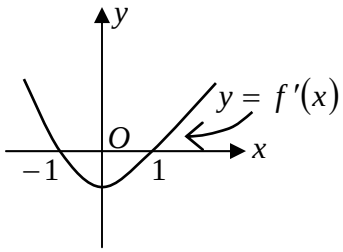
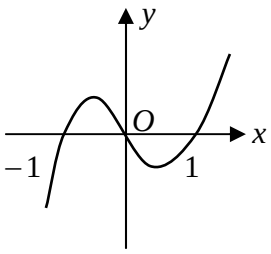
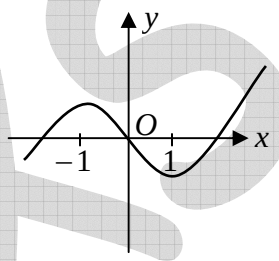
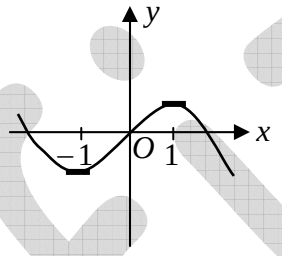
B.H.U. (2014) – M.Sc. Tech (Geophysics)

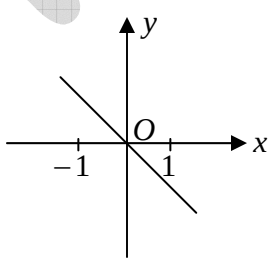
Q1. The graph of the derivative of f is shown in the figure below. Which of the following could be the graph of f ?



(a)


(b)


(c)


(d)


Q2. The area between the curves $y = x$ and $y = \sin x$ for $0 \geq x \geq \frac{\pi}{4}$ is

(a) $\frac{\pi^2}{32} + \frac{1}{\sqrt{2}} - 1$ (b) $\frac{\pi^2}{32}$ (c) $\frac{\pi^2}{32} - \frac{1}{\sqrt{2}} - 1$ (d) 1

Q3. The center of curvature of the parabola $y^2 = 4px$ corresponding to any point on the curve is

(a) $\left(3x - 2p, \frac{y^3}{4p^2}\right)$ (b) $\left(3x + 2p, -\frac{y^3}{4p^2}\right)$

(c) $\left(-3x - 2p, \frac{y^3}{4p^2}\right)$ (d) $\left(3x + 2p, \frac{y^3}{4p^2}\right)$

Q4. The point (x, y) on the curve of $y = \sqrt{x}$ nearest to the point $(4, 0)$ is

(a) $x = \frac{7}{2},\ y = \sqrt{\frac{7}{2}}$ (b) $x = \sqrt{\frac{7}{2}},\ y = \frac{7}{2}$

(c) $x = \frac{7}{4},\ y = \sqrt{\frac{7}{4}}$ (d) $x = \sqrt{\frac{6}{2}},\ y = \frac{6}{2}$

Q5. Consider the polynomial $y = ax^n + bx^3 + c,\ n > 4$. The nth derivative of this polynomial $\frac{d^n y}{dx^n}$ is

(a) $n!$ (b) n (c) $a * n!$ (d) $a * n$

Q6. If the length of a rectangle decreases at the rate of 3 cm/sec and its width increases at the rate of 2 cm/sec, the rate of change of the area of the rectangle when its length is 10 cm and its width is 4 cm is

(a) $14\,\text{cm}^2/\text{sec}$ (b) $6\,\text{cm}^2/\text{sec}$ (c) $9\,\text{cm}^2/\text{sec}$ (d) $8\,\text{cm}^2/\text{sec}$

Q7. If $3x^2 + 2xy + y^2 = 2$, then the value of $\frac{dy}{dx}$ at $x = 1$ is

(a) 2 (b) 0 (c) -2 (d) not defined

Q8. The function $y = x + \frac{2}{x}$ has a relative maximum at the value of x equal to

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

Q9. The asymptotes of the graph of the parametric equations $x = \frac{1}{t},\ y = \frac{t}{t+1}$ are

(a) $x = 0,\ y = 0$ (b) $x = 0$ only (c) $x = -1,\ y = 0$ (d) $x = -1$ only

Q10. The curvature of the cubical parabola $y = x^3$ at $(1, 1)$ is

(a) $\frac{6}{\sqrt{1000}}$ (b) 0.3 (c) 0.6 (d) $\frac{3}{\sqrt{1000}}$

Q11. What is the average (mean) value of $3t^3 - t^2$ over the interval $-1 \le t \le 2$?

(a) $\frac{11}{4}$ (b) $\frac{7}{2}$ (c) 8 (d) $\frac{33}{4}$

Q12. Consider the integral $I_n = \int x^n e^x dx$. Which of the following is true?

(a) $I_{n+1} = x^{n+1}e^x - (n+1)I_{n-1}$ (b) $I_n = x^n e^x + nI_{n+1}$

(c) $I_{n+1} = x^{n+1}e^x - (n+1)I_n$ (d) $I_n = x^n e^x + n\,I_{n-1}$

Q13. For what values of α and β the critical number (extremum) of the polynomial function $f(x) = x^3 + \alpha x + \beta$ is 4?

(a) $\alpha = 48$ and $\beta =$ arbitrary (b) $\alpha = -48$ and $\beta =$ arbitrary

(c) $\alpha =$ arbitrary and $\beta = 48$ (d) $\alpha =$ arbitrary and $\beta = -48$

Q14. The mean value theorem guarantees the existence of a special point on the graph $y = \sqrt{x}$ between $(0, 0)$ and $(4, 2)$. What are the coordinates of this point?

(a) $(2, 1)$ (b) $(1, 1)$ (c) $(2, \sqrt{2})$ (d) None of the above

Q15. The value of the integral $\int_0^1 \sqrt{x^2 - 2x + 1}\, dx$ is

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

Q16. If $U = x^y$, then $\frac{\left(\frac{\partial U}{\partial x} + \frac{\partial U}{\partial x}\right)}{U}$ is

(a) $\frac{y}{x} + \log(x)$ (b) $\frac{y}{x} + \log(y)$ (c) $\frac{x}{y} + \log(x)$ (d) $\frac{x}{y} - \log(y)$

Q17. The slope of the line passing through the points $\left(1, -\frac{1}{2}\right)$ and $(-1, 1)$ is

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

Q18. The coordinates of the fourth corner of a rectangle, when three of whose corners $(-1, 2), (4, 2), (-1, -3)$ is

(a) $(1, 4)$ (b) $(4, 1)$ (c) $(4, -3)$ (d) $(-1, 3)$

Q19. The vertex of the parabola $2y - x^2 - 4x + 6 = 0$ is

(a) $(2, 5)$ (b) $(-2, -5)$ (c) $(5, 2)$ (d) $(-5, -2)$

Q20. The plane P through $A(2, -3, -4)$ with normal vector $\vec{n} = 4\hat{i} - \hat{j} + 3\hat{k}$ is

(a) $4x + y + 3z = 1$ (b) $4x - 3y + z = -1$

(c) $4x - y + 3z = -1$ (d) $4x - y + 3z = 1$

Q21. The angle between the two planes $3x + 4y - 5z = 1$ and $4x + 5y - 6z = 1$ is

(a) $\sin^{-1}\left(\frac{60}{\sqrt{50}}\right)$ (b) $-\cos^{-1}\left(\frac{60}{\sqrt{50}}\right)$

(c) $\cos^{-1}\left(\frac{62}{\sqrt{50}\sqrt{77}}\right)$ (d) $-\sin^{-1}\left(\frac{62}{\sqrt{50}\sqrt{77}}\right)$

Q22. $M = \begin{vmatrix} 3 & 1 \\ 1 & 2 \end{vmatrix}$ is the discriminant of the conic section. Then the conic section is a

(a) parabola (b) hyperbola

(c) ellipse (d) rectangular hyperbola

Q23. The equation of the line with a slope 5 and passing through the point $(-3, 3)$ is

(a) $y + 3 = 5(x - 3)$ (b) $y = \frac{5}{3}(x - 3)$

(c) $y = \frac{5}{3}(x + 3)$ (d) $y - 3 = 5(x + 3)$

Q24. Consider two circles $x^2 + y^2 + 2ax + 2by = 0$ and $x^2 + y^2 + 2cx + 2dy = 0$ touch each other. Then the following condition is true.

(a) $ab - bc = 0$

(b) $ac - bd = 0$

(c) $ad - bc \neq 0$

(d) No condition on a, b, c, d

Q25. The equation of the hyperbola with foci $(0, 0)$ and $(0, 4)$ and asymptotes $y = \pm\frac{1}{2}x$ is

(a) $x^2 - \frac{(y-2)^2}{4} = 1$ (b) $x^2 + \frac{(y-2)^2}{4} = -1$

(c) $y^2 - \frac{(x-2)^2}{4} = 1$ (d) $y^2 + \frac{(x-2)^2}{4} = 1$

Q26. Which one of the following statements is correct? The graph of $y^2 = x^2 + 9$ is symme about

I. The *x*-axis II. The y-axis III. The origin

(a) I only (b) II only (c) I and II only (d) I, II and III

Q27. The polar form of a parabola is

(a) $r = \frac{2p}{1-\cos\theta}$ (b) $r = \frac{-2p}{1-\sin\theta}$ (c) $r = \frac{2p}{1+\cos\theta}$ (d) $r = \frac{2p}{-1+\sin\theta}$

Q28. The intervals of numbers satisfying the inequality $|x+1| > 2$ are

(a) $x > -1$ and $x < 3$ (b) $x < 1$ and $x > -3$

(c) $x > 3$ and $x < -1$ (d) $x > 1$ and $x < -3$

Q29. Solution of the inequality with absolute value is $|x^2 + x - 2| < x + 3$ is

(a) $(-\sqrt{5}, \sqrt{5})$ (b) $(-\sqrt{5}, -1) \cup (-1, \sqrt{5})$

(c) $(-\infty, -1) \cup (-1, +\infty)$ (d) $(-1, \sqrt{5})$

Q30. The eigenvalues of the matrix $\sigma = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$ are

(a) $i, -i$ (b) (i, i) (c) $1, -1$ (d) $1, 1$

Q31. The inverse of the matrix $\begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{pmatrix}$

is

(a) $\frac{1}{5}\begin{pmatrix} 3 & 2 & -2 \\ 3 & 2 & 2 \\ -2 & 3 & 2 \end{pmatrix}$ (b) $\frac{1}{5}\begin{pmatrix} -3 & 2 & 2 \\ 2 & 3 & -2 \\ 2 & 2 & -3 \end{pmatrix}$

(c) $\frac{1}{5}\begin{pmatrix} -3 & 2 & 2 \\ 2 & -3 & 2 \\ 2 & 2 & -3 \end{pmatrix}$ (d) $\frac{1}{5}\begin{pmatrix} -3 & 2 & -2 \\ 2 & -3 & 2 \\ -2 & 2 & -3 \end{pmatrix}$

Q32. The values of λ and μ for which of the following equations admit a unique solution are

$$\begin{cases} x+y-z=6 \\ x+2y+3z=10 \\ x+2y+\lambda z=\mu \end{cases}$$

(a) $\lambda=3,\ \mu$ is constant (b) $\lambda\neq 3,\ \mu$ is arbitrary

(c) λ is arbitrary, $\mu\neq 3$ (d) $\lambda\neq 3,\ \mu$ is rational

Q33. The fraction $\frac{(5x+7)}{(x^2+2x-3)}$ is equal to

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

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

Q34. For any numbers a, b and non-zero c, if c is positive and $a<b$, then

(a) $ac<bc$ and $\frac{a}{c}<\frac{b}{c}$ (b) $ab<ac$ and $\frac{a}{b}<\frac{a}{c}$

(c) $ac>bc$ and $\frac{a}{c}<\frac{b}{c}$ (d) $ac<bc$ and $\frac{a}{c}>\frac{b}{c}$

Q35. For what value of μ the determinant of the matrix

$$A=\begin{pmatrix} 2 & -\mu & 0 \\ -1 & 5 & 1 \\ 3 & \mu^2 & 5 \end{pmatrix}$$ is 26?

(a) $(6, 2)$ (b) $(-6, -2)$ (c) $(-6, 2)$ (d) $(6, -2)$

Q36. The matrix M have three eigenvalues λ_1, λ_2 and λ_3. One of the eigenvalues is -2 and the trace and determinant are 1 and 8 respectively. What are other two eigenvalues?

(a) $(-1, 4)$ (b) $(1, 4)$ (c) $(1, -4)$ (d) $(-1, -4)$

Q37. The function $f(x)=a_n x^n + a_{n-1}x^{n-1} + a_{n-2}x^{n-2} + \cdots + a_0$ has n roots, then $(f(x))$ where m is a real positive integer, have

(a) n roots (b) n^m roots (c) nm roots (d) m roots

Q38. If the position vector $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $\vec{w} = w_1\hat{i} + w_2\hat{j} + w_3\hat{k}$ is a constant vector then $\vec{\nabla}\times\vec{w}\times\vec{r}$ is

(a) w^2 (b) $2\vec{w}$ (c) 0 (d) $\vec{w}$

Q39. If a force $\vec{F} = 2x^2 y\hat{i} + xy\hat{j}$ displaces a particle in the xy plane from $(0, 0)$ to $(1, 4)$ along the curve $y = 4x^2$, then the work done is

(a) 5 (b) 6 (c) 8 (d) 10

Q40. Three vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ are linearly independent if and only if

(a) $\vec{a}\cdot(\vec{b}\times\vec{c})=0$ (b) $\vec{a}\times(\vec{b}\times\vec{c})=0$ (c) $\vec{a}\cdot(\vec{b}\times\vec{c})\neq 0$ (d) $\vec{a}\times(\vec{b}\times\vec{c})\neq 0$

Q41. The moment about the point $\hat{i}+2\hat{j}-\hat{k}$ of a force represented by $3\hat{i}+\hat{k}$ acting through the point $2\hat{i}-\hat{j}+3\hat{k}$ is

(a) $-3\hat{i}+11\hat{j}+9\hat{k}$ (b) $2\hat{i}+5\hat{j}+2\hat{k}$ (c) $11\hat{j}+9\hat{k}$ (d) $3\hat{i}+11\hat{j}$

Q42. The value of $\vec{\nabla}\times r^n\,\vec{r}$, where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and n is an integer, is

(a) n (b) 1 (c) 0 (d) ∞

Q43. $\nabla \cdot \left(3x^2\, i + 5xy^2\, j + xyz^2\, k\right)$ at the point $(1, 2, 3)$ is

(a) 36 (b) 37 (c) 38 (d) 35

Q44. The integral $\int_S \vec{F} \cdot \hat{n}\, ds$, where s is the unit sphere defined by $x^2 + y^2 + z^2 = 1$ and $\vec{F}$ is the vector field $\vec{F} = 2xi + y^2 j + z^2 k$, is equal to

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

Q45. For the following value of m, the vectors $5\hat{i} + 6\hat{j} + 7\hat{k}$, $7\hat{i} + m\hat{j} + 9\hat{k}$ and $3\hat{i} + 20\hat{j} + 5\hat{k}$ are coplanar

(a) 8 (b) -8 (c) 6 (d) -6

Q46. If $\frac{dy}{dx} = e^y$ and $y = 0$ when $x = 1$, then

(a) $y = \log x$ (b) $y = \log(2 - x)$ (c) $y = -\log(2 - x)$ (d) $y = -\log x$

Q47. The integral $\int_C \left[\left(x^2 + xy\right)dx + \left(x^2 + y^2\right)dy\right]$, where C is the square formed by the lines $y = \pm 1$, $x = \pm 1$ is equal to

(a) 0 (b) 1 (c) -1 (d) ± 1

Q48. The general solution of $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 2y = e^x$ is

(a) $y = C_1 e^x + C_2 e^{-2x} + \frac{x}{3}e^{-x}$ (b) $y = C_1 e^{-x} + C_2 e^{-2x} + \frac{x}{3}e^x$

(c) $y = C_1 e^x + C_2 e^{2x} + \frac{x}{3}e^{-x}$ (d) $y = C_1 e^{-x} + C_2 e^{2x} + \frac{x}{3}e^x$

where C_1 and C_2 are arbitrary constants.

Q49. The linear harmonic oscillator, $\frac{d^2x}{dt^2} + x = 0$, with the initial conditions $x(0) = 4$, $\dot{x}(0) = 3$ admits the solution

(a) $3\sin t + 4\cos t$ (b) $4\sin t + 3\cos t$ (c) $3\sin t - 4\cos t$ (d) $4\sin t - 3\cos t$

Q50. If $\frac{dy}{dx} = y\tan x$, then y is equal to

(a) $\frac{1}{2}\tan^2 x + c$ (b) $c\tan x + c$ (c) $c\sec x$ (d) $In\left|\cos x\right| + c$

where c is constant.

Q51. If $f'(x) = -f(x)$ and $f(1) = 1$, then $f(x) = ?$

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

Q52. The inverse Laplace transform of the function $\log\left(1+\frac{w^2}{s^2}\right)$ is

(a) $\frac{2}{t}(1-\cos wt)$ (b) $\frac{2}{(1-\cos wt)}$ (c) $\frac{2}{(1-\sin wt)}$ (d) $1-\sin wt$

Q53. $C = x\frac{dy}{dx} - y^3 + x$ is the invariant (constant) curve for

(a) $x\frac{d^2y}{dx^2} = 3y^2\frac{dy}{dx} - 1 - \frac{dy}{dx}$ (b) $x\frac{d^2y}{dx^2} = 1 - 3y^2\frac{dy}{dx} + \frac{dy}{dx}$

(c) $\frac{d^2y}{dx^2} = 3y^2\frac{dy}{dx} - 1 - \frac{dy}{dx}$ (d) $x\frac{d^2y}{dx^2} = 3y^2\frac{dy}{dx} - 1 - x\frac{dy}{dx}$

Q54. The curve $y = e^{x} + e^{-x}$ satisfies the differential equation

(a) $\frac{dy}{dx} = y$ (b) $\frac{dy}{dx} = -y$ (c) $\frac{d^2y}{dx^2} = y$ (d) $\frac{d^2y}{dx^2} = -y$

Q55. For the differential equation $y\frac{dy}{dx} + 2\cos(y)\,y = 1$, which of the following is true?

(a) The differential equation is first-order linear and homogenous

(b) The differential equation is first-order linear and non-homogenous

(c) The differential equation is first-order nonlinear and homogenous

(d) The differential equation is first-order nonlinear and non-homogenous

Q56. If $\tan a = \frac{1}{3}$ and $\tan b = \frac{1}{2}$, then $a+b$ is

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

Q57. arc $\sin r = \theta$, then θ is

(a) $-i\,\mathrm{In}\left(\sqrt{1-r^2}+ir\right)$ (b) $i\,\mathrm{In}\left(\sqrt{1-r^2}+ir\right)$

(c) $-i\,\mathrm{In}\left(\sqrt{1-r^2}-ir\right)$ (d) $i\,\mathrm{In}\left(\sqrt{1-r^2}-ir\right)$

Q58. Which one of the following defines a function f for which $f(-x) = -f(x)$?

(a) $f(x) = x^2$ (b) $f(x) = \sin x$ (c) $f(x) = \cos x$ (d) $f(x) = e^x$

Q59. If $\log(a+ib) = (c+id)$, then

(a) $c = \log\left(\sqrt{a^2+b^2}\right),\ d = \tan^{-1}\left(\frac{b}{a}\right)$ (b) $c = \log\left(a^2+b^2\right),\ d = \tan^{-1}\left(\frac{a}{b}\right)$

(c) $c = \log\left(\sqrt{a^2+b^2}\right),\ d = \frac{1}{2}\tan^{-1}\left(\frac{b}{a}\right)$ (d) $c = \log\left(a^2+b^2\right),\ d = \tan^{-1}\left(\frac{b}{a}\right)$

Q60. The real value of the function $\frac{F(z_1)}{F(z_2)}$ for $F(z) = z + |z|^2\ z,\ z_1 = 3e^{i\frac{\pi}{2}}$ and $z_2 = 2e^{i\pi}$ is

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

Q61. Let the functions f and g have 6 and 3 roots, respectively. If all the roots of g are also roots of f, then how many roots does the function $f \times g$ has?

(a) 3 (b) 6 (c) 9 (d) 18

Q62. One of the values of $(i)^{\frac{1}{3}}$ is

(a) $-i$ (b) i (c) -1 (d) 1

Q63. For a right angled triangle if one of the angle is $\alpha\left(\alpha \neq \frac{\pi}{2}\right)$, the other angle is

(a) $\pi - \alpha$ (b) $\alpha - \frac{\pi}{2}$ (c) $\frac{\pi}{2} - \frac{\alpha}{2}$ (d) $\frac{\pi}{2} - \alpha$

Q64. Consider the matrix $A(\theta)=\begin{pmatrix}\sin(\theta) & -\cos(\theta)\\ \cos(\theta) & \sin(\theta)\end{pmatrix}$ and $\rho=|A(\theta)||A(\phi)|$. For $\phi=\theta-\frac{\pi}{2}$ the value of ρ is

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

Q65. The points of intersection of $f=\sin^2(2\theta)$ and $f=\cos^2(2\theta)$ between $\frac{-\pi}{2}$ to $\frac{\pi}{2}$ are

(a) $\left(\frac{-\pi}{4},\frac{\pi}{4}\right)$ (b) $\left(\frac{-3\pi}{8},\frac{3\pi}{8}\right)$ (c) $\left(\frac{-\pi}{8},\frac{\pi}{8}\right)$ (d) $\left(\frac{-3\pi}{8},\frac{3\pi}{8}\right)$

Q66. A gun moving at a speed 30 m/sec fires at an angle 30° with a velocity 150 m/s relative to the gun. The distance between the gun and projectile when projectile hits the ground $(g=10\,m/\sec)$ is

(a) 1850 m (b) 1750 m (c) 1950 m (d) 1050 m

Q67. The displacement of particle executing simple harmonic motion obeys the equation $y=1.60\sin(1.3\,t)$. Here, y is in centimeters and t is in seconds. The magnitude of the velocity at $t=0$ is

(a) $v=1.08\,m/s$ (b) $v=0.08\,m/s$ (c) $v=3.08\ m/s$ (d) $v=2.08\ m/s$

Q68. One spring has force constant $200\,\mathrm{Nm^{-1}}$, another has force constant $500\,\mathrm{Nm^{-1}}$. If they are joined in series, the force constant will be nearest to

(a) 700 N/m (b) 300 N/m (c) 143 N/m (d) 100 N/m

Q69. A particle moves in a straight line so that its distance at time t from a fixed point of the line is $8t-3t^2$. What is the total distance covered by the particle between $t=1$ and $t=2$?

(a) 1 (b) $\frac{4}{3}$ (c) $\frac{5}{3}$ (d) 2

Q70. The degrees of freedom of the particle constrained to move only on surface of the sphere is

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

Q71. A body whose three principal moments of inertia are all equal, that is $I_1 = I_2 = I_3$, is called as

(a) asymmetrical top
(b) symmetrical top
(c) spherical top
(d) None of the above

Q72. What is the necessary condition for a force $\vec{F}$ to be conservative?

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

Q73. When a rigid body rotates about an axis and the external torque is zero, then for that body the following is a constant

(a) Angular velocity
(b) Moment of inertia
(c) Linear momentum
(d) Angular momentum

Q74. If a body has mass *m*, velocity at centre of mass v_c, moment of inertia I_c and rotational velocity ω, then total kinetic energy is

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

Q75. The angular momentum of a rotational body, with angular velocity ω and moment of inertia *I*, is given by

(a) $\frac{1}{2}I\omega$ (b) $I\omega$ (c) $\frac{1}{2}I\omega^2$ (d) $I\omega^2$

Q76. In metals the skin depth for electromagnetic waves

(a) increases with increase in frequency
(b) decreases with increase in frequency
(c) does not depend on frequency
(d) increases or decreases with frequency depending on the conductivity of metal

Q77. A plane polarized electromagnetic wave with $\vec{E}$ vector parallel to the plane of incidence is incident from air to glass. It is found that $\theta_i + \theta_t = 90°$, where θ_i is the angle of incidence and θ_t is the angle of transmittance then

(a) there will not be any reflected wave

(b) the reflected wave will be in a direction perpendicular to transmitted wave

(c) the reflected wave will be in a direction perpendicular to incident wave

(d) the reflected wave will be perpendicular to the refrated wave

Q78. The average value of the Poynting vector for a plane polarized sinusoidal electromagnetic wave in free space is given by

(a) $\frac{1}{2}\varepsilon_0 E^2$ (b) $\frac{1}{2}\mu_0 B_0^2$ (c) $\frac{1}{2}\frac{\mu_0 B^2}{C}$ (d) $\frac{1}{2}C\varepsilon_0 E_0^2$

E_0 and B_0 are the peak values of the amplitudes of electric and magnetic field.

Q79. The dielectric constant of any dielectric materials for electromagnetic waves

(a) increases with frequency

(b) is independent of frequency

(c) decreases with frequency

(d) decreases with frequency in radio frequency range but increases with frequency in optical range

Q80. How many 2 input NAND gates will be required to realize the operation of 3 input OR gates?

(a) 3 (b) 4 (c) 5 (d) 6

Q81. The simplified Boolean expression in POS for the Boolean expression $Y = AB\overline{C} + A\overline{B}C + \overline{A}BC + ABC$ is given by

(a) $Y = AB + BC + AC$ (b) $Y = (A+B)\cdot(B+C)\cdot(C+A)$

(c) $Y = (\overline{A}+B)\cdot(\overline{B}+C)\cdot(\overline{C}+A)$ (d) $Y = \overline{A}B + \overline{B}C + \overline{C}A$

Q82. Two 4-bit numbers can be added by using

(a) 4 full addres (b) 8 half addres

(c) 3 full adder and 1 half adder (d) 1 full adder and 3 half adder

Q83. Which one of the following is not the basic logic gate?

(a) AND (b) OR (c) NOT (d) XOR

Q84. The wavelength of an electromagnetic wave of frequency wave $10\,GH_3$ traveling in a medium with $\mu = 4\pi \times 10^{-7}$ H/m and $\varepsilon = \frac{1}{36\pi} \times 10^{-9}$ F/m will be

(a) 3 cm (b) 3 metre (c) 30 cm (d) 30 metre

Q85. A material has $\sigma = 10^{-2}$ s/m and $\varepsilon = 2\varepsilon_0$ at what frequency will the conduction current be equal to the displacement current?

(a) 6.3×10^{6} Hz (b) 9.1×10^{7} Hz (c) 3.1×10^{8} Hz (d) 5.3×10^{9} Hz

Q86. Which one of the following is not a Maxwell's equation of electromagnetic?

(a) $\oint_S \vec{D}\cdot\vec{ds} = q$ (b) $\oint \vec{B}\cdot d\vec{l} = \mu_0 I$

(c) $\oint \vec{H}\cdot\vec{dl} = \int_s \left(\vec{J} + \frac{\partial \vec{D}}{\partial t}\right)\cdot\vec{ds}$ (d) $\oint E\cdot\vec{dl} = \frac{\partial}{\partial t}\int_s \vec{B}\cdot\vec{ds}$

Q87. For plane electromagnetic waves in vacuum which of the following statements is not true?

(a) These are transverse in natures

(b) Electric and magnetic field waves are in phase

(c) There is a phase difference of $90°$ between electric and magnetic fields

(d) $\vec{E}\times\vec{H}$ points in the direction of propagation of electromagnetic wave

Q88. The de Broglie wavelength of an electron moving with velocity 10 m/sec is (given $h = 6.63\times10^{-34}\ J-\text{sec},\ m_e = 9.1\times10^{-31}\ kg$)

(a) $3.6\times10^{-11}\ m$ (b) $1.44\times10^{-10}\ m$

(c) $11.0\times10^{-11}\ m$ (d) $7.3\times10^{-11}\ m$

Q89. If we pour some drops of water between the plate and lens in Newton's ring experiment, then the rings will

(a) increase in diameter (b) decrease in diameter

(c) become elliptical (d) become invisible

Q90. Two polarizing sheets have directions such that the transmitted light has maximum intensity $I_{\max}$. Through what angle must either sheet be turried so that the intensity of transmitted light becomes $\frac{I_{\max}}{2}$?

(a) $\pm 30°$ (b) $\pm 60°$ (c) $\pm 45°$ (d) $\pm 90°$

Q91. A circularly polarised light can be distinguished from unpolarized light by passing it through

(a) Nicol prism (b) polarizing sheet

(c) half-wave plate (d) quarter-wave plate

Q92. If mirror M_2 in Michelson interferometer is moved through 0.233 mm, then 792 fringes are counted. The wavelength of light is

(a) 715 nm (b) 656 nm (c) 588 nm (d) 536 nm

Q93. If $C_{r.m.s,}\overline{C}$ and C_m denote the r.m.s. speed, average speed and most probable speed of molecules in a gas obeying Maxwellian distribution of molecular speeds, then

(a) $C_m > \overline{C} > C_{r.m.s.}$ (b) $\overline{C} > C_{r.m.s.} > C_m$

(c) $C_{r.m.s.} > \overline{C} > C_m$ (d) $C_{r.m.s.} > C_m > \overline{C}$

Q94. Which one of the following is not the correct Maxwell's thermodynamic equations?

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

Q95. In placing a thin sheet of mica of thickness 12×10^{-5} cm in the path of the one of the interfering beams in Young's double slit experiment the central fringe shifts equal to a fringe width. If the wavelength of light is $\lambda = 600$ nm, then the refractive index of mica is

(a) $\mu = 1.30$ (b) $\mu = 1.48$ (c) $\mu = 1.56$ (d) $\mu = 1.50$

Q96. In Fraunhofer diffraction of a single slit the width of the outral maxima is

(a) $\frac{2f\lambda}{a}$ (b) $\frac{f\lambda}{2a}$ (c) $\frac{a}{2f\lambda}$ (d) $\frac{2a}{f\lambda}$

Q97. If in defining the specific heat temperature is represented in $°F$ instead of $°C$, then the value of specific heat

(a) decreases (b) increases

(c) remain unchanged (d) fluctuates

Q98. If C_p and C_v are the molar specific heats of a gas at constant pressure and constant volume respectively. The ratio of adiabatic and isothermal moduli of elasticity will be

(a) $\frac{C_p - C_v}{C_p}$ (b) $\frac{C_p - C_v}{C_v}$ (c) $\frac{C_v}{C_p}$ (d) $\frac{C_p}{C_v}$

Q99. A Carnot engine has an efficiency of 40% and a heat sink temperature of $27°C$. What should be the temperature of heat sink so that the efficiency becomes 50%?

(a) $200°K$ (b) $250°K$ (c) $325°K$ (d) $350°K$

Q100. Total time of light of a projectile laundied with velocity u at angle θ with the horizontala is

(a) $\frac{u\sin\theta}{g}$ (b) $\frac{2u\cos\theta}{g}$ (c) $\frac{2u\sin\theta}{g}$ (d) $\frac{u\cos\theta}{g}$

Q101. A bullet of mass m travelling with velocity v gets embedded into a sand bag of mass M suspended by an instretchable string. The loss of kinetic energy in the process would be

(a) $\frac{1}{2}\frac{m^2v^2}{(M+m)}$ (b) $\frac{1}{2}\frac{m^2v^2}{(M+m)}$ (c) $\frac{1}{2}\frac{(M+m)^2v^2}{m}$ (d) $\frac{1}{2}\frac{mM}{(m+M)}v^2$

Q102. The largest and the smallest distance of the earth from the sun in its orbit are r_1 and r_2 respectively. Its distance from the sun at the perpendicular to the major axis of the orbit passing through the sun would be

(a) $\frac{2r_1r_2}{(r_1+r_2)}$ (b) $\frac{(r_1+r_2)}{2r_1r_2}$ (c) $\frac{r_1+r_2}{2}$ (d) $\frac{r_1-r_2}{2}$

Q103. If the noise level in Varanasi is 80 dB and that in Chandigarh is 40 dB, then the intensity of noise in Varanasi exceeds that in Chandigarh by a factor of

(a) 2 (b) 2^4 (c) 10^4 (d) 20

Q104. When an intense beam of laser light goes from air into water there is no change in its

(a) intensity (b) frequency (c) velocity (d) wavelength

Q105. The magnification of the image by a concave mirror of focal length f is m. If the image is real the distance of the object from the mirror would be

(a) $(m-1)f$ (b) $(m+1)f$ (c) $\frac{m+1}{m}f$ (d) $\left(\frac{m-1}{m}\right)f$

Q106. If the half-life of a radio active substance is 3 days, then by what factor would its activity reduce in 9 days?

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$ (c) $\frac{1}{8}$ (d) $\frac{7}{8}$

Q107. A system of three identical condensers will store maximum energy of

(a) two are connected in series and third in parallel to them

(b) two are connected in parallel and third in series with the combination

(c) all three connected in series

(d) all three connected in parallel

Q108. A mass spectrograph is used for the determination of

(a) specific charge of an ion (b) atomic mass

(c) spectral lines of isotopes (d) atomic charge

Q109. The series of spectral lines in the spectrum of hydrogen atom that lies partly in the ultraviolet and partly in the visible region is called

(a) Balmer series (b) Lyman series (c) Brackett series (d) Paschen series

Q110. Neglecting the relativistic effect the wavelength associated with electron of kinetic energy E is proportional to

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

Q111. The unit for measurement of man's exposure to nuclear radiation is

(a) Curie (b) Becquerel (c) Rutherford (d) Fermi

Q112. A metallic wire of length L hanging from the roof is stretched by an small amount l when a body of mass m is attached to its free end. The mechanical energy stored in the wire is

(a) $\frac{mgl}{L}$ (b) $\frac{mgl^2}{L}$ (c) $\frac{mgl}{2}$ (d) $\frac{mgl^2}{2L}$

Q113. Two uniform circular discs A and B of equal masses and thicknesses are made of materials of densities ρ_A and ρ_B respectively. If their moment of inertia about an axis passing through the center and normal to the circular faces are I_A and I_B respectively, then

(a) $\frac{I_A}{I_B}=\frac{\rho_A}{\rho_B}$ (b) $\frac{I_A}{I_B}=\frac{\rho_B}{\rho_A}$ (c) $\frac{I_A}{I_B}=\left(\frac{\rho_A}{\rho_B}\right)^2$ (d) $\frac{I_A}{I_B}=\left(\frac{\rho_B}{\rho_A}\right)^2$

Q114. The main use of a voltage series negative feedback amplifier is as a

(a) power amplifier
(b) current amplifier
(c) impedance matching device
(d) low input impedance voltage amplifier

Q115. In RC coupled transistor amplifier the upper cut off in frequency response is obtained due to

(a) coupling capacitance (b) blocking capacitance
(c) by pass capacitance (d) junction capacitance

Q116. The width of the depletion region layer of a P-N junction diode

(a) decreases with increasing doping concentration
(b) increases with increasing doping concentration
(c) is independent of doping concentration
(d) decrease with increasing reverse bias

Q117. Avalanche break down in Zener diode is a phenomena primarily caused by ionization of immobile ions.

(a) due to high electric field

(b) due to collision with high velocity minorly charge carriers

(c) due to collision with high velocity majority charge carriers

(d) due to tunneling of charge carriers

Q118. A circuit having an inductance of $\frac{1}{\pi}$ Henry and resistance of 100 ohms is connected to AC power supply at 50 Hz frequency. The reactance and impedance of the circuit is

(a) 100 Ω, 100 Ω (b) 141.1 Ω, 100 Ω

(c) 100 Ω, 141.1 Ω (d) 141.1 Ω, 141.1 Ω

Q119. A rectangular wave having cross-sectional area $6\text{ cm} \times 4\text{ cm}$ is operating at a frequency 7.56 Hz in dominant mode. The guide wavelength will be

(a) 4.24 cm (b) 2.25 cm (c) 4.5 cm (d) 3.16 cm

Q120. The change in the boiling point of water when the pressure is increased by 10^6 dynes/cm^2 on assuming normal boiling point 100 °C, specific volume of steam 1677 cm^3/gm and latent heat of vaporization of water 540 cal/gm, will be about

(a) 28 °C (b) 12 °C (c) 15 °C (d) 40 °C

Q121. Indicate the false $T\,dS$ equation from the equations given below

(a) $T\,dS = C_V\,dT + T\left(\frac{\partial S}{\partial V}\right)_T dV$ (b) $T\,dS = C_V dT + T\left(\frac{\partial P}{\partial T}\right)_V dV$

(c) $T\,dS = C_P dT + T\left(\frac{\partial S}{\partial P}\right)_T dP$ (d) $T\,dS = C_P dT + T\left(\frac{\partial V}{\partial T}\right)_P dP$

Q122. The Bernoulli's theorem is based on the principle of

(a) conservation of momentum (b) conservation of energy

(c) conservation of mass (d) conservation of velocity

Q123. Kirchhoff's law of junctions in electrical circuits is based on the principle of

(a) conservation of energy (b) conservation of momentum

(c) conservation of charge (d) conservation of mass

Q124. *P-N* junction diode cannot be used as a

(a) rectifier (b) modulator (c) demodulator (d) oscillator

Q125. The unit of Planck's constant is equivalent to

(a) angular momentum (b) power

(c) energy (d) linear momentum

Q126. Which of the following thermodynamic parameter remains constant during Joule-Thomson expansion?

(a) Entropy (b) Enthalpy

(c) Pressure (d) Helmholtz free energy

Q127. If the height of the geostationary satellite from the center of earth is 42000 km, then the height of the satellite whose orbital time period is 3 hours, from the center of earth would be

(a) 21000 km (b) 5225 km (c) 10500 km (d) 15725 km

Q128. An air bubble of diameter 2 mm rises steadily through a solution of density 1750 kg/m^3 at the rate of 0.36 m/sec. Find the coefficient of viscosity of solution assuming the density of air to be negligible

(a) 2.2 poise (b) 1.1 poise (c) 2.2 centipoise (d) 1.1 centipoise

Q129. Indicate the false statement about Lasers

(a) these are coherent sources of light

(b) these are monochromatic sources of light

(c) two independent Laser sources can produce interference

(d) the laser light can be hardly converged

Q130. X-rays of 10.0 p.m. are scattered from a target in all directions and the maximum wavelength present in the scattered X-rays it 14.9 p.m. Find the wavelength of the X-rays scattered at 45°

(a) 10.7 p.m. (b) 12.425 p.m. (c) 11.25 p.m. (d) 9.3 p.m.

Q131. The wave particle duality was demonstrated by the

(a) Stern-Gerlach experiment (b) Davisson-Germer experiment

(c) Franck-Hertz experiment (d) Michelson-Morley experiment

Q132. Raman scattering is a quantum mechanical process involving

(a) one photon (b) one photon and one electron

(c) two photons (d) two photon and one electron

Q133. Planck's radiation formula reduces to

(a) Rayleigh-Jeans formula at low frequencies

(b) Rayleigh-Jeans formula high frequencies

(c) Wien's displacement formula at low temperature

(d) Rayleigh-Jeans formula at low temperature

Q134. Two linearly polarised light waves of unequal amplitudes with their planes of polarization perpendicular to each other on superposition give rise to

(a) circularly polarized light (b) plane polarized light

(c) unpolarised light (d) elliptically polarized light

Q135. 10 gm water at $0°C$ is heated and transformed to 10 gm steam at $100°C$. If the latent heat of evaporation at $100\ °C$ is 538 cal/gm, then the change in entropy is

(a) 14.45 cal/°K (b) 17.54 cal/°K (c) 13.56 cal/°K (d) 18.65 cal/°K

Q136. If for any thermodynamic system $\oint \phi\, dse \neq 0$ for all cyclic irreversible processes, then the variable ϕ is

(a) internal energy u (b) pressure p

(c) temperature T (d) entropy S

Q137. If the frame around which wire is wound in a moving coil galvanometer is metallic, then its

(a) sensitivity is increased (b) hysteresis is decreased

(c) damping is increased (d) time period of oscillation is decreased

Q138. When white light source is used in Young's double slit experiment the colour of first bright fringes on both sides of the central dark fringe will be

(a) violet (b) blue (c) green (d) red

Q139. A tuning fork of frequency 512 Hz is vibrated with a sonometer wire and 6 beats per sec are heard. The beat frequency reduces if the tension in the string of sonometer wire is slightly decreased. The original frequency of vibration of sonometer wire is

(a) 500 (b) 518 (c) 506 (d) 524

Q140. For a van der Waals' gas the Joule-Thomson coefficient is given by

(a) $\frac{1}{C_P}\left[b-\frac{2a}{RT}\right]$ (b) $\frac{1}{C_v}\left[\frac{2a}{RT}-b\right]$ (c) $\frac{1}{C_P}\left[\frac{2a}{RT}-b\right]$ (d) $\frac{1}{C_V}\left[b-\frac{2a}{RT}\right]$

Q141. The Fourier series

$$F(x)=\frac{3}{2}+\frac{6}{\pi}\left[\sin\frac{\pi x}{5}+\frac{1}{3}\sin\frac{3\pi x}{5}+\frac{1}{5}\sin\frac{\sin 5\pi x}{5}+\cdots\right]$$

represents a square wave of

(a) amplitude 3 and time period 5 (b) amplitude $\frac{3}{2}$ and time period 10

(c) amplitude 3 and time period 10 (d) amplitude $\frac{3}{2}$ and time period 5

Q142. A reversible heat engine converts $\frac{1}{6}$th heat, which it absorbs from source into useful work. When the temperature of the sink is reduced by $60\,°C$, its efficiency is doubled. Then the temperature of the source is

(a) 240 K (b) 300 K (c) 480 K (d) 360 K

Q143. A diffraction grating is illuminated by a Laser light of wavelength 500 nm. If the second order spectral line is observed at 30°, then the number of lines per centimeter of grating is

(a) 5000 (b) 6000 (c) 4000 (d) 3000

Q144. For a series *L*-*C*-*R* resonance circuit the power factor at resonance is

(a) infinity (b) zero (c) half (d) unity

Q145. A bridge rectifier is preferred over an ordinary full-wave rectifier because

(a) its rectification efficiency is high

(b) its ripple factor is small

(c) its transformer does not require center tap secondary

(d) its peak inverse voltage is low

Q146. Indicate the false statement regarding the early effect in transistor

(a) base current decreases with increasing $|V_{CB}|$

(b) emitter current increase with increas $|V_{CB}|$

(c) α decreases with increasing $|V_{CB}|$

(d) β increases with increasing $|V_{CB}|$

Q147. What will be the maximum wave length of light that will cause the photoelectrons to be emitted from sodium target whose work function is 23 eV $\left(h = 4.14\times10^{-15}\ \text{eV}\times\text{sec}\right)$?

(a) 270 nm (b) 675 nm (c) 810 nm (d) 540 nm

Q148. Indicate the false statement about the conclusions drawn from Michelson-Morley experiment

(a) hypothetical ether does not exist

(b) all motions are relative to a universal from of reference

(c) the speed of light is same for all observers

(d) all motions are relative to a specified frame of reference

Q149. Gibbs' free energy G is defined as

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

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

Q150. The radius of gyration of a thin uniform rod of mass $M = 100$ gm and length $l = 1$ metre about an axis passing through its center of gravity and perpendicular of its length is

(a) $k = \frac{1}{2\sqrt{3}}$ metre

(b) $k = \frac{1}{3\sqrt{3}}$ metre

(c) $k = \frac{1}{4\sqrt{3}}$ metre

(d) $k = \frac{1}{6\sqrt{3}}$ metre