1. A heated body emits radiation which has maximum intensity near the frequency of f_0. The emissivity of the material is 0.5. If the absolute temperature of the body is doubled,

(a) The maximum intensity of radiation will be near the frequency $2f_0$.

(b) The maximum intensity of radiation will be near the frequency $f_0/2$

(c) The total energy emitted will increase by a factor of 12

(d) The total energy emitted will increase by a factor of 8.

2. An ideal refrigerator has a freezer at a temperature of $-12°C$. The coefficient of performance of the engine is 5. The temperature of the air (to which the heat ejected) is

(a) 50°C

(b) 45.2°C

(c) 40.2°C

(d) 37.5°C

3. Let C_p and C_v Denote the molar specific heat capacities of an ideal gas at constant pressure and volume, respectively. Which of the following is a universal constant?

(a) $\frac{C_p}{C_v}$.

(b) C_pC_v

(c) $C_p - C_v$

(d) C_p+C_v

4. A hot liquid is kept in a big room. The logarithm of the numerical value of the temperature difference between the liquid and room is plotted against time. The plot will be nearly

(a) A straight line

(b) A circular arc

(c) A parabola

(d) An ellipse

5. An ideal heat engine operates between two temperatures 600 K and 900 K. What is the engine's efficiency?

(a) 50%

(b) 80%

(c) 100%

(d) 33%

6. An ideal gas heat engine operates between 227 °C and 127 °C. It absorbs 8.0×10^4 Cal of heat at a higher temperature. The amount of heat converted into work is:

(a) 6.4×10^4 cal

(b) 6.0×10^4 cal

(c) 2.4×10^4 cal

(d) 1.6×10^4 cal.

7. The volume of a cell in six-dimensional phase space is

(a) h^3

(b) h^6

(c) h^{-3}

(d) h^{-6}

8. The mean internal energy of one-dimensional classical harmonic oscillator in equilibrium with heat bath of temperature T is

(a) $\frac{1}{2}K_BT$

(b) K_BT

(c) $\frac{3}{2}K_BT$

(d) $3K_BT$

9. If $\vec{A}$ is solenoidal, $\vec{\nabla} \times \vec{\nabla} \times \vec{\nabla} \times \vec{\nabla} \times \vec{A}$ is equal to

(a) $\nabla^4\vec{A}$

(b) $\nabla^3\vec{A}$

(c) $\nabla(\nabla \times \vec{A})$

(d) $\nabla.\vec{A}$

10. $\Gamma(n+1)$ *is equal to*

(a) $\Gamma(n-1)$

(b) $n\,\Gamma(n-1)$

(c) $n\,\Gamma(n+1)$

(d). $n\,\Gamma(n)$

11. Find the value of $(\Gamma(7/2))/(\Gamma(1/2))$

(a) 3/4

(b) 3/8

(c) 15/8

(d). none of these.

12. At the point of the singularity of an analytic function f(z), it is

(a) analytic

(b) not analytic

(c) may or may not be analytic

(d) None of these.

13. If F(s) is the complex Fourier transformation of f(x), then F{f(ax} is equal to

(a) $\frac{1}{a}F(\frac{s}{a})$

(b) $a\,F(\frac{s}{a})$

(c) $\frac{2}{a^2}F(\frac{s}{a})$

(d) $\frac{1}{a^2}F(\frac{s}{a})$

14. Function Z^2 is:

(a) Not analytics anywhere.

(b) Analytic at origin only.

(c) Analytic at everywhere.

(d) Analytic in the upper-half plane only

15. Which of the following is not correct?

(a) $H_{2n}(0)=(-1)^n\frac{(2n)!}{n!}$

(b) $H_{2n+1}(0)=0$

(c) $H'_{2n}(0)=0$

(d) $H'_{2n+1}(0)=0$

16. What is the value of $x\delta'(x)$?

(a) $-\delta(x)$

(b) $\delta(x)$

(c) $2\delta(x)$

(d) $-3\delta(x)$

17. A cylinder is filled with non-viscous liquid of density d to height h_0 and a hole is made at a height h_1 From the bottom of the cylinder. The velocity of the liquid coming out of the hole is:

(a) $\sqrt{2gh_0}$

(b) $\sqrt{2g(h_0 - h_1)}$

(c) $\sqrt{gdh_1}$

(d) $\sqrt{gdh_0}$

18. For the Lagrangian $L=\frac{1}{2}\dot{q}^2 - q\dot{q} + q^2$, find p conjugate to q:

(a) $q + \dot{q}$

(b) $q\ \dot{q}$

(c) $\dot{q} - q$

(d) $q - \dot{q}$

19. What is the height of the Geo stationary satellite above the surface of the earth?

(a) $35.8 \times 10^3 Km$

(b) $71 \times 10^3 Km$

(c) $17.9 \times 10^9 Km$

(d) None of these.

20. A hollow and solid Sphere of the same mass has an equal moment of about diameter. The ratio of their radii

(a) $\sqrt{3}: \sqrt{5}$

(b) 3: 5

(c) 5: 3

(d) $\sqrt{5}: \sqrt{3}$

21. Which of the following relation is true

(a) $Y = \eta(1 + \sigma)$

(b) $Y = 2\eta(1 + \sigma)$

(c) $Y = K(1 - 2\sigma)$

(d) $Y = 2K(1 - 2\sigma)$

22. Two capillary tubes of same length l but radii r_1 and r_2 , they are fitted in parallel to the bottom of a vessel. The pressure head is P . What should be the radius r of a single tube that can replace the two pipes so that the flow rate is the same as before?

(a) $r = r_1 + r_2$

(b) $r^2 = r_1^2 + r_2^2$

(c) $r^4 = r_1^4 + r_2^4$

(d) $\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2}$

23. Rainbow is an example of which phenomenon?

(a) Refraction and scattering.

(b) Total internal reflection only.

(c) Dispersion and reflection

(d) Dispersion and total internal reflection.

24. If an equiconvex lens of focal length f and power P is cut into half in thickness, what are each half's focal length and power?

(a) Zero

(b) f/2

(c) f

(d) 2f

25. Two slits in Young's double-slit experiment have widths in the ratio 81 :1. The ratio of the amplitudes of light waves is

(a) 3 :1

(b) 3 : 2

(c) 9 :1

(d) 6:1

26. The first diffraction minima due to single slit diffraction are at $\theta = 30^0$ for the light of wavelength $5000A^0$. The width of the slit is:

(a) 5×10^{-5}cm

(b) 10×10^{-5}cm

(c) 2.5×10^{-5}cm

(d) 1.25×10^{5}cm

27. A beam of light strikes a piece of glass at an angle of incidence 60^0 And the reflected beam is completely plane-polarized. The refractive index of the glass is

(a) 1.5

(b) $\sqrt{3}$

(c) $\sqrt{2}$

(d) 3/2

28. When the separation between two charges is increased, the electric potential energy of charges:

(a) Increases

(b) Decreases

(c) Remains the same

(d) May increase or decrease

29. A non-conducting sheet of large surface area and thickness d contains uniform charge distribution of density ρ. The electric field at point P inside the plate, at a distance $x\ from$ the central plane is:

(a) $\frac{\rho x}{\epsilon_0}$

(b) $\frac{\rho x}{2\epsilon_0}$

(c) $\frac{2\rho x}{\epsilon_0}$

(d) $\rho x \epsilon_0$

30. A dielectric slab is inserted between the plates of an isolated capacitor. The force between the plates will

(a) Increase

(b) Decrease

(c) Remain unchanged

(d) Becomes zero.

31. How many time constants will elapse before the power delivered by the battery drops to half of its maximum value in an RC circuit?

(a) 0.96

(b) 0.69

(c) 6.9

(d) 9.6

32. An experimenter's diary reads as follows: a charged particle is projected in a magnetic field of $(7.0\hat{\imath} - 3.0\hat{\jmath}) \times 10^{-3} T$. The acceleration of the particle is found to be $x\hat{\imath} + 7.0\hat{\jmath} \times 10^{-6} m/s^2$. What is the value of x?

(a) 3.0

(b) 4.0

(c) 7.0

(d) 5.0

33. The force acting on a current-carrying wire, joining two fixed points a and b in a uniform magnetic field, is

(a) Depend on the area of a loop

(b) Depend on the shape of a loop

(c) Independent of the shape of the loop

(d) None of these.

34. An electron makes 3×10^5 revolutions per second in a circle of radius $0.5A^0$. The magnetic field at the center of the circles is

(a) $6 \times 10^{-10}T$

(b) $3 \times 10^{-10}T$

(c) $4 \times 10^{-10}T$

(d) None of these.

35. The magnetic susceptibility is negative for

(a) Paramagnetic materials only

(b) Diamagnetic material only

(c) Ferromagnetic materials only

(d) Paramagnetic and Ferromagnetic materials

36. A rod of length l rotates with small but uniform angular velocity ω about its perpendicular bisector. A uniform magnetic field B exists parallel to the axis of rotation. The potential difference between the center of the rod and an end is

(a) Zero

(b) $B\omega l^2$

(c) $\frac{1}{2}B\omega l^2$

(d) $\frac{1}{8}B\omega l^2$

37. An alternating current is given by $i = i_1 sin\omega t + i_2 cos\omega t$. The current r.m.s current is given

(a) $\frac{i_1+i_2}{\sqrt{2}}$

(b) $\frac{|i_1+i_2|}{\sqrt{2}}$

(c) $\sqrt{\frac{i_1^2+i_2^2}{2}}$

(d) $\sqrt{\frac{i_1^2+i_2^2}{\sqrt{2}}}$

38. If magnetic monopole existed, then which of the following Maxwell's equations will be modified?

(a) $\vec{\nabla}.\vec{D}=0$

(b) $\vec{\nabla}.\vec{B}=0$

(c) $\vec{\nabla}\times\vec{E}=-\frac{d\vec{B}}{dt}$

(d) $\vec{\nabla}\times\vec{H}=\vec{j}+\frac{d\vec{D}}{dt}$

39. The energy per unit time, per unit area transported by the electromagnetic field, is expressed as

(a) $S=\frac{1}{\mu_0}(\vec{E}\times\vec{B})$

(b) $S=(\vec{E}\times\vec{B})$

(c) $S=\mu_0(\vec{E}\times\vec{B})$

(d) $S=\frac{1}{\epsilon_0}(\vec{E}\times\vec{B})$

40. The universal gate is

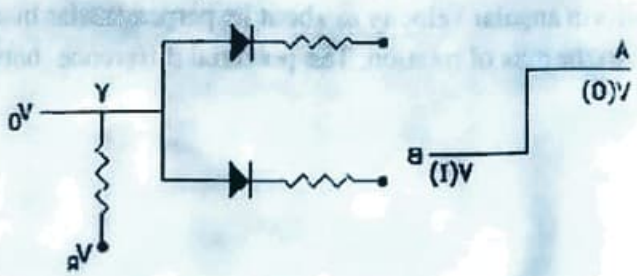
(a) NAND gate

(b) OR gate

(c) AND gate

(d) None of the above

41. The circuit in the given figure is a ..... gate.



(a) positive logic OR gate

(b) negative logic OR gate

(c) negative logic AND gate

(d) positive logic AND gate

42. A JFET is a

(a) current-controlled device

(b) low input resistance

(c) voltage-controlled device

(d) is always forward-biased

43. The half-life of a particular particle as measured in the lab is $4.0 \times 10^{-8} s$ when its speed is 0.8c, its actual lifetime is

(a) 3.4×10^{-8}

(b) 2.4×10^{-8}

(c) 1.4×10^{-8}

(d) None of these.

44. The total energy of a particle is precise twice its rest energy; its speed is

(a) 0.866c

(b) 0.64c

(c) 0.36c

(d) 0.2c

45. If a particle of rest mass m_0 moves with speed $\frac{c}{\sqrt{2}}$ then its mass would be

(a) $\sqrt{2}\ m_0$

(b) $\sqrt{3}\ m_0$

(c) $\sqrt{5}\ m_0$

(d) $\sqrt{7}\ m_0$

46. The amplitude of simple harmonic oscillation reduces to 1/3 in the first 20 seconds, then in the first 40 seconds, its amplitude becomes:

(a) 1/3

(b) 1/9

(c) 1/27

(d) $1/\sqrt{3}$

47. The wavelength of light coming from a distant galaxy is 0.5% more than that coming from a source on earth. So what is the velocity of the galaxy?

(a) $1.5 \times 10^6 m/s.$

(b) $3 \times 10^6 m/s.$

(c) 3×10^8 m/s.

(d) 1.5×10^8m/s.

48. A 2keV electron enters a magnetic field of $5 \times 10^{-4}\ Wb/m^2$. If the radius of the electron path is 0.303m, the value of e/m of the electron would be

(a) 4.71×10^{11}C/Kg

(b) 7.71×10^{11}C/Kg

(c) 1.74×10^{11}C/Kg

(d) 1.74×10^{-11}C/Kg

49. If the Bohr orbit of the hydrogen atom, the total energy of the electron is $-21.75\times 10^{-19}J$ then the potential energy will be

(a) $-43.52 \times 10^{-19}J$

(b) $-21.75\times 10^{-19}J$

(c) $-10.88\times 10^{-19}J$

(d) $-13.60\times 10^{-19}J$.

50. If, according to the Bohr Model of hydrogen, the ionization energy of the atom in its ground state is 13.6eV, then the energy required to ionize the atom from its first excited state will be

(a) 6.8eV

(b) 3.4eV

(c) 1.7eV

(d) 0.85eV

51. On which of the following levels of hydrogen the spin-orbit interaction does not affect?

(a) s-level.

(b) p-level.

(c) d-level

(d) f-level.

52. The Larmor precessional frequency f of an electron of charge e in a magnetic field is

(a) $\frac{4\pi e}{mB}$

(b) $\frac{eB}{4\pi m}$

(c) $\frac{mB}{4\pi e}$

(d) $\frac{em}{4\pi B}$

53. Planck's radiation law can account for the energy distribution in the spectrum of black body radiation in the

(a) low wavelength region of the blackbody radiation spectrum.

(b) high wavelength region of the blackbody radiation spectrum.

(c) entire wavelength region of the blackbody radiation spectrum.

(d) None of these.

54. What is the kinetic energy T of a photoelectron from the K-shell of an atom, if E_k is K-ionisation energy?(ϑ *is the frequency of photon*)

(a) $T = h\vartheta + E_k$

(b) $T = h\vartheta - E_k$

(c) $T = \sqrt{h^2\vartheta^2 - {E_k}^2}$

(d) $T = \sqrt{h^2\vartheta^2 + {E_k}^2}$

55. In Compton scattering, the incident photon loses maximum energy to the electron when a photon is scattered at

(a) 0^0

(b) 45^0

(c) 90^0

(d) 180^0

56. Which one of the following pairs of phenomena illustrates the particle aspect of wave-particle duality?

(a) Compton effect and Bragg's law

(b) Photoelectric effect and Compton effect.

(c) Compton effect and Pauli's principle

(d) Photoelectric effect and Bragg's law

57. The duration of radar pulse is $10^{-6}s$. The uncertainty in its energy would be

(a) 0

(b) $1.05 \times 10^{-35}J$

(c) $1.05\times 10^{-21}J$

(d) $1.05\times 10^{-28}J$

58. The energies of a particle in a box are given by

(a) Continuous energy spectrum.

(b) $\frac{n^2\pi^2\hbar^2}{2ml^2}$

(c) $\frac{\pi^2\hbar^2}{2mL^2n^2}$

(d) $\frac{n\hbar}{2\pi}$.

59. Which of the following wave functions can be solutions to Schrodinger's equation for all values of x?

(a) $\Psi = A\,secx.$

(b) $\Psi = A\,tanx$

(c) $\Psi = Ae^{x^2}$

(d) $\Psi = Ae^{-x^2}$

60. Which of the following operators is linear?

(a) $\hat{C}\,u=u^2$

(b) $\hat{D}u=\frac{du}{dx}$

(c) $Eu=\frac{1}{u}$

(d) None of these.

61. How many Bravais lattices can exist in nature?

(a) 17

(b) 14

(c) 32

(d) 23

62. Which of the following Bragg reflections are absent for an fcc crystal?

(a) 100

(b) 200

(c) 220

(d) 111

63. There is no flux penetration through the specimen below a lower critical field H_c then superconductor is

(a) Type-I superconductor

(b) Type-II superconductor

(c) Fluxoid

(d) None of these.

64. The particles π^0, $\pi^{\pm}$ are

(a) Spin $\frac{1}{2}$ Leptons.

(b) Spin $\frac{1}{2}$ Baryons.

(c) Spin -0 mesons.

(d) Spin - 1 mesons.

65. Baryon number conservation law means

(a) Baryons can only be created.

(b) Baryons cannot be created, only annihilated.

(c) Baryons can be created as well as annihilate.

(d) Baryons can neither be created nor annihilated, only transformed into each other.

66. The Proton state is

(a) uud

(b) udd

(c) uds

(d) uss

67. Nuclear fission was explained by

(a) Liquid drop model

(b) Shell model

(c) Collective model

(d) Radioactive model.

68. As a result of radioactive decay a $^{238}_{92}U$ the nucleus changed to a $^{234}_{91}Pa$ Nucleus. During this decay, the particles emitted are

(a) One proton and two neutrons.

(b) One $\alpha - particle$ and one $\beta - particle$.

(c) Two$\beta - particles$ and one neutron.

(d) Two$\beta - particles$ and one proton.

69. During a negative $\beta - decay$

(a) An atomic electron is ejected.

(b) An electron that is already present within the nucleus is ejected.

(c) A neutron in the nucleus decays, emitting an electron.

(d) A part of the binding energy of nuclei is converted into an electron.

70. Cyclotron used to accelerate

(a) Electron only

(b) positive ions only.

(c) Both positive ions and electrons.

(d) neutrons only.

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