BHU (M.Sc.) 2018 (GEOPHYSICS)

No. of Questions: 120

Time: 2 Hours **Full Marks: 360**

Note: (1) Attempt as many questions as you can. Each question carries **3** marks. **One** mark will be deducted for each incorrect answer. **Zero** mark will be awarded for each unattempted question.

(2) If more than one alternative answers seem to be approximate to the correct answer, choose the closest one.

Q1. The Fourier series of the function

$$f(x)=\begin{cases}0 & -\pi\le x\le 0\\ 1 & 0\le x\le \pi\end{cases}$$

contains:

(a) Even harmonics only (b) Odd harmonics only

(c) All harmonics (d) None of the above

Q2. The amplitudes of the components of the Fourier series of a triangular wave are in the ratio:

(a) $1:\frac{1}{2}:\frac{1}{3}:\frac{1}{4}.....$ (b) $\frac{1}{1^2}:\frac{1}{3^2}:\frac{1}{5^2}:....$

(c) $1:\frac{1}{3}:\frac{1}{5}:\frac{1}{7}:....$ (d) $\frac{1}{1^2}:\frac{1}{2^2}:\frac{1}{3^2}:\frac{1}{4^2}:....$

Q3. In an L-C-R series circuit the self inductance L is $100\,m\ H$ and the capacitance C is $10\,\mu F$. The time period of oscillation in resonant condition is:

(a) $\frac{1}{2\pi\times10^{-3}}\sec$ (b) $2\pi\times10^{-3}\sec$ (c) $\frac{2\pi}{10^{-3}}\sec$ (d) $\frac{10^{-1}}{2\pi}\sec$

Q4. A tuning fork A produces 10 beats/sec with another tuning fork B of frequency $300\,\text{Hz}$. If the tuning fork A is filed, the number of beats produced is reduced to $5/\sec$. The frequency of the tuning fork A is

(a) $310\,\text{Hz}$ (b) $290\,\text{Hz}$ (c) $300\,\text{Hz}$ (d) $305\,\text{Hz}$

Q5. A person with his hands stretched horizontally is standing at the centre of a rotating disc. If he folds his hands the rotational speed of the disc:

(a) increases due to conservation of angular momenta

(b) increases due to conservation of energy

(c) decreases due to conservation of angular momenta

(d) decreases due to conservation of energy

Q6. Radius of gyration of a ring about an axis tangential to its rim and coplanar with the ring is equal to

(a) its radius

(b) $\frac{1}{\sqrt{2}}$ times its radius

(c) $\frac{\sqrt{3}}{2}$ times its radius

(d) $\sqrt{2}$ times its radius

Q7. Law of perpendicular axis theorem of moment of inertia is applicabl to:

(a) one dimensional object

(b) Two dimensional object

(c) Three dimensional object

(d) Point object

Q8. Moment of inertia is a:

(a) tensor quantity

(b) Scalar quantity

(c) Vector quantity

(d) Pseudo vector quantity

Q9. Two spheres one solid and other hollow, of same mass and external radii roll down an inclined smooth plane without slipping then:

(a) the solid sphere will reach thee bottom first

(b) the hollow sphere will reach the bottom first

(c) both the spheres will reach at the same time

(d) data is insufficient to conclude

Q10. In an LCR circuit in series with $R = 0$ the current amplitude and resonance is:

(a) zero

(b) infinite

(c) maximum and finite

(d) minimum and different from zero

Q11. A rotating disc with constant angular velocity is:

(a) a non-inertial frame

(b) an inertial frame

(c) a non-accelerated frame

(d) a frame with constant linear velocity

Q12. Acceleration of a particle

(a) is invariant under Galilean transformation

(b) is not invariant under Galilean transformation

(c) may or may not be invariant under Galilean transformation

(d) has nothing to do with the Galilean transformation

Q13. Centrifugal force is:

(a) a real force

(b) a pseudo force

(c) directed towards the centre

(d) due to inertial nature of the reference frame

Q14. A particle of mass m is moving with velocity v at 90° to the axis of rotation in a rotating frame rotating with angular velocity ω. The coriolis force on the particle has magnitude:

(a) $m\omega^2 r$ (b) $m\omega v$ (c) $2m\omega v$ (d) 0

Q15. For a conservative force $\vec{F}$ one has the relation:

(a) $\vec{\nabla}\times\vec{F}=0$

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

(c) $\vec{\nabla}.\left(\left|\vec{F}\right|\right)=0$

(d) $\vec{\nabla}\times\vec{F}$ is constant vector of finite non-zero magnitude.

Q16. For a thin spherical shell of mass M and radius R which statement is wrong?

(a) potential V is zero and attraction $\left(\vec{F}\right)$ is constant for $r<R$

(b) Potential is constant and attraction is zero for $r<R$

(c) V varies as $\frac{1}{r}$ for $r>R$

(d) $\vec{F}$ varies as $\frac{1}{r^2}$ for $r>R$

Q17. For an undamped oscillator the quality factor Q has the value:

(a) 0

(b) ∞

(c) which depends on the frequency of oscillation

(d) which depends on the stored energy of the oscillator

Q18. The path of one projectile as seen from another projectile will always be:

(a) a parabolic path (b) a circular path

(c) an elliptic path (d) a straight line

Q19. The conservative force $\vec{F}$ and potential energy V are related by:

(a) $\vec{F} - \vec{\nabla}V$ (b) $\vec{F} - \vec{\nabla}V$ (c) $\vec{F} - \vec{\nabla}\times V$ (d) $\vec{F} - \vec{\nabla}.V$

Q20. When two simple harmonic vibrations with same frequency, but different amplitudes, at 90^{o} to each other combine the resulting vibration is:

(a) a circular vibration

(b) an elliptic vibration

(c) a linear vibration

(d) none of the above three type of vibration

Q21. A satellite, revolving round a planet of density ρ in a circular orbit very close to the planet surface, has the time period of revolution:

(a) $\sqrt{G\rho}$ (b) $\sqrt{\frac{3G\rho}{\pi}}$ (c) $\sqrt{\frac{G}{3\pi\rho}}$ (d) $\sqrt{\frac{3\pi}{G\rho}}$

Q22. Total energy of a simple pendulum E. When the displacement is half of the amplitude, its potential energy is:

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

Q23. Two SHMs at 90^{o} to each other having time periods in the ratio 1:2 combine. If the phase difference between the two vibrations is $\frac{\pi}{2}$ the resultant vibration is:

(a) of shape eight-digit (8) (b) of circular shape

(c) of elliptic shape (d) of parabolic shape

Q24. In a resonance vibration, if the frictional forces are zero, the sharpness of the resonance:

(a) is minimum

(b) maximum

(c) depends on the vibration frequency

(d) depends on the mass of the oscillating body

Q25. Moment of inertia of a hoop of mass M and radius R about an axis perpendicular to its plane and tangential to its circumference is:

(a) MR^2 (b) $2MR^2$ (c) $\frac{3}{2}MR^2$ (d) $\frac{MR^2}{2}$

Q26. A top of mass m, moment of inertia I is spinning with an angular velocity $\vec{\omega}$ in a gravitation field of acceleration due to gravity g. The centre of mass is at a distance r from the tip of the peg of the top. Then the precessional frequency of the top depends on:

(a) m, g, r (b) m, g, ω (c) m, r, ω (d) m, g, r, I an ω

Q27. For angular momentum $\vec{J}$, torque $\vec{\tau}$ and angular velocity $\vec{\omega}$ the following relation holds

(a) $\vec{\tau} = \vec{\omega} \times \vec{J}$ (b) $\vec{\tau} = \vec{J} \times \vec{\omega}$ (c) $\vec{J} = \vec{\omega} \times \vec{\tau}$ (d) $\vec{J} = \vec{\tau} \times \vec{\omega}$

Q28. Te equation of state for an ideal gas is $PV = RT$. The values of volume expansivity β and isothermal compressibility K are given as:

(a) $\beta = \frac{1}{T}, K = P$ (b) $\beta = \frac{1}{T}, K = \frac{1}{P}$

(c) $\beta = T, K = \frac{1}{P}$ (d) $\beta = T, K = P$

Q29. The correct form of first law of thermodynamics is written as:

(a) $dQ = du + dw$ (b) $\delta Q = du + \delta w$

(c) $\delta Q = du + dw$ (d) $dQ = \delta u + dw$

Q30. A molecule of a gas impinges on the wall of a containing vassel and retraces back its path after collision with the wall. If the mass of the molecule be m and its velocity normal to the wall be u, the change in its momentum will be:

(a) $2mu$ (b) zero (c) mu (d) $\sqrt{2mu}$

Q31. A real gas at temperature of inversion is suffering Joule-Kelvin expansion. Enthalpy of the gas:

(a) Increases (b) decreases

(c) Remains Constant (d) None of these

Q32. The inversion temperature for a gas is $200\,K$. The Boyle temperature of the gas will be:

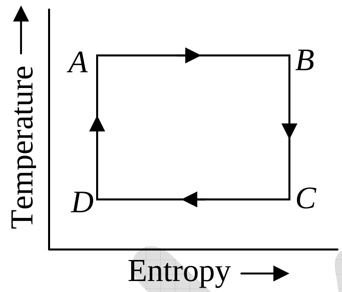
(a) $400\,K$ (b) $100\,K$ (c) $675\,K$ (d) $1350\,K$

Q33. If pressure on an ice block is increased, its melting point:

(a) Increases (b) decreases

(c) Remains unchanged (d) None of these

Q34. In the temperature - entropy diagram shown below, part AB of the cycle ABCD corresponds



(a) An isothermal process (b) An adiabatic process

(c) An isochoric process (d) An isobasic process

Q35. Specific heat of water at $100^0\,C = 1.01$ cal/gm degree, latent heat of vaporization decreases at the rate of 0.64 cal/K, latent heat of vaporization of steam $= 54$ C cal/gm. The specific heat of steam is

(a) 1.08 cal/gm-degree (b) -1.08 cal/gm-degree

(c) 1.08 J/Kg-degree (d) -1.08 J/Kg-degree

Q36. If Wien's constant $b = 0.3$ cm-K, the temperature of the sun whose radiation has maximum energy at wavelength $\lambda = 5500\,A^o$ will be

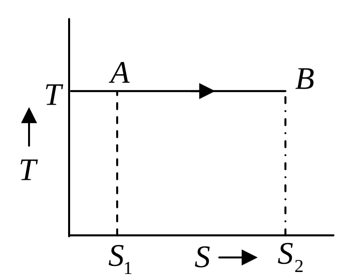
(a) $5000\ ^oC$ (b) 5455 K (c) 3000 K (d) 8000 K

Q37. An isentropic process on a T-S diagram is represented by:

(a) A horizontal line (b) A vertical line

(c) A line inclined at 45^o (d) None of these from the S-axis

Q38. Work done in a thermodynamic process from A to B as represented by an isotherm on a T-S indicator diagram shown here is given by:



(a) $S_2 - S_1$ (b) $T(S_2 - S_1)$

(c) TS_1 (d) $T/(S_2 - S_1)$

Q39. The multiplier to be used for making δQ integral along a reversible path between an initial and a final state is:

(a) $\frac{1}{Q}$ (b) $\frac{1}{S}$ (c) T (d) $\frac{1}{T}$

Q40. Irregular stirring of a viscous thermally insulating liquid is an example of:

(a) Adiabatic dissipation of work into internal energy of a system

(b) The transformation of internal energy of a system into mechanical energy

(c) Process exhibiting external thermal irreversibility

(d) None of these

Q41. Conduction of heat from a system to its cooler surrounding is an example of:

(a) A reversible process (b) An irreversible process

(c) An isentropic process (d) An isenthalpic process

Q42. If H is enthalpy, then change in enthalpy between an initial and final states of a system during a thermodynamic process $H_f - H_i = Q$ corresponds to:

(a) Throttling process (b) Reversible process

(c) Isobaric process (d) Adiabatic process

Q43. Helmholtz function remains constant during:

(a) an isothermal process

(b) an adiabatic process

(c) a reversible isothermal and isochoric process

(d) a reversible isothermal and isobaric process

Q44. Which relation gives correct Maxwell's thermo dynamical equation?

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

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

Q45. At $4^{\circ}C$, for water:

(a) $C_P < C_V$ (b) $C_V < C_P$ (c) $C_P = C_V$ (d) $\frac{C_P}{C_V} = \infty$

Q46. Pressure exerted by diffuse radiiation equals:

(a) Half of the energy density of radiation

(b) One third of the energy density of the radiation

(c) The energy density of the radiation

(d) Twice the energy density of radiation

Q47. The number of modes of vibration associated with black body radiation inside a black body radiation-chamber of volume V, is:

(a) $\frac{4\pi v v^2}{c^2}dv$ (b) $\frac{3\pi v v^2}{c^3}dv$ (c) $\frac{4\pi v^2}{c^2}dv$ (d) $\frac{8\pi v^2}{c^3}dv$

where range of frequencies lies between v ad $v-dv$

Q48. The radiant emittance of a black body at temperature of $4000\,K$

(a) $1452\,\text{watts/m}^2$ (b) $14520\,\text{watts/m}^2$

(c) $14520\,\text{Kw/m}^2$ (d) $1452\,\text{Kw/m}^2$

Given Stefan's constant $\sigma = 5.672\times10^{-8}\,\text{S.I.units}$

Q49. In order to increases the kinetic energy of ejected photoelectrons these should be an increase in

(a) Intensity of radiation

(b) Wavelength of radiation

(c) Frequency of radiation

(d) Both the wavelength and intensity of radiation

Q50. Which of the following statements about photon is incorrect?

(a) Its rest mass is zero (b) It's momentum is $hu > c$

(c) Its energy is hu (d) Photons exert no pressure

Q51. In Compton scattering, the change in wavelength of X-ray photons scattered at scattering angle 90^o is:

(a) $0.048\,\overset{o}{A}$ (b) $0.024\,\overset{o}{A}$ (c) $2.4\,\overset{o}{A}$ (d) $4.8\,\overset{o}{A}$

Q52. A certain excited state of a H-atom has a life time $10^{-8}\,\text{sec}$, the minimum error with which the energy of the given excited state can be measured is:

(a) 10^{-16} Joule (b) 10^{-26} Joule (c) 1.6×10^{-19} Joule (d) None of these

Q53. With exciting line $2536\,A^{o}$ a Raman line for a sample is observed at $2612\,A^{o}$. The Raman shift is:

(a) 2×10^{-5} m^{-1} (b) 1×10^{-1} m^{-1}

(c) 1.15×10^{5} m^{-1} (d) 3×10^{8} m^{-1}

Q54. The distance between two successive positions of a movable mirror of a Michelson's interferometer giving distinct fringes in the case of sodium light having wavelengths $5890\,\mathring{A}$ and $5896\,\mathring{A}$ will be:

(a) $2.894\,\text{cm}$ (b) $0.02894\,\text{cm}$ (c) $28.94\,\text{cm}$ (d) $2.894\,\text{mm}$

Q55. In a Michelson's interferometer experiment, 260 fringes cross the field of view when the movable mirror is displaced through a distance $0.0589\,\text{mm}$. The wavelength of monochromatic light used will be:

(a) $5890\,\mathring{A}$ (b) $5896\,\mathring{A}$ (c) $4531\,\mathring{A}$ (d) $4.531\,\mu\text{m}$

Q56. In the standardisation of metre, which of fringes are useful?

(a) curved fringes which are monochromatic

(b) while light fringes

(c) Broad fringes

(d) None of these

Q57. When a stretched wire is cut, then it snaps. In this process;

(a) First, internal energy of the system is converted to mechanical energy and then back into internal energy

(b) External Mechanical irreversibility occurs

(c) This is a reversible process

(d) This is a thermally irreversible process

Q58. With what velocity a rod lying along x-direction should move in this direction, so that its length is contracted by 50%?

(a) $\frac{C}{2}$ (b) $\frac{2}{3}C$ (c) $\frac{\sqrt{3}}{2}C$ (d) $\frac{C}{4}$

Where C is the velocity of light

Q59. The function of emitter resistance R_{ε} in CE transistor amplifier is:

(a) To have desirable value of I_{CQ}

(b) To provide positive feedback

(c) To provide negative feedback

(d) To provide larger amplification

Q60. The direction of propagation of electromagnetic wave is given by direction of:

(a) Vector $\vec{E}$ (b) Vector $\vec{H}$

(c) Vector $\left(\vec{E}\times\vec{H}\right)$ (d) None of these

Q61. The rank of the matrix $A=\begin{bmatrix} 1 & 1 & 1 \\ b+c & c+a & a+b \\ bc & ca & ab \end{bmatrix}$ where $a\neq b\neq c$, is

(a) <3 (b) <2 (c) 3 (d) 2

Q62. Which of the following statement is true?

(a) Every square matrix can be unequely expressed as the sum of a symmetric and a skew symmetric matrix

(b) In a skew symmetric matrix at least one diagonal element is non zero

(c) If A and B are both symmetric matrix then AB is symmetric if and only if $AB\neq BA$

(d) If A is a square matrix then $(A-A)$ is symmetric and $(A+A)$ is skew symmetric

Q63. Let A be a square matrix of order n then adjoint of the adjoint of A is

(a) $|A|^{n-1}$ (b) $|A|^{n-2}$ (c) $|A|^{n-1}, A$ (d) $|A|^{n-2}, A$

Q64. If $A=\begin{bmatrix}1 & 2 & 3\\ 1 & 3 & 4\\ 1 & 4 & 3\end{bmatrix}$, then A^{-1} is:

(a) $\begin{bmatrix}\frac{7}{3} & -3 & \frac{1}{3}\\ -\frac{1}{3} & 0 & \frac{1}{3}\\ -\frac{1}{3} & 1 & -\frac{1}{3}\end{bmatrix}$ (b) $\begin{bmatrix}\frac{7}{2} & -3 & \frac{1}{2}\\ -\frac{1}{2} & 0 & \frac{1}{2}\\ -\frac{1}{2} & 1 & -\frac{1}{2}\end{bmatrix}$

(c) $\begin{bmatrix}-\frac{7}{3} & 3 & -\frac{1}{3}\\ \frac{1}{3} & 0 & -\frac{1}{3}\\ \frac{1}{3} & -1 & \frac{1}{3}\end{bmatrix}$ (d) $\begin{bmatrix}-\frac{7}{2} & 3 & -\frac{1}{2}\\ \frac{1}{2} & 0 & -\frac{1}{2}\\ \frac{1}{2} & -1 & \frac{1}{2}\end{bmatrix}$

Q65. The eigen values of a Hermitian matrix are:

(a) Always all zero (b) Always all imaginary

(c) All reals (d) zero or one

Q66. The eigen values of the matrix $A=\begin{bmatrix}6 & -2 & 2\\ -2 & 3 & -1\\ 2 & -1 & 3\end{bmatrix}$

(a) $2,4,6$ (b) $2,2,8$

(c) $2,4,4$ (d) $2,3,8$

Q67. Which of the following relation is true for the matrix $A=\begin{bmatrix}2 & 2 & 1\\ 1 & 3 & 1\\ 1 & 2 & 2\end{bmatrix}$

(a) $A^3+7A^2+11A-51=0$ (b) $A^3-7A^2+11A-51=0$

(c) $A^3-7A^2-11A+51=0$ (d) $A^3+7A^2-11A+51=0$

Q68. The real value of $\lambda x+2y-3z=\lambda x$, $3x+y+2z=\lambda y, 2x+3y+z=\lambda z$ has a non zero solution is

(a) 2 (b) 3 (c) 1 (d) 6

Q69. The equation which has roots $1,-3,4$ is:

(a) $x^3+2x^2-11x-12=0$ (b) $x^3-2x^2+12x-11=0$

(c) $x^3-2x^2-11x+12=0$ (d) $x^3-2x^2-12x+11=0$

Q70. Let $r_1, r_2\, r_3$ be the roots of the equation $2x^3-3x^2+kx-1=0$ are the sum of two roots is 1 then the value of constant k is

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

Q71. If the roots of the equation $x^3-px^2+qx-r=0$ are in H.P, then the following is true:

(a) $9r^2-27pqr+2q^3=0$ (b) $27r^2-9pqr-3q^3=0$

(c) $27r^2-9pqr+2q^3=0$ (d) $9r^2-27pqr-3q^3=0$

Q72. If the roots of the equation $x^3+3px^2+3qx+r=0$ are in G.P then the following relation is true

(a) $p^3=rq^2$ (b) $p^3=rq^3$ (c) $p^2r=q^2$ (d) $p^3r=q^3$

Q73. If α,β,γ are the roots of the equation $x^3+ax^2+bx+c=0$ then the value of $(\beta+)(\gamma+\alpha)(\alpha+\beta)$ is:

(a) $2ab-c$ (b) $c-ab$ (c) $ab-2c$ (d) $2ab+c$

Q74. The equation whose roots are three times of the roots of the equation $x^2+2x^3-2x+1=0$ is:

(a) $y^3+6y^2-18y+27=0$ (b) $y^3-18y^2+y+27=0$

(c) $y^3-6y^2+18y-27=0$ (d) $y^3+18y^2-6y-27=0$

Q75. For which values of λ and μ the system of equation

$x+y+z=6, x+2y+3z=10, x+2y+\lambda z=\mu$ has no solution:

(a) $\lambda=10, \mu=3$ (b) $\lambda=2, \mu=10$

(c) $\lambda=3, \mu=10$ (d) $\lambda=3, \mu\neq 10$

Q76. If n is any positive integer, then the value of $(1+i)^n+(1-i)^n$ is:

(a) $2^{(n/2)+1}\cos\frac{n\pi}{4}$ (b) $2^{(n/2)-1}\cos\frac{n\pi}{4}$

(c) $2^{(n/2)+1}\sin\frac{n\pi}{4}$ (d) $2^{(n/2)-1}\sin\frac{n\pi}{4}$

Q77. All values of $(1)^{1/3}$ are:

(a) $1, \frac{1}{2}\left(1 \pm \sqrt{3}i\right)$ (b) $1, \frac{1}{2}\left(-1 \pm \sqrt{3}\right)$

(c) $-1, \frac{1}{2}\left(1 \pm \sqrt{3}\right)$ (d) $1, \frac{1}{2}\left(-1 \pm \sqrt{3}i\right)$

Q78. The value of $\lim_{x \to 0} \frac{\sin n\theta - n\sin\theta}{\theta\left(\cos n\theta - \cos\theta\right)}$ is:

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

Q79. Solution of $\tan^{-1} 2x + \tan^{-1} 3x = \frac{\pi}{4}$ is:

(a) $x = \frac{1}{3}$ (b) $x = \frac{1}{2}$ (c) $x = \frac{1}{6}$ (d) $x = 1$

Q80. The value of $\log(-1)$ is:

(a) π (b) $\frac{\pi}{2}$ (c) $-i\,\pi$ (d) $i\,\pi$

Q81. Principal value of $(i)^i$ is:

(a) e^{π} (b) $e^{-\pi}$ (c) $e^{-\pi/2}$ (d) $e^{\pi/2}$

Q82. If $f(x) = xe^{x(1-x)}$ then $f(x)$ is:

(a) increasing on $\mathbb{R}$ (b) decreasing on $\mathbb{R}$

(c) decreasing on $\left[-\frac{1}{2}, 1\right]$ (d) increasing on $\left[-\frac{1}{2}, 1\right]$

Q83. Real part of the expression $\log\sin(x+iy)$ is:

(a) $\frac{1}{2}\log\left[\frac{1}{2}\left(\cosh y - \cos x\right)\right]$ (b) $\frac{1}{2}\log\left[\frac{1}{2}\left(\cosh y - \cos x\right)\right]$

(c) $\frac{1}{2}\log\left[\frac{1}{2}\left(\cosh 2y - \cos 2x\right)\right]$ (d) $\frac{1}{2}\log\left[\frac{1}{2}\cosh y - \cos x\right]$

Q84. If $y = \sin ia \sin xy$ then $11 - x^2, y_2$ is:

(a) $2xy_1 - a^2 y$ (b) $-xy_1 + a^2 y$

(c) $xy_1 + 2^2 y$ (d) $xy_1 - 2a^2 y$

Q85. then which of the following is true:

(a) $\left(1-x^2\right)y_2 + \left(2x - 11y_1\right) = 0$ (b) $\left(1-x^2\right)y_2 + \left(2x - 11y_1\right) = 0$

(c) $\left(1-x^2\right)y_2 - \left(2x-1\right)y_1 = 0$ (d) $\left(1-x^2\right)y_2 + \left(2x-1\right)y = 0$

Q86. $y = \cos\left(m \sin^{-1} x\right)\left(1-x^2\right)y_2$

(a) $\left(2n+1\right)xy_{n+2} - \left(m^2+n^2\right)y_n$ (b) $\left(2n-1\right)xy_{n-2} + \left(m^2-n^2\right)y_n$

(c) $\left(2n-1\right)xy_{n+2} - \left(m^2+n^2\right)y_n$ (d) $\left(2n+1\right)xy_{n+2} - \left(m^2-n^2\right)y_n$

Q87. The asymptores parallel to x axis of the curve

$y^4 - x^2y^2 + 2xy^2 - 4x^2 - y - 1 = 0$

(a) $x + y = 0$ (b) $x - y + 1 = 0$

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

Q88. The radius of curvature at the point $\left(p, r\right)$ on the cardioid $r^3 = 2ap^2$ is:

(a) $\frac{1}{3}\sqrt{2ar}$ (b) $\frac{2}{3}\sqrt{ar}$ (c) $\frac{2}{3}\sqrt{2ar}$ (d) $\frac{1}{3}\sqrt{2ar}$

Q89. If the function $f\left(x\right) = 2x^3 - 9ax^2 + 12a^2x + 1$, where $a > 0$, attains its maximum and minimum and minimum at p and q respectively such that $p^2 = q$, then a is:

(a) $\frac{1}{2}$ (b) 3 (c) 1 (d) 2

Q90. The maximum value of the function $\left(x-1\right)\left(x-2\right)\left(x-3\right)$ is:

(a) $\frac{2}{3}$ (b) $\frac{2}{3\sqrt{3}}$ (c) $\frac{2}{\sqrt{3}}$ (d) $\frac{1}{3\sqrt{3}}$

Q91. For the function $f(x)=(x-1)(x-3)(x-5)$ in $[0,4]$ the value of C of Lagrange's mean value theorem is:

(a) $\frac{6-\sqrt{21}}{3}$ (b) $\frac{6+\sqrt{21}}{3}$ (c) $\frac{8-\sqrt{23}}{2}$ (d) $\frac{9-\sqrt{21}}{3}$

Q92. The value of $I=\int_0^{x/2}\frac{\sin^{2018}x}{\sin^{2018}x+\cos^{2018}x}$ is:

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

Q93. The value $I = fx\sinh x\, dx$ is:

(a) $x\cosh x-\sinh x$ (b) $x\cosh x+\sinh x$

(c) $\cosh x-x\sinh x$ (d) $\cosh x+x\sinh x$

Q94. The value of $I=\int_0^{\pi/2}\sin^6 x\cos^5 x\,dx$

(a) $\frac{8}{369}$ (b) $\frac{8}{693}$ (c) $\frac{8}{639}$ (d) $\frac{8}{396}$

Q95. The whole area of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is:

(a) $4\pi ab$ (b) $\frac{\pi ab}{4}$ (c) πab (d) $\frac{\pi ab}{2}$

Q96. The entire length of the cardioid $r=a(1+\cos 0)$ is:

(a) $2a$ (b) $4a$ (c) $8a$ (d) $6a$

Q97. The volume of the solid generated by revolving the cardiod $r=a(1+\cos\theta)$ about the initial line is:

(a) $\frac{2}{3}\pi a^1$ (b) $\frac{8}{3}\pi a^3$ (c) $4\pi a^3$ (d) $\frac{4\pi a^3}{3}$

Q98. The surface of the solid generated by the revolution of the asteroid $x^{2/3}+y^{2/3}=a^{2/3}$ about x-axis is:

(a) $\frac{12\pi a^2}{5}$ (b) $\frac{6\pi a^2}{5}$ (c) $\frac{12\pi a^2}{5}$ (d) $\frac{6\pi a^3}{5}$

Q99. The locus of a point (x, y) satisfying the equation

$3(3x-2y+4)^2+2(2x+3y-5)^2=39$ is:

(a) a Parabola
(b) an Ellipse
(c) a Hyperbola
(d) a Circle

Q100. The equation of circle orthogonal to the circles $x^2+y^2-6x+8=0$ and $x^2+y^2-2x-2y-7=0$ and passing through the origin is:

(a) $3x^2+3y^2-8x+29y=0$
(b) $2x^2+2y^2-8x+7y=0$
(c) $3x^2+3y^2-8x+2y=0$
(d) $2x^2+2y^2-8x-2y=0$

Q101. $\frac{\ell}{r}=e\cos\theta+\cos(\theta-\alpha)$ is the tangent at point α of the conic:

(a) $\frac{\ell}{r}=1+e\cos\theta$
(b) $\frac{\ell}{r}=1-e\cos\theta$
(c) $\frac{\ell}{r}=-1+e\cos\theta$
(d) $\frac{\ell}{r}=1+e\cos(\theta-\alpha)$

Q102. The equation of the right circular cone whose vertex is the origin, axis as z axis and semivertical angle α, is:

(a) $x^2+y^2=2z^2\tan^2\alpha$
(b) $x^2+y^2=z^2\tan^2\alpha$
(c) $x^2-y^2=z^2\tan^2\alpha$
(d) $x^2+y^2-z^2\tan^2\alpha$

Q103. Condition that plane $ux+vy+wz=0$ cuts cone $xy+yz+zx=0$ in perpendicular lines is:

(a) $u+v+w=0$
(b) $u^2+v^2+w^2=0$
(c) $\frac{1}{u}+\frac{1}{v}+\frac{1}{w}=0$
(d) $\frac{1}{u^2}+\frac{1}{v^2}+\frac{1}{w^2}=0$

Q104. The equation of the right circular of radius a cm and whose axis is x axis is:

(a) $x^2+y^2=a^2$
(b) $y^2+z^2=a^2$
(c) $x^2+z^2=a^2$
(d) $x^2+y^2+z^2=a^2$

Q105. The equation $\frac{x^2}{a^2}+\frac{y^2}{b^2}-\frac{z^2}{c^2}=1$ represents:

(a) An Ellipsoid (b) An Elliptic paraboloid

(c) A hyperbolic paraboloid (d) A Hyperboloids of one sheet

Q106. If $\phi(x,y,z)=3x^2y-y^3z^2$ then gradient of ϕ at the point $(1,2,-1)$ is:

(a) $-12i-9j-16k$ (b) $-12i+9j-16k$

(c) $-9i+12j-16k$ (d) $16i-9j-12k$

Q107. The angle between the surfaces $x^2+y^2+z^2=9$ and $z=x^2+y^2-3$ at the point $(2,-1,2)$ is:

(a) $\theta=\cos^{-1}\left(\frac{16}{\sqrt{21}}\right)$ (b) $\theta=\cos^{-1}\left(\frac{16}{3\sqrt{21}}\right)$

(c) $\theta=\cos^{-1}\left(\frac{8}{3\sqrt{21}}\right)$ (d) $\theta=\cos^{-1}\left(\frac{8}{\sqrt{21}}\right)$

Q108. If $f=xy^2i+2x^2yzj-3yz^2k$ then curl f at the point $(1,-1,1)$ is:

(a) $i-j-2k$ (b) $2i-j-2k$

(c) $-i+2j-k$ (d) $-i-2k$

Q109. If $f=x^2y+2xyz+z^2$ then curl grad f is:

(a) 0 (b) $xi+zk$

(c) $xi-yj-zk$ (d) $-xi+zk$

Q110. If $F=x^2y^2i+yj$ and the curve C is $y^2=4x$ in the xy plane from $(0,0)$, then $\int_C F.dr$ is:

(a) 256 (b) 264 (c) 64 (d) 72

Q111. If C is the circle $x^2+y^2=1$ then value of $\int_C\left[\{\cos x\sin y-xy\}dx+\sin x\cos ydy\right]$ is:

(a) 4 (b) 2 (c) 0 (d) $\frac{1}{4}$

Q112. For the vector $F=xi-yj+2z$ over the sphere $x^2+y^2+(z-1)^2=1$, the value of $\int_C F.nds$ is:

(a) $\frac{8\pi}{3}$ (b) $\frac{4\pi}{3}$ (c) $\frac{2\pi}{3}$ (d) $\frac{\pi}{3}$

Q113. Which is the solution of the differential equation $\left(D^2-2D+2\right)y=0, y=Dy=1$ when $t=0$:

(a) $y=e^t\sin t$ (b) $y=e^t\cos t$ (c) $y=\cos t$ (d) $y=e^t$

Q114. Particular integral of the differential equation $\frac{d^2y}{dx^2}+a^2y=\cos ax$ is:

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

Q115. The complementary function of the differential equation $\frac{d^2y}{dx^2}+\frac{d^2y}{dx^2}+y\ \ ax+be^x\sin 2x$ is:

(a) $e^x\left(c_1\cos\sqrt{3}x+c_2\sin\sqrt{3}x\right)+e^x\left(c_3\cos\sqrt{3}x+c_4\sin\sqrt{3}x\right)$

(b) $e^{\frac{x}{2}}\left(c_1\cos\sqrt{3}x+c_2\sin\sqrt{3}x\right)+e^{\frac{-x}{2}}\left(c_3\cos\sqrt{3}x+c_4\sin\sqrt{3}x\right)$

(c) $e^{\frac{x}{2}}\left(c_1\cos\frac{1}{2}\sqrt{3}x+c_2\sin\frac{1}{2}\sqrt{3}x\right)+e^{\frac{x}{2}}\left(c_3\cos\frac{1}{2}\sqrt{3}x+c_4\sin\frac{1}{2}\sqrt{3}x\right)$

(d) $e^x\left(c_1\cos\frac{1}{2}\sqrt{3}x+c_2\sin\frac{1}{2}\sqrt{3}x\right)+e^x\left(c_3\cos\frac{1}{2}\sqrt{3}x+c_4\sin\frac{1}{2}\sqrt{3}x\right)$

Q116. Solution of the integral equation $F(t)=1+\int_0^1F(u)\sin(t-1)\,du$ is:

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

Q117. Solution of integral equation $\int_0^1\frac{F(u)\,du}{\sqrt{1-u}}=1+t+t^2$ is:

(a) $F(t)=\frac{1}{\pi}\left(t^{-\frac{1}{2}}-t^{\frac{1}{2}}+\frac{8}{3}t^{\frac{3}{2}}\right)$ (b) $F(t)=\frac{2}{\pi}\left(t^{-\frac{1}{2}}+2t^{\frac{1}{2}}+\frac{8}{3}t^{\frac{3}{2}}\right)$

(c) $F(t)=\frac{1}{\pi}\left(t^{-\frac{1}{2}}+2t^{\frac{1}{2}}+\frac{8}{3}t^{\frac{3}{2}}\right)$ (d) $F(t)=\frac{2}{\pi}\left(t^{-\frac{1}{2}}+t^2+\frac{8}{3}t^2\right)$

Q118. For a common catenary the relation between x, y and s is:

(a) $s=c\cosh(x/c)$ (b) $s=c\sin\psi$

(c) $s=c\tan(x/c)$ (d) $x=c\log\left[\frac{\sqrt{s^2+c^2+s}}{c}\right]$

Q119. An endless chain of weight w rests in the form of a circular band round a smooth vertical cone which has its vertex upwards. Assuming the vertical angle of the cone to be 2α, the tension in the chain due to its weight is:

(a) $T = \dfrac{w\tan\alpha}{2\pi}$ (b) $T = \dfrac{w\cot\alpha}{2\pi}$

(c) $T = \dfrac{w\tan 2\alpha}{\pi}$ (d) $T = \dfrac{w\cot 2\alpha}{\pi}$

Q120. A partical is projected at an angle α with the horizontal from the foot of plane whose inclination to the horizontal is β then it will strike the plane at right angle if:

(a) $\cot\beta = 2\tan(\alpha-\beta)$ (b) $\tan\beta = 2\cot(\alpha-\beta)$

(c) $\cot\beta = \dfrac{1}{2}\tan(\alpha-\beta)$ (d) $\tan\beta = \dfrac{1}{2}\cot(\alpha-\beta)$