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UDUPI

CET25P11 DUAL NATURE OF RADIATION AND MATTER

Class 12 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 75**

1. When photons of energy, $h\nu$ fall on an aluminum plate (of work function E_0), photoelectrons of maximum kinetic energy K are ejected. If the frequency of radiation is doubled, the maximum kinetic energy of the ejected photoelectrons will be **[1]**

   a) 2K
   b) K
   c) $K + E_0$
   d) $K + h\nu$

2. A photon of wavelength 663 nm is incident on a metal surface. The work function of the metal is 1.50 eV. The maximum kinetic energy of the emitted photo electrons is **[1]**

   a) 3.0×10^{-20} J
   b) 4.5×10^{-20} J
   c) 9.0×10^{-20} J
   d) 6.0×10^{-20} J

3. Electrons used in an electron microscope are accelerated by a voltage of 25 kV. If the voltage is increased to 100 kV, then the de-Broglie wavelength associated with the electrons would **[1]**

   a) increase by 4 times
   b) decrease by 2 times
   c) increase by 2 times
   d) decrease by 4 times

4. The photoelectrons emitted from a given cathode on the incidence of a given monochromatic beam of light have a/an **[1]**

   a) energy spread with an upper limit
   b) energy spread with a lower limit
   c) definite energy only
   d) energy spread with no sharp limits

5. At stopping potential, the kinetic energy of emitted photoelectron is **[1]**

   a) minimum
   b) zero
   c) cannot de predicted
   d) maximum

6. Light of wavelength 500 nm is incident on metal with work function 2.28 eV. The de-Broglie wavelength of the emitted electron is **[1]**

   a) $< 2.8 \times 10^{-9}$ m
   b) $< 2.8 \times 10^{-10}$ m
   c) $\geq 2.8 \times 10^{-9}$ m
   d) $\leq 2.8 \times 10^{-12}$ m

7. Light of frequency $1.5\ v_0$ is incident on a photosensitive material of threshold frequency v_0. If the frequency of the incident radiation is kept constant and intensity is increased, the photo current will: **[1]**

   a) decrease
   b) first decrease and then become zero
   c) increase
   d) not change

8. The ratio of de-Broglie wavelength associated with two electrons accelerated through 25 V and 36 V is **[1]**

a) $\frac{5}{6}$ b) $\frac{36}{25}$

c) $\frac{6}{5}$ d) $\frac{25}{36}$

9. Photons of energy 4.3 eV are incident on a photosensitive surface of work function 2·3 eV. The stopping potential for photoelectrons is: **[1]**

a) 2.3 eV b) 4.3 eV

c) 2.0 eV d) 6.6 eV

10. What is the energy of a photon whose wavelength is 6840 $\mathring{A}$? **[1]**

a) 3.6 eV b) 12.1 eV

c) -13.6 eV d) 1.81 eV

11. What will be the number of photons emitted per second by a 10 W sodium vapour lamp assuming that 90% of the consumed energy is converted into light? [Wavelength of sodium light is 590 nm, and h = 6.63×10^{-34} Js] **[1]**

a) 0.267×10^{18} b) 0.267×10^{19}

c) 0.267×10^{17} d) 0.267×10^{20}

12. If an electron and a photon propagate in the form of waves having the same wavelength, it implies that they have the same: **[1]**

a) energy b) velocity

c) momentum d) angular momentum

13. Work function of tungsten and sodium are 4.4 eV and 2.3 eV respectively. If threshold wavelength of sodium is 5460$\mathring{A}$, then threshold wavelength of tungsten is **[1]**

a) 6000 $\mathring{A}$ b) 11360 $\mathring{A}$

c) 8000 $\mathring{A}$ d) 2854 $\mathring{A}$

14. 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 **[1]**

a) 6×10^{18} b) 3×10^{19}

c) 62×10^{20} d) 1.5×10^{20}

15. If de-Broglie wavelength of an alpha particle and a proton are equal, then the ratio of their momentum is **[1]**

a) 1 : 4 b) 1 : 2

c) 1 : 1 d) 2 : 1

16. The maximum kinetic energy of the photoelectrons varies: **[1]**

1. inversely with the intensity and is independent of the frequency of the incident radiation
2. inversely with the frequency and is independent of the intensity of the incident radiation
3. linearly with the frequency and the intensity of the incident radiation
4. linearly with the frequency and is independent of the intensity of the incident radiation

a) Option iv

b) Option iii

c) Option ii

d) Option i

17. Photons of frequency v are incident on the surfaces of two metals A and B of threshold frequencies $\frac{3}{4}$v and $\frac{2}{3}$v, respectively. The ratio of maximum kinetic energy of electrons emitted from A to that from B is **[1]**

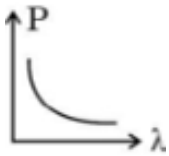
a) 3 : 2

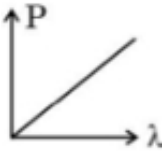
b) 2 : 3

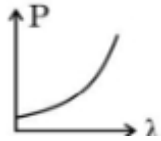
c) 3 : 4

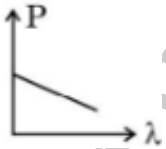
d) 4 : 3

18. Which of the following figures represents the variation of a particle's momentum with the de Broglie wavelength associated with it? **[1]**

a) 

b) 

c) 

d) 

19. Ultraviolet radiations of 6.2 eV fall on an aluminium surface. Kinetic energy of fastest electrons emitted is (work function = 4.2 eV) **[1]**

a) 9×10^{-32} J

b) 7×10^{-25} J

c) 3.2×10^{-21} J

d) 3.2×10^{-19} J

20. If the energy of a photon corresponding to a wave length of 6000 $\overset{0}{A}$ is 3.32×10^{19} joule, the photon energy for a wavelength of 4000 $\overset{0}{A}$ will be **[1]**

a) 6.98×10^{19} joules

b) 5.98×10^{19} joules

c) 4.98×10^{19} joules

d) 2.22×10^{19} joules

21. The value of Planck's energy is **[1]**

a) $nhc\lambda$

b) $\frac{nh\lambda}{c}$

c) $nh\lambda$

d) $\frac{nhc}{\lambda}$

22. A photosensitive metallic surface has work function, $h\nu_0$. If photons of energy $2h\nu_0$ 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 $5h\nu_0$, then maximum velocity of photoelectrons will be **[1]**

a) 8×10^6 m/s

b) 2×10^6 m/s

c) 8×10^5 m/s

d) 2×10^7 m/s

23. Proton and α-particle have the same de Broglie wavelength. What is the same for both of them? **[1]**

a) Energy

b) Momentum

c) Time period

d) Frequency

24. Threshold wavelength of a photoelectric emission from a material is 600 nm. Which of the following illuminating source will emit photoelectrons? **[1]**

a) 100 W, ultraviolet lamp

b) Both 10 W, ultraviolet lamp and 100 W, ultraviolet lamp

c) 400 W, infrared lamp

d) 10 W, ultraviolet lamp

25. The de Broglie wave corresponding to a particle of mass m and velocity v has a wavelength associated with it **[1]**

a) $\frac{mh}{v}$

b) $\frac{m}{hv}$

c) hmv

d) $\frac{h}{mv}$

26. The work function of a photoelectric material is 3.32 eV. The threshold frequency will be equal to **[1]**

a) 6×10^{14} Hz

b) 7×10^{14} Hz

c) 8×10^{14} Hz

d) 9×10^{14} Hz

27. Threshold frequency of a photon required to eject a photoelectron from the surface of cesium is (work function of cesium is 2.1 eV) **[1]**

a) 4.04×10^{14} Hz

b) 4.56×10^{14} Hz

c) 5.06×10^{14} Hz

d) 6.64×10^{14} Hz

28. Light of wavelength 4000 $\overset{0}{A}$ is incident on a metal plate whose work function is 2 eV. The maximum kinetic energy of the emitted photoelectrons would be **[1]**

a) 1.5eV

b) 2.0eV

c) 0.5eV

d) 1.1eV

29. If the threshold wavelength of radiations required to eject a photoelectron from a metal surface is 6×10^{-7} m, then work function of the metal is **[1]**

a) 4.4×10^{-15} J

b) 5.5×10^{-21} J

c) 3.3×10^{-19} J

d) 6.6×10^{-9} J

30. If the maximum kinetic energy of emitted photo electrons from a metal surface of work function 2.5 eV, is 1.7 eV. If wavelength of incident radiation is halved, then stopping potential will be **[1]**

a) 6.7 V

b) 1.1 V

c) 5 V

d) 2.5 V

31. A photo-cell is illuminated by a source of light, which is placed at a distance d from the cell. If the distance becomes $\frac{d}{2}$, then the number of electrons emitted per second will be **[1]**

a) two times

b) four times

c) same

d) one-fourth

32. 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 photoelectric effect is **[1]**

a) 4λ

b) $\frac{\lambda}{6}$

c) 6λ

d) $\frac{\lambda}{4}$

33. What kV potential is to be applied on X-ray tube so that minimum wavelength of emitted X-rays may be 1 $\overset{o}{A}$ (h = 6.6×10^{-34} Js)? **[1]**

a) 12.84 kV

b) 11.98 kV

c) 12.42 kV

d) 10.78 kV

34. Which of the following metals thermionically emits an electron at the relatively lowest temperature among them? **[1]**

a) Molybdenum

b) Copper

c) Aluminium

d) Platinum

35. In an experiment of photoelectric emission for incident light of 4000 $\overset{0}{A}$, the stopping potential is 2V. If the wavelength of incident light is made 3000 $\overset{0}{A}$, then stopping potential will be **[1]**

a) 2 Volt

b) less than 2 volt

c) more than 2 volt

d) zero

36. A photocell is illuminated by a small bright source placed 1 m away. When the same source of light is placed 0.5 m away, the number of electrons emitted by photocathode would **[1]**

a) decrease by a factor of 4

b) decrease by a factor of 2

c) increase by a factor of 2

d) increase by a factor of 4

37. If an electron accelerated through a potential difference of 500 volt attains a speed of $1.33 \times 10^{7} \mathrm{ms}^{-1}$, then specific charge of the electron should be **[1]**

a) $1.76 \times 10^{11} \mathrm{Ckg}^{-1}$

b) $1.66 \times 10^{11} \mathrm{Ckg}^{-1}$

c) $1.86 \times 10^{11} \mathrm{Ckg}^{-1}$

d) $1.96 \times 10^{11} \mathrm{Ckg}^{-1}$

38. The kinetic energy of an electron, which is accelerated in the potential difference of 100 volts, is **[1]**

a) 6.636 cal

b) 1.602×10^{-17} J

c) 416.6 cal

d) 1.6×10^{4} J

39. Maximum velocity of photoelectrons emitted from a metal surface having work function 4 eV is (given: frequency of incident radiations is 10^{15} Hz) **[1]**

a) $2.25 \times 10^{5} \mathrm{ms}^{-1}$

b) $3.25 \times 10^{8} \mathrm{ms}^{-1}$

c) $6 \times 10^{5} \mathrm{ms}^{-1}$

d) $4 \times 10^{8} \mathrm{ms}^{-1}$

40. An electron of mass m and charge e is accelerated from rest through a potential difference V in vacuum. Its final velocity will be **[1]**

a) $\frac{\mathrm{eV}}{2\,\mathrm{m}}$

b) $\sqrt{\frac{eV}{m}}$

c) $\sqrt{\frac{2eV}{m}}$

d) $\frac{eV}{m}$

41. The work functions for metals A, B and C are respectively 1.92 eV, 2.0 eV and 5 eV. According to Einstein's equation, the metals which will emit photoelectrons for radiation of wavelength 4100 $\overset{\mathrm{o}}{\mathrm{A}}$ is/are **[1]**

a) A and B only

b) all the three metals

c) B only

d) A only

42. Photoelectrons are emitted by a metal surface only when **[1]**

a) light is incident at an angle greater than the critical angle

b) the wavelength of the incident light exceeds a certain minimum value

c) frequency of the incident light exceeds a certain minimum value

d) metal is initially charged

43. 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 **[1]**

a) 2.3 V

b) 0.5 V

c) 1.3 V

d) 1.8 V

44. In a photoelectric cell, the photoelectric current depends on the **[1]**

a) wavelength of light

b) potential difference applied

c) intensity of light

d) frequency of light

45. For photoelectric emission from certain metal, the cut-off 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) **[1]**

a) $2\sqrt{\frac{h\nu}{m}}$

b) $\sqrt{\frac{h\nu}{(2m)}}$

c) $\sqrt{\frac{h\nu}{m}}$

d) $\sqrt{\frac{2h\nu}{m}}$

46. In an experiment on photoelectric effect, the intensity of incident radiation is increased, keeping the frequency v the same. The number of photoelectrons emitted will: **[1]**

a) increase

b) remain same

c) decrease

d) depend on frequency

47. In a photo-emissive cell, with an exciting wavelength λ, the fastest electron has speed v. If the exciting wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will be: **[1]**

a) $v(\frac{3}{4})^{1/2}$

b) greater than $v(\frac{4}{3})^{1/2}$

c) $v(\frac{4}{3})^{1/2}$

d) less than $v(\frac{4}{3})^{1/2}$

48. The work function of a substance is 4 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately: **[1]**

a) 540 nm

b) 220 nm

c) 400 nm

d) 310 nm

49. The work-function for a metal is 3 eV. To emit a photoelectron of energy 2 eV from the surface of this metal, the wavelength of the incident light should be: **[1]**

a) 2875 $\overset{o}{A}$

b) 6187 $\overset{o}{A}$

c) 12375 $\overset{o}{A}$

d) 4125 $\overset{o}{A}$

50. If photons of frequency ν are incident on the surfaces of metals. A & B of threshold frequencies $\frac{v}{2}$ and $\frac{v}{3}$ respectively, the ratio of the maximum kinetic energy of electrons emitted from A to that from B is **[1]**

a) $\sqrt{3} : \sqrt{2}$

b) 1 : 3

c) 3 : 4

d) 2 : 3

51. Photoelectrons emitted from a metal have **[1]**

a) different speeds starting from 0 to certain maximum.

b) Both same kinetic energy and same frequency

c) same kinetic energy.

d) same frequency.

52. 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 6 eV are incident on C, no photoelectrons will reach anode A. If the stopping potential of A relative to C is **[1]**

a) -3 V

b) -1 V

c) +4 V

d) +3 V

53. Light of frequency 6.4×10^{14} Hz is incident on a metal of work function 2.14 eV. The maximum kinetic energy of the emitted electrons is about: **[1]**

a) 1.02 eV

b) 0.51 eV

c) 0.10 eV

d) 0.25 eV

54. A photoelectric surface is illuminated successively by monochromatic light of wavelength λ and $\frac{\lambda}{2}$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function of the surface of the material (h = Planck's constant, c = speed of light) is **[1]**

a) $\frac{2hc}{\lambda}$

b) $\frac{hc}{2\lambda}$

c) $\frac{hc}{\lambda}$

d) $\frac{hc}{3\lambda}$

55. When ultraviolet rays incident on metal plate then photoelectric effect does not occur. It occurs by incidence of **[1]**

a) X-rays

b) Light waves

c) Radio waves

d) Infrared rays

56. If we consider electrons and photons of same wavelength, then they will have same **[1]**

a) velocity

b) momentum

c) angular momentum

d) energy

57. A photoelectric cell is illuminated by a point source of light 1 m away. The plate emits electrons having stopping potential V. Then: **[1]**

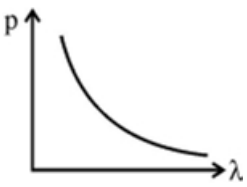
a) V decreases as distance increase.

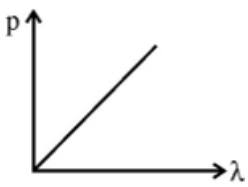
b) V increases as distance increase.

c) V becomes zero when distance increases or decreases.

d) V is independent of distance (r).

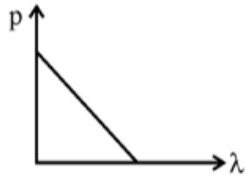
58. The graph showing the correct variation of linear momentum (p) of a charge particle with its de-Broglie wavelength (λ) is- **[1]**

a) 

b) 

c)

d)



59. A particle of mass 1 mg has the same wavelength as an electron moving with a velocity of 3×10^8 ms^{-1}. The velocity of the particle is (mass of electron = 9.1×10^{-3} kg) **[1]**

a) 9×10^{-2} ms^{-1} b) 2.7×10^{-18} ms^{-1}

c) 3×10^{-31} ms^{-1} d) 2.7×10^{-21} ms^{-1}

60. Which one of the following metals does not exhibit emission of electrons from its surface when irradiated by visible light? **[1]**

a) Rubidium b) Caesium

c) Sodium d) Cadmium

61. The photoelectric work function for a metal surface is 4.125 eV. The cut-off wavelength for this surface is **[1]**

a) 6000 $\mathring{A}$ b) 4125 $\mathring{A}$

c) 3000 $\mathring{A}$ d) 2062.5 $\mathring{A}$

62. An electron beam has a kinetic energy equal to 100 eV. Find its wavelength associated with a beam, if mass of electron = 9.1×10^{-31} kg and 1eV = 1.6×10^{-19}J/eV. **[1]**

(Planck's constant = 6.6×10^{-34} Js)

a) 0.12 $\mathring{A}$ b) 6.3 $\mathring{A}$

c) 1.2 $\mathring{A}$ d) 24.6 $\mathring{A}$

63. The maximum velocity of the photoelectron emitted by a metal is 1.8×10^6 ms^{-1}. Take the value of the specific charge of the electron is 1.8×10^{11} C kg^{-1}. Then the stopping potential in volt is: **[1]**

a) 6 b) 1

c) 9 d) 3

64. A light of frequency v is incident on a metal surface whose work function is W_0. The kinetic energy of emitted electron is K. If the frequency of the incident light is doubled then the kinetic energy of emitted electron will be **[1]**

a) less than K b) between K and 2K

c) 2K d) more than 2K

65. If light of wavelength 4000 $\mathring{A}$ is incident on a sodium surface for which the threshold wavelength of photoelectrons is 5420 $\mathring{A}$, then work-function of sodium is **[1]**

a) 4.58 eV b) 0.57 eV

c) 1.14 eV d) 2.29 eV

66. Greenlight causes the emission of photoelectron from a surface, but not the yellow light. Emission of photoelectron will occur if the surface is illuminated by **[1]**

a) microwave b) infrared rays

c) ultraviolet rays

d) red rays

67. The work function of a metal is 4eV. To emit photo electrons with zero velocity from this, the wavelength of incident radiation must be **[1]**

a) $1700\overset{o}{A}$

b) $2700\overset{o}{A}$

c) $3100\overset{o}{A}$

d) $5900\overset{o}{A}$

68. The dual nature of light is exhibited by **[1]**

a) refraction and interference

b) photoelectric effect

c) diffraction and reflection

d) diffraction and photoelectric effect

69. E, c and v represent the energy, velocity and frequency of a photon. Which of the following represents its wavelength? **[1]**

a) $\frac{hc}{E}$

b) $\frac{hv}{c^2}$

c) $\frac{hv}{c}$

d) hv

70. The value of Planck's constant is **[1]**

a) 6.63×10^{-34} kg-m^2/sec

b) 6.63×10^{-34} kg-m^2

c) 6.63×10^{-34} J-sec

d) 6.63×10^{-34} J/sec

71. The cathode of a photoelectric cell is changed such that the work function changes from W_1 to W_2 ($W_2 > W_1$). If the currents before and after changes are I_1 and I_2, all other conditions remaining unchanged, then (assuming $h\nu > W_2$), **[1]**

a) $I_1 = I_2$

b) $I_1 < I_2$

c) $I_1 < I_2 < 2I_1$

d) $I_1 > I_2$

72. When photon of energy 4.0 eV strikes the surface of a metal A, the ejected photoelectrons have maximum kinetic energy T_A eV and de-Broglie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photon of energy 4.50 eV is $T_B = (T_A - 1.5)$eV. If the de-Broglie wavelength of these photoelectrons $\lambda_B = 2\lambda_A$, then the work function of metal B is: **[1]**

a) 3eV

b) 2eV

c) 1.5eV

d) 4eV

73. For Bragg's diffraction by a crystal to occur, then the X-ray of wavelength λ and interatomic distance d must be such that **[1]**

a) λ is greater than 2d

b) λ is smaller than 2d

c) λ is smaller than or equal to 2d

d) λ equals 2d

74. The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6 eV fall on it is 4 eV. The stopping potential is **[1]**

a) 2 V

b) 10 V

c) 4 V

d) 6 V

75. The curve drawn between velocity and frequency of a photon in vacuum will be a **[1]**

a) straight line passing through origin and making an angle of 45° with frequency axis

b) straight line parallel to frequency axis

c) hyperbola

d) straight line parallel to velocity axis