BHU GEOPHYSICS 2015

Q1. A 50 gm bullet moving with velocity 10 $m/\sec$ strikes a block of 950 gm at rest and gets embedded in it. The loss in kinetic energy will be:

(a) 100% (b) 95% (c) 5% (d) zero

Q2. The escape velocity on the surface of the earth is V_0, If M and R are the mass and radius of the earth, then the escape velocity on another planet of mass $2M$ and radius $\frac{R}{2}$ will be:

(a) $4V_0$ (b) $2V_0$ (c) V_0 (d) $V_{0/2}$

Q3. The geostationary satellite moves in a circular orbit of radius about:

(a) 42000 Km (b) 36000 Km (c) 30000 Km (d) 24000 Km

Q4. If the total energy of a particle is thrice its rest mass energy then the velocity of the particle in terms of velocity of light is:

(a) $\frac{C}{3}$ (b) $\frac{2C}{3}$ (c) $\frac{2\sqrt{2}}{3}C$ (d) $\frac{\sqrt{2}}{3}C$

Q5. The half life of certain particle in its own frame at rest is 36 $\mu\sec$. Its half life for an observer moving at constant velocity $0.8\,c$ with respect in the particles will be:

(a) 36 $\mu\sec$ (b) 50 $\mu\sec$ (c) 60 $\mu\sec$ (d) 121.6 $\mu\sec$

Q6. If $\vec{F}$ is a c conservative force then:

(a) $\vec{\nabla}.\vec{F}=0$ (b) $\vec{\nabla}\times\vec{F}=0$ (c) $\vec{\nabla}\vec{F}$ (d) $\vec{\nabla}\times\vec{\nabla}\times\vec{F}=0$

Q7. Width of any resonance curve:

(a) is directly proportional to quality factor

(b) is inversely proportional to quality factor

(c) is independent of quality factor

(d) is independent of resonance frequency

Q8. A perfect mcanoatomic gas undergoes reversible adiabatic expansion. The relationship between its volume v and internal energy u at any stage of expansion is given by:

(a) $uv^{\frac{1}{2}} = \text{constant}$ (b) $uv = \text{constant}$

(c) $uv^{\frac{2}{3}} = \text{constant}$ (d) $uv^{\frac{4}{3}} = \text{constant}$

Q9. A system A interacting with restrain R undergoes a reversible transformatican of its thermodynamics state. If ∇S_A is the change in the entropy of A and ∇S_A that of R during this transformation, then in general

(a) $\nabla S_A = \nabla S_R$ (b) $\nabla S_A = -\nabla S_R$

(c) $\nabla S_A = 0, \nabla S_R > 0$ (d) $\nabla S_A > 0, \nabla S_R = 0$

Q10. When some work is done by heat energy there will be some wastage of energy, this is in accordance with:

(a) First law of thermodynamics

(b) Second law of thermodynamics

(c) Third law of thermodynamics

(d) Zeroth law of thermodynamics

Q11. The work done in moving an object of mass m through distance $\vec{S} = \left(2\vec{i} + 6\vec{j} + 2\vec{k}\right)$ meter on application of a force $\vec{F} = \left(3\vec{i} + \vec{j} - \vec{k}\right)$ Newton is given by:

(a) 29 Joules (b) 8 Joules (c) 10 Joules (d) 25 Joules

Q12. two masses connected by an inextensible string over a fixed frictionless pulley. The sum of the masses of two boxes in M and difference in their masses is m. If we ignore the masses of the pulley and string then the downward acceleration of heavier lose is

(a) $\frac{M}{m}g$ (b) $\frac{m}{M}g$ (c) $\frac{M^2 - m^2}{2m}g$ (d) $\frac{M^2 - m^2}{2M}g$

Q13. An ideal gas undergoes a process during which υ constant, where P is the pressure and v is the volume of the gas. If the volume of the gas decreases the temperature will:

(a) increase (b) decrease

(c) remain constant (d) first increases their decreases

Q14. If 100 gm of steam at $150^0 C$ is cooled and frozen into 100 gm of ice at $0^o C$. Specific heat of steam is 2.01 $kJ/kg\ {}^oK$ and specific heat of water is 4.18 $kj/kg^0 K$. The total heat removed during the process is [Given Latent heat of ice 80 cal/gm Latent heat of vapour $= 536\ Cal/gm$]:

(a) 211 kJ (b) 311 kJ (c) 351 kJ (d) 401 kJ

Q15. The width of interference fringes in young's double slit experiment increases

(a) on increases the slit width

(b) on decreasing the wavelength of interring light

(c) on decreasing the distance between the slit and the screen

(d) on decreasing the distance between two slits

Q16. On placing a thin sheets of mica of thickness 12×10^{-5} cm in the path of the one of the two interfering beams in Fresnel's liprism arrangement it is found that the central fring was shifted by a distance equal to the width of the bright fringe of $\lambda = 6\times10^{-5}$ cm then find the refractive index of the mica:

(a) 1.33 (b) 1.4 (c) 1.5 (d) 1.45

Q17. A Newton's ring arrangement is used with a source of light emitting two wavelengths $\lambda_1 = 6\times10^{-5}$ cm and $\lambda_2 = 4.5\times10^{-5}$ cm. It is found that the n^{th} dark ring to λ_1 coincides with $(n+1)$ th dark ring due to λ_2. Find the value of n

(a) 4 (b) 3 (c) 2 (d) 5

Q18. In Michelaon interferometer white light fringes are formed. It is found that on introducing a glass plate $(\mu = 1.5)$ of thickness $0.5\ mm$ the central fring shifts. By what distance the mirror M_1 must be moved to bring the central dark fringe to its initial position on the cross wires:

(a) $0.16\ mm$ (b) $0.25\ mm$ (c) $0.50\ mm$ (d) $0.08\ mm$

Q19. We wish to use a plate of glass $(\mu = 1.5)$ as polarizer. What must be the angle of incidence so that the reflected light is completely polarized:

(a) 56.3^0 (b) 65.4^0 (c) 36.5^0 (d) 45.6^0

Q20. What requirement must be met for the envelop of the central maxima of double slit Fraunal offer diffraction pattern to contain exactly eleven fringes if it is given that the slit width is a and the separation between the two slits is of:

(a) $\frac{d}{a} = \frac{9}{2}$ (b) $\frac{d}{a} = \frac{13}{2}$ (c) $\frac{d}{a} = \frac{11}{2}$ (d) $\frac{d}{a} = \frac{7}{2}$

Q21. The sodium source of light has doublet whose components are $5890\ \overset{o}{A}$ and $5896\ \overset{o}{A}$, find the minimum number of lines in a grating to resolve this doublet in the first order:

(a) 796 (b) 982 (c) 856 (d) 490

Q22. Find the thickness of the quarter wave plate for light of wavelength $6000\ \overset{0}{A}$, given that $\mu_0 = 1.544$ and $\mu_0 = 1.553$:

(a) $16.6 \times 10^{-4}\ cm$ (b) $33.2 \times 10^{-4}\ cm$

(c) $8.3 \times 10^{-4}\ cm$ (d) $66.4 \times 10^{-4}\ cm$

Q23. A beam of light is analysed by a Nical prism after passing through quarter wave plate. Two position of maximum intensity and two positions of zero intensity are found on one complete rotation of Nicalprism. The light is :

(a) unpolarized (b) plane polarized

(c) circularly polarized (d) Elliptically polarized

Q24. The plane of polarization is rotated by 6^{o} by a tube 20 cm long containing a solution made by dissolving 100 gm of Rochelle salt in a liter of water. How many grams of salt must there be in a liter of a solution which relates the plane of polarization through 6.75^{0} when placed in a tube 15 cm long:

(a) 120 gm (b) 150 gm (c) 80 gm (d) 140 gm

Q25. Indicate the false statement about the dispersive power of a diffraction grating:

(a) It increases with the order of the spectrum

(b) It increases with the grating element

(c) It increases with the number of ruling per unit length the grating

(d) It decreases with grating element

Q26. If the width of the transparent position is equal to hall the width of opaque portion in a diffraction grating then the missing order of spectrum will be

(a) 1^{st}, 3^{rd} , 5^{th} etc (b) 2^{nd}, 4^{th}, 6^{th}, etc

(c) 3^{rd}, 6^{th}, 9^{th}, etc (d) 5^{th}, 10^{th}, 15^{th}, etc

Q27. If v_1 and v_2 denote the specific volumes of liquid and vapour respectively and L be the latent heat of evaporation of liquid at temperature T then the rate of change of pressure P with temperature is given by:

(a) $\frac{dP}{dT}=\frac{L}{T\left(v_2-v_1\right)}$ (b) $\frac{dP}{dT}=\frac{L}{T\left(v_1-v_2\right)}$

(c) $\frac{dP}{dT}=\frac{T}{L\left(v_2-v_1\right)}$ (d) $\frac{dP}{dT}=\frac{T}{L\left(v_1-v_2\right)}$

Q28. Indicate the wrong relation among the four Maxwell's relations given below:

(a) $\left(\frac{\partial S}{\partial V}\right)_T=\left(\frac{\partial P}{\partial T}\right)_V$ (b) $\left(\frac{\partial S}{\partial P}\right)_T=\left(\frac{\partial V}{\partial T}\right)_P$

(c) $\left(\frac{\partial T}{\partial V}\right)_S=-\left(\frac{\partial P}{\partial S}\right)_V$ (d) $\left(\frac{\partial T}{\partial P}\right)_S=\left(\frac{\partial V}{\partial S}\right)_P$

Q29. The first TdS equation is given by:

(a) $TdS = C_V dT - T\left(\frac{\partial P}{\partial T}\right)_V dV$ (b) $TdS = C_P dT - T\left(\frac{\partial V}{\partial T}\right)_P dP$

(c) $TdS = C_V dT + T\left(\frac{\partial P}{\partial T}\right)_V dV$ (d) $TdS = C_P dT + T\left(\frac{\partial V}{\partial T}\right)_P dP$

Q30. The first energy equation is given by:

(a) $\left(\frac{\partial u}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_P + P$ (b) $\left(\frac{\partial u}{\partial P}\right)_T = T\left(\frac{\partial V}{\partial T}\right)_P - P\left(\frac{\partial V}{\partial P}\right)_T$

(c) $\left(\frac{\partial u}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_P - P$ (d) $\left(\frac{\partial u}{\partial P}\right)_T = T\left(\frac{\partial V}{\partial T}\right)_P + P\left(\frac{\partial V}{\partial P}\right)_T$

Q31. The heat capacity equation

$$C_P - C_V = T\left(\frac{\partial V}{\partial T}\right),\left(\frac{\partial P}{\partial T}\right)_V$$

can be rewritten as:

(a) $C_P - C_V = T\left(\frac{\partial V}{\partial T}\right)_P^2\left(\frac{\partial V}{\partial P}\right)_T$ (b) $C_P - C_V = T\left(\frac{\partial P}{\partial T}\right)_V^2\left(\frac{\partial V}{\partial P}\right)_P$

(c) $C_P - C_V = -T\left(\frac{\partial P}{\partial T}\right)_P^2\left(\frac{\partial P}{\partial V}\right)_T$ (d) $C_P - C_V = -T\left(\frac{\partial V}{\partial T}\right)_P^2\left(\frac{\partial P}{\partial V}\right)_T$

Q32. In thermodynamics Gibb's function G is defined as:

(a) $G = u + PV + TS$ (b) $u + PV - TS = G$

(c) $G = u - PV + TS$ (d) $G = u - PV - TS$

Q33. From the third law of thermodynamic we can not directly prove that:

(a) Heat capacity vanishes at absolute zero

(b) Coefficient of volume expansion vanishes at absolute zero

(c) $C_P = C_V$ at absolute zero

(d) Absolute zero is unattainable by a finite change of parameters

Q34. If for any thermodynamic system $\oint dx = 0$ for all cyclic processes then the variable be can not be:

(a) Internal energy (b) Pressure

(c) Temperature (d) Volume

Q35. If 1 kg of water at $0^{o}C$ is mixed with 1 kg of water at 100^{0}. The change in the entropy of the system after mixing is:

(a) $24\ cal/{}^{0}K$ (b) $144\ cal/{}^{0}K$

(c) $168\ cal/{}^{0}K$ (d) $48\ cal/{}^{0}K$

Q36. The ratio of the emissive power to the absorptive power for radiation of given wavelength is the same for all bodies at the same temperature is called:

(a) Steian's law (b) Newton's law

(c) Kirownoff's law (d) rayleigh Jean's law

Q37. If S_0 is the salar constant, σ is the Stefan's constant, r is the radius of the sun and R_0 is the mean distance of the earth from the center of the sun then the temperature of the sun is given by:

(a) $T = \left(\frac{R_0^2}{\sigma r^2} \times S_0\right)^{\frac{1}{4}}$ (b) $T = \left(\frac{\sigma r^2}{R_0^2} \times \frac{S_0}{60}\right)^{\frac{1}{4}}$

(c) $T = \left(\frac{R_0^2}{\sigma r^2} \times \frac{S_0}{60}\right)^{\frac{1}{4}}$ (d) $T = \left[\frac{\sigma T^2}{R_0^2} \times S_0\right]$

Q38. The heat required for the reversible isothermal expansion of 1 mol of a vander-waal's gas from volume V_1 to V_2 is given by:

(a) $RT \ln\left(\frac{V_2 - le}{V_1 - le}\right)$ (b) $RT \ln\left\{\left(V_2 - le\right)\left(V_1 - le\right)\right\}$

(c) $RT \ln\left(\frac{V_1 - le}{V_2 - le}\right)$ (d) $RT \ln\frac{V_2}{V_1}$

Q39. A body is rotating with a constant angular velocity $\vec{\omega}$ about an axis passing through the origin of coordinates. If $\vec{r}$ is the position vector for a point fixed in the rotating body then the linear velocity $\vec{V}$ of that point is related with $\vec{\omega}$ and $\vec{r}$ by the relation:

(a) $\vec{\omega} = \vec{v} \times \vec{r}$ (b) $\vec{v} = \vec{\omega} \times \vec{r}$ (c) $\vec{v} = \vec{\omega}.\vec{r}$ (d) $\vec{\omega} = \vec{v}.\vec{r}$

Q40. Find the centripetal force acting on a satellite orbiting around the earth in a circular orbit of radius r with its center at the center of earth given that the mass of earth is Me and mass of the satellite in Ms and angular velocity of the satellite is w.

(a) $-\frac{GMe\ Ms}{r^3}\vec{r}$ (b) $Msw^1\vec{r}$

(c) $\frac{GMe\ Ms}{r^3}\vec{r}$ (d) $-Msw^2\vec{r}$

Q41. An object fixed respect to the surface of a planet identical in mass and radius to the earth experience zero gravitational acceleration at the equator, what is the length of the day on that planet:

(a) 13 hrs (b) 1.3 hrs (c) 12 hrs (d) 1.2 hrs

Q42. A cylinder of mass M and radius R is rolling down an inclined plane without slipping. If the height of the inclined plane from the surface of the earth is h. Find the speed v of the center of mass of the cylinder when it reaches the button of the inclined plane:

(a) $v = \sqrt{2gh}$ (b) $v = \sqrt{\frac{4}{3}gh}$ (c) $v = \sqrt{\frac{gh}{2}}$ (d) $v = \sqrt{\frac{3}{4}gh}$

Q43. A small object of mass m is attached to a light at ring which passes through a hallow tube the tube is held vertically by one hand and the strong by the other. The object is set into rotation in a circle of radius r_1 with a speed v_1. The string is then pulled down shortening the path of the radius to r_2 the new leaner speed v_2 will be:

(a) $v_2 = v_1\left(\frac{r_1}{r_2}\right)$ (b) $v_2 = \left(\frac{r_1^2}{r_2}\right)v_1$

(c) $v_2 = \sqrt{\frac{r_1}{r_2}}v_1$ (d) $v_2 = \sqrt{\frac{r_2}{r_1}}v_1$

Q44. In a playground there is a small merry ground of radius $4\ m$ and mass $12\ kg$. The radius of gyration of the merry-go-round is $3\ m$. A child of mass $3\ kg$ runs at a speed of $10m/\sec$ tangent to the rein of the merry go round when it is at rest and then jumps on it. Find the angular velocity of the merry-ground and the child neglecting the friction:

(a) $0.58\ rad/\sec$ (b) $0.69\ rad/\sec$

(c) $0.77\ rad/\sec$ (d) $0.83 rad/\sec$

Q45. If two $1\ gm$ masses moving with equal and opposite velocities of $10\ cm/\sec$ collide and stick together after collision then the additional rest mass of the joined pair will be:

(a) $2\times10^{10}\ gm$ (b) $2\times10^{11}\ gm$

(c) $1\times10^{-11}\ gm$ (d) $1\times10^{-10}\ gm$

Q46. For shorter wavelengths the Planck's radiation formula can easily Explain:

(a) Wien's law (b) Rayleigh-Jean's law

(c) Stefan's law (d) Newton's law

Q47. If the proper mean life time of π^+ mesion is $\tau = 2.5\times10^{-8}\ \sec$. Then the distance traveled by a burst of π^+ mesons traveling with speed $v = 0.73\ C$ will be about:

(a) 500 meter (b) 350 meter (c) 800 meter (d) 350 meter

Q48. A satellite stationary with respect to the surface of a planet identical in mass and radius to the earth experiences zero gravitational acceleration at the equator. What is the length of the day at the planet:

(a) 1.2 hr (b) 12 hr (c) 1.3 hr (d) 15 hr

Q49. The dominant mode in a rectangular waveguide is:

(a) TE_{01} (b) TE_{10} (c) TM_{01} (d) TM_{10}

Q50. A lossless transmission line characteristic impendence $70\ \Omega$ and phase constant $3\ rad/m$ at a frequency $100\ MHz$. Find the capacitance per meter

(a) $68.2\ pF/m$ (b) $82.6\ pF/m$

(c) $56. pF/m$ (d) $47.9\ pF/m$

Q51. The concept of displacement current was given by:

(a) Faraday (b) Ampere (c) Lorentz (d) Maxwell

Q52. A medium is characterized by $\sigma = v$, $\mu = \mu_0$ and $\in = \in_0$, and electric field of an E.M. wave is given by $\vec{E} = 20\sin\left(10^8 t + \frac{2}{3}z\right)\hat{a}y\ volt/m$ calculate $\vec{H}$

(a) $\vec{H} = \frac{1}{6\pi}\sin\left(10^8 t + \frac{2}{3}z\right)\hat{a}x\ Amp/m$ (b) $\vec{H} = \frac{1}{6\pi}\cos\left(10^8 t + \frac{2}{3}z\right)\hat{a}y\ Amp/m$

(c) $\vec{H} = \frac{1}{6\pi}\cos\left(10^8 1 + \frac{2}{3}z\right)\hat{a}x\ Amp/m$ (d) $\vec{H} = \frac{1}{6\pi}\sin\left(10^8 t + \frac{2}{3}z\right)\hat{a}y\ Amp/m$

Q53. If $\vec{A}$ is the vector Potential and V is the scalar potential at any point then the electric field of an E.M. wave at that point is:

(a) $\vec{E} = -\vec{\nabla}V + \frac{\partial\vec{A}}{\partial t}$ (b) $\vec{E} = -\vec{\nabla}V + \frac{\partial\vec{A}}{\partial t}$

(c) $\vec{E} = -\vec{\nabla}V$ (d) $\vec{E} = -\vec{\nabla}V + \frac{\partial\vec{A}}{\partial t}$

Q54. In a certain medium the electric field of an E.M. wave is given by $\vec{E} = 10\cos\left(10^8 t - 3y\right)\hat{a}x\ \frac{V}{m}$ what type of medium is it?

(a) Free space (b) Perfect conductor

(c) Perfect dielectric (d) Lossless dielectric

Q55. A uniform plane wave in a lossy medium has a phase constant 1.6 rad/m at a frequency of 10^7 Hz and its magnitude is reduced by 60% for every 2 meter traveled. Find the skin depth

(a) 2.18 m (b) 4.36 m (c) 11.09 m (d) 3.56 m

Q56. In a full wave rectifier the output DC voltage for input A.C. vloltage $V = V_P \sin wt$ is given by:

(a) $\frac{2V_P}{x}$ (b) $\frac{V_P}{\pi}$ (c) V_P (d) $\frac{V_P}{2}$

Q57. For a transistor the value of h_{fe} is 49 then the value of h_{fb} will be:

(a) 0.99 (b) 0.98 (c) 50 (d) 0.2

Q58. In the frequency response of R.C. coupled CE amplifier the upper cutoff frequency is obtained due to:

(a) Blocking capacitor (b) Bypass capacitor

(c) Junction capacitor (d) Coupling capacitor

Q59. If a $P-N$ junction diode is reverse baised then its depletion width:

(a) Increases (b) Decreases

(c) Remains unchanged (d) Diminishes to almost zero width

Q60. It silicon chip doped with as is heated and its temperature is start increasing from room temperature then its resistance:

(a) decreases (b) increases

(c) Remains unchanged (d) first increases and then decreases

Q61. In multistage amplifiers C.E. amplifier is used at intermediate stages because:

(a) Its voltage gain is high (b) Its power gain is high

(c) Its input impedance is very high (d) Its output impendence is very low

Q62. Find the concentration of donor atoms to be added to an intrinsic Si sample to produce N type material of conductivity 480 s/m. The electron molulety in Ntype silicon is 0.38 $m^2/v.\text{sec}$:

(a) $7.9\times10^{21}/m^3$ (b) $8.7\times10^{20}/m^3$

(c) $5.7\times10^{21}/m^3$ (d) $6.3\times10^{20}/m^3$

Q63. Indicate the false statement about the advantages of full wave rectifier over a half wave rectifier:

(a) Smaller ripple voltage (b) Larger peak inverse voltage

(c) Large rectification efficiency (d) Smaller transformer losses

Q64. Indicate the false statement about the π section filter:

(a) D.C. output voltage is larger

(b) R.M.S current in the transformer is larger

(c) It has a very good regulation

(d) smaller value of inductor is required

Q65. Indicate the wrong statement about the Raman effect:

(a) In the scattered light waves of lower as well as higher frequencies than the frequency of original wave is found

(b) Sheft in frequency depends on the frequency of original wave

(c) The extra frequencies are $v \pm v_1, v \pm v_2, v \pm v_3$ where v is original frequency

(d) It is due to the effect of interaction between light and matter

Q66. The lines of hydrogen spectrum in Paschen series are given by:

(a) $\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$ (b) $\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$

(c) $\frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$ (d) $\frac{1}{\lambda} = R\left(\frac{1}{4^2} - \frac{1}{n^2}\right)$

Q67. The work function of tangaton is 5.4 ev when the surface is ilhiminated by the light of 175 nm the maximum energy of the photoelctrons will be given by (Take $h = 6.626 \times 10^{24}$ joule-sec):

(a) 1.4 eV (b) 1.3 eV (c) 1.5 eV (d) 1.7 eV

Q68. If we plot a graph between the mase K.E the photoelectrons and the frequency of the light incident on the photoelectrode then the intercept on the axis gives the value of:

(a) Threshold frequency (b) Stopping potential

(c) Planck's constant (d) Electron charge

Q69. Find the shortest wavelength present in the radiation from an X ray machine when accelerating potential is $50.000\ V$ ($e = 1.6 \times 10^{-19}$ caul)

(a) 0.05 nm (b) 0.0156 nm (c) 0.0248 nm (d) 0.03 nm

Q70. X rays of wavelength 10.0 pm are scattered from a target. Find the maximum kinetic energy of the recoil electrons:

(a) $6.64\times10^{-15}\ J$ (b) $3.27\times10^{-15}\ J$ (c) $8.54\times10^{-12}\ J$ (d) $4.27\times10^{-12}\ J$

Q71. Find the de Broglic wavelength of an electron with a velocity of $V=10^{7}\ m/\sec$ (mass of the electron $=9.1\times10^{-31}\ kg$)

(a) $5.3\times10^{-11}\ m$ (b) $7.3\times10^{-11}\ m$ (c) $3.65\times10^{-11}\ m$ (d) $9.6\times10^{-11}\ m$

Q72. Indicate the false conclusion given below derived from the Michelson-Morley experiment:

(a) All motion is relative to a specified frame of reference

(b) All motion is relative to a universal frame of reference

(c) The either does not exist

(d) The light waves does not require a material medium for its propagation

Q73. two concentric concentric cylinders form a coaxial transmission line. If a and b are the diameters of inner and outer conductor respectively then the capacitance per unit length of this coaxial line (Assume that $\in$ is the permitunity of the material between the conductors is given by):

(a) $\dfrac{2\pi\in}{\ln\left(\dfrac{b}{a}\right)}$ (b) $2\pi\in/\text{n}\left(\dfrac{b}{a}\right)$ (c) $\dfrac{2\pi\in}{b^2-a^2}$ (d) $2\pi\in\left(\dfrac{1}{a^2}-\dfrac{1}{b^2}\right)$

Q74. If the input to the full wave rectifier is $V(t)=\sin wt$ then the Fourier series for the output $f(t)$ is given by:

(a) $f(t)=\dfrac{2}{\pi}-\dfrac{4}{\pi}\sum_{n=2,4,6...}^{\infty}\dfrac{\sin nwt}{(n^2-1)}$ (b) $f(t)=\dfrac{2}{\pi}-\dfrac{4}{\pi}\sum_{n=2,4,6...}^{\infty}\dfrac{\cos nwt}{(n^2-1)}$

(c) $f(t)=\dfrac{4}{\pi}-\dfrac{2}{\pi}\sum_{n=2,4,6...}^{\infty}\dfrac{\sin nwt}{(n^2-1)}$ (d) $f(t)=\dfrac{4}{\pi}-\dfrac{2}{\pi}\sum_{n=2,4,6...}^{\infty}\dfrac{\cos nwt}{(n^2-1)}$

Q75. Indicate the false statement about the construction of Ballatic galvanometer:

(a) its coil is bound on a non con conducting frame

(b) its coil is made of thin copper wire

(c) number of turns in the coil is large

(d) moment of inertia of the coil should be small

Q76. If $\frac{d^2\vec{A}}{dt^2} = 6t\hat{i} - 24i^2\hat{j} + 4\sin t\hat{k}$ and $\vec{A}(0) - 2\hat{i} - \hat{j}, \frac{d\vec{A}}{dt}(0) = -\hat{i} - 3\hat{k}$, then $\vec{A}$ is given by:

(a) $\vec{A} = 6\hat{i} - 48t\hat{j} + 4\cos t\hat{k}$

(b) $\vec{A} = 3\hat{i} - 8t^3\hat{j} + 4\cos t\hat{k}$

(c) $\vec{A} = \left(t^3 - t + 2\right)\hat{i} + \left(1 - 2t^4\right)\hat{j} + \left(1 - 4\sin t\right)\hat{k}$

(d) $\vec{A} = \left(6 + 3t^2\right)\hat{i} - \left(8t^3 + 48t\right)\hat{j}$

Q77. In cylindrical coordinate system (δ, ϕ, z) divergence of a vector field $\vec{A} = \left(A_\delta, A_\phi, A_z\right) = A_\delta e_\delta^1 + A\phi\vec{e}\phi + A_z\vec{e}$ is:

(a) $\nabla.\vec{A} = \left(\frac{\partial A_\delta}{\partial_\delta}, \frac{\partial A_\phi}{\partial_\phi}, \frac{\partial A_z}{\partial_z}\right)$

(b) $\nabla.\vec{A} = \frac{\partial A_\delta}{\partial_\delta} + \frac{\partial A_\phi}{\partial_\phi} + \frac{\partial A_z}{\partial_z}$

(c) $\nabla.\vec{A} = \frac{1}{\delta\phi z}\left[\frac{\partial}{\partial_\delta}\left(\delta A_\delta\right) + \frac{\partial A_\phi}{\partial_\phi} + \frac{\partial}{\partial_z}\left(\delta A_z\right)\right]$

(d) $\nabla \cdot \vec{A} = \frac{1}{\delta}\left[\frac{\partial}{\partial_\delta}\left(\delta A\delta\right) + \frac{\partial A_\phi}{\partial_\phi} + \frac{\partial}{\partial_z}\left(\delta Az\right)\right]$

Q78. In spherical coordinates (r,θ,ϕ) curl of a field

$\vec{A}=(A_r, A_\theta, A_\phi)=A_r\vec{e}_r+A_\theta\vec{e}_\theta+A_\phi\vec{e}_\phi$ is:

(a) $\frac{1}{r^2\sin\phi}\left\{\left(\frac{\partial}{\partial\theta}(r\cos\theta A_\phi)-\frac{\partial}{\partial\phi}(rA_\theta)\right)\hat{e}_r-\left(\frac{\partial Ar}{\partial\phi}+\frac{\partial}{r}(r\sin\theta A_\phi)\right)r\hat{e}_\theta + \left(\frac{\partial}{\partial r}(rA_r)+\frac{\partial Ar}{\partial\theta}\right)r\sin\theta\hat{e}_\phi\right\}$

(b) $\frac{1}{r^2\sin\theta}\left\{\left(\frac{\partial}{\partial\theta}(r\sin\theta A_\phi)-\frac{\partial}{\partial\phi}(rA_\theta)\right)\hat{e}_r+\left(\frac{\partial Ar}{\partial\phi}-\frac{\partial}{\partial r}(r\sin\theta A_\phi)\right)r\hat{e}_\theta + \left(\frac{\partial}{\partial r}(rA_\theta)-\frac{\partial Ar}{\partial\theta}\right)r\sin\theta\vec{e}_\phi\right\}$

(c) $\frac{1}{r\theta\phi}\left\{\left(\frac{\partial}{\partial\theta}(A\phi)-\frac{\partial}{\partial\phi}(A_\theta)\right)\hat{e}_r+\left(\frac{\partial}{\partial r}(A_\theta)-\frac{\partial}{\partial\theta}(A_r)\right)\hat{e}_\theta+\left(\frac{\partial}{\partial\phi}(rA_r)-\frac{\partial}{\partial\theta}\right)(r\sin\phi A_r)\hat{e}_\phi\right\}$

(d) $\frac{1}{r\sin\theta\sin\phi}\left\{\left(\frac{\partial A\phi}{\partial\theta}-\frac{\partial A\theta}{\partial\phi}\right)\hat{e}_r+\left(\frac{\partial Ar}{\partial\phi}-\frac{\partial A\phi}{\partial\theta}\right)\hat{e}_\theta+\left(\frac{\partial A_\theta}{\partial r}-\frac{\partial Ar}{\partial\theta}\right)\hat{e}_\phi\right\}$

Q79. The curl of cross product of two fields $\vec{A}$ and $\vec{B}$ is given by:

(a) $\nabla\times(\vec{A}\times\vec{B})=(\vec{B}\cdot\nabla)\vec{A}-\vec{B}(\nabla\cdot\vec{A})-(\vec{A}\cdot\nabla)\vec{B}+\vec{A}(\nabla\cdot\vec{B})$

(b) $\nabla\times(\vec{A}\times\vec{B})=(\vec{A}\cdot\nabla)\vec{B}+(\vec{B}\cdot\nabla)\vec{A}-\vec{A}(\nabla\cdot\vec{B})-\vec{B}(\nabla\cdot\vec{A})$

(c) $\nabla\times(\vec{A}\times\vec{B})=(\vec{A}\cdot\nabla)\vec{B}-\vec{A}(\nabla\cdot\vec{B})-(\vec{B}\cdot\nabla)\vec{A}+\vec{B}(\nabla\cdot\vec{A})$

(d) $\nabla\times(\vec{A}\times\vec{B})=\vec{B}(\nabla\times\vec{A})-\vec{A}(\nabla\cdot\vec{B})$

Q80. Green's first identity is given by:

(a) $\iiint_V\left[\phi\nabla^1\psi+(\nabla\phi)(\nabla\psi)\right]dV=\iint_S(\phi\nabla\psi)dS$

(b) $\iiint_V\left[\phi\nabla^2\psi-(\nabla\phi)(\nabla\psi)\right]dV=\iint_S(\phi\nabla\psi)dS$

(c) $\iiint_v\left[\phi\nabla^2\psi+(\nabla\phi)(\nabla\psi)\right]dv=\iint_S(\phi\nabla\psi)dS$

(d) $\iiint_V\left[\phi\nabla^2\psi+(\nabla\phi)(\nabla\psi)\right]dV=\iint_S\left(\nabla(\phi\psi)+\phi\nabla\psi\right)dS$

Q81. The eccentricity of hyperbola given by $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ is given by:

(a) $e=\sqrt{2}ab$ (b) $e^2=\frac{a^2+b^2}{a^2}$

(c) $e^2=\frac{a^2-b^2}{a^2}$ (d) $e^2=\frac{a^2+b^2}{b^2}$

Q82. If d_1 and d_2 denote the distances of any point on an ellipse from its major and minor axes respectively, which axes have the respective lengths $2a$ and $2b$, then

(a) $\frac{2d_1}{a^2}+\frac{2d_2}{b^2}=1$ (b) $\frac{d_1^2}{a^2}+\frac{d_2^2}{b^2}=1$

(c) $\frac{d_1^2}{a^2}+\frac{d_2^2}{b^2}=1$ (d) $\frac{d_1^2}{a^2}+\frac{d_2^2}{b^2}=-1$

Q83. Let P,Q,R be three points on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ with centre C. If CP,CQ and CR are inclined equally to each other, then:

(a) $\frac{1}{CP^2}+\frac{1}{CQ^2}+\frac{1}{CR^2}=\frac{1}{3}\left(\frac{1}{a^2}+\frac{1}{b^2}\right)$ (b) $\frac{1}{CP^2}+\frac{1}{CQ^2}+\frac{1}{CR^2}=\frac{2}{3}\left(\frac{1}{a^2}+\frac{1}{b^2}\right)$

(c) $\frac{1}{CP^2}+\frac{1}{CQ^2}+\frac{1}{CR^2}=\frac{3}{2}\left(\frac{1}{a^2}+\frac{1}{b^2}\right)$ (d) $\frac{1}{CP^2}+\frac{1}{CQ^2}+\frac{1}{CR^2}=3\left(\frac{1}{a^2}+\frac{1}{b^2}\right)$

Q84. If PSP' and QSQ' are two mutually orthogonal focal chords of a conic $\frac{l}{r}=1+e\cos\theta$, then value of $\frac{(SP+Sp'+SQ+SQ')(SP.SP'SQ.SQ')}{(SP+SP')(SQ+SQ')(SP.SP'+SQ.SQ')}$ is:

(a) $\frac{e}{l}$ s (b) $\frac{l}{e}$ (c) $\frac{l}{2}$ (d) el

Q85. Locus of centres of conics, passing through four points $P(a_1,0),Q(0,b),R(a_2,0),M(0,b_2)$, no three of which are collinear is:

(a) an ellipse (b) a parabola (c) a hyperbola (d) a circle

Q86. Locus of points of intersection of two perpendicular tangents one to each of two given confocal conics is:

(a) a hyperbola (b) a circle (c) a parabola (d) an ellipse

Q87. Locus of points of contact of parallel tangents to system of confocals is:

(a) a circle (b) an ellipse

(c) a parabola (d) a rectangular hyperbola

Q88. The normal at the points $t_1 = \left(at_1^2, 2at_1\right)$ and $t_2 = \left(at_2^2, 2at_2\right)$ to the parabola $y^2 = 4ax$ in the point:

(a) $\left[a\left(t_1+t_2\right)^2, 2a\left(t_1+t_2\right)\right]$

(b) $t_3 = 2\left(-\left(t_1+\frac{2}{t_2}\right)\right) = \left(a\left(-\left(t_1+\frac{2}{t_2}\right)\right)^2, -2a\left(t_1+\frac{2}{t_2}\right)\right)$

(c) $(0,0)$

(d) $\left(2a+a\left(t_1^2+t_1t_2+t_2^2\right), at_1t_2\left(t_1+t_2\right)\right)$

Q89. The shortest distance between the passing through the points $P_1(6,2,2)$ and $P_2(-4,0-1)$ in the directions $\hat{i}-2\hat{j}+2\hat{k}$ and $3\hat{i}-2\hat{j}-2\hat{k}$ respectively is:

(a) 4 units (b) 9 units (c) 16 units (d) 36 units

Q90. For the triangle $\Delta\, ABC$ with vertices $A(a,0,0), B(0,b,0), C(0,0,c)$ the circumcentre of the triangle $\Delta\, ABC$ is:

(a) $\left(\frac{a}{3}, \frac{b}{3}, \frac{c}{3}\right)$

(b) $\left(\frac{ab^2c^2}{b^2c^2+c^2a^2+a^2b^2}, \frac{a^2bc^2}{b^2c^2+c^2a^2+a^2b^2}, \frac{a^2b^2c}{b^2c^2+c^2a^2+a^2b^2}\right)$

(c) $\left(\frac{1}{a\left(a^{-2}+b^{-2}+c^{-2}\right)}, \frac{1}{b\left(a^{-2}+b^{-2}+c^{-2}\right)}, \frac{1}{c\left(a^{-2}+b^{-2}+c^{-2}\right)}\right)$

(d) $\left(\frac{a^3(b^2+c^2)}{2\left(b^2c^2+c^2a^2+a^2b^2\right)}, \frac{b^3\left(c^2+a^2\right)}{2\left(b^2c^2+c^2a^2+a^2b^2\right)}, \frac{c^3\left(a^2+b^2\right)}{2\left(b^2c^2+c^2a^2+a^2b^2\right)}\right)$

Q91. If θ is the angle between the pair of planes $ax^2+by^2+cz^2+2fyz+2gzx+2hxy=0$, then

(a) $\tan\theta=\pm\frac{\sqrt{a^2+b^2+c^2-gh-hf-fg}}{a+b+c}$ (b) $\tan\theta=\pm\frac{\sqrt{f^2+g^2+h^2-bc-ca-ab}}{a+b+c}$

(c) $\tan\theta=\pm\frac{\sqrt{a^2+b^2+c^2-gh-hf-fg}}{f+g+h}$ (d) $\tan\theta=\pm\frac{\sqrt{f^2+g^2+h^2-bc-ca-ab}}{f+g+h}$

Q92. Consider four district points $O(0,0,0), A(a,0,0), B(0,b,0), C(0,0,c)$ then the surface area of the sphere passing through the point O, A, B and C is:

(a) $\frac{\pi}{6}\left(a^2+b^2+c^2\right)^{\frac{1}{2}}$ (b) $\pi\left(a^2+b^2+c^2\right)$

(c) $\pi a^2b^2c^2$ (d) $\pi\left(a^2+b^2+c^2\right)^{\frac{1}{2}}$

Q93. The enveloping cylinder of $ax^2+by^2+cz^2=1$, whose generators are parallel to the line $\frac{x}{l}=\frac{y}{m}=\frac{z}{n}$ is given by:

(a) $\left(bc+bmy+cnz\right)^2=\left(aP+bm^2+cn^2\right)\left(ax^2+by^2+cz^2-1\right)$

(b) $\left(al^2+bm^2+cn^2\right)^2=\left(ax^2+by^2+cz^2-1\right)\left(abx+bmy+cnz\right)$

(c) $\left(ax^2+by^2+cz^2-1\right)^2=\left(abx+bmy+cnz\right)\left(aP+bm^2+cn^2\right)$

(d) $\left(abx+bmy+cnz\right)\left(ax^2+by^2+cz^2-1\right)=a^2P+b^2m^2+c^2n^2$

Q94. The equation of the C one with its vertex at the origin $(0,0,0)$ and with its guiding curve as the circle passing through the points $A(a,0,0), B(0,b,0)$ and $C(0,0,c)$ is:

(a) $\left(b^2-c^2\right)yz+b\left(c^2-a^2\right)zx+c\left(a^2-b^2\right)xy=0$

(b) $\left(\frac{b}{c}-\frac{c}{b}\right)yz+\left(\frac{c}{a}-\frac{a}{c}\right)zx+\left(\frac{a}{b}-\frac{b}{a}\right)xy=0$

(c) $\left(\frac{b}{c}+\frac{c}{b}\right)xy+\left(\frac{c}{a}+\frac{a}{c}\right)yz+\left(\frac{a}{b}+\frac{b}{a}\right)zx=0$

(d) $a\left(b^2+c^2\right)yz+b\left(c^2+a^2\right)zx+c\left(a^2+b^2\right)xy=0$

Q95. The maximum number of normals drawn from a point to a central conicode is:

(a) 3 (b) 4 (c) ∞ (d) 6

Q96. The general solution of differential equation $x\log x\dfrac{dy}{dx}+y=\log x$ is

(a) $y=c+\log x$

(b) $y\log x+c+\dfrac{1}{2}(\log x)^2$

(c) $y=c+\dfrac{1}{2}\log x$

(d) $y\log x=c+\log x$

Q97. The differential equation $\left(xy^2+ax^2y\right)dx+\left(x^3+x^2y\right)dy=0$ is exact when a is equal to:

(a) 2 (b) 4 (c) 1 (d) 3

Q98. The complementary function of differential equation $\dfrac{d^4y}{dx^4}=\dfrac{d^2y}{dx^2}=\tan x$ is:

(a) $(c_1+c_2)+c_3e^{x}+c_4e^{-x}$

(b) $(c_1+c_2x)e^{x}+(c_3+c_4x)e^{-x}$

(c) $(c_1+c_2)e^{x}+(c_3+c_4)e^{-x}$

(d) $(c_1+c_2x)+c_3e^{-x}+c_4xe^{-x}$

Q99. The particular integral of the differential equation $\dfrac{d^4y}{dx^4}-a^4y=\cos ax$

(a) $\dfrac{x}{4a^1}\cos ax$ (b) $\dfrac{x}{4a^3}\cos ax$ (c) $\dfrac{x}{4a^3}\sin ax$ (d) $\dfrac{x}{4a^3}\sin ax$

Q100. The general solution of the differential equation

$\dfrac{d^3y}{dx^3}-3\dfrac{d^2y}{dx^2}+3\dfrac{dy}{dx}-y=8e^{3x}$ is:

(a) $y=\left(c_1+c_2x+c_3x^3\right)e^{x}+e^{3x}$

(b) $y=\left(c_1+c_2x\right)e^{x}+c_3e^{-x}+e^{3x}$

(c) $y=\left(c_1+c_2x+c_3x^2\right)e^{x}+e^{3x}$

(d) $y=\left(c_1+c_2x+c_3x^2\right)e^{x}+8e^{3x}$

Q101. The general solution of the differential $\dfrac{d^2y}{dx^2}=\left[1+\left(\dfrac{dy}{dx}\right)^2\right]^{1/2}$ *is* :

(a) $y=\sinh\left(x+c_1\right)+c_2$

(b) $y=-\cos\left(x+c_1\right)+c_2$

(c) $y=\cosh\left(x+c_1\right)$

(d) $y=\sin\left(x+c_1\right)+c_2$

Q102. The general solution of the differential equation

$$y\frac{d^2y}{dx^2} = \left(\frac{dy}{dx}\right)^2 = y^2 \log x \text{ is}$$

(a) $\log y = c_1 e^x + c_2 e^{-x}$

(b) $\log y = c_1 \sin x + c_2 \cos x$

(c) $y = \log\left(c_1 e^x + c_2 e^{-x}\right)$

(d) $y = \log\left(c_1 \sin x + c_2 \cos x\right)$

Q103. The differential equation, whose set of independent solution is $\left(e^x, \sin x, \cos x\right)$

(a) $\frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$

(b) $\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} + 3\frac{dy}{dx} - y = 0$

(c) $\frac{d^3y}{dx^3} - \frac{d^2y}{dx^2} + \frac{dy}{dx} - y = 0$

(d) $\frac{d^3y}{dx^3} + 3\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + y = 0$

Q104. The solution of the integral equation

$$\int_0^x e^{x-1} y(t)\,dt = x \text{ is:}$$

(a) $y(x) = 1 + x$

(b) $y(x) = 2 - x$

(c) $y(x) = 1 - x$

(d) $y(x) = 2 + x$

Q105. The integral equation $y(x) + \lambda \int_0^1 \sin xt\, y(t)\,dt = x$ is:

(a) volterra integral equation of first kind

(b) Fredholm integral equation of first kind

(c) volterra integral equation of second kind

(d) Fredholm integral equation of second kind

Q106. If the Laplace transform of $f(t)$ is $F(s)$, then the Laplace transform of $f(at)$ is:

(a) $F(as)$

(b) $F\left(\frac{s}{a}\right)$

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

(d) $\frac{1}{a}F\left(\frac{s}{a}\right)$

Q107. If the Laplace transform if $\sin(at)$ is $a\left(s^2+a^2\right)$, then the Laplace transform of $t\sin(at)$ is:

(a) $\frac{as}{\left(s^2+a^2\right)^2}$ (b) $\frac{-2as}{\left(s^2+a^2\right)^2}$ (c) $\frac{2as}{\left(s^2+a^2\right)^2}$ (d) $\frac{2as}{s^2+a^2}$

Q108. If the Laplace transform of $\sin 2t$ is $\frac{2}{\left(s^2+4\right)}$, then the Laplace transform of $\frac{\sin 2t}{t}$ is:

(a) $\tan^{-1} s$ (b) $\tan^{-1}\frac{s}{2}$ (c) $\cot^{-1}\frac{s}{2}$ (d) $\cot^{-1} s$

Q109. If $u(t-a)$ is unit step function, then the function $f(t)$ defined as $f(t)=\begin{cases}8 & t<2\\ 6 & t>2\end{cases}$ in terms of unit step function can be expressed as:

(a) $8+2u(t-2)$ (b) $8+u(t-2)$

(c) $8-2u(t-2)$ (d) $8-u(t-2)$

Q110. If the Laplace transform of $y(t)$ is $y(s)$, then application of Laplace transform in initial value problem $y^n-y=t, y(0)=y'(0)=1$ results as:

(a) $y(s)=\frac{1}{s^2\left(s^2-1\right)}$ (b) $y(s)=\frac{1}{s^2}$

(c) $y(s)=\frac{1}{s-1}\frac{1}{s^2\left(s^2-1\right)}$ (d) $y(s)=\frac{1}{s^2-1}$

Q111. Forces $P, 2P, 3P$ and $4P$ act along the sides of AB, BC, AD and DC respectively of a square $ABCD$. The magnitude of their resultant is:

(a) $3\sqrt{2}P$ (b) $5\sqrt{3}P$ (c) $5\sqrt{2}P$ (d) $3\sqrt{3}P$

Q112. If a system of coplanar forces $(2,3)$ and $(4,5)$ act at the points $(1,1)$ and $(2,2)$ then the equation of the action of their resultant is:

(a) $6x-8y=3$ (b) $8x-6y=5$ (c) $8x-6y=3$ (d) $6x-8y=5$

Q113. Forces P, Q, R act along the sides BC, CA, AB of a triangle ABC taken in order. If their resultant passes through the centre of the inscribed circle of the triangle ABC then:

(a) $P-Q-R=O$ (b) $P-Q+R=O$

(c) $-P-Q+R=O$ (d) $P+Q+R=O$

Q114. An endless chain of weight w rests in the form of a circular band round a smooth vertical cone which has vertex upwards. If a is the semi vertical angle of the cone then tension in the chain due to its weight is:

(a) $\frac{\omega \tan\alpha}{2\pi}$ (b) $\frac{\omega \cot\alpha}{\pi}$ (c) $\frac{\omega \cot\alpha}{2\pi}$ (d) $\frac{\omega \tan\alpha}{\pi}$

Q115. The work done by the tension T of a string in a small extension of its length from x to $x+\delta x$ is:

(a) $-T.\delta x$ (b) $T.\delta x$ (c) $-\delta T.\delta x$ (d) $\delta T.\delta x$

Q116. If a string of length 5 units and weight 50 units is hanging in the form of a catenary $2y = \cosh(2x)$ then the tension at the lowest point of the catanary is:

(a) 10 units (b) 5 units (c) 25 units (d) None of these

Q117. A string hangs between two fixed points in the form of a cateenary $y = \cosh x$, if the arc length of a point on the catenary from the vertex is $\sqrt{3}$ then its height above the vertex is:

(a) 4 (b) 3 (c) 2 (d) 1

Q118. If a body is just on the point of sliding down a rough inclined plane under its own weight then the inclination of the plane is:

(a) less than the angle of friction (b) equal to the angle of friction

(c) greater then the angle of frication (d) none of these

Q119. If a particle is executing a simple harmonic motion about a centre O starting from a point A such that $OA = 9$ metres and the acceleration of the particle at P towards PO is 4 metre/sec^2, where $OP = 1$ metre, then the maximum speed achieved by the particle during the course of motion is:

(a) 6 metres/sec (b) 9 metres/sec (b) 12 metres/sec (d) 18 metres/sec

Q120. If a particle is projected from the lowest point of a smooth vertical circle of radius 10 metres with velocity $\sqrt{(10\,g)}$ metres/sec and moves along the inside of the circle then the angle through which the particle can oscillate about the lowest point is:

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

Q121. The sides of a rectangular plate of mass m are formed by the four straight lines $y=-3;\ y=4,\ x=5;\ x=-4$ then its moment of inertia about a line through the centre of the plate and parallel to x - axis is:

(a) $\frac{m}{3}\left(\frac{9}{2}\right)^2$ (b) $\frac{m}{3}\left(\frac{7}{2}\right)^2$ (c) $\frac{4m}{3}\left(\frac{9}{2}\right)^2$ (d) $\frac{4m}{3}\left(\frac{7}{2}\right)^2$

Q122. If a rigid body swing, under gravity, from a fixed horizontal axis then the time of a complete oscillation is:

(a) $2\pi\sqrt{\left(\frac{k^2 h}{g}\right)}$ (b) $2\pi\sqrt{\left(\frac{k^2 g}{h}\right)}$ (c) $2\pi\sqrt{\left(\frac{hg}{k^2}\right)}$ (d) $2\pi\sqrt{\left(\frac{k^2}{hg}\right)}$

where k is the radius of gyration of the rigid body about the fixed axis, and h is the distance between the fixed axis and the centre of inertia of the rigid body.

Q123. The specific gravity of a fluid is three times that of a cylinder. If the cylinder floats vertically with 8 cm of its length above the fluid then the whole length of the cylinder is

(a) $10\,cm$ (b) $12\,cm$ (c) $14\,cm$ (d) $16\,cm$

Q124. If the mass of a cube of side $10\,cm$ is $10\,gm$ then its moment of inertia about any axis through its centre is:

(a) $\frac{8}{3}(250)\,gm\,cm^2$ (b) $\frac{4}{3}(250)\,gm\,cm^2$

(c) $\frac{2}{3}(250)\,gm\,cm^2$ (d) $\frac{11}{3}(250)\,gm\,cm^2$

Q125. A triangle is wholly immersed in a liquid with its centre of gravity at a depth $2\,cm$ and its centre of pressure at a depth $3\,cm$. If the triangle is lowered through a distance $2\,cm$ then the depth of its centre of pressure in the new position is:

(a) $\frac{5}{2}cms$ (b) $\frac{7}{2}cms$ (c) $\frac{9}{2}cms$ (d) $\frac{11}{2}cms$

Q126. If $x_1 = \cos\frac{x}{2^r} + i\sin\frac{\pi}{2^r},\ i = \sqrt{-1},\ r \ge 1$, then the value of $x_1, x_2, x_3, ...$ ad inf. is

(a) $\cos\pi$ (b) $\cos 2\pi$ (c) $\sin\pi$ (d) $\cos\frac{\pi}{2}$

Q127. If $2\cos\phi = x + \frac{1}{x}$ then the value of $2\cos r\phi$ is:

(a) $2\left(x^t + \frac{1}{x^r}\right)$ (b) $x^r - \frac{1}{x^t}$ (c) $x^t + \frac{1}{x^t}$ (d) $2\left(x^r - \frac{1}{x^r}\right)$

Q128. If $2\cos\theta = x + \frac{1}{x}$ and $2\cos\phi = y + \frac{1}{y}$, then the value of $x^m y^n + \frac{1}{x^m y^n}$ is:

(a) $\cos(m\theta - n\phi)$ (b) $\sin(m\theta + n\phi)$

(c) $\cos(m\theta + n\phi)$ (d) $2\cos(m\theta - n\phi)$

Q129. If $\cos\alpha + \cos\beta + \cos\gamma = 0,\ \sin\alpha + \sin\beta + \sin\gamma = 0$, then $\cos 3\alpha + \cos 3\beta + \cos 3\gamma$ is:

(a) $2\cos(\alpha + \beta + \gamma)$ (b) $3\cos(\alpha + \beta + \gamma)$

(c) $\cos(\alpha + \beta + \gamma)$ (d) none of these

Q130. If $(a_1 + ib_1)(a_2 + ib_2)....(a_n + ib_n) = A + iB$ then $\tan^{-1}\left(\frac{b^1}{a^1}\right) + \tan^{-1}\left(\frac{b^2}{a^2}\right) + ... + \tan^{-1}\left(\frac{b_n}{a_n}\right)$ is:

(a) $\tan^{-1}\left(\frac{B}{A}\right)$ (b) $\tan^{-1}\left(\frac{A}{B}\right)$ (c) $\tan^{-1}\left(\frac{B^2}{A^2}\right)$ (d) $\tan^{-1}\left(\frac{A^2}{B^2}\right)$

Q131. By De Moivre's Theorem, $(\sin x + i\cos x)^n$ is equal to:

(a) $\cos nx + i\sin nx$ (b) $\cos n\left(\frac{\pi}{2}+x\right)+i\sin n\left(\frac{\pi}{2}+x\right)$

(c) $\cos n\left(\frac{x}{2}-x\right)$ (d) $\cos n\left(\frac{\pi}{2}-x\right)i\sin n\left(\frac{\pi}{2}-x\right)$

Q132. The expression $\log\sin(x+iy)$ is resolved into its real and imaginary parts as:

(a) $\frac{1}{2}\log_e\left[\frac{\sinh 2y+\cos 2x}{2}\right]+i\left[2n\pi+\tan^{-1}(\cot x\tanh y)\right]$

(b) $\frac{1}{2}\log_e\left[\frac{\sinh 2y-\cos 2x}{2}\right]+i\left[2n\pi+\tan^{-1}(\cot x\tanh y)\right]$

(c) $\frac{1}{2}\log_e\left[\frac{\cosh 2y+\cos 2x}{2}\right]+i\left[2n\pi+\tan^{-1}(\cot x\tanh y)\right]$

(d) $\frac{1}{2}\log_e\left[\frac{\cosh 2y-\cos 2x}{2}\right]+i\left[2n\pi+\tan^{-1}(\cot x\tanh y)\right]$

$n \in N =$ Set of natural numbers

Q133. $\log(-i)$ is equal to:

(a) $\frac{\pi}{2}i$ (b) $-\frac{\pi}{2}i$ (c) $-i$ (d) None of these

Q134. $\log\left(\frac{\sin(x+iy)}{\sin(x-iy)}\right)$ is equal to:

(a) $2i\tan^{-1}(\cot x\tanh y)$ (b) $2i\tan^{-1}(\tan x\tanh y)$

(c) $2i\tan^{-1}(\tan x\coth y)$ (d) $2i\tan^{-1}(\sin x\tanh y)$

Q135. $i\log\left(\frac{x-i}{x+i}\right)$ is equal to

(a) $\pi-\tan^{-1}x$ (b) $\pi-2\tan^{-1}x$ (c) $\pi-3\tan^{-1}x$ (d) $\pi-4\tan^{-1}x$

Q136. $\dfrac{23x-11x^2}{(2x-1)(9-x^3)}$ when resolved into partial fractions is equal to:

(a) $\dfrac{1}{2x-1}+\dfrac{4}{3+x}-\dfrac{1}{3-x}$ (b) $\dfrac{4}{2x-1}+\dfrac{1}{3+x}-\dfrac{1}{3-x}$

(c) $\dfrac{1}{2x-1}-\dfrac{4}{3+x}+\dfrac{1}{3-x}$ (d) $-\dfrac{1}{2x-1}-\dfrac{1}{3+x}-\dfrac{4}{3+x}$

Q137. When $x<1$, the sum of the infinite series

$$\frac{1}{(1-x)(1-x^3)}+\frac{x^2}{(1-x^3)(1-x^2)}+\frac{x^4}{(1-x^5)(1-x^2)}+.... \text{ is equal to:}$$

(a) $\dfrac{1}{(1+x)(1+x^2)}$ (b) $\dfrac{1}{(1+x)(1-x^2)}$

(c) $\dfrac{1}{(1-x)(1+x^2)}$ (d) $\dfrac{1}{(1-x)(1-x^2)}$

Q138. If sum of any two quantities x, y, z be greater than the third, then $(x+y+z)^3>$

(a) $9(y+z-x)(z+x-y)(x+y-z)$ (b) $27(y+z-x)(z+x-y)(x+y-z)$

(c) $\dfrac{27}{8}(y+z-x)(z+x-y)(x+y-z)$ (d) None of these

Q139. $x\sqrt{\dfrac{1+x}{1-x}}>y\sqrt{\dfrac{1+y}{1-y}}$:

(a) If x and y are integers and positive and $x>y$

(b) If x and y are fractions and $x<y$

(c) If x and y are proper fractions and positive and $x>y$

(d) If x and y are proper fractions and positive and $y>x$

Q140. If $\begin{vmatrix} 1 & 3 & 9 \\ 1 & x & x^2 \\ 4 & 6 & 9 \end{vmatrix} = 0$, then

(a) $x = 3$ (b) $x = 3$ or 6 (c) $x = 3$ or $\frac{3}{2}$ (d) None of these

Q141. If $\omega \neq 1$ is a cube root of unity, then

$$\begin{vmatrix} 1 & 1+i+\omega^2 & \omega^2 \\ 1-i & -1 & \omega^2-1 \\ -i & -1+\omega-i & -1 \end{vmatrix}$$

is equal to:

(a) 0 (b) 1 (c) i (d) ω

Q142. A quadratic equation with rational coefficients can have:

(a) both root equal and irrational

(b) one root rational and other irrational

(c) one root real and other root imaginary

(d) none of these

Q143. If the equation $x^2 - (2+m)x + (m^2 - 4m + 4) = 0$ has coincident roots then:

(a) $m = 0, m = 1$ (b) $m = 0, m = 2$

(c) $m = \frac{2}{3}, m = 6$ (d) $m = \frac{2}{3}, m = 1$

Q144. The value of 'a' for which the sum of the squares of the roots of the equation $x^2 - (a-2)x - a - 1 = 0$ assumes the least value is:

(a) 2 (b) 3 (c) 0 (d) 1

Q145. Equation $x^{10} - 4x^6 + x^4 - 2x - 3 = 0$ has:

(a) at least six imaginary roots (b) at least four imaginary roots

(c) at most six imaginary roots (d) at most four imaginary roots

Q146. If α, β are the roots of $ax^2 + bx + c = 0$ and $\alpha + h, \beta + h$ are the roots of $px^2 + qx + r = 0$, then the value of h is:

(a) $\left(\frac{b}{a} - \frac{a}{b}\right)$ (b) $\frac{1}{2}\left(\frac{b}{a} - \frac{q}{p}\right)$ (c) $-\frac{1}{2}\left(\frac{b}{a} - \frac{q}{p}\right)$ (d) None of these

Q147. If a square matrix A is such that

$$A^T A = | = AA^T$$

then $|A|$ is equal to:

(a) 0 (b) ± 1 (c) ± 2 (d) None of these

Q148. If $A^2 - A + | = 0$, then the inverse of A is:

(a) $1 - A$ (b) $A - 1$ (c) A (d) $A + 1$

Q149. Let $A = \begin{pmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{pmatrix}, 10(B) = \begin{pmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{pmatrix}$ if B is the inverse of A, then α is:

(a) -2 (b) 1 (c) 2 (d) 5

Q150. The system of equation

$$x + y + z = 1$$

$$3x + 2y = z = 2$$

$$4x + 3y + 2z = 3$$

has:

(a) No solution

(b) A unique solution

(c) Infinitely many solutions

(d) More than one but finitely many solutions