

**BHU-2012 (Geo-Physics)**

- Q1. All value of  $(-1)^{1/3}$  are  
 (a)  $1, \frac{1}{2}(1 \pm \sqrt{3})$  (b)  $-1, \frac{1}{3}(1 \pm \sqrt{2})$  (c)  $-1, \frac{1}{2}(1 \pm \sqrt{3})$  (d)  $1, \frac{1}{3}(1 \pm \sqrt{2})$
- Q2. Roots of  $x^7 + 1 = 0$  are for  $r = 0, 1, 2, 3, 4, 5$  and 6  
 (a)  $\cos\left(\frac{2r\pi + \pi}{7}\right) + i\sin\left(\frac{2r\pi + \pi}{7}\right)$  (b)  $\cos\left(\frac{3r\pi + \pi}{7}\right) + i\sin\left(\frac{3r\pi + \pi}{7}\right)$   
 (c)  $\cos\left(\frac{2r\pi + \pi}{7}\right) - i\sin\left(\frac{2r\pi + \pi}{7}\right)$  (d)  $\cos\left(\frac{3r\pi + \pi}{7}\right) - i\sin\left(\frac{3r\pi + \pi}{7}\right)$
- Q3. If  $\frac{\sin \theta}{\theta} = \frac{2165}{2166}$ , then angle  $\theta$  is nearly equal to  
 (a) 2 (b) 3 (c) 4 (d) 5
- Q4. The value of  
 $\lim_{n \rightarrow 0} \frac{\sin n\theta - n \sin \theta}{\theta(\cos n\theta - \cos \theta)}$  is  
 (a)  $\frac{n}{2}$  (b)  $\frac{n}{3}$  (c)  $\frac{2n}{3}$  (d)  $\frac{3n}{2}$
- Q5. The value of  $i \log \frac{x-i}{x+i}$  is  
 (a)  $2\pi - \tan^{-1} x$  (b)  $2\pi + \tan^{-1} x$  (c)  $\pi + 2 \tan^{-1} x$  (d)  $\pi - 2 \tan^{-1} x$
- Q6. Principal value of  $(i)^i$  is  
 (a)  $e^\pi$  (b)  $e^{-\pi}$  (c)  $e^{-\pi/2}$  (d)  $e^{\pi/2}$
- Q7.  $\cos \frac{2\pi}{7}, \cos \frac{4\pi}{7}, \cos \frac{8\pi}{7}$  are the roots of equation  
 (a)  $8x^3 - 4x^2 + 4x + 1 = 0$  (b)  $8x^3 + 4x^2 - 4x + 1 = 0$   
 (c)  $8x^3 - 4x^2 - 4x + 1 = 0$  (d)  $8x^3 + 4x^2 - 4x - 1 = 0$   
 where  $x = \cos \theta$

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Q8. The equation whose roots are  $-3, -1, \frac{5}{3}$  is

(a)  $3x^3 + 7x^2 - 11x + 15 = 0$

(b)  $3x^3 - 7x^2 + 11x - 15 = 0$

(c)  $3x^3 + 11x^2 - 7x + 15 = 0$

(d)  $3x^3 - 11x^2 + 7x + 15 = 0$

Q9. The eigenvalue of the matrix

$$A \begin{bmatrix} \cos \theta & \sin \theta \\ \sin \theta & -\cos \theta \end{bmatrix} \text{ are}$$

(a) 0, 1

(b) 1, -1

(c) 0, -1

(d) 1, 1

Q10. The eigenvalue of the matrix

$$A = \begin{bmatrix} 1 & -1 & 4 \\ 3 & 2 & -1 \\ 2 & 1 & -1 \end{bmatrix} \text{ are}$$

(a) 1, 2, 3

(b) -1, 2, 3

(c) 1, -2, 3

(d) 1, 2, -3

Q11. The characteristic equation of the matrix

$$A = \begin{bmatrix} 3 & 0 \\ 8 & -1 \end{bmatrix} \text{ is}$$

(a)  $\lambda^2 - 2\lambda - 3 = 0$

(b)  $\lambda^2 + 2\lambda - 3 = 0$

(c)  $\lambda^3 - 3\lambda + 2 = 0$

(d)  $\lambda^2 + 3\lambda - 2 = 0$

Q12. The eigenvalues of a triangular matrix are just the

(a) diagonal elements of matrix

(b) reciprocal of diagonal elements of matrix

(c) diagonal elements of matrix with opposite sign

(d) None of these

Q13. The rank of the matrix

$$A = \begin{bmatrix} 6 & 1 & 3 & 8 \\ 4 & 2 & 6 & -1 \\ 10 & 3 & 9 & 7 \\ 16 & 4 & 12 & 15 \end{bmatrix} \text{ is}$$

(a) 2

(b) 3

(c) 4

(d) 1

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Q14. The value of the determinant

$$A = \begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^2 & b^2 & c^2 \end{vmatrix} \text{ is}$$

- (a)  $(a+b)(b+c)(c+a)$  (b)  $a^2b^2c^2$   
 (c)  $(1-a)(1-b)(1-c)$  (d)  $(a-b)(b-c)(c-a)$

Q15. if  $x = 2$  is a root of the equation

$$\begin{vmatrix} x & -6 & -1 \\ 2 & -3x & x-3 \\ -3 & 2x & x+2 \end{vmatrix} = 0$$

then other roots are

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

Q16. The system of equations  $x + y + z = 1$ ,  $x + 2y + 4z = \lambda$ ,  $x + 4y + 10z = \lambda^2$  has a solution  $x = 2k + 1, y = -3k, z = k$  for which of  $\lambda$ ?

- (a)  $\lambda = 0$  (b)  $\lambda = -1$  (c)  $\lambda = +1$  (d)  $\lambda = 2$

Q17. If the roots of the equation  $x^3 + 3px^2 + 3qx + r = 0$  are in GP, then

- (a)  $P^2r = q^2$  (b)  $pr^3 = q^3$  (c)  $pr^2 = q^2$  (d)  $p^3r = q^3$

Q18. If the roots of the equation  $x^n - 1 = 0$  are  $1, \alpha, \beta, \gamma, \dots$ , then the value of  $(1 - \alpha)(1 - \beta)(1 - \gamma) \dots$  is

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

Q19. The system of equations  $x + 2y + z = 8$ ,  $2x + y + 3z = 13$ ,  $3x + 4y - \lambda z = \mu$  has infinite solution for the following values of  $\lambda, \mu$

- (a)  $3\lambda + 11 = 0, \mu = 22$  (b)  $3\lambda + 22 = 0, \mu = 11$   
 (c)  $\lambda \neq -\frac{11}{3}, \mu \neq 22$  (d)  $\lambda \neq \frac{11}{2}, \mu \neq 22$

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- Q20. For which real value of  $\lambda$  the system of equations  $x + 2y + 3z = \lambda x$ ,  $3x + y + 2z = \lambda y$ ,  $2x + 3y + z = \lambda z$  has a non-zero solution?
- (a) 3 (b) -3 (c) 6 (d) -6
- Q21. If  $y = (\sin^{-1} x)^2$ , then the value of  $(1 - x^2)y_2 - xy_1$  is
- (a) 0 (b) 4 (c) 2 (d) -2
- Q22. If  $y = x^{n-1} \log x$ , then the value of  $D^n y$  is
- (a)  $(n-1)!/x$  (b)  $(n-1)! \log x$   
(c)  $n!/x$  (d)  $n! \log x$
- Q23. The curve  $x^3 + x^2y - xy^2 - y^3 - 3x - y - 1 = 0$  has the asymptotes
- (a)  $y = x, y = x + 1, y = -x - 1$  (b)  $y = x, y = x - 1, y = x + 1$   
(c)  $y = x, y = x - 1, y = -x - 1$  (d)  $y = x, y = -x + 1, y = -x - 1$
- Q24. The curve  $\frac{a^2}{x^2} - \frac{b^2}{y^2} = 1$  has the asymptotes
- (a)  $x = \pm a, y = \pm b$  (b)  $x = \pm a$   
(c)  $y = \pm b$  (d)  $x = \pm a, y = \pm bi$
- Q25. The radius of curvature of a parabola  $y^2 = 4ax$  at the point  $(x, y)$  is
- (a)  $\frac{2}{\sqrt{a}}(x+a)^{3/2}$  (b)  $2\sqrt{a}(x+a)^{3/2}$   
(c)  $\frac{2}{\sqrt{a}}(x+a)^{-3/2}$  (d)  $2\sqrt{a}(x+a)^{-3/2}$
- Q26. The radius of curvature of a cycloid  $x = a(t + \sin t), y = a(1 - \cos t)$  at any point  $t$  is
- (a)  $4a \sin\left(\frac{t}{2}\right)$  (b)  $2a \sin\left(\frac{t}{2}\right)$  (c)  $4a \cos\left(\frac{t}{2}\right)$  (d)  $2a \cos\left(\frac{t}{2}\right)$
- Q27. Function  $u = x^3 y^2 (1 - x - y)$  has maximum value at the point
- (a)  $\left(\frac{1}{2}, \frac{1}{2}\right)$  (b)  $\left(\frac{1}{3}, \frac{1}{3}\right)$  (c)  $\left(\frac{1}{2}, \frac{1}{3}\right)$  (d)  $\left(\frac{1}{3}, \frac{1}{2}\right)$

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- Q28. If  $x^x y^y z^z = c$ , then the value of  $\frac{\partial^2 z}{\partial x \partial y}$  at  $x = y = z$  is  
 (a)  $(x \log ex)$  (b)  $-(x \log ex)$  (c)  $(x \log ex)^{-1}$  (d)  $-(x \log ex)^{-1}$
- Q29. For the function  $f(x) = \sqrt{x^2 - 4}$  in the interval  $[2, 4]$  the value of constant  $c$  by Lagrange mean value theorem is  
 (a)  $\sqrt{3}$  (b)  $\sqrt{6}$  (c)  $2\sqrt{3}$  (d)  $\sqrt{5}$
- Q30.  $\int_0^1 \int_0^1 (x^2 + y^2) dx dy$  has the value  
 (a) 1 (b) 0 (c)  $\frac{1}{3}$  (d)  $\frac{2}{3}$
- Q31.  $\int_0^1 \int_{y^2}^1 \int_0^{1-x} x dz dx dy$  has the value  
 (a)  $\frac{1}{16}$  (b)  $\frac{4}{21}$  (c)  $\frac{1}{10}$  (d)  $\frac{4}{35}$
- Q32. The whole area of the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  is  
 (a)  $\pi ab$  (b)  $2\pi ab$  (c)  $3\pi ab$  (d)  $\frac{\pi}{2} ab$
- Q33. The whole length of the curve  $x^2(a^2 - x^2) = 8a^2 y^2$  is  
 (a)  $\pi a\sqrt{2}$  (b)  $\pi a 2\sqrt{2}$  (c)  $\frac{\pi}{2} a\sqrt{2}$  (d)  $\frac{\pi}{3} a\sqrt{2}$
- Q34. The volume of the solid generated by revolving the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  about the  $x$ -axis is  
 (a)  $\frac{2}{3} \pi ab^2$  (b)  $\frac{4}{3} \pi ab^2$  (c)  $\frac{2}{3} \pi ab^3$  (d)  $\frac{4}{3} \pi ab^3$
- Q35. The area of a loop of the curve  $r^2 = a^2 \cos 2\theta$  is  
 (a)  $a^2$  (b)  $\frac{a^2}{2}$  (c)  $2a^2$  (d)  $3a^2$

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Q36. The cardioid  $r = a(1 + \cos \theta)$  revolves about the initial line, then the volume of solid generated is

- (a)  $\frac{5\pi a^3}{3}$       (b)  $\frac{7\pi a^3}{3}$       (c)  $\frac{8\pi a^3}{3}$       (d)  $\frac{10\pi a^3}{3}$

Q37. The Cartesian coordinates of the point whose polar coordinates are  $(2\sqrt{2}, \pi/4)$ , are

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

Q38. The equation of straight line passing through points whose polar coordinates are  $(3, 30^\circ)$  and  $(4, 90^\circ)$  is

- (a)  $\frac{1}{r} = \frac{5}{\sqrt{3}} \cos \theta + \frac{1}{12} \sin \theta$       (b)  $\frac{1}{r} = \frac{5}{12\sqrt{3}} \cos \theta + \frac{1}{4} \sin \theta$   
 (c)  $\frac{1}{r} = \frac{3}{\sqrt{5}} \cos \theta + \frac{1}{4} \sin \theta$       (d)  $\frac{1}{r} = \frac{5}{2\sqrt{3}} \cos \theta + \frac{1}{12} \sin \theta$

Q39. The condition that the straight line  $\frac{1}{r} = a \cos \theta + b \sin \theta$  may touch the circle  $r = 2c \cos \theta$  is

- (a)  $bc + 2ac = 1$       (b)  $bc + 2a^2c^2 = 1$   
 (c)  $b^2c^2 + 2ac = 1$       (d)  $b^2c^2 + 2a^2c^2 = 1$

Q40. Equation  $\frac{l}{r} = 2 \sin^2 \frac{\theta}{2}$  represents  $a/an$

- (a) ellipse      (b) hyperbola      (c) parabola      (d) straight line

Q41. Equation of the tangent of conic  $\frac{l}{r} = 1 + e \cos \theta$  at a point  $\theta = \alpha$  is

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

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- Q42. Equation to the normal of conic  $\frac{l}{r} = 1 + e \cos \theta$  at a point  $\theta = \alpha$  is
- (a)  $\frac{el \sin \alpha}{r(1 + e \cos \alpha)} = -e \sin \theta + \sin(\theta - \alpha)$       (b)  $\frac{el \sin \alpha}{r(1 + e \cos \alpha)} = e \sin \theta + \sin(\theta - \alpha)$
- (c)  $\frac{el \sin \alpha}{r(1 + e \cos \alpha)} = \sin \theta - e \sin(\theta - \alpha)$       (d)  $\frac{el \sin \alpha}{r(1 + e \cos \alpha)} = -e \sin \theta - \sin(\theta - \alpha)$
- Q43. The equation of director circle of a conic  $\frac{l}{r} = 1 + e \cos \theta$  is
- (a)  $r^2(1 - e^2) + 2elr \cos \theta - 2l^2 = 0$       (b)  $r^2(1 + e^2) - 2elr \cos \theta + 2l^2 = 0$
- (c)  $2r^2(1 - e^2) + elr \cos \theta - 2l^2 = 0$       (d)  $2r^2(1 + e^2) + 2elr \cos \theta + 2l^2 = 0$
- Q44. Equation of cylinder whose generator is parallel to line  $\frac{x}{1} = \frac{y}{-2} = \frac{z}{3}$  and guiding curve is  $x^2 + 2y^2 = 1, z = 0$  is
- (a)  $3x^2 + 6y^2 + 3z^2 + 2zx - 8yz - 3 = 0$       (b)  $3x^2 + 6y^2 - 3z^2 + 2zx + 8yz + 3 = 0$
- (c)  $3x^2 + 6y^2 + 3z^2 - 2zx + 8yz + 3 = 0$       (d)  $3x^2 + 6y^2 + 2z^2 - 2z - 8yz + 3 = 0$
- Q45. Equation of right circular cylinder whose radius is  $a$ , axis  $X$ -axis is
- (a)  $x^2 + y^2 = a^2$       (b)  $x^2 + z^2 = a^2$       (c)  $y^2 + z^2 = a^2$       (d)  $x^2 + y^2 + z^2 = a^2$
- Q46. Enveloping cylinder of a surface with that surface
- (a) intersects      (b) touches
- (c) intersects in a curve      (d) none of these
- Q47. The equation of right circular cylinder whose axis is  $x + y = 0, x + y + 3z = 6$  and radius 4 is
- (a)  $x^2 + y^2 - 2z^2 + 2xy + 8z - 24 = 0$       (b)  $x^2 + y^2 - 2z^2 - 2xy + 8z + 24 = 0$
- (c)  $x^2 + y^2 + 2z^2 - 2xy - 8z + 24 = 0$       (d)  $x^2 + y^2 + 2z^2 + 2xy - 8z - 24 = 0$

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- Q48. If  $r = a \cos ti + a \sin tj + tk$ , then  $\frac{d^2 r}{dt^2}$  is
- (a)  $a \cos ti + a \sin tj$  (b)  $-a \cos ti - a \sin tj$   
(c)  $-a \cos ti + a \sin tj$  (d)  $a \cos ti - a \sin tj$
- Q49. The necessary and sufficient condition that a vector  $a(t)$  has a fixed direction is
- (a)  $a \cdot \frac{da}{dt} = 0$  (b)  $a \cdot \frac{da}{dt} \neq 0$  (c)  $a \times \frac{da}{dt} = 0$  (d)  $a \times \frac{da}{dt} \neq 0$
- Q50. If  $r = (\cos nt)i + (\sin nt)j$ , then  $r \times \frac{dr}{dt}$  is
- (a)  $ni$  (b)  $nj$  (c)  $nk$  (d)  $0$
- Q51. If  $a = x^2 yzi - 2xz^3 j + xz^2 k$  and  $b = 2zi + yj - x^2 k$ , then  $\frac{\partial^2}{\partial x \partial y}(a \times b)$  at the point  $(1, 0, -2)$  is
- (a)  $4i + 8j$  (b)  $4i - 8j + 2k$  (c)  $-4i - 8j$  (d)  $4i + 8j - 2k$
- Q52. If  $\phi(x, y, z) = 2x^2 y^3 - 3y^2 z^3$ , then gradient  $\nabla \phi$  at the point  $(1, -1, 1)$  is
- (a)  $-4i - 12j + 9k$  (b)  $4i + 12j - 9k$  (c)  $4i + 12j - 9k$  (d)  $-4i + 8j - 2k$
- Q53. If  $\hat{r} = xi + yj + zk$ , then gradient  $r^n$  is
- (a)  $nr^{n-2}\hat{r}$  (b)  $nr^{n-1}\hat{r}$  (c)  $nr^{n-2}$  (d)  $nr^{n-1}$
- Q54. The directional derivative of  $\phi = (x^2 + y^2 + z^2)^{-1/2}$  at the point  $(3, 1, 2)$  in the direction of the vector  $yz i + zx j + xy k$  is
- (a)  $\frac{9}{14\sqrt{14}}$  (b)  $-\frac{9}{14\sqrt{14}}$  (c)  $-\frac{9}{49\sqrt{14}}$  (d)  $\frac{9}{49\sqrt{14}}$
- Q55. If  $r = xi + yj + zk$ , then  $\text{div } r$  is
- (a) 1 (b) 0 (c) 3 (d) -3
- Q56. If  $\phi$  is differentiable vector function, then value of  $\text{curl grad } \phi$  is
- (a) 1 (b) -1 (c)  $\phi$  (d) 0

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- Q57. Any vector point function  $F$  is irrotational if  
 (a)  $\nabla \times F = 0$       (b)  $\nabla \cdot F = 0$       (c)  $\nabla \cdot (\nabla F) = 0$       (d)  $\nabla F = 0$
- Q58. If  $F = \text{grad}\phi$ , then  $\text{curl } F$  is  
 (a)  $-1$       (b)  $+1$       (c)  $0$       (d)  $\phi$
- Q59. If  $F = xyi + yzj + zyk$  and  $C$  is a curve  $r = ti + t^2j + t^3k$ , where  $t$  varies from  $-1$  to  $1$ , then  $\int_C F \cdot dr$  is  
 (a)  $\frac{10}{3}$       (b)  $\frac{7}{3}$       (c)  $\frac{7}{10}$       (d)  $\frac{10}{7}$
- Q60. If  $S$  is any closed surface enclosing a volume  $V$  and  $F = xi + 2yj + 3zk$ , then  $\iiint_S F \cdot \hat{n} dS$  is  
 (a)  $2V$       (b)  $3V$       (c)  $5V$       (d)  $6V$
- Q61. For the vector  $F = xi - yj + 2zk$  over the sphere  $x^2 + y^2 + (z-1)^2 = 1$ , the value of  $\iiint_S F \cdot \hat{n} dS$   
 (a)  $\frac{4\pi}{3}$       (b)  $\frac{6\pi}{3}$       (c)  $\frac{8\pi}{3}$       (d)  $\frac{10\pi}{3}$
- Q62. The value of  $\int_C [\cos x \sin y - xy] dx + \sin x \cos y dy$  by Green's theorem for circle  $c$   
 $x^2 + y^2 = 1$  is  
 (a)  $0$       (b)  $1$       (c)  $2$       (d)  $3$
- Q63. The solution of differential equation  $y'' - 2y' + 2y = 0$  with the initial condition  $y(0) = y'(0) = 1$  is  
 (a)  $y = e^t \sin t$       (b)  $y = e^t \cos t$       (c)  $y = e^{-t} \sin t$       (d)  $y = e^{-t} \cos t$

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- Q64. The solution of differential equation  $x'' + m^2x = a \cos nt, t > 0, x(0) = x_0, x'(0) = x_1$  is
- (a)  $x = x_0 \cos mt + \frac{x_1}{m} \sin mt + \frac{a}{m^2 - n^2} (-\cos mt + \cos nt)$
- (b)  $x = x_0 \sin mt + \frac{x_1}{m} \cos mt + \frac{a}{m^2 - n^2} (-\cos mt + \cos nt)$
- (c)  $x = x_0 \cos mt - \frac{x_1}{m} \sin mt + \frac{a}{m^2 - n^2} (-\cos mt + \cos nt)$
- (d)  $x = x_0 \sin mt + \frac{x_1}{m} \cos mt + \frac{a}{m^2 - n^2} (-\cos mt + \cos nt)$
- Q65. Which of the following is not the solution of the differential equation  $(D^2 - 1)y = 0$ ?
- (a)  $e^x$                       (b)  $e^x + c$                       (c)  $e^{-x}$                       (d)  $ae^x + be^{-x}$
- Q66. The general solution of the differential equation  $D^2y = 0$  is
- (a)  $y = c_1 + c_2e^x$                       (b)  $y = (c_1 + c_2x)e^x$
- (c)  $y = (c_1 + c_2x)e^{-x}$                       (d)  $y = c_1 + c_2x$
- Q67. The solution of the differential equation  $(D^2 + 1)y = \cos 2x$  is
- (a)  $y = c_1 \cos x + c_2 \sin x + \frac{1}{3} \cos 2x$                       (b)  $y = c_1 \cos x - c_2 \sin x + \frac{1}{3} \sin 2x$
- (c)  $y = c_1 \cos x + c_2 \sin x - \frac{1}{3} \cos 2x$                       (d)  $y = c_1 \cos x - c_2 \sin x - \frac{1}{3} \sin 2x$
- Q68. The orthogonal trajectory of  $xy = k^2$  is
- (a)  $x^2 - y^2 = 2c$                       (b)  $2x^2 - 3x^2 = 2c$
- (c)  $x^2 + y^2 = 3c$                       (d)  $2x^2 + 3x^2 = 2c$
- Q69. The member of orthogonal trajectory of  $x^2 + 3y^2 = cy$  which passes through the point  $(1, 2)$  is
- (a)  $y^2 = x^2(3x - 1)$                       (b)  $2y^2 = x^2(3x + 1)$
- (c)  $y^2 = x^2(3x + 1)$                       (d)  $2y^2 = x^2(3x - 1)$

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Q70. The solution of the integral equation

$$F(t) = a \sin t - 2 \int_0^1 F(u) \cos(t-u) du$$

is

- (a)  $ate^{-t}$                       (b)  $ate^t$                       (c)  $ate^{-2t}$                       (d)  $ate^{2t}$

Q71. The solution of the integral equation

$$F(t) = e^{-t} - 2 \int_0^1 \cos(t-u) F(u) du$$

is

- (a)  $e^{-t}(1-t)^3$                       (b)  $e^t(1-t)^2$                       (c)  $e^t(1-t)^3$                       (d)  $e^{-t}(1-t)^2$

Q72. The solution of differential equation  $(D+1)^2 y = t$ , given that  $y = -3$ , when  $t = 0$  and  $y = -1$ , when  $t = 1$  is

- (a)  $y = -2 + t - e^{-t} + te^{-t}$                       (b)  $y = -2 + t + e^{-t} - te^{-t}$   
(c)  $y = -2 + t - 2e^{-t} + te^{-t}$                       (d)  $y = -2 + t + 2e^{-t} + te^{-t}$

Q73. Which relation is not true for a common catenary?

- (a)  $y = c \cosh\left(\frac{x}{c}\right)$                       (b)  $x = c \log(\sec \psi + \tan \psi)$   
(c)  $y = c \sec \psi$                       (d)  $s = c \sin \psi$

Q74. If a body is slightly displaced from its position of equilibrium and the forces acting on it in its displaced position are in equilibrium, the body is said to be in

- (a) stable equilibrium                      (b) neutral equilibrium  
(c) unstable equilibrium                      (d) limiting equilibrium

Q75. If  $V_1, V_2$  are the velocities at the ends of a focal chord of a projectile path and  $V$  the horizontal component of velocity, then

- (a)  $\frac{1}{V_1^2} - \frac{1}{V_2^2} = \frac{1}{V^2}$                       (b)  $\frac{1}{V_1^2} + \frac{1}{V_2^2} = \frac{1}{V^2}$   
(c)  $\frac{1}{V_1^2} - \frac{1}{V_2^2} > \frac{1}{V^2}$                       (d)  $\frac{1}{V_1^2} - \frac{1}{V_2^2} < \frac{1}{V^2}$

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- Q76. Galilean transformations and Maxwell's electromagnetic theory  
 (a) are consistent (b) are inconsistent  
 (c) complement each other (d) reinforce each other
- Q77. A synchronous relay satellite reflects TV signals and transmits TV programmes from one part of the world to the other part because  
 (a) period of revolution of the satellite around the earth is greater than the period of rotation of the earth about its axis  
 (b) period of revolution of the satellite around the earth is less than the period of rotation of the earth about its axis  
 (c) period of revolution of the satellite around the earth is equal to the period of rotation of the earth about its axis  
 (d) mass is less than that of the mass of the earth
- Q78. Two uniform circular discs  $A$  and  $B$  of equal masses and thickness are made of materials of densities  $d_A$  and  $d_B$  respectively. If their moments of inertia about an axis passing through the centre and normal to the circular face are  $I_A$  and  $I_B$  respectively, then  
 (a)  $\frac{I_A}{I_B} = \frac{d_A}{d_B}$  (b)  $\frac{I_A}{I_B} = \frac{d_B}{d_A}$  (c)  $\frac{I_A}{I_B} = \frac{d_A^2}{d_B^2}$  (d)  $\frac{I_A}{I_B} = \frac{d_B^2}{d_A^2}$
- Q79. A planet revolves around the sun in an elliptic orbit with semi-major and semi-minor axes  $a$  and  $b$  respectively. Then its time period  $T$  of revolution around the sun satisfies the rule  
 (a)  $T^2 \propto b^3$  (b)  $T^2 \propto a^3$  (c)  $T^2 \propto \left(\frac{a+b}{2}\right)^3$  (d)  $T^2 \propto \left(\frac{a-b}{2}\right)^3$
- Q80. A solid cylinder, whose moment of inertia of about its axis is  $I$  is allowed to roll on a surface without slipping. If its angular velocity is  $\omega$ , then its kinetic energy is  
 (a)  $E = I\omega^2$  (b)  $E = \frac{3}{2}I\omega^2$  (c)  $E = \frac{1}{2}I\omega^2$  (d)  $E = 2I\omega^2$

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- Q81. If  $(d_1, r_1, I_1)$  and  $(d_2, r_2, I_2)$  are the densities, radii of curvatures and moments of inertia of a circular body, then for the condition  $(I_1 > I_2)$  to be true, we require
- (a)  $(r_1 > r_2)$  (b)  $(d_1 > d_2)$   
(c)  $(d_1 > d_2)$  and  $(r_1 > r_2)$  (d)  $(d_1 < d_2)$  and  $(r_1 < r_2)$
- Q82. When the external torque acting on a system is zero, then
- (a) its angular momentum alone is conserved  
(b) its rotational kinetic energy alone is conserved  
(c) both angular momentum and rotational kinetic energy are conserved  
(d) both angular momentum and rotational kinetic energy are not conserved
- Q83. The radius of gyration of a thin rod of mass  $M = 100\text{ g}$  and length  $L = 1\text{ m}$  about an axis passing through its centre of gravity and perpendicular to its length is
- (a)  $k = \frac{1}{6\sqrt{2}}m$  (b)  $k = \frac{1}{4\sqrt{3}}m$  (c)  $k = \frac{1}{3\sqrt{2}}m$  (d)  $k = \frac{1}{2\sqrt{3}}m$
- Q84. If a  $\beta$  particle of mass  $m_e$  is emitted from a radioactive nucleus of mass number  $A$ , with a velocity  $v$ , then the speed of the recoil nucleus will be
- (a)  $v' = \frac{vm_e}{(A - m_e)}$  (b)  $v' = \frac{vm_e}{(A + m_e)}$   
(c)  $v' = \frac{4v}{(A - 4)}$  (d)  $v' = \frac{v}{A}$
- Q85. In the absence of external force, if  $a_{cm}$  and  $v_{cm}$  are the acceleration and velocity in the centre of mass system, the conservation of momentum for a system of particles is expressed as
- (a)  $mv_{cm} = 0$  (b)  $mv_{cm} = F_{ext}$   
(c)  $mv_{cm} = \text{constan } t$  (d)  $ma_{cm} = 0$

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Q86. The centre of mass of a system of  $n$  particles of total mass  $M$  is defined as a point whose position vector in an inertial frame  $S$  is given by

$$(a) R_{cm} = \sum_{i=1}^{i=n} m_i r_i$$

$$(b) R_{cm} = \frac{1}{M} \sum_{i=1}^{i=n} m_i r_i$$

$$(c) R_{cm} = \frac{1}{M} \sum_{i=1}^{i=n} r_i$$

$$(d) R_{cm} = \sum_{i=1}^{i=n} r_i$$

Q87. For an observer rotating the earth, the effective acceleration due to gravity is

$$(a) a' = g$$

$$(b) a' = g - 2\omega v'$$

$$(c) a' = \omega \times (\omega \times r)$$

$$(d) a' = g_0 \omega \times (\omega \times r)$$

where  $\omega$  is the angular velocity of the earth,  $v'$  the velocity of the rotating observer and  $g_0$  is the acceleration due to gravity in the absence of the rotational motion of the earth about its axis.

Q88. The rotation of a Foucault's pendulum denotes

(a) the spinning motion of the earth

(b) the earth to be stationary

(c) the rotational motion of the earth

(d) precessional motion of the earth

Q89. Two colliding particles in the centre of mass frame

(a) will approach as well as move away from each other with equal and opposite momentum

(b) will only approach each other with equal and opposite momentum

(c) will only separate from each with equal and opposite momentum

(d) will precess after collision

Q90. A boy of mass  $M$  stands on a platform of radius  $R$  capable of free rotation about its axis.

The moment of inertia of the platform is  $I$ . Assume the system is at rest. If a friend of the boy throws a ball of mass  $m$  with a velocity  $v$  and if the boy catches it, the angular velocity of the system in the process is

$$(a) \omega = \frac{mv^2 R}{(M+m)R^2}$$

$$(b) \omega = \frac{mvR}{I + (M+m)R^2}$$

$$(c) \omega = \frac{mvR}{(M+m)R}$$

$$(d) \omega = \frac{mvR^2}{(M+m)R}$$

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- Q91. When the length of a simple pendulum is increased by 44%, the percentage increase in its time period is given as  
(a) 20 (b) 60 (c) 40 (d) 15
- Q92. A simple pendulum with a brass bob has a time period  $T$ , is immersed in a liquid and allowed to oscillate. If the density of the liquid is  $1/8$  times that of brass, then the new time period for oscillation will be  
(a)  $\frac{8}{7}T$  (b)  $2T$  (c)  $T$  (d)  $\sqrt{\frac{8}{7}}T$
- Q93. Two bodies  $M$  and  $N$  of equal masses, are- suspended from two separate massless springs of spring constants  $k_1$  and  $k_2$  respectively. If they oscillate with equal maximum velocities, then the ratio of frequency of  $M$  to that of  $N$  is  
(a)  $k_1/k_2$  (b)  $k_2/k_1$  (c)  $\sqrt{k_1/k_2}$  (d)  $\sqrt{k_2/k_1}$
- Q94. A circuit having an impedance of  $1/\pi H$  and resistance of  $100\Omega$  is supplied a.c. power at 50 cycles/sec frequency. The reactance and impedance of the circuit are  
(a)  $100\Omega, 100\Omega$  (b)  $100\Omega, 141.1\Omega$   
(c)  $141.1\Omega, 100\Omega$  (d)  $141.1\Omega, 141.1\Omega$
- Q95. Undamped oscillations are produced in those  $L-C-R$  circuits which have  
(a) provisions for compensating losses  
(b)  $R-C$  phase shift network  
(c) low  $Q$  factor  
(d) coils with low  $L/R$  ratio
- Q96. The resultant of two simple harmonic motions  $y = y_0 \sin(\omega t)$  and  $x = x_0 \sin(\omega t)$  will be  
(a) an ellipse (b) a circle (c) a figure of 8 (d) a straight line
- Q97. During wave motion, the pressure of a wave is  
(a) a maximum at rarefactions (b) a minimum at compressions  
(c) a constant through (d) a maximum at compressions

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- Q98. Two periodic waves  $y = 10\sin(200\pi t)$  and  $x = 10\sin(205\pi t)$  have their displacement centimeters and time measured in seconds. The time interval between maximum and minimum sounds after superposition is
- (a) 0.1 sec                      (b) 0.2 sec                      (c) 0.4 sec                      (d) 0.9 sec
- Q99. The response of conduction electrons to an electromagnetic field is determined by the constitutive relation  $j = \sigma E$ . If  $\sigma$  increases with temperature, the medium is
- (a) a conductor                      (b) an insulator  
(c) a semiconductor                      (d) a dielectric
- Q100. Skin depth refers to that distance travelled by an electromagnetic wave in a metal for which its amplitude reduces by a factor \_\_\_\_\_ from the maximum value at the surface.
- (a)  $1/e$                       (b)  $2e/3$                       (c)  $4\pi/3$                       (d)  $1/2\pi$
- Q101. A rectangular waveguide having a breadth of 5 cm and thickness of 3 cm internally has an electromagnetic signal propagating through it. Then the cut-off frequency for the waveguide is
- (a)  $f_c = 2GHz$                       (b)  $f_c = 1GHz$                       (c)  $f_c = 3GHz$                       (d)  $f_c = 5Hz$
- Q102. Poynting's theorem can be considered as a statement of conservation of----- in electrostatics.
- (a) charge                      (b) energy  
(c) probability density                      (d) volume
- Q103. The electrical conductivity of a semiconductor increases when the electromagnetic radiation of wavelengths shorter than 2480 nm is incident on it. The band gap energy in electron volts of the semiconductor is
- (a)  $1.1eV$                       (b)  $2.5eV$                       (c)  $0.5eV$                       (d)  $0.7eV$
- Q104. In a full-wave rectifier circuit, operating from 50 Hz mains frequency, the fundamental frequency in the ripple would be
- (a) 50 Hz                      (b) 100 Hz                      (c) 25 Hz                      (d) 70.7 Hz

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- Q105. If  $\mu_e$  and  $\mu_h$  are the electron and hole mobilities respectively in a semiconductor, which one of the following is true?
- (a)  $\mu_e > \mu_h$                       (b)  $\mu_e = \mu_h$                       (c)  $\mu_e < \mu_h$                       (d)  $\mu_e > 0$  and  $\mu_h > 0$
- Q106. In a full-wave rectifier, if the input a.c. current frequency is  $\nu$  the output frequency is
- (a)  $2\nu$                                       (b)  $\nu/2$                                       (c)  $4\nu$                                       (d) zero
- Q107. If the temperature of a transistor rises by  $10^0 C$ . which of the following current doubles?
- (a)  $I_C$                                       (b)  $I_B$                                       (c)  $I_{CBO}$                                       (d)  $I_E$
- Q108. Electronic distribution of a silicon atom is
- (a) 2, 10, 2                                      (b) 2, 8, 4                                      (c) 2, 7, 5                                      (d) 2, 4, 8
- Q109. The depletion region of a  $P-N$  junction diode is formed
- (a) during the process of manufacture  
(b) under forward bias  
(c) under reverse bias  
(d) under a reduction of temperature
- Q110. The width of the depletion layer of a  $P-N$  junction diode
- (a) decreases with light doping  
(b) increases with light doping  
(c) is independent of applied voltage  
(d) is increased under reverse bias
- Q111. Avalanche breakdown is a phenomenon occurring primarily due to
- (a) collision                                      (b) doping                                      (c) ionisation                                      (d) recombination
- Q112. The emitter region of a transistor is generally doped the heaviest because it
- (a) has to dissipate the maximum power  
(b) has to supply the charge carriers  
(c) is the first region of the transistor  
(d) must possess low resistance
- Q113. When the emitter-base junction of a transistor is reverse biased, the collector current
- (a) is reversed                                      (b) is increased                                      (c) is decreased                                      (d) becomes zero

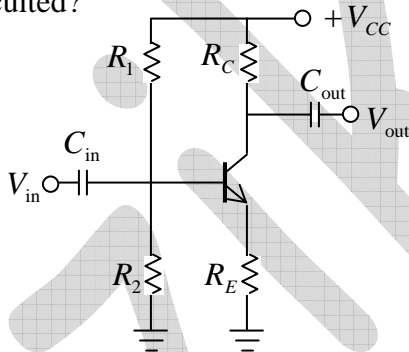
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- Q114. The basic reason for using an emitter bypass capacitance in a  $CE$  amplifier circuit is to
- keep the emitter at a.c. ground
  - prevent excessive degeneration from taking place
  - decrease the voltage gain
  - bypass low frequency signal component
- Q115. The main use of an emitter follower circuit is as a /an
- power amplifier
  - impedance matching device
  - low-input impedance circuit
  - follower of signals
- Q116. What will happen to the circuit shown in the figure below, if the potential divider resistance  $R_2$  is open circuited?



- Output signal will become zero
  - $Q$  – point gets affected there by producing
  - $V_{in}$  will become zero
  - base current  $I_B$  will reduce to zero
- Q117. The primary function of a filter is to
- minimize a.c. input variations
  - suppress odd harmonics
  - stabilize d.c. level of the output voltage
  - remove ripples from the rectified output
- Q118. Two coherent light beams of intensity  $I$  and  $4I$  are superposed. The minimum and maximum possible intensities in the resultant beam are
- $9I$  and  $I$
  - $9I$  and  $3I$
  - $5I$  and  $I$
  - $5I$  and  $3I$

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- Q119. In placing a thin sheet of mica of thickness  $12 \times 10^{-5} \text{ cm}$  in the path of one of the interfering beams in a Young's double slit experiment, the central fringe shifts equal to a fringe width. If the wavelength of light  $\lambda = 600 \text{ nm}$ , the refractive index of mica is
- (a)  $\mu = 1.61$                       (b)  $\mu = 1.48$                       (c)  $\mu = 1.5$                       (d)  $\mu = 1.56$
- Q120. Dichorism means selective absorption of
- (a) unpolarised light                      (b) scattered light  
(3) dispersed light                      (d) one of the polarised components
- Q121. If in a bi-refracting crystal the magnitudes of  $E_x$  and  $E_y$  are equal and the phase angle between the two is  $60^\circ$ , then the waves are
- (a) linearly polarised light                      (b) plane polarised ligh  
(c) circularly polarised light                      (d) elliptically polarised
- Q122. Which of the following properties of light supports conclusively the wave theory of light?
- (a) Light obeys laws of reflection  
(b) Speed of light is smaller in water than in vacuum  
(c) Light shows interference  
(d) Light shows photoelectric effect
- Q123. A ray of light is incident on the surface of a glass plate of refractive index  $\mu = 1.55$  at the polarising angle. The angle of refraction is
- (a)  $0^\circ 0'$                       (b)  $147^\circ 11'$                       (c)  $32^\circ 49'$                       (d)  $57^\circ 11'$
- Q124. From Brewster's law it follows that the angle of polarisation depends upon
- (a) wavelength of light  
(b) orientation of the plane of polarisation  
(c) orientation of the plane of vibration  
(d) refractive index of the medium
- Q125. The maximum intensity produced by two coherent waves of intensity  $I_1$  and  $I_2$  will be
- (a)  $I_1 + I_2$                       (b)  $I_1^2 + I_2^2$   
(c)  $I_1 + I_2 + 2\sqrt{I_1 I_2}$                       (d) zero

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Q126. In Fraunhofer diffraction at a single slit, the directions of the secondary maxima are given by

$$(a) \sin \theta_n = \frac{(2n+1)\lambda}{2a}$$

$$(b) \cos \theta_n = \frac{2a}{(2n+1)\lambda}$$

$$(c) \sin \theta_n = (2n+1)\lambda \cdot 2a$$

$$(d) \sin \theta_n = \frac{a\lambda}{(2n+1)}$$

Q127. In Fraunhofer diffraction at a single slit, the width of the central maximum is

$$(a) W = \frac{a}{2f\lambda}$$

$$(b) W = \frac{2f\lambda}{a}$$

$$(c) W = 2fa\lambda$$

$$(d) W = \frac{f\lambda}{2a}$$

Q128. Practically Fresnel diffraction can be observed only if

(a) the source and the screen lie at infinity

(b) high power convergent lenses are available

(c) source and the screen are separated by finite distances

(d) even the source is absent

Q129. The central spot in a Newton's fringe pattern appears dark because, due to reflection light -suffers a phase change of

(a)  $90^\circ$

(b)  $180^\circ$

(c)  $270^\circ$

(d)  $45^\circ$

Q130. If for a Newton's rings pattern, the diameter of the  $n^{\text{th}}$  dark ring is 8 mm and that of the  $(n+10)^{\text{th}}$  dark ring is 12 mm, the radius of the plano-convex lens is 3 m, then the wavelength of the incident light is

(a)  $\lambda = 666.7 \text{ nm}$

(b)  $\lambda = 490.7 \text{ nm}$

(c)  $\lambda = 583.6 \text{ nm}$

(d)  $\lambda = 580.7 \text{ nm}$

Q131. When the principal section of the Nicol prism is perpendicular to the direction of vibrations of the incident ray

(a) only purely plane polarised light comes out of the prism

(b) only the extraordinary ray of light comes out of the prism

(c) the extraordinary ray of light does not come out of the prism

(d) no light emerges from the prism

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Q132. For a plane polarised light incidenting on a bi-refringent crystal, the emergent beam will be circularly polarised if the phase difference is

- (a)  $\delta = \left(n + \frac{1}{2}\right)\pi$       (b)  $\delta = n\pi$       (c)  $\delta = \left(n + \frac{3}{2}\right)\pi$       (d)  $\delta = (2n + 1)\pi$

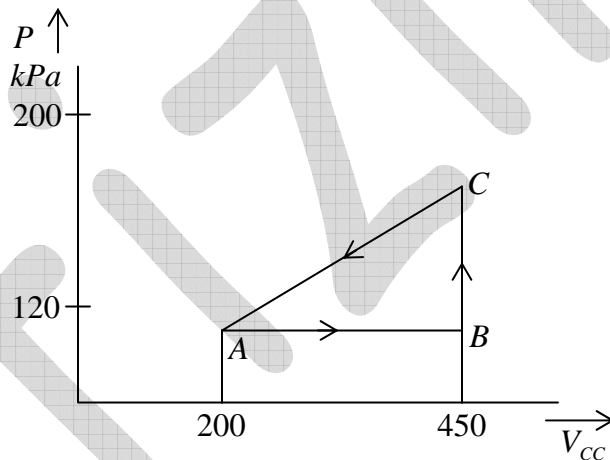
Q133. If  $N_1$  and  $N_2$  are the population densities of the ground state and excited state and  $g_1$  and  $g_2$  are the statistical weight factors for these states, the condition for lasing action is

- (a)  $\frac{N_2}{N_1} < \frac{g_2}{g_1}$       (b)  $\frac{N_2}{N_1} > \frac{g_2}{g_1}$       (c)  $\frac{N_1}{N_2} = \frac{g_2}{g_1}$       (d)  $\frac{N_1}{N_2} > 1$

Q134. For an atomic system, the rates of the stimulated and spontaneous emission will be equal if

- (a)  $e^{h\nu/kT} = 2$       (b)  $e^{h\nu/kT} = 1/2$       (c)  $e^{h\nu/kT} = \frac{\sqrt{3}}{4}$       (d)  $e^{h\nu/kT} = 1$

Q135. The work done by a gas in the diagram shown in the figure below is



- (a) 30 J      (b) 20 J      (c) -20 J      (d) -10 J

Q136. A tyre pumped to a pressure of 3.375 atmospheres, bursts suddenly. If the adiabatic constant is  $\nu = 1.5$ , what is the final temperature?

- (a) 27 °C      (b) 0 °C      (c) -73 °C      (d) -27 °C

Q137. A Carnet engine has an efficiency of 40% and a heat sink temperature of 27 °C. What should be the temperature if the efficiency is to be increased to 50% ?

- (a) 25 K      (b) 50 K      (c) 75 K      (d) 100 K

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Q138. An ideal gas expands according to the law  $PV^{3/2} = \text{constant}$ . From this we can conclude that

- (a) the adiabatic exponent of the gas  $k = 1.5$
- (b) the molar specific heat  $C = C_v - 2R$
- (c) temperature increases during the process
- (d) such a process cannot occur

Q139. Which of the following parameters does not characterize the thermodynamic state of matter?

- (a) Work
- (b) Pressure
- (c) Temperature
- (d) Volume

Q140. A Carnot engine takes  $3 \times 10^6$  calories of heat from a reservoir at  $627^\circ\text{C}$  and gives it to a sink at  $27^\circ\text{C}$ . The work done by the engine is

- (a)  $8.4 \times 10^6 J$
- (b)  $16.8 \times 10^6 J$
- (c)  $4.2 \times 10^6 J$
- (d) zero

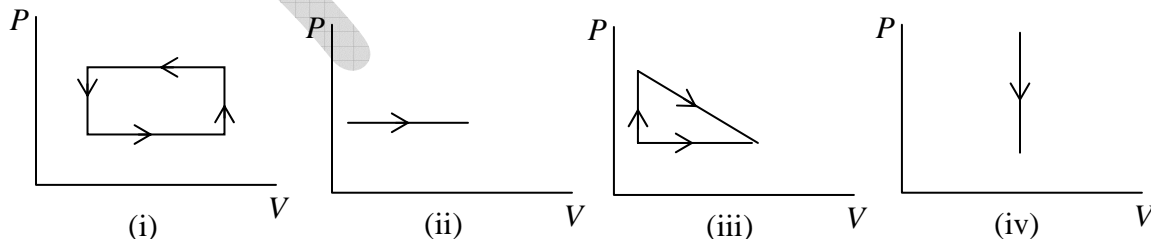
Q141. The ratio of the work done by an ideal diatomic gas to the heat supplied by the gas in an isobaric process is

- (a) 5 : 7
- (b) 3 : 5
- (c) 2 : 7
- (d) 5 : 3

Q142. If  $C_p$  and  $C_v$  are the molar specific heats of a gas at constant pressure and 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)  $\frac{C_p}{C_v}$

Q143. In the following, the indicator diagrams representing maximum and minimum amounts of work done are respectively



- (a) (iii) and (ii)
- (b) (ii) and (iii)
- (c) (ii) and (iv)
- (d) (iii) and (iv)

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- Q144. If in defining the specific heat, temperature is represented in  $^{\circ}\text{F}$  instead of  $^{\circ}\text{C}$ , then the value of specific heat will
- (a) decrease (b) increase  
(c) remain unchanged (d) fluctuate
- Q145. A body cools in 7 minutes from  $60^{\circ}\text{C}$  to  $40^{\circ}\text{C}$ . The temperature of the gas after the next 7 minutes will be \_\_\_\_\_ (Assume that the temperature of the surrounding  $T = 0^{\circ}\text{C}$ )
- (a)  $32^{\circ}\text{C}$  (b)  $38^{\circ}\text{C}$  (c)  $22^{\circ}\text{C}$  (d)  $28^{\circ}\text{C}$
- Q146. A solid at a temperature  $T_1$  is kept in an evacuated chamber at temperature  $T_2$ , such that  $T_1 > T_2$ . The rate of growth of temperature is proportional to
- (a)  $T_2 - T_1$  (b)  $T_2^2 - T_1^2$  (c)  $T_2^3 - T_1^3$  (d)  $T_2^4 - T_1^4$
- Q147. Two bodies are at temperatures  $27^{\circ}\text{C}$  and  $927^{\circ}\text{C}$  respectively. The heat energy radiated by them will be in the ratio
- (a) 1: 256 (b) 1:64 (c) 1: 4 (d) 1: 16
- Q148. X-rays of wavelength  $0.1 \text{ \AA}$  are incident on a target and are scattered at an angle of  $180^{\circ}$ . If the Compton wavelength  $\lambda_c = 2.426 \times 10^{-12} \text{ m}$ , the wavelength of the scattered X-rays is
- (a)  $0.149 \text{ \AA}$  (b)  $0.074 \text{ \AA}$  (c)  $0.032 \text{ \AA}$  (d)  $0.052 \text{ \AA}$
- Q149. Ultraviolet light of wavelength  $350 \text{ nm}$  and intensity  $1.00 \text{ W/m}^2$  is directed at a potassium surface having an area of  $1.00 \text{ cm}^2$ . If 0.50 % of the incident photons produce photoelectrons, the number of photoelectrons emitted per second is
- (a)  $17.6 \times 10^{11}$  (b)  $4.4 \times 10^{11}$  (c)  $8.8 \times 10^{11}$  (d)  $2.2 \times 10^{11}$
- (Assume the maximum kinetic energy of the photoelectrons as  $5.68 \times 10^{-19} \text{ J/photon}$ .)
- Q150. If the accelerating potential of an X-ray machine is  $V$ , then the shortest wavelength of the X-rays produced by it is
- (a)  $\left(\frac{hc}{Ve}\right)$  (b)  $\left(\frac{hc}{Ve}\right)^2$  (c)  $\left(\frac{hc}{Ve}\right)^3$  (d)  $\left(\frac{hc}{Ve}\right)^{2/3}$

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