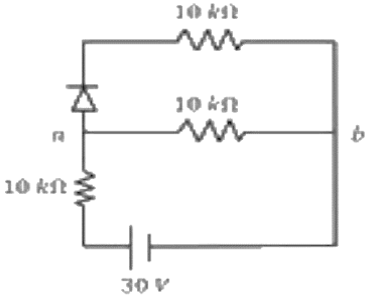
PART-I PHYSICS

1. **If the weight of an object at the pole is 196 N, then the weight of the object at the equator is? $(g = 10\ m/s^2$; the radius of earth $= 6400$ km$)$**
   (a) 194.32 N (b) 194.66 N
   (c) 195.32 N (d) 195.66 N
2. **In a house 15 bulbs of 45 W, 15 bulbs of 100 W, 15 bulbs of 10 W and two heaters of 1 kW each is connected to 220 V mains supply. The minimum fuse current will be**
   (a) 5 A (b) 20 A
   (c) 25 A (d) 15 A
3. **In an adiabatic process, the volume is doubled. Find the ratio of final average relaxation time and initial relaxation time. Given $\frac{C_p}{C_v} = \gamma$**
   (a) $\frac{1}{2}$ (b) $(2)^{\frac{1+\gamma}{2}}$
   (c) $\left(\frac{1}{2}\right)^{\gamma}$ (d) $\left(\frac{1}{2}\right)^{\frac{\gamma}{2}+1}$
4. **A block of mass 10 kg is suspended from a string of length 4 m. When pulled by a force F along horizontal from the midpoint. The upper half of the string makes 45° with the vertical, value of F is**
   (a) 100 N (b) 90 N
   (c) $75N$ (d) $70N$
5. **The surface mass density of a disc varies with radial distance as $\sigma = A + Br$, where A and B are positive constants. The moment of inertia of the disc about an axis passing through its centre and perpendicular to the plane is**
   (a) $2\pi a^4\left(\frac{A}{4} + \frac{Ba}{5}\right)$ (b) $2\pi a^4\left(\frac{4A}{4} + \frac{B}{5}\right)$
   (c) $\pi a^4\left(\frac{A}{4} + \frac{Ba}{5}\right)$ (d) $2\pi a^4\left(\frac{A}{5} + \frac{Ba}{4}\right)$
6. **Cascaded Carnot engine is an arrangement in which heat sink of one engine is source for other. If high temperature for one engine is T_1, low temperature for other engine is T_2 (Assume work done by both engines is same). Calculate lower temperature of first engine.**
   (a) $\frac{2T_1T_2}{T_1+T_2}$ (b) $\frac{T_1+T_2}{2}$
   (c) 0 (d) $\sqrt{T_1T_2}$
7. **Activity of a substance changes from $700s^{-1}$ to $900s^{-1}$ in 30 minutes. Find its halflife in minutes.**
   (a) 66 (b) 62
   (c) 56 (d) 50
8. **In YDSE, separation between slits is 0.15 mm, distance between slits and screen is 1.5 m and wavelength of light is 589 nm. Then, fringe width is**
   (a) 5.9 mm (b) 3.9 mm
   (c) 1.9 mm (d) 2.3 mm
9. **An ideal fluid is flowing in a pipe in streamline flow. Pipe has maximum and minimum diameter of 6.4 cm and 4.8 cm respectively. Find out the ratio of minimum to maximum velocity.**
   (a) $\frac{81}{256}$ (b) $\frac{9}{16}$
   (c) $\frac{3}{4}$ (d) $\frac{3}{16}$
10. **There is an electric circuit as shown in the figure. Find potential difference between points a and b**



(a) 0 V (b) 15 V
(c) 10 V (d) 5 V

11. A particle of mass m and positive charge q is projected with a speed of V_o in y-direction in the presence of electric and magnetic field and both of them are in x-direction. Find the instant of time at which the speed of particle becomes double the initial speed.

(a) $t = \frac{mV_o\sqrt{3}}{qE}$ (b) $t = \frac{mV_o\sqrt{2}}{qE}$
(c) $t = \frac{mV_o}{qE}$ (d) $t = \frac{mV_o}{2qE}$

12. Two sources of sound moving with the same speed V and emitting frequencies of 1400 Hz are moving such that one source s_1 is moving towards the observer and s_2 is moving away from the observer. If observer hears a beat frequency of 2 Hz, then find the speed of the source (Given $V_{\text{sound}} \gg V_{\text{source}}$ and $V_{\text{sound}} = 350$ m/s.)

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

13. An electron and a photon have same energy E. Find the de Broglie wavelength of electron to wavelength of photon. (Given mass of electron is m and speed of light is c)

(a) $\frac{2}{C}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$ (b) $\frac{1}{C}\left(\frac{E}{2m}\right)^{\frac{1}{3}}$
(c) $\frac{1}{C}\left(\frac{E}{m}\right)^{\frac{1}{2}}$ (d) $\frac{1}{C}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

14. A ring is rotated about diametric axis in a uniform magnetic field perpendicular to the plane of the ring. If initially the plane of the ring is perpendicular to the magnetic field. Find the instant of time at which EMF will be maximum and minimum respectively.

(a) 2.5sec, 5sec (b) 5sec, 7.5sec
(c) 2.5sec, 7.5sec (d) 10sec, 5sec

15. Electric field in space is given by $\vec{E}(t) = \frac{E_0(\hat{i}+\hat{j})}{\sqrt{2}}\cos(\omega t + kz)$. A positively charged particle at $(0, 0, \pi/k)$ is given velocity $v_0\hat{k}$ at $t = 0$. Direction of force acting on particle is

(a) $f = 0$ (b) Antiparallel to $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$
(c) Parallel to $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$ (d) $\hat{k}$

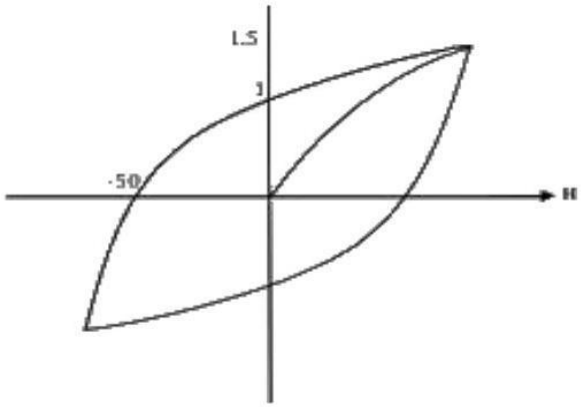
16. Focal length of convex lens in air is 16 cm$(\mu_{\text{glass}} = 1.5)$. Now the lens is submerged in liquid of refractive index 1.42. Find the ratio of focal length in medium to focal length in air.

(a) 9 (b) 17
(c) 1 (d) 5

17. A lift of mass 920 kg has a capacity of 10 persons. If average mass of person is 68 kg. Friction force, between lift and lift shaft is 6000 N. The minimum power of motor required to move the lift upward with constant velocity 3 m/s is $[g = 10\ \text{m/s}^2]$

(a) 66000 W (b) 63248 W
(c) 48000 W (d) 56320 W

18. The hysteresis curve for a material is shown in the figure. Then for the material retentivity, coercivity and saturation magnetization respectively will be



(a) 50 A/m, 1 T, 1.5 T (b) 1.5 T, 50 A/m, 1 T
(c) 1 T, 50 A/m, 1.5 T (d) 50 A/m, 1.5 T, 1 T

19. An inductor of inductance 10mH and a resistance of 5Ω is connected to a battery of 20 V at $t = 0$. Find the ratio of current in the circuit at $t = \infty$ to current at $t = 40$sec.

(a) 1.06 (b) 1.48
(c) 1.15 (d) 0.84

20. Find the dimensions of $\frac{B^2}{2\mu_o}$

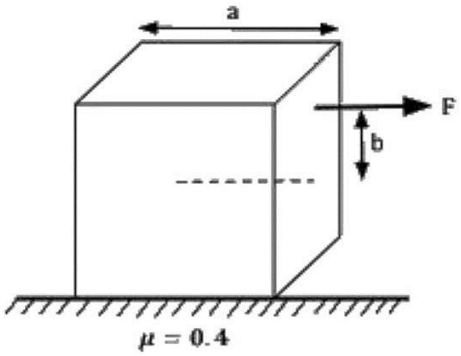
(a) $ML^{-1}T^{-2}$ (b) ML^2T^{-2}
(c) $ML^{-1}T^2$ (d) $ML^{-2}T^{-1}$

21. A capacitor of 60pF charged to 20 V. Now, the battery is removed, and this capacitor is connected to another identical uncharged capacitor. Find heat loss in nJ.

22. When m grams of steam at 100°C is mixed with 200grams of ice at 0°C, it results in water at 40°C. Find the value of m in grams

(Given, Latent heat of fusion $(L_f) = 80$cal/g, Latent heat of vaporization $(L_v) = 540$ cal/g, specific heat of water $(C_w) = 1$cal/g/°C)

23. A solid cube of side ' a ' is shown in the figure. Find the maximum value of c $\frac{100b}{a}$ for which the block does not topple before sliding.



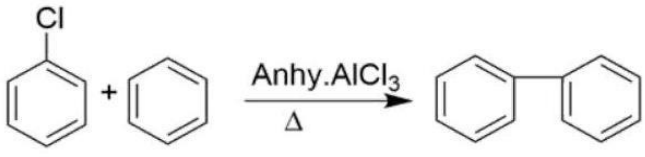
24. Magnitude of resultant of two vectors $\vec{P}$ and $\vec{Q}$ is equal to magnitude of $\vec{P}$. Find the angle between $\vec{Q}$ and resultant of $2\vec{P}$ and $\vec{Q}$.

25. A battery of unknown emf connected to a potentiometer has balancing length 560 cm. If a resistor of resistance 10Ω is connected in parallel with the cell the balancing length change by 60 cm. If the internal resistance of the cell is $\frac{n}{10}$Ω, the value of ' n ' is

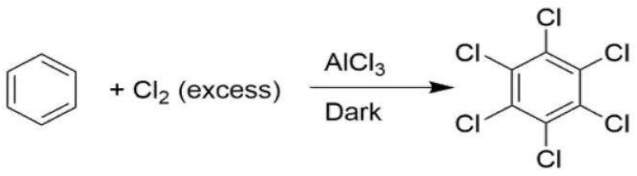
PART-II CHEMISTRY

26. Which of the following reactions are possible?

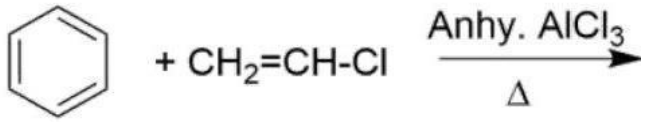
(A)



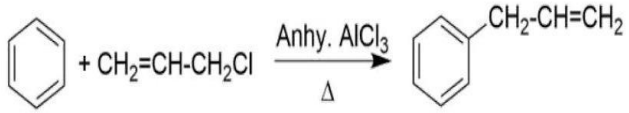
(B)



(C)

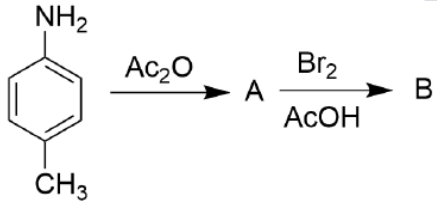


(D)

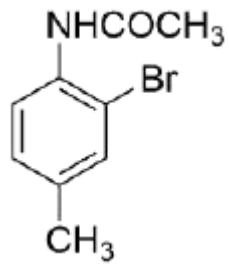


(a) A, B, C (b) B, D
(c) A, C, D (d) A, C

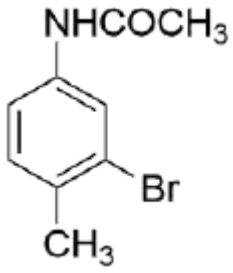
27. B in the given reaction is?



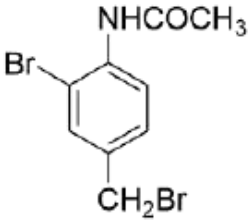
(a)



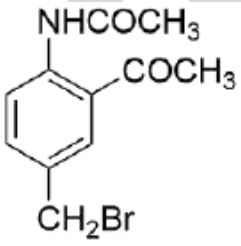
(b)



(c)



(d)



28. The correct statement about gluconic acid is:

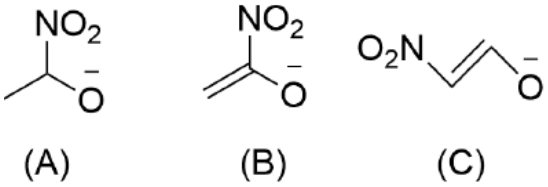
(a) It is prepared by oxidation of glucose with HNO_3

(b) It is obtained by partial oxidation of glucose

(c) It is a dicarboxylic acid

(d) It forms hemiacetal or acetal

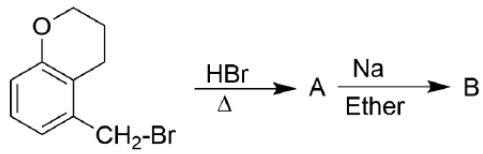
29. The stability order of the following alkoxide ions are:



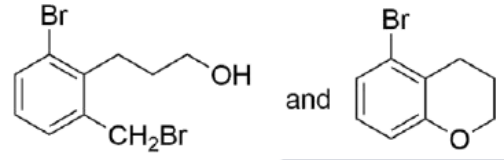
(A) (B) (C)

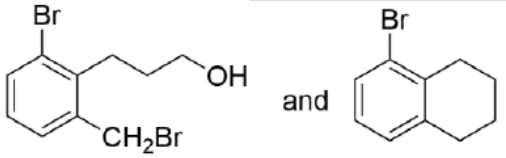
(a) C > B > A (b) A > C > B
(c) B > A > C (d) C > A > B

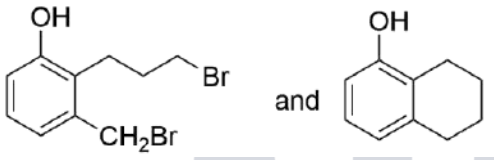
30.

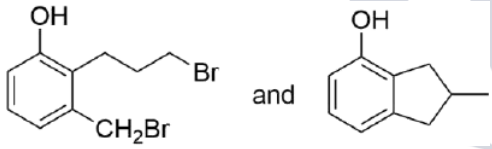


A and B are

(a) 

(b) 

(c) 

(d) 

31. For the complex $[Ma_2b_2]$ if M is sp^3 or dsp^2 hybridized respectively then the total number of optical isomers respectively, are:

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

32. The bond order and magnetic nature of CN^- respectively, are

(a) 3, diamagnetic (b) 3, paramagnetic
(c) 2.5, paramagnetic (d) 2.5, diamagnetic

33. Which of the following is incorrect?

(a) $\Lambda_m^0 NaCl - \Lambda_m^0 NaBr = \Lambda_m^0 KCl - \Lambda_m^0 KBr$
(b) $\Lambda_m^0 H_2O = \Lambda_m^0 HCl + \Lambda_m^0 NaOH - \Lambda_m^0 NaCl$
(c) $\Lambda_m^0 NaI - \Lambda_m^0 NaBr = \Lambda_m^0 NaBr - \Lambda_m^0 KBr$
(d) $\Lambda_m^0 NaCl - \Lambda_m^0 KCl = \Lambda_m^0 NaBr - \Lambda_m^0 KBr$

34. $NaOH + Cl_2 \rightarrow A +$ Other products

Hot & conc.

$Ca(OH)_2 + Cl_2 \rightarrow B +$ Other products

Cold & dil.

A and B respectively are:
(a) $NaClO_3, Ca(OCl)_2$ (b) $NaClO_3, Ca(ClO_3)_2$
(c) $NaCl, Ca(ClO_3)_2$ (d) $NaClO, Ca(ClO_3)_2$

35. There are two beakers (I) having pure volatile solvent and (II) having a volatile solvent and a non-volatile solute. If both the beakers are placed together in a closed container then:

(a) Volume of solvent beaker will decrease and solution beaker will increase

(b) Volume of solvent beaker will increase and solution beaker will also increase

(c) Volume of solvent beaker will decrease and solution beaker will also decrease

(d) Volume of solvent beaker will increase and solution beaker will decrease

36. Metal with low melting point containing impurities of high melting point can be purified by
(a) Zone refining (b) Vapor phase refining
(c) Distillation (d) Liquation

37. Which of the following statements are correct?

(I) On decomposition of H_2O_2, O_2 gas is released.

(II) 2-ethylanthraquinol is used in the preparation of H_2O_2

(III) On heating $KClO_3$, $Pb(NO_3)_2$ and $NaNO_3$, O_2 gas is released.

(IV) In the preparation of sodium peroxoborate, H_2O_2 is treated with sodium metaborate.
(a) I,II, IV (b) II, III, IV
(c) I, II, III, IV (d) I, II, III

38. Among the following, which is a redox reaction?

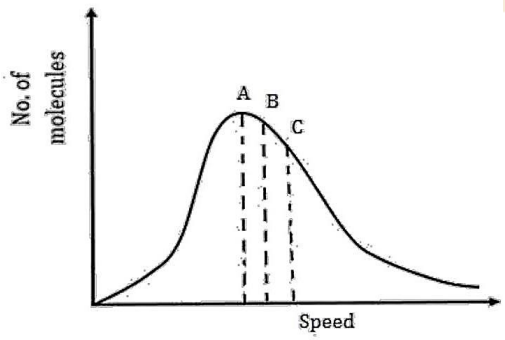
(a) $N_2 + O_2 \overset{2000\ K}{\rightarrow}$

(b) Formation of O_3 from O_2

(c) Reaction between NaOH and H_2SO_4

(d) Reaction between $AgNO_3$ and NaCl

39.



Select the correct options:
a. $A = C_{MPS}, B = C_{Average}, C = C_{RMS}$
b. $A = C_{Average}, B = C_{MPS}, C = C_{RMS}$

c. $A = C_{RMS}, B = C_{Average}, C = C_{MPS}$
d. $A = C_{Average}, B = C_{MPS}, C = C_{RMS}$

40. Which one of the following, among each pairs, will release maximum energy on gaining one electron? $(A = F, Cl), (B = S, Se), (C = Li, Na)$
(a) $(A) = Cl, (B) = S, (C) = Li$
(b) $(A) = F, (B) = Se, (C) = Na$
(c) $(A) = F, (B) = S, (C) = Na$
(d) $(A) = Cl, (B) = Se, (C) = Li$

41. Which of the following statements are incorrect?
(a) Co^{3+} with strong field ligand forms a high magnetic moment complex.

(B) For Co^{3+}, if pairing energy (P) $> \Delta_0$, then the complex formed will have t_{2g}^4, e_g^2 configuration

(C) For $[Co(en)_3]^{3+}, \lambda_{absorbed}$ is less than $\lambda_{absorbed}$ for $[CoF_6]^{3-}$

(D) If $\Delta_o = 18000\ cm^{-1}$ for Co^{3+}, then with same ligands for it $\Delta_t = 16000\ cm^{-1}$
(a) A, D (b) B, C
(c) A, B (d) A, B, C, D

42. 0.6 g of urea on strong heating with NaOH evolves NH_3. The liberated NH_3 will react completely with which of the following HCl solutions?
(a) 100 mL of 0.2 NHCl
(b) 400 mL of 0.2 NHCl
(c) 100 mL of 0.1 NHCl
(d) 200 mL of 0.2 NHCl

43. Number of sp^2 hybrid carbon atoms in aspartame is

44. 3 grams of acetic acid is mixed in 250 mL of 0.1MHCl. This mixture is now diluted to 500 mL. 20 mL of this solution is now taken in another container. $\frac{1}{2}$ mL of 5MNaOH is added to this. Find the pH of this solution. ($\log 3 = 0.4771, pK_a = 4.74$)

45. The flocculation value for As_2S_3 sol by HCl is $30 mmol L^{-1}$. Calculate mass of H_2SO_4 required in grams for 250 mLsol is

46. $NaCl \xrightarrow{K_2Cr_2O_7/\ Conc.\ H_2SO_4} (A) \xrightarrow{NaOH} (B) \xrightarrow{Dil.\ H_2SO_4, H_2O_2} (C)$

Determine the total number of atoms in per unit formula of (A), (B) & (C).

47. Calculate the ΔH_f° (in kJ/mol) for $C_2H_6(g)$, if $\Delta H_c^\circ[C_{(graphite)}] = -393.5\ kJ/mol, \Delta H_c^\circ[H_2(g)] = -286\ kJ/mol$ and $\Delta H_c^\circ[C_2H_6(g)] = -1560\ kJ/mol$.

PART-III MATHEMATICS

48. From any point P on the line $x = 2y$, a perpendicular is drawn on $y = x$. Let the foot of perpendicular be Q. Find the locus of mid point of PQ.
(a) $5x = 7y$ (b) $2x = 3y$
(c) $7x = 5y$ (d) $3x = 2y$

49. Let θ_1 and θ_2 (where $\theta_1 < \theta_2$) are two solutions of $2\cot^2\theta - \frac{5}{\sin\theta} + 4 = 0, \theta \in [0, 2\pi)$ then $\int_{\theta_1}^{\theta_2} \cos^2 3\theta d\theta$ is equal to

(a) $\frac{\pi}{9}$ (b) $\frac{2\pi}{3}$
(c) $\frac{\pi}{3}+\frac{1}{6}$ (d) $\frac{\pi}{3}$

50. Coefficient of x^7 in $(1+x)^{10}+x(1+x)^9+x^2(1+x)^8+\cdots+x^{10}$ is
(a) 260 (b) 210
(c) 420 (d) 330

51. Let α and β are the roots of $x^2-x-1=0$ such that $P_k=\alpha^k+\beta^k, k\geq 1$ then which one is incorrect?
(a) $P_5=P_2\times P_3$
(b) $P_1+P_2+P_3+P_4+P_5=26$
(c) $P_5=11$
(d) $P_3=P_5-P_4$

52. The area bounded by $4x^2\leq y\leq 8x+12$ is
(a) $\frac{127}{3}$ (b) $\frac{125}{3}$
(c) $\frac{128}{3}$ (d) $\frac{124}{3}$

53. Contrapositive of $A\subset B$ and $B\subset C$ then $C\subset D$
(a) $C\not\subset D$ or $A\not\subset B$ or $B\not\subset C$
(b) $C\subset D$ or $A\not\subset B$ and $B\not\subset C$
(c) $C\subset D$ and $A\not\subset B$ or $B\not\subset C$
(d) $C\subset D$ or $A\not\subset B$ or $B\not\subset C$

54. Let $3+4+8+9+13+14+18+$ .40 terms $=S$. If $S=(102)m$ then $m=$
(a) 5 (b) 10
(c) 25 (d) 20

55. $\left({}^{36}C_{r+1}\right)\times\left(k^2-3\right)={}^{35}C_r\times 6$, then the number of ordered pairs (r,k), where $k\in$ I, are
(a) 2 (b) 6
(c) 3 (d) 4

56. Let $f(x)$ be a five-degree polynomial which has critical points $x=\pm 1$ and $\lim_{x\to 0}\left(2+\frac{f(x)}{x^3}\right)=4$ then which one is incorrect.
(a) $f(x)$ has minima at $x=1$ and maxima at $x=-1$
(b) $f(1)-4f(-1)=4$
(c) $f(x)$ has maxima at $x=1$ and minima at $x=-1$
(d) $f(x)$ is odd

57. If LMVT is applicable on $f(x)=x^3-4x^2+8x+11$ in $[0,1]$, the value of c is
(a) $\frac{4+\sqrt{5}}{3}$ (b) $\frac{4+\sqrt{7}}{3}$
(c) $\frac{4-\sqrt{7}}{3}$ (d) $\frac{4-\sqrt{5}}{3}$

58. Consider there are 5 machines. Probability of a machine being faulty is $\frac{1}{4}$. Probability of at most two machines being faulty is $\left(\frac{3}{4}\right)^3 k$, then the value of k is
(a) $\frac{17}{4}$ (b) $\frac{17}{8}$
(c) $\frac{17}{2}$ (d) 4

59. $a_1,a_2,a_3,\ldots,a_9$ are in geometric progression where $a_1<0$ and $a_1+a_2=4, a_3+a_4=16$. If $\sum_{i=1}^{9}a_i=4\lambda$, then λ is equal to
(a) 171 (b) -513
(c) $-\frac{511}{3}$ (d) -171

60. If $y\sqrt{1-x^2}=k-x\sqrt{1-y^2}$ and $y\left(\frac{1}{2}\right)=-\frac{1}{4}$. Then $\frac{dy}{dx}$ at $x=\frac{1}{2}$ is
(a) $\frac{2}{\sqrt{5}}$ (b) $-\frac{\sqrt{5}}{2}$
(c) $-\frac{\sqrt{5}}{4}$ (d) $\frac{\sqrt{5}}{2}$

61. Let $A = [a_{ij}], B = [b_{ij}]$ are two 3×3 matrices such that $b_{ij} = \lambda^{i+j-2} a_{ij}$ and $|B| = 81$. Find $|A|$ if $\lambda = 3$
(a) $\frac{1}{81}$ (b) $\frac{1}{27}$
(c) $\frac{1}{9}$ (d) 3

62. Pair of tangents are drawn from the origin to the circle $x^2 + y^2 - 8x - 4y + 16 = 0$, then the square of length of chord of contact is
(a) $\frac{8}{5}$ (b) $\frac{8}{13}$
(c) $\frac{24}{5}$ (d) $\frac{64}{5}$

63. Let $y(x)$ is the solution of differential equation $(y^2 - x)\frac{dy}{dx} = 1$ and $y(0) = 1$, then find the value of x where the curve cuts the x-axis .
(a) $2 - e$ (b) 2
(c) $2 + e$ (d) e

64. Let $4\alpha \int_{-1}^{2} e^{-\alpha|x|} dx = 5$ then $\alpha =$
(a) $\ln\sqrt{2}$ (b) $\ln\frac{3}{4}$
(c) $\ln 2$ (d) $\ln\frac{4}{3}$

65. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ and $\lambda = \vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$ and $\vec{d} = \vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}$ then $(\lambda, d) =$
(a) $\left(\frac{3}{2}, 3\vec{a} \times \vec{b}\right)$ (b) $\left(-\frac{3}{2}, 3\vec{a} \times \vec{c}\right)$
(c) $\left(-\frac{3}{2}, 3\vec{a} \times \vec{b}\right)$ (d) $\left(\frac{3}{2}, 3\vec{a} \times \vec{c}\right)$

66. $3x + 4y = 12\sqrt{2}$ is a tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{9} = 1$, then the distance between foci of ellipse is
(a) $2\sqrt{5}$ (b) $2\sqrt{7}$
(c) 4 (d) $2\sqrt{3}$

67. If mean and variance of $2, 3, 16, 20, 13, 7, x, y$ are 10 and 25 respectively then xy is equal to

68. If $Q \equiv \left(\frac{5}{3}, \frac{7}{3}, \frac{17}{3}\right)$ is foot of perpendicular drawn from $P(1, 0, 3)$ onto a line L and line L is passing through $(\alpha, 7, 1)$, then value of α is

69. If system of equations $x + y + z = 6, x + 2y + 3z = 10, 3x + 2y + \lambda z = \mu$ has more than 2 solutions, then $(\mu - \lambda^2)$ is

70. If $f(x)$ is defined in $x \in \left(-\frac{1}{3}, \frac{1}{3}\right)$ &

$$f(x) = \begin{cases} \left(\frac{1}{x}\right)\log_e\left(\frac{1+3x}{1-2x}\right) & x \neq 0 \\ k & x = 0 \end{cases}$$

The value of k such that $f(x)$ is continuous is

71. Let $X = \{x: 1 \leq x \leq 50, x \in \mathrm{N}\}, A = \{x: x \text{ is a multiple of } 2\}, B = \{x: x \text{ is a multiple of } 7\}$. Then the number of elements in the smallest subset of X which contain elements of both A and B is