BHU-2011 (Geo-Physics)

Q1. If $|x|<1,$ the sum of the infinite series

$$\sum_{r=1}^{\infty}\frac{x^{r-1}}{(1+x^r)(1+x^{r+1})}$$ is

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

Q2. The partial fractions of $\frac{(x+1)^3-x^3}{(3x+1)(x-2)}$ are

(a) $\frac{1}{7(3x+1)}-\frac{19}{7(x-2)}$ (b) $1-\frac{19}{7(x-2)}+\frac{1}{7(3x+1)}$

(c) $\frac{19}{7(x-2)}-\frac{1}{7(3x+1)}$ (d) $1+\frac{19}{7(x-2)}-\frac{1}{7(3x+1)}$

Q3. If $x\in(-2,7)$, the maximum value of $(7-x)^4(2+x)^5$ is

(a) 800000 (b) 80000 (c) 640000 (d) $7^4\times 2^5$

Q4. $(6+x)^3(1-x)^4$ is maximum, where $x\in(-6,1)$, when x is equal to

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

Q5. If the roots of the equation $x^n-1=0$ are $1,\alpha_1,\alpha_2,.....\alpha_{n-1}$, then the value of $(1-\alpha_1)(1-\alpha_2)....(1-\alpha_{n-1})$ is

(a) 0 (b) 1 (c) n^2 (d) n

Q6. If α,β,γ are the roots of the equation $ax^3+bx^2+cx+d=0$, then the value of $(\beta+\alpha)(\gamma+\alpha)(\alpha+\beta)$ is

(a) $\frac{bc-ad}{a^2}$ (b) $\frac{ad-bc}{a^2}$ (c) $\frac{ac-bd}{a^2}$ (d) $\frac{bd-ac}{a^2}$

Q7. If A is an $n\times n$ matrix such that $A^2+A+I=0$, then A^{100} is equal to

(a) A (b) $-A$ (c) A^2 (d) $-A^2$

Q8. If A is an $n\times n$ matrix, then det $(Adj\ Adj\ A)$ is equal to

(a) $(\det A)^{n(n-1)}$ (b) $(\det A)^{n^2}$ (c) $(\det A)^{(n-1)^2}$ (d) $(\det A)^{n-1}$

Q9. If $x = cy + bz, y = az + cx, z = bx + ay$ and x, y, z are not all zero, then the value of $a^2 + b^2 + c^2 + 2abc$ is

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

Q10. The system of equation $x - 2y + 2z = 4,\ 3x + y + 4z = 6,\ x + y + z = 1$ has

(a) no solution (b) unique solution

(c) infinitely many solution (d) zero solution

Q11. If $z = \cos\frac{2\pi}{3} + i\sin\frac{2\pi}{3}$, then the value of $1 + z^n + z^{2n}$, where n is not multiple of 3 is

(a) 3 (b) $1 + z$ (c) $1 + z^2$ (d) 0

Q12. If $i^{A+iB} = A + iB$, then $\log_e\left(A^2 + B^2\right)$ is equal to

(a) $-\pi A$ (b) $-\pi B$ (c) πB (d) πA

Q13. if $|r| < 1$, the expansion of $\frac{r\sin\theta}{1 - 2r\cos\theta + r^2}$ is

(a) $\sum_{n=1}^{\infty} r^n \sin n\theta$ (b) $1 + \sum_{n=1}^{\infty} r^n \sin n\theta$

(c) $1 + \sum_{n=1}^{\infty} r^n \cos n\theta$ (d) $\sum_{n=1}^{\infty} r^n \cos n\theta$

Q14. The sum of the infinite series $\frac{1}{1.3} + \frac{1}{5.7} + \frac{1}{9.11} + \ldots$ is

(a) $\frac{\pi^2}{6}$ (b) $\frac{\pi^2}{4}$ (c) $\frac{\pi}{8}$ (d) $\frac{\pi}{4}$

Q15. The Principle value of $\log_e \frac{(1+i)\left(1+i\sqrt{3}\right)}{\sqrt{3}+i}$ is

(a) $\frac{1}{2}\log_e 2 + \frac{7\pi i}{12}$ (b) $\log_e 2 + \frac{5\pi i}{12}$

(c) $\frac{1}{2}\log_e 2 + \frac{\pi i}{12}$ (d) $\frac{1}{2}\log_e 2 + \frac{5\pi i}{12}$

Q16. The modulus and argument of $\frac{3-i}{2+i}+\frac{3+i}{2-i}$ are respectively

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

Q17. If n is an integer, the value of $i^{n-1}+i^{.n}+i^{n+1}+i^{n+2}$ is equal to

(a) 4 (b) 1 (c) -1 (d) 0

Q18. The value of $\cos\left(\log_e i^i\right)$ is

(a) 0 (b) $-i$ (c) 1 (d) -1

Q19. If $y=\sqrt{2x-x^2}$, then $y^3\frac{d^2y}{dx^2}$ is equal to

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

Q20. If $D^n \tan^{-1}\frac{x}{a}=(-1)^{n-1}(n-1)!\sin^n\varphi \sin n\varphi$, then φ is equal to

(a) $\tan^{-1}\frac{x}{a}$ (b) $\tan^{-1}\frac{a}{x}$ (c) $\tan^{-1}(ax)$ (d) $\tan^{-1}\left(\frac{1}{ax}\right)$

Q21. If $y=\sin^{-1}x$, then value of $\left(\frac{d^3y}{dx^3}\right)_{x=0}$ is

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

Q22. The point of intersection of the curve $x^2y^2-x^2+xy-y^2=0$ and its asymptotes lie on the curve

(a) $x^2+y^2=1$ (b) $xy+1=0$

(c) $x^2-xy+y^2=0$ (d) $xy-1=0$

Q23. all the asymptotes of the curve $\frac{a^2}{x^2}+\frac{b^2}{y^2}=1$ are

(a) $\left(x^2-a^2\right)\left(y^2-b^2\right)=0$ (b) $\left(x^2-b^2\right)\left(y^2-a^2\right)=0$

(c) $x^2y^2-a^2b^2=0$ (d) none of these

Q24. The correct formula for the radius of curvature of a curve is

(a) $\rho = p - \frac{d^2 p}{d\psi^2}$ (b) $\rho = r\frac{dp}{dr}$

(c) $\rho = \frac{-\frac{dy}{ds}}{\frac{d^2x}{ds^2}}$ (d) $\rho = \sqrt{\left(\frac{d^2x}{ds^2}\right)^2 + \left(\frac{d^2y}{ds^2}\right)^2}$

Q25. The radius of curvature at any point of the curve $r = a(1-\cos\theta)$ is

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

Q26. The length of chord of curvature through the pole of the curve $r = ae^{\theta}$ is

(a) $4r$ (b) $3r$ (c) $2r$ (d) r

Q27. The curve $r = a\cos 6\theta$ has

(a) 6 loops (b) 3 loops (c) 24 loops (d) 12 loops

Q28. In the curve $y^2 = (x-2)^2(x-5)$, the point (2, 0) is

(a) single point (b) cusp (c) node (d) conjugate point

Q29. The maximum value of $\sin x(1+\cos x)$ is

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

Q30. $\frac{\log_e x}{x}$ is maximum when x is equal to

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

Q31. If $u = \sin^{-1}\frac{x}{y} + \tan^{-1}\frac{y}{x}$ *then* , $\frac{\partial u}{\partial x} / \frac{\partial u}{\partial y}$ is equal to

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

Q32. If $u = t^n e^{-r^2/4t}$ satisfies the equation

$$\frac{\partial}{\partial r}\left(r^2 \frac{\partial u}{\partial r}\right) = r^2 \frac{\partial u}{\partial t}$$

then n is equal to

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

Q33. If $x = r\cos\theta, y = r\sin\theta$, then

$$\frac{\partial x}{\partial r}\frac{\partial y}{\partial \theta} - \frac{\partial x}{\partial \theta}\frac{\partial y}{\partial r}$$

is equal to

(a) $-r$ (b) $-r\cos 2\theta$ (c) r (d) $r\cos 2\theta$

Q34. If $u = \log_e\left(x^3 + y^3 - x^2 y - xy^2\right)$, then $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}$ is equal to

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

Q35. $\lim_{x \to 0} \frac{2 - x^2 - 2\cos x}{x^4}$ is equal to

(a) $\frac{1}{24}$ (b) $-\frac{1}{24}$ (c) $\frac{1}{12}$ (d) $-\frac{1}{12}$

Q36. $\int_a^b \frac{f(x)dx}{f(x) + f(a+b-x)}$ is equal to

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

Q36. The area, bounded by the curve $y = \log_e x$, x-axis and the ordinates $x = 1, x = 2$ is

(a) $\log_e 4$ (b) $\log_e\left(\frac{2}{e}\right)$ (c) $(\log_e 2)^2$ (d) $\log_e\left(\frac{4}{e}\right)$

Q38. $\int x\left(\log x^2\right)^2 dx$ is equal to

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

(c) $x^2\left(1-\log_e x^2 \log_e \dfrac{x}{e}\right)+c$ (d) $x^2 \log_e x^2 \log_e\left(\dfrac{x}{e}\right)+c$

Q39. The volume of the solid generated by revolving $\dfrac{x^2}{a^2}+\dfrac{y^2}{b^2}=1$ about x-axis is

(a) $\dfrac{4}{3}\pi\left(a^3+b^3\right)$ (b) $\dfrac{4}{3}\pi ab^2$ (c) $\dfrac{2}{3}\pi\left(a^3+b^3\right)$ (d) $\dfrac{4}{3}\pi a^2 b$

Q40. The whole length of the curve $r=a(1-\cos\theta)$ is

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

Q41. The asymptotes of the hyperbola $x^2+3xy+2y^2+2x+3y=0$ are given by

(a) $x^2+3xy+2y^2+2x+3y+1=0$ (b) $x^2+3xy+2y^2+2x+3y-1=0$

(c) $x^2+3xy+2y^2=0$ (d) $x^2+3xy+xy^2+x+2y=0$

Q42. The condition that the line $\dfrac{l}{r}=A\cos\theta+B\sin\theta$ may touch the conic $\dfrac{l}{r}=1+e\cos\theta$ is

(a) $A^2+B^2=1$ (b) $(A-e)^2+B^2=1$

(c) $(A+e)^2+B^2=1$ (d) $A^2+(B-e)^2=1$

Q43. The equation of the parabola, which touches the conic $x^2+xy+y^2-2(x+y)+1=0$ at the points, where it is cut by the line $x+y+1=0$, is

(a) $(x-y)^2=7(x+y)-1$ (b) $(x+y)^2=7(x-y)-1$

(c) $(x-y)^2=14(x+y)+1$ (d) $(x-y)^2=14(x+y)-1$

Q44. The equation of the conic confocal with $x^2+2y^2=2$ and passing through the point $\left(0,\sqrt{2}\right)$ is

(a) $2x^2+3y^2=1$ (b) $2x^2+3y^2=6$

(c) $x^2+2y^2=4$ (d) $2x^2+y^2=2$

Q45. The distance of the point $(1,2,3)$ from the line through $(2,3,4)$ and $(-1,2,5)$ is

(a) $\sqrt{\dfrac{6}{11}}$ (b) $2\sqrt{6}$ (c) $2\sqrt{\dfrac{6}{11}}$ (d) $\sqrt{6}$

Q46. The equation of the plane through $(2,3,-4)$ and $(1,-1,3)$ and to parallel to the x-axis is

(a) $4x-y-5=0$ (b) $7x+4y-5=0$

(c) $7y+4z-5=0$ (d) $7x+z-10=0$

Q47. The radius of the circle $x^2+y^2+z^2-x+z-2=0,\ x+2y-z=4$ is

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

Q48. The vertical angle of a right circular cone having three mutually perpendicular generators is

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

Q49. The maximum number of normals which can be drawn from a point to a central conicoid is

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

Q50. The radius of the right circular cylinder, whose guiding curve is $x^2+y^2+z^2=9,\ x-y+z=3$ is

(a) $2\sqrt{6}$ (b) $\sqrt{6}$ (c) $3\sqrt{2}$ (d) $\sqrt{3}$

Q51. The line $\frac{x-3}{2}=\frac{y-4}{3}=\frac{z-5}{3}$ lies on the plane

(a) $4x+4y-5z-3=0$ (b) $x+y-z-2=0$

(c) $x+y-z-1=0$ (d) $4x+4y+5z-3=0$

Q52. The angle between the planes $x+y+z+1=0$ and $2x-2y+4z+2=0$ is

(a) $\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (b) $\cos^{-1}\left(\frac{1}{\sqrt{6}}\right)$ (c) $\cos^{-1}\left(\frac{\sqrt{2}}{3}\right)$ (d) $\cos^{-1}\left(\sqrt{\frac{2}{3}}\right)$

Q53. The general equation of orthogonal trajectory of family of curves $r^n=a^n\cos n\theta$, where a is the parameter, is

(a) $r^n=b^n\cos n\theta$ (b) $r^n=b^n\sin n\theta$

(c) $r^n\cos n\theta=b$ (d) $r^n\sin n\theta=b$

Q54. The solution of the differential equation $\frac{d^2y}{dx^2} - y = e^x$, given that $y = 0, \frac{dy}{dx} = \frac{1}{2}$ when $x = 0$ is

(a) $y = xe^x$ (b) $y = e^x$ (c) $y = \frac{1}{2}xe^x$ (d) $y = \frac{1}{2}e^x$

Q55. The particular integral of the differential equation $\frac{d^2y}{dx^2} + 4y = \sin 2x$ is

(a) $-\frac{x}{4}\sin 2x$ (b) $\frac{x}{2}\sin 2x$ (c) $\frac{x}{4}\cos 2x$ (d) $-\frac{x}{4}\cos 2x$

Q56. If $y = e^{2x} + e^{-3x}$ satisfies the differential equation $\frac{d^2y}{dx^2} + A\frac{dy}{dx} + By = 0$, then A, B are respectively equal to

(a) $2, -3$ (b) $-2, 3$ (c) $1, -6$ (d) $-6, 1$

Q57. The solution of the differential equation

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

is

(a) $y^3 = ax + b$ (b) $y^2 = ax + b$ (c) $y^3 = ax^2 + bx$ (d) $y^2 = ax^2 + bx$

Q58. If $\mathcal{L}(F(t)) = f(s)$, then $\mathcal{L}\left\{\frac{d^2F(t)}{dt^2}\right\}$ is equal to

(a) $s^2 f(s) - sf'(0) - f(0)$ (b) $s^2 f(s) - sF'(0) - F(0)$

(c) $s^2 f(s) - sf(0) - f'(0)$ (d) $s^2 f(s) - sF(0) - F'(0)$

Q59. $\mathcal{L}^{-1}\left\{\frac{4s + 12}{s^2 + 8s + 16}\right\}$ is equal to

(a) $4(1+t)e^{-4t}$ (b) $4(1-t)e^{-4t}$ (c) $4te^{-4t}$ (d) $4e^{-4t}$

Q60. If $L(F(t)) = f(s)$, then $\mathcal{L}^{-1}\left\{\frac{d^n f(s)}{ds^n}\right\}$ is equal to

(a) $(-1)^n F(t)$ (b) $t^n F(t)$ (c) $(-1)^n t^n F(t)$ (d) $(-1)^n t^{n-1} F(t)$

Q61. If $\vec{u} = u_1\hat{i} + u_2\hat{j} + u_3\hat{k}$, then div curl $\vec{u}$ is equal to

(a) curl curl $\vec{u} + \nabla^2\vec{u}$ (b) $u_2\dfrac{\partial^2 u_3}{\partial x^2} + u_3\dfrac{\partial^2 u_1}{\partial y^2} + u_1\dfrac{\partial^2 u_2}{\partial z^2}$

(c) $\dfrac{\partial^2 u_1}{\partial x^2} + \dfrac{\partial^2 u_2}{\partial y^2} + \dfrac{\partial^2 u_3}{\partial z^2}$ (d) 0

Q62. div grad r^m, where $r = |\vec{r}|$ is equal to

(a) $m(m+1)r^{m-2}$ (b) $m(m-1)r^{m+1}$ (c) $m(m-1)r^{m-2}$ (d) $m(m+1)r^{m-1}$

Q63. If S is any closed surface enclosing a volume V and $\vec{F} = ax\hat{i} + by\hat{j} + cz\hat{k}$, then $\int_S\int \vec{F}\cdot\hat{n}\,dS$ is equal to

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

Q64. The value of $\int_S\int \vec{r}\,\hat{n}\,dS$ where S is the part of the sphere $x^2 + y^2 + z^2 = 1$ above xy-plane, is

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

Q65. div $\left(r^m\,\vec{r}\right)$, where $r = \left|\vec{r}\right|$ is equal to

(a) $(m+2)r^m$ (b) $(m+3)r^{m+1}$ (c) $(m+3)r^m$ (d) $(m+2)r^{m+1}$

Q66. The forces P, Q, R acting along the sides BC, CA and AB respectively are such that $P\cos A + Q\cos B + R\cos C = 0$ then their resultant passes through the.

(a) incentre (b) circumcentre (c) orthocentre (d) centroid

Q67. Forces equal to $3P, 5P$ and $7P$ act along the sides BC, CA and AB respectively of an equilateral triangle ABC, the magnitude of their resultant is

(a) $3P$ (b) $2\sqrt{7}P$ (c) $2\sqrt{3}P$ (d) $15P$

Q68. Four equal heavy uniform rods each of weight W are freely jointed so as to form a rhombus which is suspended from an angular point and kept in shape by connecting the middle points of upper two rods by a light rod. If the angle of rhombus at the point 'of suspension is 2α, the thrust in the rod is

(a) $4W\sin\alpha$ (b) $2W\tan\alpha$ (c) $2W\cos\alpha$ (d) $4W\tan\alpha$

Q69. If a uniform heavy string of length l is suspended between two points in the same horizontal line distant a apart, then the parameter c of the catenary is given by

(a) $l = 2c\sinh\frac{a}{2c}$ (b) $l = c\sinh\frac{a}{c}$

(c) $l = 2c\sinh\frac{a}{c}$ (d) $l = c\sinh\frac{a}{2c}$

Q70. The distance of the centre of gravity of a thin hemispherical shell of radius r from its centre is

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

Q71. A uniform ladder rests in limiting equilibrium with its lower end resting on a rough horizontal plane and its upper end against a smooth vertical wall. If μ is the coefficient of friction, the inclination of the ladder with the vertical is given by

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

Q.72 A particle executing SHM with time period T when moves from the position of maximum displacement to one in which the displacement is half the amplitude takes the time

(a) $\frac{1}{6}T$ (b) $\frac{1}{4}T$ (c) $\frac{1}{3}T$ (d) $\frac{1}{2}T$

Q73. If a particle is projected from a point A with a given velocity u so as to pass through another point B, the product of the two times of flight is

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

Q74. A heavy particle of mass m is suspended by a string of length a and hangs vertically. It is then projected with velocity u so that it just makes a complete revolution, then

(a) $u^2 = \left(2+\sqrt{3}\right)ag$ (b) $u^2 = 5ag$ (c) $u^2 = 4ag$ (d) $u^2 = 6ag$

Q75. If W and w are the weights of a body in vacuum and water respectively, the weight of the body in air of specific gravity σ is

(a) $w+\sigma(W-w)$ (b) $W+\sigma(W-w)$

(c) $W-\sigma(W-w)$ (d) $w-\sigma(W-w)$

Q76. Two electrons are moving in opposite directions with speeds 0 ·8c and O· 4c respectively, where c is the velocity of light. Their relative speed is about

(a) $0.4c$ (b) $0.46c$ (c) $0.49c$ (d) $1.2c$

Q77. If c is the velocity of light, then the speed at which a body should move for its mass to become twice its rest mass is

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

Q78. If sun radiates energy at the rate of 4×10^{26} $joules/\sec$, the rate at which its mass is decreasing, is

(a) $4.44\times10^{9}\ kg$ (b) $2.44\times10^{6}\ kg$

(c) $6.44\times10^{16}\ kg$ (d) $8.44\times10^{12}\ kg$

Q79. The percentage contraction produced in length of a rod moving with a speed of $0.80c$ where c is the velocity of light, in a direction parallel to its length is about

(a) 50 (b) 60 (c) 80 (d) 40

Q80. The acceleration due to gravity on the moon is just one-sixth that of the earth. If the moon and earth were assumed to have the same average composition, the ratio of moon's radius to that of the earth is

(a) 1:6 (b) 1:3 (c) 2:5 (d) 3:5

Q81. A satellite is orbiting just above the surface of a planet of average density d with a period T. If G is the universal constant of gravitation, the quantity $T^2 d$ d is equal to

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

Q82. For a geosynchronous orbit, the period of rotation of the satellite should be approximately

(a) 23 hours, 56 minutes (c) 12 hours, 34 minutes

(c) 10 hours, 56 minutes (d) 18 hours, 30 minutes

Q83. A satellite is orbiting the earth. Its speeds at perihelion and aphelion are related to the distances from the perihelion and aphelion as

(a) $\frac{v_p}{v_\alpha} = \frac{r_\alpha}{r_p}$ (b) $\frac{v_\alpha}{v_p} = \frac{r_\alpha}{r_p}$ (c) $\frac{v_p}{v_\alpha} = \frac{1}{r_p}$ (d) $\frac{v_p}{v_\alpha} = \frac{1}{r_\alpha}$

Q84. Which of the following forces is conservative?

(a) $F = 2xyz\,\hat{k}$ (b) $F = yz\,\hat{i} + zx\,\hat{j} + xy\,\hat{k}$

(c) $F = x^2 z\,\hat{i} + y^2 z\,\hat{j} + z^2\,\hat{k}$ (d) $F = x^2 yz\,\hat{i} - xyz^2\,\hat{k}$

Q85. An ice skater spins with arms outstretched at 1.9 revolutions/sec. Her moment of inertia at this time is $1.44\,kg\,m^2$. She pulls in her arms to increase her rate of spin. If her moment of inertia is $0.48\,kg\,m^2$ after she pulls in her arms, her new rate of rotation is

(a) 4.2 rev/s (b) 6.4 rev/s (c) 5.7 rev/s (d) 3.6 rev/s

Q86. A boy stands on a freely rotating platform. With his arms extended, his rotation speed is 0.25 revolutions/sec. But when he draws them in, his speed increases to 0.8 rev/sec. Then the ratio of the initial and final moments of inertia is

(a) 3.2 (b) 6.2 (c) 7.2 (d) 2.4

Q87. A pump lifts water from a lake to a large tank 20 m above the lake. If the pump transfers $5m^3$ of water to the tank, the work done by the pump (assuming the height of the tank is negligible when compared to the height of the tank and also that $1m^3$ of water = 1000 kg) is

(a) $0.72\,MJ$ (b) $0.98\,MJ$ (c) $0.56\,MJ$ (d) $0.24\,MJ$

Q88. The velocity of an 800 gm object changes from $\vec{v}_0 = (3i - 4j) to \vec{v}_f = (-6j + 2k)$. The change in its kinetic energy is

(a) $6.0\,J$ (b) $12.0\,J$ (c) $18.0\,J$ (d) $9.0\,J$

Q89. The potential energy function for the force between two atoms in a diatomic molecule can be approximately expressed as $U(x) = \frac{a}{x^{12}} - \frac{b}{x^6}$, where a and b are positive constants, and x is the distance between the atoms. $U(x)$ will be minimum when

(a) $x = \left(2\frac{a}{b}\right)^{\frac{1}{6}}$ (b) $x = \left(\frac{a}{b}\right)^{\frac{5}{6}}$ (c) $x = \left(2\frac{a}{b}\right)^{\frac{1}{2}}$ (d) $x = \left(2\frac{a}{b}\right)^{\frac{1}{5}}$

Q90. When two particles execute simple harmonic motion simultaneously, the resultant motion is an ellipse if

(1) the frequencies are in the ratio 1: 3 and the phase difference is $\frac{\pi}{4}$

(2) the frequencies are in the ratio 1: 2 and the phase difference is $\frac{\pi}{4}$

(3) the frequencies. are in the ratio 1:3 and the phase difference is $\frac{\pi}{8}$

(4) the frequencies are in the ratio 1:1 and the phase difference is $\frac{\pi}{4}$

Q91. Two tuning forks A and B produce 6 beats per second when sounded to gether. When B is slightly loaded with wax, the beats reduce to 4 per sec. If the frequency of A is 512 vib/sec the frequency of b is

(a) $512\,vib/\sec$ (b) $516\,vib/\sec$

(c) $518\,vib\sec$ (d) $520\,vib/\sec$

Q92. In a series $L-C-R$ circuit, $R = 100\Omega,$, $X_L = 300\,\Omega$ and $X_C = 200\,\Omega$. Then the phase angle ϕ of the circuit is

(a) 0^0 (b) 90^0 (c) 45^0 (d) 60^0

Q93. In an a.c. circuit which consists of an inductance and a resistance connected in series, the variation of impedance with frequency is shown by

(a) figure

(b)

(c)

(d)

Q94. If the capacitance of a series $L-C-R$ circuit is reduced to one-fourths its previous value while keeping the inductance a constant, its resonance frequency is

(a) twice its previous value (b) thrice its previous value

(c) four times its previous value (d) one-fourths of its previous value

Q95. A series $L-C-R$ circuit has a resonant frequency of 2 MHz and a $Q-$factor of 100. Its bandwidth is

(a) $20\,kHz$ (b) $2\,kHz$ (c) $4\,kHz$ (d) $40\,kHz$

Q96. When a capacitor is added in series in an $L-C-R$ circuit, the impedance of the circuit

(a) decreases

(b) increases

(c) remains constant

(d) depends on frequency of the a.c. mains

Q97. For a series $L-C-R$ circuit under resonance condition, the power factor is

(a) infinity (b) zero (c) 0.5 (d) unity

Q98. For the harmonic wave $\psi(x,t) = A\sin(kx \pm \omega t)$. the wave number and wave length are related as

(a) $k = \frac{2\pi}{\lambda}$ (b) $k = \frac{4\pi}{\lambda^2}$ (c) $k = \frac{\lambda^2}{4\pi}$ (d) $k = \frac{\lambda}{2\pi}$

Q99. A wave is represented as $\psi(x,t) = 10^3 \sin\pi\left(3\times10^5 x - 9\times10^{14} t\right)$ Then its wave velocity is

(a) $v = 3\times10^6\ m/s$ (b) $v = 9\times10^8\ m/s$

(c) $v = 3\times10^8\ m/s$ (d) $v = 9\times10^6\ m/s$

Q100. A wavefront is a surface over which the following is a constant

(a) Amplitude (b) Frequency (c) Phase (d) Wave number

Q101. A certain radio station transmits at a frequency of $900\,kHz$. The number of wave crests that pass a point each second if the point is 50 km from the station, is

(a) 9.00×10^{5} (b) 3.00×10^{8} (c) 9.00×10^{8} (d) 3.00×10^{5}

Q102. A radio station transmits at a frequency of $900\,kHz$. The wavelength of its waves is

(a) 256 m (b) 640 m (c) 400 m (d) 333 m

Q103. A radar system sends out pulses of extremely short radio waves. How many microseconds after a pulse transmitted will an echo from an airplane 30000 m away from the radar station be received?

(a) $300\,\mu s$ (b) $200\,\mu s$ (c) $400\,\mu s$ (d) $100\,\mu s$

Q104. For a linearly polarised electromagnetic plane wave whose electric field is of the form. $\vec{E} = E_x(z,t)\hat{i}$, its magnetic component is given by

(a) $\vec{B} = B_x(y,t)\hat{i}$ (b) $\vec{B} = B_y(z,t)\hat{j}$

(c) $\vec{B} = B_x(x,t)\hat{k}$ (d) $\vec{B} = B_x(z,t)\hat{k}$

Q105. Television frequencies are of the order of 100 MHz while radio broadcast frequencies are of the order of 1 MHz. The ratio of e.m.f.s generated in a loop antenna by a television wave to that generated' by a radio wave if both have equal electric field intensities, is

(a) 50:1 (b) 60:1 (c) 100:1 (d) 200:1

Q106. A laser emits a 2 mm diameter beam of highly collimated light at a power level or radiant flux of 100 mW. Neglecting any divergence of the beam, its irradiance is

(a) $31.8\,kW/m^2$ (b) $63.6\,kW/m^2$ (c) $15.9\,kW/m^2$ (d) $42.8\,kW/m^2$

Q107. A certain laser beam has a cross-sectional area of $2.0\,mm^2$ and a power of 0.80 mW. The intensity of the .beam is

(a) 800 mW (b) 1600 mW (c) 560 mW (d) 400 mW

Q108. The average energy flux density delivered by sunlight to the surface of the earth on a clear day is $\langle S\rangle = 1.0\,kW/m^2$. Then the momentum density for sunlight $\langle P_m\rangle$ is

(a) $1.1\times10^{14}\,kg\,m/s\,m^3$ (b) $2.4\times10^{-13}\,kg\,m/s\,m^3$

(c) $3.6\times10^{16}\,kg\,m/s\,m^3$ (d) $4.2\times10^{18}\,kg\,m/s\,m^3$

Q109. The following waves do not exist in a waveguide

(a) TM waves (b) TE waves (c) TEM waves (d) TE and TM waves

Q110. When a wave travelling in air enters 3 waveguide

(a) the phase velocity will increase

(b) the group velocity will increase

(c) the phase velocity will decrease

(d) both phase velocity and group velocity will decrease

Q111. When a transmission line is terminated by its characteristics impedance

(a) it behaves as an infinite line (b) standing wave pattern is obtained

(c) zero power reaches the load (d) power gets reflected to the source

Q112. For TEM mode propagation in a transmission line

(a) $\vec{E}$ is entirely transverse to direction of propagation and $\vec{H}$ has a component in the direction of propagation

(b) $\vec{H}$ is entirely transverse to direction of propagation and $\vec{E}$ has a component in the direction of propagation

(c) both $\vec{E}$ and $\vec{H}$ have components in the direction of propagation

(d) both $\vec{E}$ and $\vec{H}$ are entirely transverse to the direction of propagation

Q113. In semiconductors like silicon, the unit cell is

(a) simple cubic (b) body-centred cubic

(c) face-centred cubic (d) hexagonal

Q114.

The electronic distributions of electrons in the various orbits of a silicon atom are

(a) 2. 10, 2 (b) 2, 7, 5 (c) 2, 8, 4 (d) 2, 4, 8

Q115. Conduction electrons have more mobility than holes because they

(a) air lighter (b) experience collisions less frequently

(c) have negative charge (d) need less energy to move them

Q116. Major part of current in an intrinsic semiconductor is due to

(a) conduction-band electrons (b) valence-band electrons

(c) holes in the valence band (d) thermally generated electrons

Q117. The leakage current of a $P-N$ junction diode is caused by

(a) chemical potential (b) barrier voltage

(c) heat energy (d) dopant

Q118. A transistor has $\alpha = 0.98$, $I_B = 100\mu A$ and $I_{CO} = 6\mu A$. Its collector current I_C is

(a) 5.2 mA (b) 4·6 mA (c) 7.2 mA (d) 9.6 mA

Q119. The emitter of a transistor is generally doped the heaviest because it

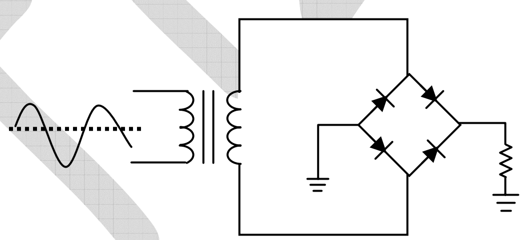
(a) has to dissipate maximum power

(b) has to supply the charge carriers

(c) is the first region of the transistor

(d) must possess low resistance

Q120. In the rectifier circuit shown below, the AC signal voltage is $E = 5\sin(2\pi 50t)$. Then the ripple frequency of the output voltage is



(a) 25 Hz (b) 50 Hz (c) 100 Hz (d) 200 Hz

Q121. A bridge rectifier is preferred over an ordinary full-wave rectifier, because

(a) it uses four diodes

(b) its transformer has no centre tap

(c) it needs much smaller transformer for the same output

(d) it has higher efficiency

Q122. In a CE class A voltage amplifier, the worst case condition occurs when

(a) zero signal input (b) maximum signal input

(c) high load resistance (d) transformer coupling

Q123. When two laser lights having wavelengths λ and λ' incident independently on a pair of slits, they produce interference patterns having fringe widths $\Delta x = 6.3$ mm and $\Delta x' = 7.6$ mm respectively. If $\lambda = 630$ nm, λ' is

(a) 760 nm (b) 660 nm (c) 560 nm (d) 860 nm

Q124. When the movable mirror of a Michelson's interferometer illuminated by monochromatic light is shifted by 0·015 mm, a shift of 50 fringes is observed. Then the wavelength of light used is

(a) 400 nm (b) 500 nm (c) 600 nm (d) 800 nm

Q125. In a Newton's ring experiment, the diameter of the nth dark ring changes from 1.2 cm to 1 cm when the air space between the lens and plate is replaced by a transparent liquid. The refractive index of the liquid is

(a) 1.33 (b) 1.44 (c) 1.5 (d) 2·33

Q126. Newton's rings are formed by a light of 400 nm wavelength. Between the third and sixth bright fringe, the change in thickness of the air film is

(a) 600 nm (b) 800 nm (c) 300 nm (d) 900 nm

Q127. When one leg of a Michelson's interferometer is lengthened by a distance, say x, 150 dark fringes sweep through the field of view. If the wavelength of light used is 480 nm, the value of x is

(a) 12000 nm (b) 24000 nm (c) 48000 nm (d) 36000 nm

Q128. Two wavelengths of light λ_1 and λ_2 are sent through a Young's double slit apparatus simultaneously. If the third order λ_1 bright fringe is to coincide with fourth order λ_2 bright fringe, then the wavelengths are related as

(a) $\lambda_2 = \frac{3}{4}\lambda_1$ (b) $\lambda_2 = \frac{2}{5}\lambda_1$ (c) $\lambda_2 = \frac{4}{3}\lambda_1$ (d) $\lambda_2 = \frac{5}{3}\lambda_1$

Q129. A diffraction grating is illuminated by a laser of wavelength 500 nm. If a second order spectral line is observed at 30°, the number of lines per centimetre of the grating is

(a) 6000 (b) 5000 (c) 4000 (d) 2000

Q130. If a beam of polarised light has one-fourths of the initial intensity after passing through an analyzer, the angle between the axis of the analyzer and the initial amplitude of the beam is

(a) 30° (b) 45° (c) 60° (d) 90°

Q131. Ordinary light incident on one Polaroid sheet falls on a second Polaroid whose plane of vibration makes an angle of 60° with that of the first Polaroid. If the Polaroids are assumed to be ideal, the fraction of the original light transmitted through both the Polaroids is

(a) $\frac{1}{8}$ (b) $\frac{2}{8}$ (d) $\frac{3}{8}$ (4) $\frac{5}{8}$

Q132. Linearly polarised light is incident at Brewster's angle on the surface of a medium. If the incident beam is polarised parallel to the plane of incidence, then

(a) no light is reflected at all

(b) no light is refracted at all

(c) some of the light is reflected and some refracted

(d) neither the light is reflected nor refracted

Q133. Plane polarised light is incident on a quartz crystal at an angle 30°. The quartz crystal is cut with faces parallel to the axis. If the wavelength of light is 500 nm, refractive index for ordinary ray is 1.54 and that for extraordinary ray is 1.553, the ratio of intensities of the extraordinary ray and ordinary ray is

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

Q134. The tube in a Laurent's half shade polarimeter is 20 cm long. It is filled with a solution of cane sugar formed by dissolving 10 gm of sugar in 40 c.c. of distilled water. If the rotation of the plane of polarisation is 34°, the specific rotation of cane sugar is

(a) 54° (b) 68° (c) 72° (d) 84°

Q135. The rotation of the plane of polarised light for the green mercury line produced by 1 mm of quartz cut perpendicular to the optic axis is 20°. If this quartz plate is placed between two parallel Nicol prisms, then the intensity of transmitted light is zero for a thickness of the quartz plate equal to

(a) 2.5 mm (b) 3.5 mm (c) 5 mm (d) 4.5 nm

Q136. The total number of lines on a grating to just resolve 4000 Å and 4001 Å wavelength lines in the first order spectrum is

(a) 4000 (b) 4200 (c) 5400 (d) 6400

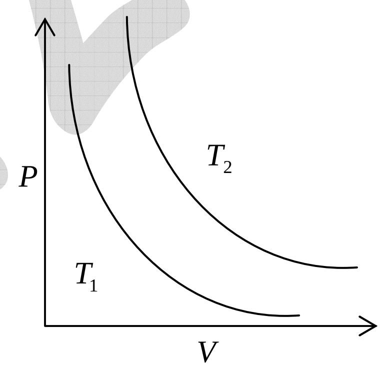
Q137. Green light of wavelength 500 nm illuminates a pair of narrow slits 1 mm apart. The separation of the bright bands in the interference pattern on a screen 2 m away is

(a) 0.1 mm (b) 0·25 mm (c) 1·0 mm (4) 0.4 mm

Q138. A reversible heat engine converts $1/6$th heat which it absorbs from source into useful work. When the temperature of the sink is reduced by 62° C, its efficiency is doubled. Then the temperature of the source is

(a) 262 K (2) 172 K (c) 272 K (d) 372 K

Q139. For a certain mass of gas the isothermal curve between P and V at temperatures T_1 and T_2 is shown in the figure below. Then

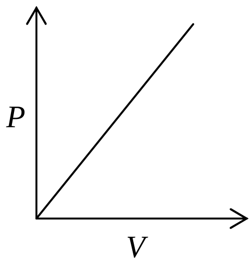


(a) $T_1 > T_2$ (b) $T_1 < T_2$

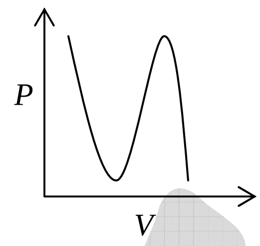
(c) $T_1 = T_2$ (d) Nothing can be predicted

Q140. For a certain mass of gas above its critical temperature the graph that best represents the pressure and volume variations is

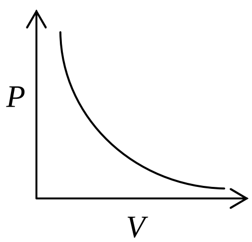
(a)



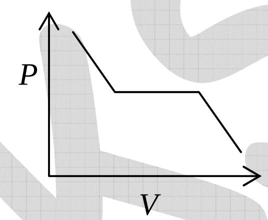
(b)



(c)



(d)



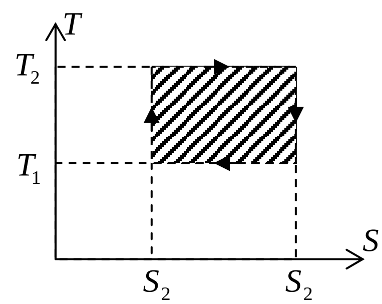
Q141. The total gain in the entropy of a working substance in a Carnot engine is

(a) negative (b) positive (c) zero (d) oscillatory

Q142. 540 gm of ice at 0^0C is mixed with 540 gm of water at 80^0C. The resultant temperature of the mixture is

(a) 0^0C (b) 40^0C (c) -20^0 (d) 80^0C

Q143. In the S-T diagram given below, the shaded area shows



(a) a net outflow of heat

(b) a net inflow of heat

(c) work done on the system

(d) work done by the system

Q144. When a certain amount of heat is given to a gas under isothermal conditions, it will result in

(a) external work being done

(b) a rise in temperature

(c) both external work and rise in temperature

(d) an increase in internal energy of the gas

Q145. The ratio of adiabatic to isochoric pressure coefficient of expansion $\frac{\beta_s}{\beta_v}$ is

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

Q146. In photoelectric experiment the wavelength of incident radiation is decreased from 6000Å to 4500Å, then

(a) the stopping potential will increase

(b) the stopping potential will decrease

(c) the photoelectric current will increase

(d) the photoelectric current may stop

Q147. Radiation from the Big Bang has been Doppler shifted to longer wavelengths by the expansion of the universe and today has a spectrum corresponding to a black body at $2.898\ K$, The wavelength at which the energy density of this radiation is a maximum, is

(a) 1.0 mm (b) 2.4 mm (c) 3.6 mm (d) 4.8 mm

Q148. It is impossible for pair production to occur in empty space because

(a) it is impossible for pair production to conserve energy in empty space

(b) it is impossible for pair production to conserve momentum in empty space

(c) it is impossible for pair production to conserve both energy and momentum in empty space

(d) of relativistic speed of the particles

Q149. For Compton scattering at 90°, the effective shift in wavelength is

(a) 0.242Å (b) 2.42Å (c) 0.0242Å (d) 0.00242Å

Q150. Raman effect is due to

(a) coherent scattering (b) incoherent scattering

(c) electronic translation (d) refraction