PART-I PHYSICS

1. A butterfly in North East direction with a velocity of $4\sqrt{2}$ m/s. Wind is blowing from North to South with a velocity of 1 m/s. Find the displacement of the bird in three seconds.

(a) 15 m, 37° North to East

(b) 15 m, 37° East to North

(c) 15 m, 37° North to West

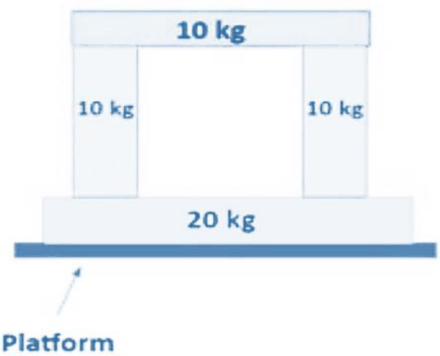
(d) None of these

2. A travelling wave moving with a velocity v. The equation of wave at two different instants $t = 0$ and $t = 3$ is given by $y = \frac{1}{1+x^2}$ and $y = \frac{1}{1+(x+1)^2}$ respectively. Find the speed v of the wave. (y is in mm, x is in cm)

(a) $\frac{1}{3}$ mm/s (b) 3 mm/s

(c) $\frac{1}{3}$ cm/s (d) 3 cm/s

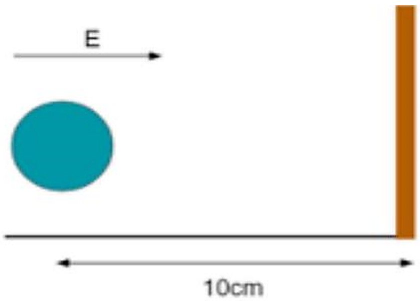
3. A block of mass 20 kg is placed on a horizontal platform and three blocks each with mass 10 kg are arranged as given in figure below. If platform accelerated downward with acceleration $2\ m/s^2$, then the normal force between 10 kg and 20 kg block is-



(a) 100 N (b) 150 N

(c) 120 N (d) 140 N

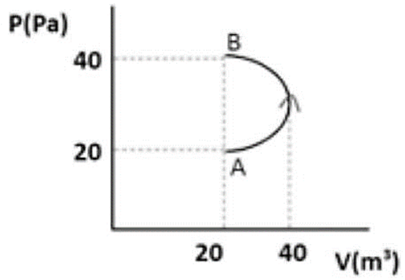
4. A ball having charge to mass $8\mu c/g$ is placed at a distance of 10 cm from a wall. Suddenly an Electric field $100 Nm^{-1}$ is switched on. Assuming collisions to be Elastic. Find Time period of oscillations.



(a) 0.5sec (b) 1sec

(c) $\sqrt{2}$sec (d) $\sqrt{3}$sec

5. If an ideal gas is taken through process AB then find work done on gas by external agent. Given curve AB is an ellipse.



(a) $200\pi J$ (b) $-200\pi J$

(c) $100\pi J$ (d) $-100\pi J$

6. If $\vec{A}\cdot\vec{B} = |\vec{A}\times\vec{B}|$, find $|\vec{A}-\vec{B}|$

(a) $\sqrt{A^2+B^2+2A\cdot B}$ (b) $\sqrt{A^2+B^2+\sqrt{2}AB}$

(c) $\sqrt{A^2+B^2-\sqrt{2}AB}$ (d) $\sqrt{A^2+B^2}$

7. Two charges are kept at a fixed distance from each other. The sum of both charges is Q. What should be charge on each of them in order to maximize force between them.

(a) $\frac{Q}{2},\frac{Q}{2}$ (b) $\frac{Q}{3},\frac{2Q}{3}$

(c) $\frac{2Q}{3},\frac{Q}{3}$ (d) $\frac{Q}{4},\frac{3Q}{4}$

8. A car is moving towards a stationary wall making Horn of frequency 400 Hz. The Reflected frequency heard by driver of car is 500 Hz. Find speed of car [= speed of sound]

(a) $\frac{V}{3}$ (b) $\frac{V}{4}$

(c) $\frac{V}{9}$ (d) $\frac{V}{12}$

9. Light emitted by hydrogen gas corresponding to transition from n = 3 to n = 2 incident on a metal plate. The electron emitted from metal plate with maximum kinetic energy enters a magnetic field 5×10^{-4} T perpendicularly. If the radius of path of electron is 7 mm then find the work function of metal.

(a) 0.91eV (b) 0.81eV

(c) 0.01eV (d) 0.5eV

10. Consider on equation $S = \alpha^2\beta\ln\left[\frac{nkR}{J\beta^2}+1\right]$

Where S = Enkopy

n = No. of moles

k = Bolzmann constant

R = Universal Gas constant

J = Mechanical equivalent of Heat

Then Dimensions of $\propto$ and β respectively.

(a) $[M^0L^0T^0], [M^1L^2T^{-2}K^{-1}]$

(b) $[M^1L^2T^{-2}], [M^1L^2T^{-2}K^{-1}]$

(c) $[M^1L^2T^{-2}K^{-1}], [M^0L^0T^0]$

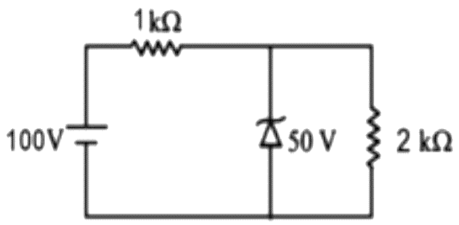
(d) None of these

11. An alpha particle and a deuteron enter a region of magnetic field which is perpendicular to their velocity. If their kinetic energies are equal, then find the ratio of their radii.

(a) $1:1$ (b) $1:\sqrt{2}$

(c) $\sqrt{2}:1$ (d) $4:2$

12. A zener diode is used in a circuit as shown. Find the current 'I' passing through the zener diode.



(a) 25 mA (b) 50 mA

(c) 100 mA (d) zero

13. A current of 5 A is flowing through magnesium wire. The current density is making an angle of 60° with Area vector. Find the electric field. (Given: Area = $2m^2$, ρ = Resistivity of Magnesium = 11×10^{-4} SI units)

(a) 55×10^{-4} V/m (b) $\frac{5}{11} \times 10^{-4}$ V/m

(c) $\frac{11}{5} \times 10^{-4}$ V/m (d) $\frac{55}{2} \times 10^{-4}$ V/m

14. A body of mass emits a photon of frequency ' v ', then loss in its internal energy is Options:

(a) hv (b) $hv\left(1-\frac{hv}{2mc^2}\right)$

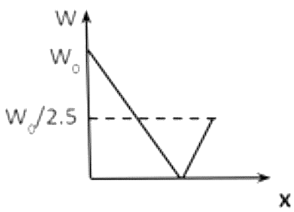
(c) $hv\left(1+\frac{hv}{2mc^2}\right)$ (d) zero

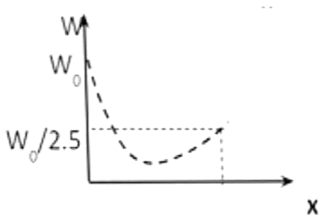
15. Tension in a spring is T_1 when length of the spring is L_1 and tension is T_2 when its length is L_2. The natural length of the spring is

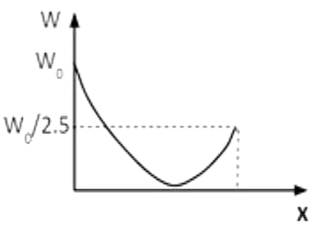
(a) $\frac{T_2 l_2 + T_1 l_1}{T_2 + T_1}$ (b) $\frac{T_2 l_2 - T_1 l_1}{T_2 - T_1}$

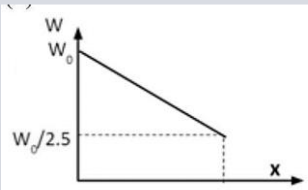
(c) $\frac{T_2 l_1 + T_1 l_2}{T_2 + T_1}$ (d) $\frac{T_2 l_1 - T_1 l_2}{T_2 - T_1}$

16. A person is standing on weighing machine and is slowly taken from the surface of Earth to the surface of mars. Given that the value of g on Earth is 10 ms^{-2} and that on Mars is $4ms^{-2}$. Draw graph of weight vs distance from earth's surface

(a) 

(b) 

(c) 

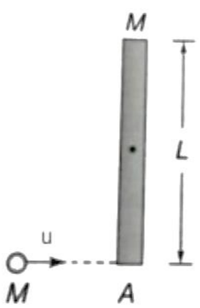
(d) 

17. A chamber containing 4 moles of diatomic gas is heated such that the temperature of the gas increases from 0°C to 50°C. Find the change in internal energy of the gas. Assume that molecules are rigid.

(a) 500R (b) 400R

(c) 300R (d) 50R

18. A particle of mass m and speed u collides elastically with the end of a uniform rod of mass M and length L as shown. If the particle comes to rest after collision, find $\frac{m}{M}$



(a) $\frac{1}{2}$ (b) 1

(c) $\frac{1}{3}$ (d) $\frac{1}{4}$

19. A radioactive material is undergoing simultaneous disintegration into two different products with half-lives 1400 years and 700 years respectively. Find the time taken by the sample to decay to one third of its initial value

(a) $\left(\frac{\ln 2}{\ln 3}, \frac{1400}{3}\right)$ years (b) $\frac{\ln 3}{\ln 2}(1400)$ years

(c) $\frac{\ln 3}{\ln 2}\frac{1400}{3}$ years (d) $\frac{\ln 3}{\ln 2}(700)$ years

PART-II CHEMISTRY

20. 10000 kJ energy is needed per day and heat of combustion 2700 kJ/mol, then find the grams of glucose needed?

(a) 666.67 (b) 650.33

(c) 459.50 (d) 576.62

21. The difference in energy between the 2nd and 3rd orbit of He^{+}ion will be?

(a) 5.34eV (b) 2.01eV

(c) 7.54eV (d) 9.24eV

22. Tyndall effect conditions

(a) The diameter of the dispersed particles is much smaller than the wavelength of the light used

(b) The refractive indices of the dispersed phase and the dispersion medium are same in magnitude

(c) The radius of the dispersed particles is much smaller than the wavelength of the light used

(d) The refractive indices of the dispersed phase and the dispersion medium is not differ greatly in magnitude

23. Intensity of colour for $NiCl_4, Ni(H_2O)_4, Ni(CN)_4$

(a) $Ni(CN)_4 > Ni(H_2O)_4 > NiCl_4$

(b) $Ni(H_2O)_4 > NiCl_4 > Ni(CN)_4$

(c) $Ni(CN)_4 > NiCl_4 > Ni(H_2O)_4$

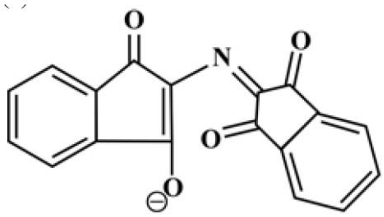
(d) $NiCl_4 > Ni(CN)_4 > Ni(H_2O)_4$

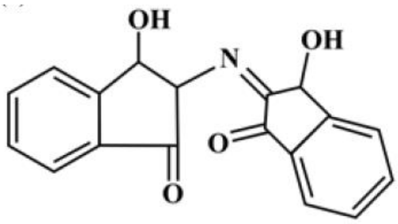
24. Azimuthal quantum number of valence electrons of Ga^{+1} is (Atomic number of Ga $= 31$)

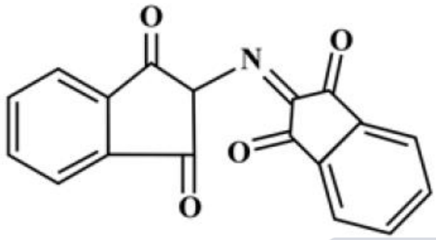
(a) $l = 0$ (b) $l = 1$

(c) $l = 2$ (d) $l = 3$

25. Structure of ruhemann's purple from ninhydrin test

(a) 

(b) 

(c) 

(d) Both (a) and (c)

26. How many equivalents of CH_3MgBr to make 2-methylpropan-2-ol from ethyl ethanoate?

(a) 4 (b) 3

(c) 5 (d) 2

27. s-block element having formula of oxide MO_2, which is yellow and paramagnetic is

(a) Na (b) K

(c) Ca (d) Mg

28. Which of the following can be purified using fractional distillation?

(a) Fe (b) Cu

(c) Zn (d) Ni

29. The hybridisation of Xenon in $XeOF_4$ is

(a) sp^3 (b) sp^3d
(c) sp^3d^2 (d) sp^3d^3

30. Number of lone pairs on central atom in I_3^-

(a) 2 (b) 1

(c) 0 (d) 3

31. Which of these have different nature?

(a) $Be(OH)_2$ and $Al(OH)_3$ (b) $B(OH)_3$ and $Al(OH)_3$

(c) $B(OH)_3$ and H_3PO_3 (d) NaOH and $Ca(OH)_2$

32. Vapour pressure of benzene and methylbenzene are 70 and 20 respectively. Both are equimolar mixture. Find the mole fraction of benzene in vapour phase?

(a) 0.33 (b) 0.77

(c) 0.50 (d) 0.66

33. Orlon is

(a) polyamide (b) polyester

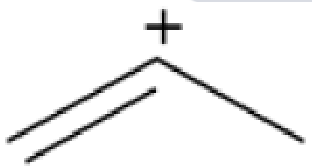
(c) polyacrylonitrile (d) Amino acid

34. An example of green chemistry in daily life:

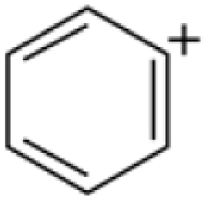
(a) CO_2 in cleaning clothes (b) Cl_2 for bleaching

(c) Tetrafluoroethane in laundry (d) All of these

35. Which of the following carbocation can show resonance?

(a) 

(b) 

(c) 

(d) 

36. Assertion: In gas phase, the angle of H_2O_2 is 90.2° and in solid phase, it is 112°

Reason: It is due to intermolecular forces

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If assertion is false but reason is true.

37. Organic compound A with $CHCl_3/KOH$ gives product B which can be decomposed by H^+/H_2O ?

(a) A = Primary amine, B = isonitrile

(b) A = Secondary amine, B = Primary amine

(c) A = isonitrile, B = Primary amine

(d) A = Carboxylic acid, B = Primary amine

38. Which of the following does not disproportionate?

(a) BrO^- (b) BrO_2^-

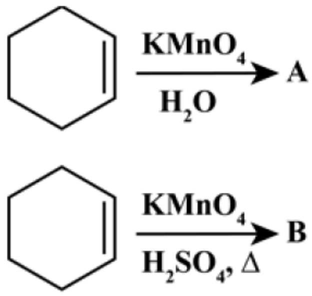
(c) BrO_3^- (d) BrO_4^-

39. IF $P_4P_{10} + HNO_3$ are mixed in $1:4$ ratio, then nature of nitrogen oxide obtained is Options:

(a) Acidic (b) Basic

(c) Amphoteric (d) Neutral

40. Product A and B for the following reaction is



(a) A = Cyclohexane-1,6-diol, B = Hexan-1,6-dioic acid

(b) A = Cyclopentane-1,5-diol B = Pentan-1,5-dioic acid

(c) A = Benzene, B = Benzoic acid

(d) A = Phenol, B = Hexane

41. 250ml0.5MNaOH, and 500ml of 1MHCl. Find the number of molecules of HCl remaining after reaction in the form of 10^{21}.

PART-III MATHEMATICS

42. The Boolean expression $(p \wedge \sim q) \Rightarrow (q \vee \sim p)$ is equivalent to:

(a) $q \Rightarrow p$ (b) $p \Rightarrow q$

(c) $\sim q \Rightarrow p80$ (d) $p \Rightarrow \sim q$

43. Let a be a positive real number such that $\int_0^a e^{x-[x]}dx = 10e - 9$ where $[x]$ is the greatest integer less than or equal to x. Then a is equal to:

(a) $10-\log_e(1+e)$ (b) $10+\log_e 2$
(c) $10+\log_e 3$ (d) $10+\log_e(1+e)$

44. The mean of 6 distinct observations is 6.5 and their variance is 10.25. If 4 out of 6 observations are 2 , 4,5 and 7 , then the remaining two observations are:
(a) 10,11 (b) 3,18
(c) 8,13 (d) 1,20

45. The value of the integral $\int_{-1}^{1}\log_e(\sqrt{1-x}+\sqrt{1+x})dx$ is equal to :
(a) $\frac{1}{2}\log_e 2+\frac{\pi}{4}-\frac{3}{2}$ (b) $2\log_e 2+\frac{\pi}{4}-1$
(c) $\log_e 2+\frac{\pi}{2}-1$ (d) $2\log_e 2+\frac{\pi}{2}-\frac{1}{2}$

46. If α and β are the distinct roots of the equation $x^2+(3)^{1/4}x+3^{1/2}=0$, then the value of $\alpha^{96}(\alpha^{12}-1)+\beta^{96}(\beta^{12}-1)$ is equal to:
(a) 56×3^{25} (b) 56×3^{24}
(c) 52×3^{24} (d) 28×3^{25}

47. Let $A=\begin{bmatrix}2 & 3\\ a & 0\end{bmatrix}$, $a\in R$ be written as P + Q where P is a symmetric matrix and Q is skew symmetric matrix. If $\det(Q)=9$, then the modulus of the sum of all possible values of determinant of P is equal to:
(a) 36 (b) 24
(c) 45 (d) 18

48. If z and ω are two complex numbers such that $|z\omega|=1$ and $\arg(z)-\arg(\omega)=\frac{3\pi}{2}$, then $\arg\left(\frac{1-2\bar{z}\omega}{1+3\bar{z}\omega}\right)$ is : (Here $\arg(z)$ denotes the principal argument of complex number z)
(a) $\frac{\pi}{4}$ (b) $-\frac{3\pi}{4}$
(c) $-\frac{\pi}{4}$ (d) $\frac{3\pi}{4}$

49. If in a triangle ABC, AB = 5 units, $\angle B=\cos^{-1}\left(\frac{3}{5}\right)$ and radius of circumcircle of $\triangle$ ABC is 5 units, then the area (in sq. units) of $\triangle$ ABC is :
(a) $10+6\sqrt{2}$ (b) $8+2\sqrt{2}$
(c) $6+8\sqrt{3}$ (d) $4+2\sqrt{3}$

50. Let $[x]$ denote the greatest integer $\leq$ x, where $x\in R$. If the domain of the real valued function $f(x)=\sqrt{\frac{|[x]|-2}{|[x]|-3}}$ is $(-\infty,a)\cup[b,c)\cup[4,\infty)$, $a<b<c$, then the value of $a+b+c$ is:
(a) 8 (b) 1
(c) -2 (d) -3

51. Let $y=y(x)$ be the solution of the differential equation $x\tan\left(\frac{y}{x}\right)dy=\left(y\tan\left(\frac{y}{x}\right)-x\right)dx$, $-1\leq x\leq 1$, $y\left(\frac{1}{2}\right)=\frac{\pi}{6}$. Then the area of the region bounded by the curves $x=0$, $x=\frac{1}{\sqrt{2}}$ and $y=y(x)$ in the upper half plane is:
(a) $\frac{1}{8}(\pi-1)$ (b) $\frac{1}{12}(\pi-3)$
(c) $\frac{1}{1}(\pi-2)$ (d) $\frac{1}{6}(\pi-1)$

52. The coefficient of x^{256} in the expansion of $(1-x)^{101}(x^2+x+1)^{100}$ is:
(a) ${}^{100}C_{16}$ (b) ${}^{100}C_{15}$
(c) $-{}^{100}C_{16}$ (d) $-{}^{100}C_{15}$

53. Let $A=[a_{ij}]$ be a 3×3 matrix, where

$$a_{ij}=\begin{cases}1, & \text{if } i=j\\ -x & \text{if } |i-j|=1\\ 2x+80, & \text{otherwise.}\end{cases}$$

Let a function $f:R\to R$ be defined as $f(x)=\det(A)$.

Then the sum of maximum and minimum values of f on R is equal to:

(a) $-\frac{20}{27}$ (b) $\frac{88}{27}$

(c) $\frac{20}{27}$ (d) $-\frac{88}{27}$

54. Let $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ and $\vec{b} = \hat{i} + \hat{j}$. If $\vec{c}$ is a vector such that $\vec{a} \cdot \vec{c} = |\vec{c}|, |\vec{c} - \vec{a}| = 2\sqrt{2}$ and the angle between $(\vec{a} \times \vec{b})$ and $\vec{c}$ is $\frac{\pi}{6}$, then the value of $|(\vec{a} \times \vec{b}) \times \vec{c}|$ is:

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

(c) 3 (d) $\frac{3}{2}$

55. The number of real roots of the equation $\tan^{-1}\sqrt{x(x+1)} + \sin^{-1}\sqrt{x^2+x+1} = \frac{\pi}{4}$ is :

(a) 1 (b) 2

(c) 4 (d) 0

56. Let $y = y(x)$ be the solution of the differential equation $e^x\sqrt{1-y^2}dx + \left(\frac{y}{x}\right)dy = 0, y(a) = -1$. Then the value of $(y(c))^2$ is equal to:

(a) $1 - 4e^3$ (b) $1 - 4e^6$

(c) $1 + 4e^3$ (d) $1 + 4e^6$

57. Let ' a ' be a real number such that the function $f(x) = ax^2 + 6x - 15, x \in R$ is increasing in $\left(-\infty, \frac{3}{4}\right)$ and decreasing in $\left(\frac{3}{4}, \infty\right)$. Then the function $g(x) = ax^2 - 6x + 15, x \in R$ has a :

(a) local maximum at $x = -\frac{3}{4}$

(b) local minimum at $x = -\frac{3}{4}$

(c) local maximum at $x = \frac{3}{4}$

(d) local minimum at $x = \frac{3}{4}$

58. Let a function $f: R \to R$ be defined as

$$f(x) = \begin{cases} \sin x - e^x & \text{if } x \le 0 \\ a + [-x] & \text{if } 0 < x < 1 \\ 2x - b & \text{if } x \ge 1 \end{cases}$$

Where $[x]$ is the greatest integer less than or equal to x. If f is continuous on R, then $(a + b)$ is equal to:

(a) 4 (b) 3

(c) 2 (d) 5

59. Words with or without meaning are to be formed using all the letters of the word EXAMINATION. The probability that the letter M appears at the fourth position in any such word is:

(a) $\frac{1}{66}$ (b) $\frac{1}{11}$

(c) $\frac{1}{9}$ (d) $\frac{2}{11}$

60. The probability of selecting integers a $\in [-5, 30]$ such that $x^2 + 2(a+4)x - 5a + 64 > 0$, for all x $\in$ R, is:

(a) $\frac{7}{36}$ (b) $\frac{2}{9}$

(c) $\frac{1}{6}$ (d) $\frac{1}{4}$

61. Let the tangent to the parabola $S: y^2 = 2x$ at the point $P(2, 2)$ meet the x-axis at Q and normal at it meet the parabola S at the point R. Then the area (in sq. units) of the triangle PQR is equal to:

(a) $\frac{25}{2}$ (b) $\frac{35}{2}$

(c) $\frac{15}{2}$ (d) 25

62. Let $\vec{a}, \vec{b}, \vec{c}$ be three mutually perpendicular vectors of the same magnitude and equally inclined at an angle θ, with the vector $\vec{a}+\vec{b}+\vec{c}$. Then $36\cos^2 2\theta$ is equal to

63. Let $A = \begin{pmatrix} 18\theta 1 & & 0 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{pmatrix}$ and $B = 7A^{20} - 20A^{7} + 2I$, where I is an identity matrix of order 3×3. If $B = [b_{ij}]$, then b_{13} is equal to

64. Let P be a plane passing through the points $(1, 0, 1), (1, -2, 1)$ and $(0, 1, -2)$. Let a vector $\vec{a} = \alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$ be such that $\vec{a}$ is parallel to the plane P, perpendicular to $(\hat{i} + 2\hat{j} + 3\hat{k})$ and $\vec{a} \cdot (\hat{i} + \hat{j} + 2\hat{k}) = 2$, then $(\alpha - \beta + \gamma)^2$ equals

65. The number of rational terms in the binomial expansion of $\left(4^{\frac{1}{4}} + 5^{\frac{1}{6}}\right)^{120}$ is

66. If the shortest distance between the lines $\overrightarrow{r_1} = \alpha\hat{i} + 2\hat{j} + 2\hat{k} + \lambda(\hat{i} - 2\hat{j} + 2\hat{k}), \lambda \in \mathrm{R}, \alpha > 0$ and $\overrightarrow{r_2} = -4\hat{i} - \hat{k} + \mu(3\hat{i} - 2\hat{j} - 2\hat{k}), \mu \in \mathrm{R}$ is 9 , then α is equal to

67. Let T be the tangent to the ellipse E: $x^2 + 4y^2 = 5$ at the point $P(1, 1)$. If the area of the region bounded by the tangent T, ellipse E, lines $x = 1$ and $x = \sqrt{5}$ is $\alpha\sqrt{5} + \beta + \gamma\cos^{-1}\left(\frac{1}{\sqrt{5}}\right)$, then $|\alpha + \beta + \gamma|$ is equal to

68. Let a, b, c, d be in arithmetic progression with common difference λ. If

$\begin{vmatrix} x+a-c & x+b & x+a \\ x-1 & x+c & x+b \\ x-b+d & x+d & x+c \end{vmatrix} = 2$ then value of λ^2 is equal to

69. There are 15 players in a cricket team, out of which 6 are bowlers, 7 are batsmen and 2 are wicketkeepers. The number of ways, a team of 11 players be selected from them so as to include at least 4 bowlers, 5 batsmen and 1 wicketkeeper, is

70. Let $y = mx + c, m > 0$ be the focal chord of $y^2 = -64x$, which is tangent to $(x + 10)^2 + y^2 = 4$. Then, the value of $4\sqrt{2}(m + c)$ is equal to

71. If the value of $\lim_{x\to 0}(2 - \cos x\sqrt{\cos 2x})^{\left(\frac{x+2}{x^2}\right)}$ is equal to e^a, then a is equal to