1.6×10^{-24} (4) 1.6×10^{-27}

7. Which one of the following statements is NOT true for de Broglie waves ?
(1) All atomic particles in motion have waves of a definite wavelength associated with them
(2) The higher the momentum, the longer is the wavelength
(3) The faster the particle, the shorter is the wavelength
(4) For the same velocity, a heavier particle has a shorter wavelength

8. In a TV tube the electron are accelerated by a potential difference of 10 kV. Then, their deBroglie wavelength is nearly
(1) 1.2 Å (2) 0.12 Å (3) 12 Å (4) 0.01 Å

9. The de Broglie waves are associated with moving particles. These particle may be
(1) electrons (2) He^{+}, Li^{2+} ions (3) Cricket ball (4) all of the above

10. What voltage must be applied to an electron microscope to produce electrons of λ. = 1.0 Å
(1) 190 volt (2) 180 volt (3) 160 volt (4) 150 volt

11. An α-particle moves along a circular path of radius 0.83 cm in a magnetic field of 0.25 Wb/m^2. The de-Broglie wavelength associated with it will be
(1) 10 Å (2) 1 Å (3) 0.1 Å (4) 0.01 Å

12. The de Broglie wavelength of a tennis ball of mass 60 g moving with a velocity of 10 metres per second is approximately - (Planck's constant, $h = 6.63 \times 10^{-34}$ Js) **[AIEEE 2003 4/300]**
(1) 10^{-33} metre (2) 10^{-31} metre (3) 10^{-16} metre (4) 10^{-25} metre

13. The de Broglie wavelength of an electron moving with a velocity $1.5 \times 10^{8}\ ms^{-1}$ is equal to that of a photon. The ratio of the kinetic energy of the electron to that of the energy of photon is :
(1) 2 (2) 4 (3) $\frac{1}{2}$ (4) $\frac{1}{4}$

14. Let p and E denote the linear momentum and the energy of a photon. For another photon of smaller wavelength (in same medium)
(1) both p and E increase (2) p increases and E decreases
(3) p decreases and E increases (4) both p and E decreases

SECTION (C):BOHR'S ATOMIC MODEL OF H-ATOM & H-LIKE SPECIES (PROPERTIES)

1. The Lyman series of hydrogen spectrum lies in the region
(1) Infrared (2) visible (3) Ultraviolet (4) of x – rays

2. Which one of the series of hydrogen spectrum is in the visible region
(1) Lyman series (2) Balmer series (3) paschen series (4) Bracket series

3. The Rutherford α–particle experiment shows that most of the α–particles pass through almost unscattered while some are scattered through large angles. What information does it give about the structure of the atom:
(1) Atom is hollow
(2) The whole mass of the atom is concentrated in a small centre called nucleus
(3) Nucleus is positively charged
(4) All the above

4. The energy required to knock out the electron in the third orbit of a hydrogen atom is equal to
(1) 13.6 eV (2) + $\frac{13.6}{9}$ eV (3) – $\frac{13.6}{3}$ eV (4) – $\frac{3}{13.6}$ eV

5. The ionization potential for second He electron is
(1) 13.6 eV (2) 27.2 eV (3) 54.4 eV (4) 100 eV

6. An electron makes a transition from orbit n= 4 to the orbit n = 2 of a hydrogen atom. The wave number of the emitted radiation (R = Rydberg's constant) will be
(1) $\frac{16}{3R}$ (2) $\frac{2R}{16}$ (3) $\frac{3R}{16}$ (4) $\frac{4R}{16}$

7. If a_0 is the Bohr radius, the radius of the n = 2 electronic orbit in triply ionized beryllium is -
(1) $4a_0$ (2) a_0 (3) $a_0/4$ (4) $a_0/16$

8. Which energy state of doubly ionized lithium (Li^{++}) has the same energy as that of the ground state of hydrogen ? Given Z for lithium = 3 :
(1) n = 1 (2) n = 2 (3) n = 3 (4) n = 4

9. If an orbital electron of the hydrogen atom jumps from the ground state to a higher energy state, its orbital speed reduces to half its initial value. If the radius of the electron orbit in the ground state is r, then the radius of the new orbit would be :
(1) 2r (2) 4r (3) 8r (4) 16r

10. The relation between λ_1: wavelength of series limit of Lyman series, λ_2: the wavelength of the series limit of Balmer series & λ_3: the wavelength of first line of Lyman series is :
(1) $\lambda_1 = \lambda_2 + \lambda_3$ (2) $\lambda_3 = \lambda_1 + \lambda_2$ (3) $\lambda_2 = \lambda_3 - \lambda_1$ (4) none of these

11. Let v_1 be the frequency of the series limited of the Lyman series, v_2 be the frequency of the first line of the Lyman series, and v_3 be the frequency of the series limited of the Balmer series.
(1) $v_1 - v_2 = v_3$ (2) $v_2 - v_1 = v_3$ (3) $v_3 = \frac{1}{2}(v_1 + v_3)$ (4) $v_1 + v_2 = v_3$

12. The innermost orbit of the hydrogen atom has a diameter of 1.06 Å. What is the diameter of the tenth orbit ?
(1) 5.3 Å (2) 10.6 Å (3) 53 Å (4) 106 Å

13. The energy difference between the first two levels of hydrogen atom is 10.2 eV. What is the corresponding energy difference for a singly ionized helium atom ?
(1) 10.2 eV (2) 20.4 eV (3) 40.8 eV (4) 81.6 eV

14. An energy of 24.6 eV is required to remove one of the electrons from a neutral helium atom. The energy (In eV) required to remove both the electrons from a neutral helium atom is : **[JEE-95,1]**
(1) 38.2 (2) 49.2 (3) 51.8 (4) 79.0

15. In the Bohr's model of a hydrogen atom, the enctripetal force is furnished by the Coulomb attraction between teh proton and the electron. If a_0 is the radius of the ground state orbit, m is the mass and e is the charge on the electron, ε_0 is the vacuum permittivity, the speed of the electron is : **[AIPMT-1998]**
(1) zero (2) $\frac{e}{\sqrt{\varepsilon_0 a_0 m}}$ (3) $\frac{e}{\sqrt{4\pi\varepsilon_0 a_0 m}}$ (4) $\frac{\sqrt{4\pi\varepsilon_0 a_0 m}}{e}$

16. The energy of an electron in the excited state of H-tom is –1.5 eV, then according to Bohr' model, its angular momentum will be : **[RPMT-2000]**
(1) 3.15×10^{-34} J-sec (2) 2.15×10^{-34} J-sec (3) 5.01×10^{-30} J-sec (4) 3.15×10^{-33} J-sec

17. The wavelength of radiation emitted is λ_0 when an electron jumps from the third to the second orbit of hydrogen atom. For the electron jump from the fourth to the second orbit of the hydrogen atom, the wavelength of radiation emitted will be **[SCRA 1998; MP PET 2001; MH CET 2003]**
(1) $\frac{16}{25}\lambda_0$ (2) $\frac{20}{27}\lambda_0$ (3) $\frac{27}{20}\lambda_0$ (4) $\frac{25}{16}\lambda_0$

18. **In** wich of the following systems will be radius of the first orbit (n =1) be minimum **[AIPMT-2003]**
(1) Doubly ionized lithium (2) Singly ionized helium
(3) Deuterium atom (4) hydrogen atom

19. Hydrogen atom is excited by means of a monochromatic radiations of wavelength 975 Å. In emission spectrum the number of possible lines are : **[RPMT-2002]**
(1) 2 (2) 4 (3) 5 (4) 6

20. According to Bohr's model of hydrogen atom, relation between principal quantum number n and radius of stable orbit : **[RPMT-2002]**
(1) $r \propto \frac{1}{n}$ (2) $r \propto n$ (3) $r \propto \frac{1}{n^2}$ (4) $r \propto n^2$

21. The minimum orbital angular momentum of the electron in hydrogen atom is **[RPMT-2003]**
(1) h (2) h/2 (3) h/2π (4) h/π

22. The energy of a hydrogen-like atom in its ground state is – 54.4 eV. It may be **[RPMT-2003]**
(1) hydrogen (2) deuterium (3) helium (4) lithium

23. The wavelength of light emitted due to transition of electron from second orbit to first orbit in hydrogen atom is **[RPMT-2003]**
(1) 6563 Å (2) 4102 Å (3) 4861 Å (4) 1215 Å

24. The ratio of specific charge of an α-particle to that of a proton is **[RPMT-2003]**
(1) 2 : 1 (2) 1 : 1 (3) 1 : 2 (4) 1 : 3

25. If 13.6 eV energy is required to Iionize the hydrogen atom, then the energy required to remove an electron from n = 2 is : **[AIEEE 2002 4/300]**
(1) 10.2 eV (2) 0 eV (3) 3.4 eV (4) 6.8 eV

26. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inter-orbit jumps of the electron for Bohr orbits is an atom of hydrogen ? **[AIEEE 2003 4/300]**
(1) 3 → 2 (2) 5 → 2 (3) 4 → 1 (4) 2 → 5

27. When an electron in an hydrogen atom makes a transition from first Bohr orbit to second Bohr orbit, how much energy it absorbs ? **[RPMT-2004]**
(1) 3.4 eV (2) 10.2 eV (3) 13.6 eV (4) 1.51 eV

28. The radius of first Bohr orbit is 0.5 Ã, then radius of fourth Bohr orbit will be : **[RPMT-2004]**
(1) 0.03 Å (2) 0.12 Å (3) 2.0 Å (4) 8.0 Å

29. The ionization energy of 10 times ionized sodium atom is **[RPMT-2007]**
(1) $\frac{13.6}{11}$ eV (2) $\frac{13.6}{(11)^2}$ eV (3) $13.6 \times (11)^2$ eV (4) 13.6 eV

30. An electron with kinetic energy 5 eV is incident on an H-atom in its ground state. The collision **[RPMT-2007]**
(1) must be elastic (2) may be partially elastic
(3) may be completely elastic (4) may be completely inelastic

31. An electron makes a transition from orbit n = 4 to the orbit n = 2 of a hydrogen atom. The wave number of the emitted radiation (R = Rydberg's constant) will be **[RPMT-2009]**
(1) 16/3R (2) 2R/16 (3) 3R/16 (4) 4R/16

32. The transition from state n = 4 to b = 3 in a hydrogen like atom results in ultraviolet radiation. Infrared radiation may be obtained in the transition **[RPMT-2014]**
(1) 2 → 1 (2) 3 → 2 (3) 4 → 2 (4) 5 → 4

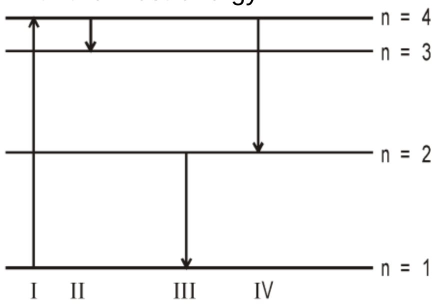
33. Energy E of a hydrogen atom with principal quantum number n is given by E = $\frac{-13.6}{n^2}$ eV.The energy of a photon ejected when the electron jumps from n = 3 state to n = 2 state of hydrogen is passionately: **[AIPMT-2004]**
(1) 0.85 eV (2) 3.4 eV (3) 1.9 eV (4) 1.5 eV

34. The total energy of an electron in the first excited state of hydrogen atom is about - 3.4 V. Its kinetic energy in this state is - **[AIPMT- 2005]**
(1) –6.8 eV (2) 3.4 eV (3) 6.8 eV (4) –3.4 eV

35. Ionization potential of hydrogen atom is 13.6eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. Accrding to Bohr's theory, the spectral lines emitted by hydrogen will be :- **[AIPMT-2006]**
(1) Two (2) Three (3) Four (4) One

36. In the phenomenon of electric discharge through gases at low pressure, the colored glow in the tube appears as a result of **[AIPMT-2008]**
(1) excitation of electrons in the atoms
(2) collision between the atoms of the gas
(3) collisions between the charged particles emitted from the cathode and the atoms of the gas
(4) collision between different electrons of the atoms of the gas

37. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy? **[AIEEE 2005 4/300]**



(1) III (2) IV (3) I (4) II

38. An alpha nucleus of energy $\frac{1}{2}mv_2$ bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to : **[AIEEE 2006 3/180]**
(1) $\frac{1}{Ze}$ (2) v_2 (3) $\frac{1}{m}$ (4) $\frac{1}{v^4}$

39. The threshold frequency for a metallic surface corresponds to an energy of 6.2 eV, and the stopping potential for a radiation incident on this surface 5 V. The incident radiation lies in **[AIEEE 2006 3/180]**
(1) X-ray region (2) ultra-violet region (3) infra-red region (4) visible region

40. Which of the following transitions in hydrogen atoms emit photons of highest frequency ?
[AIEEE 2007 3/120, –1]
(1) n = 2 to n = 6 (2) n = 6 to n = 2 (3) n = 2 to n = 1 (4) n = 1 to n = 2

41. Suppose an electron is attracted towards the origin by a force $\frac{k}{r}$ where 'k' is a constant and 'r' is the distance of the electron from the origin. By applying Bohr model to this system, the radius of the nth orbital of the electron is found to be 'r_n' and the kinetic energy of the electron to be 'T_n'. Then which of the following is true? **[AIEEE 2008 3/105, –1]**

(1) T_n independent of n, r_n independent of n, (2) $T_n \propto \frac{1}{n}$, $r_n \propto n$
(3) $T_n \propto \frac{1}{n}$ n_1, $r_n \propto n_2$ (4) $T_n \propto \frac{1}{n}$, $r_n \propto n_2$

42. The ratio of the kinetic energy of the n = 2 electron for the H atom to that of He^+ ion is :
(1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) 1 (4) 2

43. Energy levels A, B and C of a certain atom correspond to increasing values of energy i.e., $E_A < E_B < E_C$. If λ_1, λ_2 and λ_3 are wave lengths of radiations corresponding to transitions C to B, to A and C to A respectively, which of the following relations is correct – **[AIPMT- 2005]**

(1) $\lambda_3 = \lambda_1 + \lambda_3$ (2) $\lambda_3 = \lambda_2 + \lambda_3 = 0$ (3) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$ (4) $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1 + \lambda_2}$

44. If the binding energy of the electron in a hydrogen atom is 13.6 eV, the energy required to remove the electron from the first excited state of Li^{2+} is : **[AIEEE 2003 4/300]**
(1) 30.6 eV (2) 13.6 eV (3) 13.6 eV (4) 122.4 eV

45. A hydrogen atom (ionisation potential 13.6 eV) makes a transition from third excited state to first excited state. The energy of the photo emitted in the process is **[MNR 1995]**
(1) 1.89 eV (2) 2.55 eV (3) 12.09 eV (4) 1275 eV

46. Energy levels *A*, *B* and *C* of a certain atom correspond to increasing values of energy, i.e. $E_A < E_B < E_C$. If λ_1, λ_2 and λ_3 are the wavelengths of radiations corresponding to transitions *C* to *B*, *B* to *A* and *C* to *A* respectively, which of the following relations is correct ?

(1) $\lambda_3 = \lambda_1 + \lambda_2$ (2) $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1 + \lambda_2}$ (3) $\lambda_1 + \lambda_2 + \lambda_3 = 0$ (4) $\lambda_{32} = \lambda_{12} + \lambda_{22}$

47. In a mixture of H – He^+ gas (He^+ is singly ionized He atom), H atoms and He^+ ions are excited to their respective first excited states. Subsequently, H atoms transfer their total excitation energy to He^+ ions (by collisions). Assume that the Bohr model of atom is exactly valid. The quantum number n of the state finally populated in He^+ ions is :
(1) 2 (2) 3 (3) 4 (4) 5

48. The wavelength of the first spectral line in the Balmer series of hydrogen atom is 6561 Å. The wavelength of the second spectral line in the Balmer series of singly ionized helium atom is :
(1) 1215 Å (2) 1640 Å (3) 2430 Å (4) 4687 Å

49. Which of the following statements is wrong
(1) Infrared photon has more energy then photon of visible light.
(2) Photographic plates are sensitive to ultraviolet rays.
(3) Photographic plates can be made sensitive to infrared rays.
(4) Infrared rays are invisible but can cast shadows like visible light rays.

SECTION (D) : ELECTRONIC TRANSITION IN THE H/H-LIKE ATOM

1. Three photons coming from excited atomic-hydrogen sample are picked up. Their energies are 12.1eV, 10.2eV and 1.9eV. These photons must come from
(1) a single atom (2) two atoms

(3) three atom (4) either two atoms or three atoms

2. In a hypothetical atom, if transition from n = 4 to n = 3 produces visible light then the possible transition to obtain infrared radiation is :
(1) n = 5 to n = 3 (2) n = 4 to n = 2 (3) n = 3 to n = 1 (4) none of these

3. The ionization energy of hydrogen atom is 13.6 eV. Hydrogen atoms in the ground state are excited by electromagnetic radiation of energy 12.1 eV. How many spectral lines will be emitted by the hydrogen atoms?
(1) one (2) two (3) three (4) four

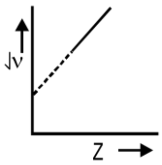
4. The wavelength of the first line in balmer series in the hydrogen spectrum is λ. What is the wavelength of the second line :
(1) $\frac{20\lambda}{27}$ (2) $\frac{3\lambda}{16}$ (3) $\frac{5\lambda}{36}$ (4) $\frac{3\lambda}{4}$

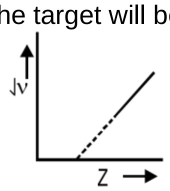
SECTION (E) : X–RAYS

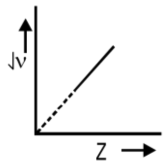
1. Why do we not use X-rays in the RADAR
(1) They can damage the target (2) They are absorbed by the air
(3) Their speed is low (4) They are not reflected by the target

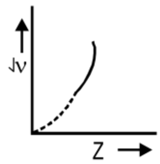
2. Production of continuous X-rays is caused by
(1) Transition of electrons from higher levels to lower levels in target atoms.
(2) Retardiation of incident electron when it enters the target atom.
(3) Transition of electrons from lower levels to higher levels in target atoms.
(4) Neutralising the incident electron.

3. The graph between the square root of the frequency of a specific line of characteristic spectrum of X-rays and the atomic number of the target will be

(1) 

(2) 

(3) 

(4) 

4. The minimum wavelength λ_{min} in the continuous spectrum of X-rays is
(1) Proportional to the potential difference V between the cathode and anode.
(2) Inversely proportional to potential difference V between the cathode and anode.
(3) Proportional to the square root of the potential difference V between the cathode and the anode.
(4) Inversely proportional to the square root of the potential difference V between the cathode and the anode.

5. For the structural analysis of crystals, X-rays are used because
(1) X-rays have wavelength of the order of the inter-atomic spacing.
(2) X-rays are highly penetrating radiations.
(3) Wavelength of X-rays is of the order of nuclear size.
(4) X-rays are coherent radiations.

6. A direct X-ray photograph of the intestines is not generally taken by the radiologists because
(1) Intestines would burst on exposure to X-rays.
(2) The X-rays would not pass through the intestines.
(3) The X-rays will pass through the intestines without causing a good shadow for any useful diagnosis.
(4) A very small exposure of X-rays causes cancer in the intestines.

7. The characteristic X-ray radiation is emitted when
(1) The bombarding electrons knock out electrons from the inner shell of the target atoms and one of the outer electrons falls into this vacancy. .
(2) The valance electrons are removed from the target atoms as a result of the collision.
(3) The source of electrons emits a mono energetic beam.
(4) The electrons are accelerated to a fixed energy.

8. X-rays are produced
(1) During electric discharge at low pressure.
(2) During nuclear explosions.
(3) When cathode rays are reflected from the target.
(4) When electrons from higher energy state come back to lower energy state.

9. If the current in the circuit for heating the filament is increased, the cutoff wavelength
(1) will increase (2) will decrease
(3) will remain unchanged (4) will change

10. The characteristic X-ray spectrum is emitted due to transition of
(1) valence electrons of the atom
(2) inner electrons of the atom
(3) nucleus of the atom
(4) both, the inner electrons and the nucleus of the atom

11. The rphotoelectric work function for a metal surface is 4.125 eV. The cut-off wavelength for this surface is : **[AIPMT-1999]**
(1) 4125 Å (2) 3000 Å (3) 6000 Å (4) 2062.5 Å

12. If λ_{min} is minimum wavelength produced in X-ray tube and $\lambda_{k\alpha}$ is the wavelength of k_α line. As the operating tube voltage is increased.
(1) $(\lambda_k - \lambda_{min})$ increases (2) $(\lambda_k - \lambda_{min})$ decreases
(3) $\lambda_{k\alpha}$ increases (4) λ_{ka} decreases

13. X-rays obtained by Collidge tube: **[RPET-90]**
(1) are mono-chromatic
(2) have all wavelengths are below a maximum wavelength.
(3) have all wavelengths are above a minimum wavelength.
(4) have all wavelengths are between a maximum and a minimum wavelength.

14. Penetration power of X-rays depend on **[MP PMT - 94]**
(1) current flowing in filament (2) nature of target
(3) applied potential difference (4) all of the above

15. The wavelength of x-ray photon is 0.01 Å, its momentum in Kg m/sec is **[RPMT -95]**
(1) 6.6×10^{-22} (2) 6.6×10^{-20} (3) 6.6×10^{-46} (4) 6.6×10^{-27}

16. For hard X-rays. **[MP PET- 97]**
(1) the wavelength is higher (2) the intensity is higher
(3) the frequency is higher (4) the photon energy is lower

17. If X-rays are passed through strong magnetic field, then X-rays **[RPMT-2002]**
(1) will deviate maximum (2) will deviate minimum
(3) pass undeviated (4) none of these

18. Minimum wavelength of X-rays produced in a Coolidge tube operated at potential difference of 40 k V is **[RPMT-2003]**
(1) 0.31 Å (2) 3.1 Å (3) 31 Å (4) 311 Å

19. An X-ray photon has a wavelength 0.01Å. Its momentum (in kg ms^{-1}) is : **[RPMT-2005]**
(1) 6.66×10^{-22} (2) 3.3×10^{-32} (3) 6.6×10^{-22} (4) 0

20. The minimum wavelength od X-rays emitted by X-ray tube is 0.4125 Å. The accelerating voltage is : **[RPMT-2006]**
(1) 30 kV (2) 50 kV (3) 80 kV (4) 60 kV

21. If the frequency of K_α, X-ray of the element of atomic number 31 is f, then the frequency of K_α, X-ray for atomic number 51 is **[RPMT-2009]**
(1) 25/9 f (2) 16/25 f (3) 9/25 f (4) zero

22. The intensity of gamma radiation from a given source is I. On passing through 36 mm of lead, it is reduced to 1/8. The thickness of lead, which will reduce the intensity to 1/2 will be :**[AIEEE 2005 4/300]**
(1) 6 mm (2) 9 mm (3) 18 mm (4) 12 mm

23. Which of the following X-rays has maximum energy, if they are produced by the collision of electrons of energy 40 keV with the same target
(1) 300 Å (2) 10 Å (3) 4 Å (4) 0.31 Å

24. Both X-rays and γ-rays are electromagnetic waves, which of the following statements is true for them
(1) Energy of X-rays is more than that of γ-rays.
(2) Wavelength of X-rays in general, is larger than that of γ-rays.
(3) Frequency of X-rays is greater than that of γ-rays.
(4) Velocity of X-rays is greater than that of γ-rays.

25. According to Moseley's law the ratio of the slopes of graph between $\sqrt{\nu}$ and Z for K_β and K_α is :
(1) $\sqrt{\frac{32}{27}}$ (2) $\sqrt{\frac{27}{32}}$ (3) $\sqrt{\frac{33}{22}}$ (4) $\sqrt{\frac{22}{33}}$

26. If the frequency of K_α X-ray emitted from element with atomic number 31 is f, then the frequency of K_α X-ray emitted from the element with atomic number 51 would be (assume that screening constant for K_α is 1) :
(1) $\frac{5}{3}f$ (2) $\frac{51}{31}f$ (3) $\frac{9}{25}f$ (4) $\frac{25}{9}f$

27. Which one of the following statements is WRONG in the context of X-rays generated from a X-ray tube?
(1) Wavelength of characteristic X-rays decreases when the atomic number of the target increases
(2) Cut-off wavelength of the continuous X-rays depends on the atomic number of the target
(3) Intensity of the characteristic X-rays depends on the electrical power given to the X-ray tube
(4) Cut-off wavelength of the continuous X-rays depends on the energy of the electrons in the X-ray tube

28. 50% of the X-rays coming from a Coolidge tube is able to pass through a 0.1 mm thick aluminum foil. The potential difference between the target and the filament is increased. The thickness of aluminimum foil, which will allow 50% of the X-ray to pass through, will be -
(1) zero (2) $<$ 0.1 mm (3) 0.1 mm (4) $>$ 0.1 mm

29. When ultraviolet rays incident on metal plate then photoelectric effect does not occur, it occur by incidence of :- **[AIPMT-2002]**
(1) Infrared rays (2) X – rays (3) Radio wave (4) Light wave

30. An X-ray photon of wavelength λ and frequency ν collides with an initialy stationary electron (but free to move) and bounces off. If λ′ and ν′ are respectively the wavelength and frequency of the scattered photon, then :
(1) $\lambda' = \lambda; \nu' = \nu$ (2) $\lambda' < \lambda; \nu' > \nu$ (3) $\lambda' > \lambda; \nu' > \nu$ (4) $\lambda' > \lambda; \nu' < \nu$

Exercise-2

ONLY ONE OPTION CORRECT TYPE

1. An image of the sun is formed by a lens of focal length 30 cm on the metal surface of a photo-electric cell and it produces a current I. The lens forming the image is then replaced by another lens of the same diameter but of focal length 15 cm. The photoelectric current in this case will be : (In both cases the plate is kept at focal plane and normal to the axis lens).
(1) I/2 (2) 2 I (3) I (4) 4 I

2. Two identical, photocathodes receive light of frequencies f_1 and f_2. If the velocities of the photoelectrons (of mass m) coming out are respectively v_1 and v_2, then : **[AIEEE 2003 4/300]**

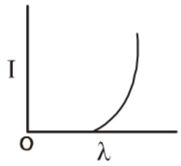
(1) $v_1^2 - v_2^2 = \frac{2h}{m}(f_1 - f_2)$ (2) $v_1 - v_2 = \left[\frac{2h}{m}(f_1 + f_2)\right]^{1/2}$

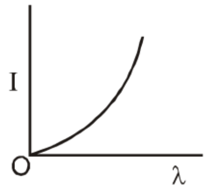
(3) $v_1^2 - v_2^2 = \frac{2h}{m}(f_1 + f_2)$ (4) $v_1 - v_2 = \left[\frac{2h}{m}(f_1 - f_2)\right]^{1/2}$

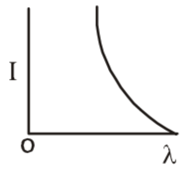
3. Monochromatic light of frequency 6.0×10^{14} Hz is produced by a a laser. The power emitted is 2×10^{-3} W. The number of photons emitted, on the average, by the source per second is :**[AIPMT-2007]**
(1) 5×10^{15} (2) 5×10^{16} (3) 5×10^{17} (4) 5×10^{14}

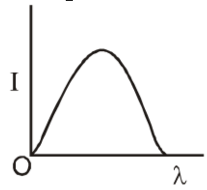
4. A particle of mass 1 mg has the same wavelength as an electron moving with a velocity of 3×10^{6} ms^{-1}. The velocity of the particle is **[AIPMT-2008]**
(1) 2.7×10^{-18} ms^{-1} (2) 9×10^{-2} ms^{-1} (3) 3×10^{-31} ms^{-1} (4) 2.7×10^{-21} ms^{-1}
(Mass of electron = 9.1×10^{-31} kg)

5. The anode voltage of a photocell is kept fixed. The wavelength of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows : **[AIEEE 2006 3/180]**

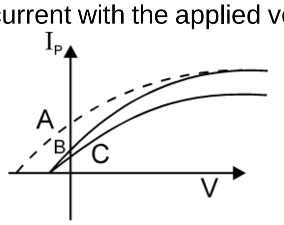
(1) 

(2) 

(3) 

(4) 

6. The graph is showing the photocurrent with the applied voltage of a photoelectric effect experiment. Then



(1) A & B will have same intensity and B & C have same frequency
(2) B & C have same intensity and A & B have same frequency
(3) A & B will have same frequency and B & C have same intensity
(4) A & C will have same intensity and B & C have same frequency

7. If $\lambda = 10^{-10}$ m changes to $\lambda' = 0.5 \times 10^{-10}$ m, find energy differenceccc (ΔE) give to the particle : **[RPMT-2006]**
(1) ΔE is equal to $\left(\frac{1}{4}\right)^{th}$ of initial energy (2) ΔE is equal to $\left(\frac{1}{2}\right)^{th}$ of initial energy
(3) ΔE is equal to twice of initial energy (4) ΔE is equal to initial energy

8. The wavelength involved in the spectrum of deuterium $\left({}_1^2D\right)$ are slightly different from that of hydrogen spectrum, because : **[AIEEE 2003 4/300]**
(1) size of the two nuclei are different
(2) nuclear forces are different in the two cases
(3) masses of the two nuclei are different
(4) attraction between the electron and the nucleus is different in the two cases

9. The total energy of electron in the ground state of hydrogen atom is –13.6 eV. The kinetic energy of an electron in the first excited state is : **[AIPMT-2007]**
(1) 3.4 eV (2) 6.8 eV (3) 13.6 eV (4) 1.7 eV

10. In Davisson-Germer experiment when electron strikes the Ni-crystal which of the following is produced- **[RPMT -93]**

(1) X-rays (2) γ-rays (3) Electron (4) photon

11. The wavelengths of K_α x-rays of two metals 'A' and 'B' are $\frac{4}{1875\ R}$ and $\frac{1}{675\ R}$ respectively, where 'R' is rydberg constant. The number of elements lying between 'A' and 'B' according to their atomic numbers is

(1) 3 (2) 6 (3) 5 (4) 4

12. If Bohr's theory is applicable to $_{100}Fm^{257}$, then radius of this atom in Bohr's unit is :

(1) 4 (2) 1/4 (3) 100 (4) 200

13. An electron in an excited state of Li^{2+} ions has angular momentum 3h/2π. The de-Broglie wavelength of he electron in this state is $p\pi a_0$ (where a_0 is the Bohr radius). The value of p is

(1) 2 (2) 4 (3) 6 (4) 10

14. If *m* is mass of electron, υ its veleocty, r the radius of stationary circular orbit around a nucleus with charge Ze, then from Bohr's first postulate, the kinetic energy K = $\frac{1}{2}mv^2$ of the electron in C.G.S. System is equal to: **[NCERT 1977]**

(1) $\frac{1}{2}\frac{Ze^2}{r}$ (2) $\frac{1}{2}\frac{Ze^2}{r^2}$ (3) $\frac{1}{2}\frac{Ze}{r}$ (4) $\frac{1}{2}\frac{Ze}{r^2}$

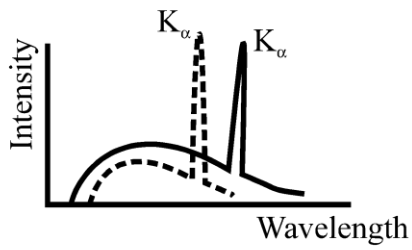
15. The attractive potential between electron and nucleus is given by $v = v_0\ \ell n\frac{r}{r_0}$, v_0 and r_0 are constants and ' r ' is the radius. The radius ' r ' of the nth Bohr's orbit depends upon principal quantum number ' n ' as: **[JEE '2003, Scr. 3/84]**

(1) $r \propto n^2$ (2) $r \propto n$ (3) $r \propto \frac{1}{n}$ (4) $r \propto \frac{1}{n^2}$

16. 50% of the x-ray coming from a coolidge tube is able to pass through 0.1 mm thick aluminium foil. If the potential difference between the target and the filament is increased, the fraction of the x ray passing through the same foil will be

(1) 0% (2) <50% (3) >50% (4) 50%

17. Figure shows the intensity-wavelength relations of X-rays coming from two different Coolidge tubes. The solid curve represents the relation for the tube A in which the potential difference between the target and the filament is V_A and the atomic number of the target material is Z_A. These quantities are V_B and Z_B for the other tube. Then,



(1) $V_A > V_B, Z_A > Z_B$ (2) $V_A > V_B, Z_A < Z_B$ (3) $V_A < V_B, Z_A > Z_B$ (4) $V_A < V_B, Z_A < Z_B$

18. Wavelengths of K_α lines of two elements are 250 and 179 pm respectively. Number of elements between these elements in the sequence will be

(1) Zero (2) 3 (3) 2 (4) 1

19. Electrons with de-Broglie wavelength λ fall on the target in an X-ray tube. The cut-off wavelength of the emitted X-rays is

(1) $\lambda_0 = \frac{2mc\ \lambda^2}{h}$ (2) $\lambda_0 = \frac{2h}{mc}$ (3) $\lambda_0 = \frac{2m^2\ c^2\ \lambda^3}{h^2}$ (4) $\lambda_0 = \lambda$

20. Which of the following wavelength is not possible for an X-ray tube which is operated at 40 kV. **[RPMT-2002]**

(1) 0.25 Å (2) 0.5 Å (3) 0.52 Å (4) 1A

21. For soft X-rays the attenuation constant for aluminium is 1.73 per cm. Then the percentage of X-rays that will pass through an aluminium sheet of thickness 1.156 cm will be

(1) 13.5% (2) 6.8% (3) 20.4% (4) 27.0%

22. An x-ray tube, when operated at 50 kV tube voltage, records an anode current 20 mA. If the efficiency of the tube for production of x-rays is 1% then the heat produced per second in calories is nearly

(1) 249 (2) 238 (3) 10 (4) 2.38

23. Which of the following are the characteristics required for the target to produce X-rays

Atomic number	Low	High	Low	high
Melting point	High	High	Low	Low
	(1)	(2)	(3)	(4)

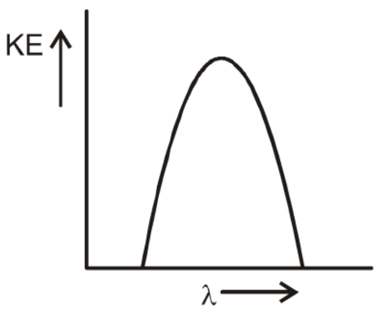
24. In a discharge tube when 200 volt potential difference is applied 6.25×10^{18} electrons move from cathode to anode and 3.125×10^{18} singly charged positive ions move from anode to cathode in one second. Then the power of tube is:

(1) 100 watt (2) 200 watt (3) 300 watt (4) 400 watt

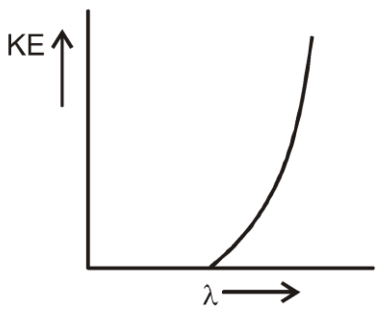
25. The wavelength of K_α X-ray of an element having atomic number z = 11 is λ. The wavelength of K_α X-ray of another element of atomic number z′ is 4λ. Then z′ is - **[JEE '2005, Scr, 3/84]**

(1) 11 (2) 44 (3) 6 (4) 4

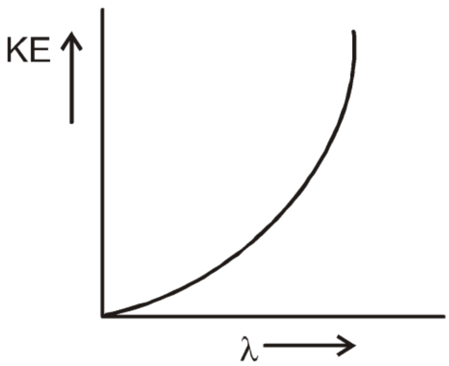
26. The angle voluate of photocell is kept fixed. The wavelength (λ) of the light falling o the cathode is gradually changed. The maximum kinetic energy (K.E.) of the photoelectrons emitted varies with λ as **[RPMT-2014]**



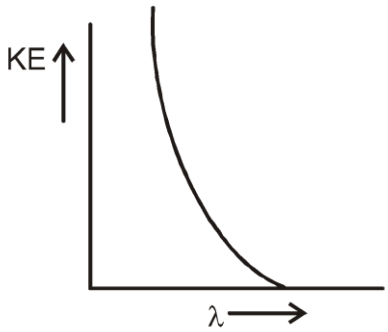
(1)



(2)



(3)



(4)

27. A photon of wavelength λ (less than threshold wavelength λ_0) is incident on a metal surface of work function W_0. The de Broglie wavelength of the ejected electron of mass 'm' is

(1) $h\left[2m\left(\frac{hc}{\lambda}-W_0\right)\right]$ (2) $\frac{h}{2m\left(\frac{hc}{\lambda}-W_0\right)}$ (3) $\frac{h}{\sqrt{2m\left(\frac{hc}{\lambda}-W_0\right)}}$ (4) $\frac{1}{h\sqrt{2m\left(\frac{hc}{\lambda}-W_0\right)}}$

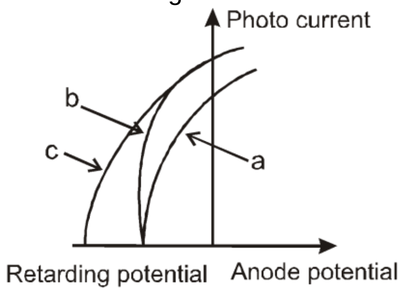
Exercise-3

PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. Monochromatic light of wavelength 667 nm is produced by a helium neon laser. The power emitted is 9 mW. The number of photons arriving per second on the average at a target irradiated by this beam is **[AIPMT-2009]**

(1) 9×10^{17} (2) 3×10^{16} (3) 9×10^{15} (4) 9×10^{19}

2. The figure shows a plot of photo current versus anode potential for a photo sensitive surface for three different radiations. Which one of the following is a correct statement ? **[AIPMT-2009]**



(1) Curves a and b represent incident radiations of different frequencies and different intensities
(2) Curves a and b represent incident radiations of same frequencies but of different intensities
(3) Curves b and c represent incident radiations of different frequencies and different intensities
(4) Curves b and c represent incident radiations of same frequencies having same intensity

3. The number of photoelectrons emitted for light of a frequency ν is proportional to (higher than the threshold frequency ν_0) **[AIPMT-2009]**

(1) $\nu - \nu_0$ (2) threshold frequency (ν_0)
(3) intensity of light (4) frequency of light (ν)

4. The ionization energy of the electron in the hydrogen atom in its ground state is 13.6 eV. The atoms are excited to higher energy levels to emit radiations of 6 wavelengths. Maximum wavelength of emitted radiation corresponds to the transition between **[AIPMT-2009]**

(1) n = 3 to n = 2 states (2) n = 3 to n = 1 states (3) n = 2 to n = 1 states (4) n = 4 to n = 3 states

5. The energy of a hydrogen atom in the ground state is –13.6 eV. The energy of a He^+ ion in the first excited state will be **[AIPMT-2010]**

(1) – 13.6 eV (2) – 27.2 eV (3) – 54.4 eV (4) – 6.8 eV

6. A source S_1 is producing 10^{15} photons per second of wavelength 5000Å. Another sorce S_2 is producing 1.02×10^{15} photons per second of wavelength 5100 Å. Then (power of S_2)/(power of S_1) is equal to **[AIPMT-2010]**

(1) 1.00 (2) 1.02 (3) 1.04 (4) 0.98

7. The potential difference that must be applied to stop the fastest photoelectrons emitted by a nickel surface, having work function 5.01 eV, when ultraviolet light of 200 nm falls on it, must be **[AIPMT-2010]**

(1) 2.4 V (2) –1.2 V (3) – 2.4 V (4) 1.2 V

8. When monochromatic radiation of intensity I falls on a metal surface, the number of photoelectrons and their maximum kinetic energy are N and T respectively. If the intensity of radiation is 2I, the number of emitted electrons and their maximum kinetic energy are respectively **[AIPMT-2010]**

(1) N and 2T (2) 2N and T (3) 2N and 2T (4) N and T

9. The electron in the hydrogen atom jumps from excited state (n = 3) to its ground state (n = 1) and the photons thus emitted irradiate a photosensitive material. If the work function of the material is 5.1 eV, the stopping potential is estimated to be (the energy of the electron in n_{th} state $E_n = -\frac{13.6}{n^2}$ eV)

[AIPMT-2010]

(1) 5.1 V (2) 12.1 V (3) 17.2 V (4) 7V

10. The threshold frequency for a photosensitive metal is 3.3×10^{14} Hz. If light of frequency 8.2×10^{14} Hz is incident on this metal, the cut-off voltage for the photoelectric emission is nearly : **[AIPMT 2011]**

(1) 2V (2) 3V (3) 5V (4) 1V

11. An electron in the hydrogen atom jumps from excited state n to the ground state. The wavelength so emitted illuminates a photosensitive material having work function 2.75 eV. If the stopping potential of the photoelectron is 10 V, the value of n is : **[AIPMT 2011]**

(1) 3 (2) 4 (3) 5 (4) 2

12. Out of the following which one is not a possible energy for a photon to be emitted by hydrogen atom according to Bohr's atomic model? **[AIPMT 2011]**

(1) 1.9 eV (2) 11.1 eV (3) 13.6 eV (4) 0.65 eV

13. Photoelectric emmision occurs only when the incident light has more than a certain minimum: **[AIPMT-2011]**

(1) power (2) wavelength (3) intensity (4) frequency

14. The wavelength of the first line of Lyman series for hydrogen atom is equal to that of the second line of Balmer series for a hydrogen like ion. The atomic number Z of hydrogen like ion is : **[AIPMT-2011]**

(1) 3 (2) 4 (3) 1 (4) 2

15. In the Davisson and Germer experiment, the velocity of electrons emitted from the electron gun can be increased by : **[AIPMT-2011]**

(1) increasing the potential difference between the anode and filament
(2) increasing the filament current
(3) decreasing the filament current
(4) decreasing the potential difference between the anode and filament

16. The decreasing order of wavelength of infrared, microwave, ultraviolet and gamma rays is: **[AIPMT-2011]**

(1) microwave, infrared, ultraviolet, gamma rays (2) gamma rays, ultraviolet, infrared, microwaves
(3) microwaves, gamma rays, infrared, ultraviolet (4) infrared, microwave, ultraviolet, gamma rays

17. Light of two different frequencies whose photons have energies 1 eV and 2.5 eV respectively illuminate a metallic surface whose work function is 0.5 eV successively. Ratio of maximum speeds emitted electrons will be : **[AIPMT-2011]**

(1) 1 : 4 (2) 1 : 2 (3) 1 : 1 (4) 1 : 5

18. Electrons used in a electron microscope are accelerated by a voltage of 25 kV. If the voltage is increased to 100kV then the de–Broglie wavelength associated with the electrons would :**[AIPMT-2011]**

(1) increases by 2 times (2) decrease by 2 times
(3) decrease by 4 times (4) increases by 4 times

19. In photoelectric emission process from a metal of work function 1.8 eV, the kinetic energy of most energetic electrons is 0.5 eV. The corresponding stopping potential is : **[AIPMT-2011]**

(1) 1.8 V (2) 1.2 V (3) 0.5 V (4) 2.3 V

20. Electron in hydrogen atom first jumps from third excited state to second excited state and then from second excited to the first excited state. The ratio of the wavelength $\lambda_1 : \lambda_2$ emitted in the two cases is **[AIPMT_Pre_2012]**

(1) 7/5 (2) 27/20 (3) 27/5 (4) 20/7

21. A 200 W sodium street lamp emits yellow light of wavelength 0.6 μm. Assuming it to be 25% efficient in converting electrical energy to light, the number of photons of yellow light it emits per second is. **[AIPMT_Pre_2012]**

(1) 1.5×10^{20} (2) 6×10^{18} (3) 62×10^{20} (4) 3×10^{19}

22. An electron of a stationary hydrogen atom passes from the fifth energy level to the ground level. The velocity that the atom acquired as a result of photon emission will be : **[AIPMT_Pre_2012]**

(1) $\frac{24\ hR}{25m}$ (2) $\frac{25\ hR}{24m}$ (3) $\frac{25\ m}{24hR}$ (4) $\frac{24\ m}{25hR}$

(m is the mass of the electron, R, Rydberg constant and h Planck's constant)

23. Monochromatic radiation emitted when electron on hydrogen atom jumps from first excited to the ground state irradiates a photosensitive material. The stopping potential is measured to be 3.57 V. The threshold frequency of the materials is : **[AIPMT_Pre_2012]**

(1) 4×10^{15} Hz (2) 5×10^{15} Hz (3) 1.6×10^{15} Hz (4) 2.5×10^{15} Hz

24. An α-particle moves in a circular path of radius 0.83 cm in the presence of a magnetic field of 0.25 Wb/m^2. The de Broglie wavelength associated with the particle will be : **[AIPMT_Pre_2012]**

(1) 1 Å (2) 0.1 Å (3) 10 Å (4) 0.01 Å

25. If the momentum of electron is changed by P, then the de Broglie wavelength associated with it changes by 0.5%. The initial momentum of electron will be : **[AIPMT 2012 (Mains)]**

(1) 200 P (2) 400 P (3) $\frac{P}{200}$ (4) 100 P

26. Two radiations of photons energies 1 eV and 2.5 eV, successively illuminate a photosensitive metallic surface of work function 0.5 eV. The ratio of the maximum speeds of the emitted electrons is : **[AIPMT 2012 (Mains)]**

(1) 1 : 4 (2) 1 : 2 (3) 1 : 1 (4) 1 : 5

27. The transition from the state n = 3 to n = 1 in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from : **[AIPMT 2012 (Mains)]**

(1) 2 → 1 (2) 3 → 2 (3) 4 → 2 (4) 4 → 3

28. For photoelectric emission from certain metal the cutoff frequency is ν. If radiation of frequency 2ν impinges on the metal plate the maximum possible velocity of the emitted electron will be (m is the electron mass) : **[NEET-2013]**

(1) $\sqrt{h\nu/m}$ (2) $\sqrt{2h\nu/m}$ (3) $2\sqrt{h\nu/m}$ (4) $\sqrt{h\nu/(2m)}$

29. The wavelength λ_e of an electron and λ_P of a photon of same energy E are related by : **[NEET_2013]**

(1) $\lambda_P \propto \lambda_e$ (2) $\lambda_P \propto \sqrt{\lambda_e}$ (3) $\lambda_P \propto \frac{1}{\sqrt{\lambda_e}}$ (4) $\lambda_P \propto \lambda_e^2$

30. Ratio of longest wave lengths corresponding to Lyman and Blamer series in hydrogen spectrum is : **[NEET-2013]**

(1) $\frac{3}{23}$ (2) $\frac{7}{29}$ (3) $\frac{9}{31}$ (4) $\frac{5}{27}$

31. When the energy of the incident radiation is increased by 20%, the kinetic energy of the photoelectrons emitted from a metal surface increased fro m emitted 0.5 eV to 0.8eV. The work function of the metal is: **[AIPMT-2014]**

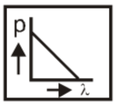
(1) 0.65 eV (2) 1.0 eV (3) 1.3 eV (4) 1.5 eV

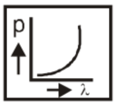
32. Hydrogen atom in ground state is excited by a monochromatic radiation of λ = 975 Å. Number of spectral lines in the resulting spectrum emitted will be : **[AIPMT-2014]**

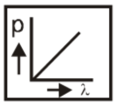
(1) 3 (2) 2 (3) 6 (4) 10

33. Which of the following figures represent the variation of particle momentum and the associated de-Broglie wavelength? **[AIPMT-2015]**

(1) 

(2) 

(3) 

(4) 

34. A certain metallic surface is illuminated with monochromatic light of wavelength λ. The stopping potential for photo-electric current for this light is $3V_0$. If the same surface is illuminated with light of wavelength 2λ, the stopping potential is V_0, the threshold wavelength for this surface for photo-electric effect is : **[AIPMT-2015]**

(1) 4λ (2) $\frac{\lambda}{4}$ (3) $\frac{\lambda}{6}$ (4) 6λ

35. A radiation of energy 'E' falls normally on a perfectly reflecting surface. The momentum transferred to the surface is (C = Velocity of light) : **[AIPMT-2015]**

(1) $\frac{2E}{C}$ (2) $\frac{2E}{C^2}$ (3) $\frac{E}{C^2}$ (4) $\frac{E}{C}$

36. When a metallic surface is illuminated with radiation of wavelength λ' the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential is $\frac{V}{4}$. The threshold wavelength for the metallic surface is : **[AIPMT-2016]**

(1) 3λ (2) 4λ (3) 5λ (4) $\frac{5}{2}\lambda$

37. Given the value of Rydberg constant is 10^7 m^{-1}, the wave number of the last line of the Balmer series in hydrogen spectrum will be : **[AIPMT-2016]**

(1) 2.5×10^7 m^{-1} (2) 0.025×10^4 m^{-1} (3) 0.5×10^7 m^{-1} (4) 0.25×10^7 m^{-1}

38. An electron of mass m and a photon have same energy E. The ratio of de-Brogli wavelengths associated with them is: **[AIPMT-2016]**

(1) $\frac{1}{c}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$ (2) $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$ (3) $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$ (4) $c(2mE)^{1/2}$

39. Electrons of mass m with de-Broglie wavelength λ fall on the target in an X-ray tube. The cutoff wavelength (λ_0) of the emitted X-ray is : **[MP-I_NEET 2016]**

(1) $\lambda_0 = \lambda$ (2) $\lambda_0 = \frac{2mc\lambda^2}{h}$ (3) $\lambda_0 = \frac{2h}{mc}$ (4) $\lambda_0 = \frac{2m^2c^2\lambda^3}{h^2}$

40. Photons with energy 5 eV are incident on a cathode C in a photoelectric cell. The maximum energy of emitted photoelectrons is 2 eV. When photons of energy 6eV are incident on C, no photoelectrons will reach the anode A, if the stopping potential of A relative to C is : **[MP-I_NEET 2016]**

(1) –3 V (2) +3 V (3) +4 V (4) –1 V

41. If an electron in a hydrogen atom jumps from the 3rd orbit to the 2nd orbit, it emits a photon of wavelength λ. When it jumps from the 4th orbit to the 3rd orbit, the corresponding wavelength of the photon will be : **[NEET 2016]**

(1) $\frac{20}{13}\lambda$ (2) $\frac{16}{25}\lambda$ (3) $\frac{9}{16}\lambda$ (4) $\frac{20}{7}\lambda$

42. The photoelectric threshold wavelength of silver is 3250×10^{-10} m. The velocity of the electron ejected from a silver surface by ultraviolet light of wavelength 2536×10^{-10} m is :
(Given $h = 4.14 \times 10^{-15}$ eVs and $c = 3 \times 10^8$ ms^{-1}) **[NEET-2017]**

(1) ≈ 6×10^5 ms^{-1} (2) ≈ 0.6×10^6 ms^{-1} (3) ≈ 61×10^3 ms^{-1} (4) ≈ 0.3×10^6 ms^{-1}

43. The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is

[NEET-2017]

(1) 2 (2) 1 (3) 4 (4) 0.5

44. The de-Broglie wavelength of a neutron in thermal equilibrium with heavy water at a temperature T (Kelvin) and mass m, is : **[NEET-2017]**

(1) $\frac{h}{\sqrt{mkT}}$ (2) $\frac{h}{\sqrt{3mkT}}$ (3) $\frac{2h}{\sqrt{3mkT}}$ (4) $\frac{2h}{\sqrt{mkT}}$

45. The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of the hydrogen atom, is : **[NEET 2018]**

(1) 1 : 1 (2) 1 : – 2 (3) 2 : –1 (4) 1 : –1

46. When the light of frequency $2v_0$ (where v_0 is threshold frequency), is incident on a metal plate, the maximum velocity of electrons emitted is v_1. When the frequency of the incident radiation is increased to $5v_0$, the maximum velocity of electrons emitted from the same plate is v_2. The ratio of v_1 to v_2 is : **[NEET 2018]**

(1) 1 : 2 (2) 2 : 1 (3) 4 : 1 (4) 1 : 4

47. An electron of mass m with an initial velocity $\vec{V} = V_0\hat{i}$ ($V_0 > 0$) enters an electric field $\vec{E} = -E_0\hat{i}$ (E_0 = constant > 0) at t = 0. If λ_0 is its de-Broglie wavelength at time t is : **[NEET 2018]**

(1) $\frac{\lambda_0}{\left(1+\frac{eE_0}{mV_0}t\right)}$ (2) λ_0 (3) $\lambda_0 t$ (4) $\lambda_0\left(1+\frac{eE_0}{mV_0}t\right)$

48. The total energy of an electron in an atom in an orbit is – 3.4 eV. Its kinetic and potential energies are, respectively : **[NEET_2019-I]**

(1) 3.4 eV, 3.4 eV (2) –3.4 eV, –3.4 eV (3) –3.4 eV, –6.8 eV (4) 3.4 eV, –6.8 eV

49. α-particle consists of: **[NEET_2019-I]**

(1) 2 protons only (2) 2 protons and 2 neutrons only

(3) 2 electrons, 2 protons and 2 neutrons (4) 2 electrons and 4 protons only

50. An electron is accelerated through a potential difference of 10,000V. Its de Broglie wavelength is, (nearly) : ($m_e = 9\times10^{-31}$ kg) **[NEET_2019-I]**

(1) 12.2 nm (2) 12.2×10^{-13} m (3) 12.2×10^{-12} m (4) 12.2×10^{-14} m

51. The radius of the first permitted Bohr orbit, for the electron, in a hydrogen atom equals 0.51Å and its ground state energy equals –13.6 eV. If the electron in the hydrogen atom is replaced by muon (μ^-) [charge same as electron and mass 207 m_e], the first Bohr radius and ground state energy will be **[NEET_2019-II]**

(1) 0.53×10^{-13} m, – 3.6 eV (2) 25.6×10^{-13} m, – 2.8 eV

(3) 2.56×10^{-13} m, – 2.8 keV (4) 2.56×10^{-13} m, – 13.6 eV

52. The work function of a photosensitive material is 4.0 eV. The longest wavelength of light that can cause photon emission from the substance is (approximately) **[NEET_2019-II]**

(1) 3100 nm (2) 966 nm (3) 31 nm (4) 310 nm

53. A proton and an α-particle are accelerated from rest to the same energy. The de Broglie wavelength λ_p and λ_α are in the ratio : **[NEET_2019-II]**

(1) 2 : 1 (2) 1 : 1 (3) $\sqrt{2} : 1$ (4) 4 : 1

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. The transition from the state n =4 to n =3 in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from: **[AIEEE 2009 4/144, –1]**
(1) 3 → 2 (2) 4 → 2 (3) 5 → 4 (4) 2 → 1

2. The surface of a metal is illuminated with the light of 400 nm. The kinetic energy of the ejected photoelectrons was found to be 1.68 eV. The work fuction of the metal is : (hc = 1240 eV.nm) **[AIEEE 2009 4/144, –1]**
(1) 1.41 eV (2) 1.51 eV (3) 1.68 eV (4) 3.09 eV

3. **Statement-1 :** When ultraviolet light is incident on a photocell, its stopping potential is V_0 and the maximum kinetic energy of the photoelectrons is K_{max}. When the ultraviolet light is replaced by X-rays, both V_0 and K_{max} increase. **[AIEEE 2010, 4/144, –1]**
Statement-2 : Photoelectrons are emitted with speeds ranging from zero to a maximum value because of the range of frequencies present in the incident light.
(1) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.
(2) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1
(3) Statement-1 is false, Statement-2 is true.
(4) Statement-1 is true, Statement-2 is false.

4. If a source of power 4 kW produces 10^{20} photons/second, the radiation belongs to a part of the spectrum called : **[AIEEE 2010, 4/144, –1]**
(1) X-rays (2) ultraviolet rays (3) microwaves (4) γ-rays

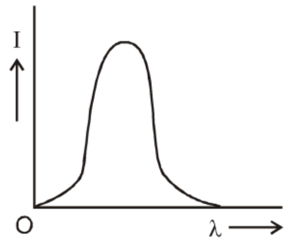
5. Energy required for the electron excitation in Li^{++} from the first to the thrid Bohr orbit is : **[AIEEE - 2011, 4/120, –1]**
(1) 12.1 eV (2) 36.3 eV (3) 108.8 eV (4) 122.4 eV

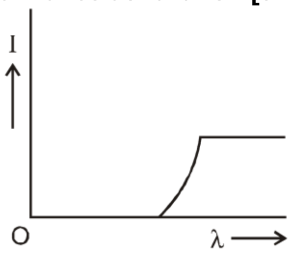
6. This questions has Statement –1 and statement –2. Of the four choices given after the statements, choose the one that best describes the two statements : **[AIEEE - 2011, 4/120, –1]**
Statement –1 :
A metallic surface is irradiated by a monochromatic light of frequency $\nu > \nu_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are K_{max} and V_0 respectively. If the frequency incident on the surface is doubled, both the K_{max} and V_0 are also doubled.
Statement –2 :
The maximum kinetic energy and the stopping potential of photoelectrons emitted from a surface are linearly dependent on the frequency of incident light.
(1) Statement –1 is true, statement –2 is false.
(2) Statement –1 is true, Statement –2 is true, Statement –2 is the correct explanation of Statement –1
(3) Statement –1 is true, Statement –2 is true, Statement –2 is not the correct explanation of Statement–1
(4) Statement–1 is false, Statement –2 is true

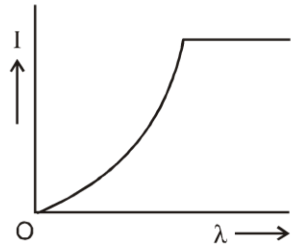
7. After absorbring a slowly moving neutron of Mass m_N (momentum ≈ 0) a nucleus of mass M breaks into two nuclei of masses m_1 and $5m_1$ ($6\,m_1 = M + m_N$) respectively. If the de Broglie wavelength of the nucleus with mass m_1 is λ, the de Broglie wevelength of the nucleus will be:**[AIEEE 2011,11 May;4, –1]**
(1) 5 λ (2) λ /5 (3) λ (4) 25 λ

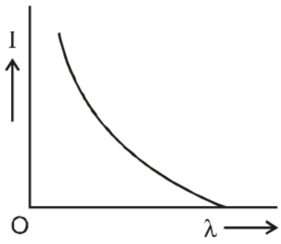
8. Hydrogen atom is excieted from ground state to another state with principal quantum number equal to 4. Then the number of spectral lines in the emission spectra will be : **[AIEEE 2012 ; 4, –1]**
(1) 2 (2) 3 (3) 5 (4) 6

9. The anode voltage of a photocellis kept fixed. The wavelength λ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows : **[JEE-Mains 2013, 4/120]**

(1) 

(2) 

(3) 

(4) 

10. The radiation corresponding to 3 → 2 transition of hydrogen atom falls on a metal surface to produce photoelectrons. These electrons are made to enter a magnetic field of 3×10^{-4} T. If the radius of the largest circular path followed by these electrons is 10.0 mm, the work function of the metal is close to : **[JEE(Main)-2014]**

(1) 1.8 eV (2) 1.1 eV (3) 0.8 eV (4) 1.6 eV

11. Hydrogen ($_1H_1$), Deuterium ($_1H_2$), singly ionised Helium ($_2He_4)^+$ and doubly ionised lithium ($_3Li_6)^{++}$ all have one electron around the nucleus. Consider an elelctron transition from n = 2 to n = 1. If the wave lengths of emitted radiation are λ_1, λ_2, λ_3, and λ_4 respectively then approximately which one of the following is correct ? **[JEE(Main)- 2014]**

(1) $4\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$ (2) $\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

(3) $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$ (4) $\lambda_1 = 2\lambda_2 = 3\lambda_3 = 4\lambda_4$

12. As an electron makes a transition from an excited state to the ground state of a hydrogen - like atom/ion **[JEE(Main)-2015; 4/120, –1]**

(1) its kinetic energy increases but potential energy and total energy decrease
(2) kinetic energy, potential energy and total energy decrease
(3) kinetic energy decreases, potential energy increases but total energy remains same
(4) kinetic energy and total energy decrease but potential energy increases

13. Match List-I (Fundamental Experiment) with List-II (its conclusion) and select the correct option from the choices given below the list : **[JEE(Main)-2015; 4/120, –1]**

	List - I		List - II
(A)	Franck-Hertz experiment	(i)	Particle nature of light
(B)	Photo-electric experiment	(ii)	Discrete energy levels of atom
(C)	Davison, Germer experiment	(iii)	Wave nature of electron
		(iv)	Structure of atom

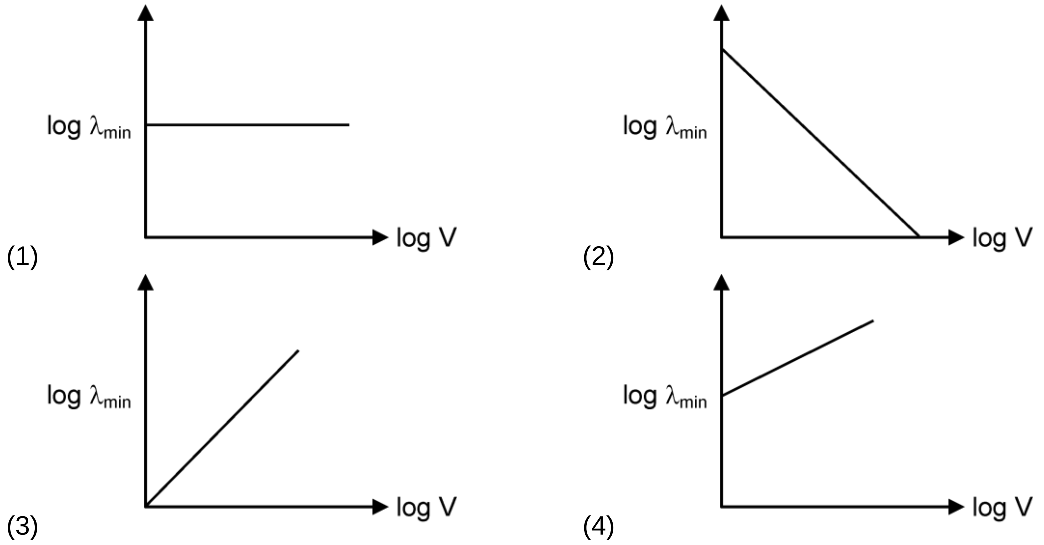
(1) (A) - (i) (B) - (iv) (C) - (iii) (2) (A) - (ii) (B)-(iv) (C) - (iii)

(3) (A) - (ii) (B) (i) (C) -(iii) (4) (A) - (iv) (B) - (iii) (C) - (ii)

14. Radiation of wavelength λ, is incident on a photocell. The fastest emitted electron has speed υ. If the wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will be: **[JEE(Main)-2016; 4/120, –1]**

(1) $< \upsilon\left(\frac{4}{3}\right)^{\frac{1}{2}}$ (2) $= \upsilon\left(\frac{4}{3}\right)^{\frac{1}{2}}$ (3) $= \upsilon\left(\frac{3}{4}\right)^{\frac{1}{2}}$ (4) $> \upsilon\left(\frac{4}{3}\right)^{\frac{1}{2}}$

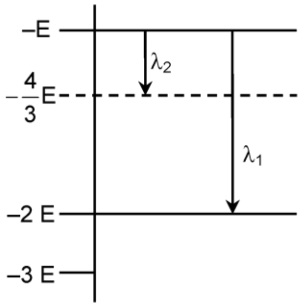
15. An electron bean is acceleration by a potential difference V to hit a metallic target to produce X-rays. It produces continuous as well as characteristic X-rays. If λ_{min} is the smallest possible wavelength of X-ray in the spectrum, the variation of log λ_{min} with log V is correctly represented in : **[JEE Main 2017]**



16. A particle A of mass m and initial velocity υ collides with a particle B of mass $\frac{m}{2}$ which is at rest. The collision is head on, and elastic. The ratio of the de-Broglie wavelengths λ_A to λ_B after the collision is : **[JEE Main-2017]**

(1) $\frac{\lambda_A}{\lambda_B} = \frac{1}{2}$ (2) $\frac{\lambda_A}{\lambda_B} = \frac{1}{3}$ (3) $\frac{\lambda_A}{\lambda_B} = 2$ (4) $\frac{\lambda_A}{\lambda_B} = \frac{2}{3}$

17. Some energy levels of a molecule are shown in the figure. The ratio of the wavelengths $r = \lambda_1/\lambda_2$, is given by : **[JEE Main-2017]**



(1) $r = \frac{1}{3}$ (2) $r = \frac{4}{3}$ (3) $r = \frac{2}{3}$ (4) $r = \frac{3}{4}$

18. If the series limit frequency of the Lyman series is ν_L, then the series limit frequency of the Pfund series is : **[JEE Main 2018]**

(1) $\nu_L/16$ (2) $\nu_L/25$ (3) $25\nu_L$ (4) $16\nu_L$

19. An electron from various excited states of hydrogen atom emit radiation to come to the ground state. Let λ_n, λ_g be the de Broglie wavelength of the electron in the n^{th} state and the ground state respectively. Let Λ_n be the wavelength of the emitted photon in transition from the n^{th} state to the ground state. For large n, (A, B are constants) **[JEE Main 2018]**

(1) $\Lambda_n^2 \approx A + B\lambda_n^2$ (2) $\Lambda_n^2 \approx \lambda$ (3) $\Lambda_n \approx A + \frac{B}{\lambda_n^2}$ (4) $\Lambda_n \approx A + B\lambda_n$

20. Surface of certain metal is first illuminated with light of wavelength λ_1 = 350 nm and then, by light of wavelength λ_2 = 540 nm. It is found that the maximum speed of the photo electrons in the two cases differ by a factor of 2. The work function of the metal (in eV) is close to : **[JEE Main 2019]**

(Energy of photon = $\frac{1240}{\lambda(\text{in nm})}$eV)

(1) 2.5 (2) 5.6 (3) 1.4 (4) 1.8

21. The magnetic filed associated with a light wave is given, at the origin, by
$B = B_0\,[\sin(3.14 \times 10^7)ct + \sin(6.28 \times 10^7)ct]$. If this light falls on a sliver pate having a work function of 4.7 eV, what will be the maximum kinetic energy of the photo electrons ? **[JEE Main 2019]**
($c = 3 \times 10^8$ ms^{-1}, $h = 6.6 \times 10^{-34}$ J-s)

(1) 6.82 eV (2) 12.5 eV (3) 7.72 eV (4) 8.52 eV

22. In an electron microscope, the resolution that can be achieved is of the order of the wavelength of electrons used. The resolve a width of 7.5×10^{-12} m, the minimum electron energy required is close to : **[JEE Main 2019]**

(1) 500 keV (2) 25 keV (3) 1 keV (4) 100 keV

23. A hydrogen atom, initially in the ground state is excited by absorbing a photon of wavelength 980Å.The radius of the atom in the excited state, in terms of Bohr radius a_0, will be : (hc = 12500 eV- Å) **[JEE Main 2019]**

(1) 16 a_0 (2) 25 a_0 (3) 9a_0 (4) 4a_0

24. If the de-Broglie wavelength of an electron is equal to 10^{-3} times the wavelength of a photon of frequency 6×10^{14} Hz, then the speed of electron is equal to : (Speed of light = 3×10^8 m/s, Planck's constant = 6.63×10^{-34}J. s Mass of electron = 9.1×10^{-31} kg) **[JEE Main 2019]**

(1) 1.7×10^6 m/s (2) 1.45×10^6 m/s (3) 1.8×10^6 m/s (4) 1.1×10^6 m/s

25. In a hydrogen like atom, when an electron jumps from the M – shell to the L - shell, the wavelength of emitted radiation is λ. If an electron jumps from N-shell to the L-shell, the wavelength of emitted radiation will be : **[JEE Main 2019]**

(1) $\frac{16}{25}\lambda$ (2) $\frac{25}{16}\lambda$ (3) $\frac{20}{27}\lambda$ (4) $\frac{27}{20}\lambda$

26. In a photoelectric experiment, the wavelength of the light incident on a metal is changed from 300 nm to 400 nm. The decrease in the stopping potential is close to : ($\frac{hc}{e}$ = 1240 nm–V) **[JEE Main 2019]**

(1) 2.0 V (2) 0.5 V (3) 1.0 V (4) 1.5 V

27. A particle of mass m moves in a circular orbit in a central potential field U(r) = $\frac{1}{2}kr^2$. If bohr's quantization conditions are applied, radii of possible orbitals and energy levels vary with quantum number n as : **[JEE Main 2019]**

(1) $r_n \propto \sqrt{n}$, $E_n \propto \frac{1}{n}$ (2) $r_n \propto \sqrt{n}$, $E_n \propto n$ (3) $r_n \propto n^2$, $E_n \propto \frac{1}{n^2}$ (4) $r_n \propto n$, $E_n \propto n$

28. A particle A of mass 'm' and charge 'q' is accelerated by a potential difference of 50 V. Another particle B of mass 4m and charge q is accelerated by a potential difference of 2500 V. The ratio of de–Broglie wavelengths $\frac{\lambda_A}{\lambda_B}$ is close to : **[JEE Main 2019]**

(1) 14.14 (2) 10.00 (3) 0.07 (4) 4.47

29. An alpha-particle of mass m suffers 1-dimensional elastic collision with a nucleus at rest of unknown mass. it s scattered directly backwards losing, 64% of its initial kinetic energy. The mass of the nucleus is : **[JEE Main 2019]**

(1) 3.5 m (2) 1.5 m (3) 4 m (4) 2 m

30. When a certain photosensitive surface is illuminated with monochromatic light of frequency ν, the stopping potential for the photo current is $-\frac{V_0}{2}$. When the surface is illuminated by monochromatic light of frequency $\frac{\nu}{2}$, the stopping potential is $-V_0$. The threshold frequency for photoelectric emission is : **[JEE Main 2019]**

(1) $\frac{4}{3}\nu$ (2) 2ν (3) $\frac{3\nu}{2}$ (4) $\frac{5\nu}{3}$

31. In a Frank-Hertz experiment, an electron of energy 5.6 eV passes through mercury vapour and emerges with an energy 0.7 eV. The minimum wavelength of photons emitted by mercury atoms is close to : **[JEE Main 2019]**

(1) 1700 nm (2) 220 nm (3) 2020 nm (4) 250 nm

Answers

EXERCISE - 1

SECTION (A) :

1.	(1)	**2.**	(4)	**3.**	(1)	**4.**	(1)	**5.**	(2)	**6.**	(3)	**7.**	(2)
8.	(3)	**9.**	(2)	**10.**	(1)	**11.**	(2)	**12.**	(2)	**13.**	(3)	**14.**	(4)
15.	(4)	**16.**	(2)	**17.**	(2)	**18.**	(1)	**19.**	(4)	**20.**	(1)	**21.**	(3)
22.	(4)	**23.**	(2)	**24.**	(2)	**25.**	(1)	**26.**	(2)	**27.**	(2)	**28.**	(1)
29.	(3)	**30.**	(2)	**31.**	(4)	**32.**	(3)	**33.**	(3)	**34.**	(1)	**35.**	(1)
36.	(3)	**37.**	(2)	**38.**	(2)	**39.**	(3)	**40.**	(4)	**41.**	(4)	**42.**	(4)
43.	(1)	**44.**	(1)	**45.**	(2)	**46.**	(4)	**47.**	(3)	**48.**	(3)	**49.**	(3)
50.	(4)	**51.**	(3)	**52.**	(3)	**53.**	(4)	**54.**	(4)	**55.**	(4)	**56.**	(2)
57.	(3)	**58.**	(2)	**59.**	(3)	**60.**	(4)	**61.**	(4)	**62.**	(4)	**63.**	(2)
64.	(1)	**65.**	(1)	**66.**	(3)	**67.**	(4)	**68.**	(4)	**69.**	(2)	**70.**	(2)
71.	(2)	**72.**	(2)	**73.**	(4)	**74.**	(4)	**75.**	(1)	**76.**	(2)	**77.**	(2)
78.	(1)												

SECTION (B) :

1.	(2)	**2.**	(3)	**3.**	(1)	**4.**	(3)	**5.**	(2)	**6.**	(3)	**7.**	(2)
8.	(2)	**9.**	(4)	**10.**	(4)	**11.**	(4)	**12.**	(1)	**13.**	(4)	**14.**	(1)

SECTION (C) :

1.	(3)	**2.**	(2)	**3.**	(4)	**4.**	(2)	**5.**	(3)	**6.**	(3)	**7.**	(2)
8.	(3)	**9.**	(2)	**10.**	(4)	**11.**	(1)	**12.**	(4)	**13.**	(3)	**14.**	(4)
15.	(3)	**16.**	(1)	**17.**	(2)	**18.**	(3)	**19.**	(4)	**20.**	(4)	**21.**	(3)
22.	(3)	**23.**	(4)	**24.**	(3)	**25.**	(3)	**26.**	(2)	**27.**	(2)	**28.**	(4)
29.	(3)	**30.**	(1)	**31.**	(3)	**32.**	(4)	**33.**	(3)	**34.**	(2)	**35.**	(2)
36.	(3)	**37.**	(1)	**38.**	(3)	**39.**	(2)	**40.**	(3)	**41.**	(1)	**42.**	(1)
43.	(4)	**44.**	(1)	**45.**	(2)	**46.**	(2)	**47.**	(3)	**48.**	(1)	**49.**	(1)

SECTION (D) :

1.	(4)	**2.**	(4)	**3.**	(3)	**4.**	(1)

SECTION (E) :

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

EXERCISE - 2

1.	(3)	**2.**	(1)	**3.**	(1)	**4.**	(1)	**5.**	(3)	**6.**	(1)	**7.**	(4)
8.	(3)	**9.**	(1)	**10.**	(3)	**11.**	(4)	**12.**	(2)	**13.**	(1)	**14.**	(1)
15.	(2)	**16.**	(3)	**17.**	(2)	**18.**	(2)	**19.**	(1)	**20.**	(1)	**21.**	(1)
22.	(4)	**23.**	(2)	**24.**	(3)	**25.**	(3)	**26.**	(4)	**27.**	(3)		

EXERCISE - 3

PART – I

1.	(2)	**2.**	(2)	**3.**	(3)	**4.**	(4)	**5.**	(1)	**6.**	(1)	**7.**	(2)
8.	(2)	**9.**	(4)	**10.**	(1)	**11.**	(2)	**12.**	(2)	**13.**	(4)	**14.**	(4)
15.	(1)	**16.**	(1)	**17.**	(2)	**18.**	(2)	**19.**	(3)	**20.**	(4)	**21.**	(1)
22.	(1)	**23.**	(3)	**24.**	(4)	**25.**	(1)	**26.**	(2)	**27.**	(4)	**28.**	(2)
29.	(4)	**30.**	(4)	**31.**	(2)	**32.**	(3)	**33.**	(1)	**34.**	(1)	**35.**	(1)
36.	(1)	**37.**	(4)	**38.**	(2)	**39.**	(2)	**40.**	(1)	**41.**	(4)	**42.**	(1)
43.	(3)	**44.**	(2)	**45.**	(4)	**46.**	(1)	**47.**	(1)	**48.**	(4)	**49.**	(2)
50.	(3)	**51.**	(3)	**52.**	(4)	**53.**	(1)						

PART – II

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