PART-I PHYSICS

1. **In a series LCR circuit, $R = 5\Omega, L = 0.5\text{mH}, C = 2.5\mu\text{F}$. The RMS value of external voltage is 250 V. Find the power dissipated if circuit is in Resonance Answer: 12500 W**

2. **The wavelength of sodium lamp is observed to be 2886Å from earth & original wavelength was 2880Å. Find speed of galaxy.**

(a) 3×10^5 m s^{-1} (b) 4×10^5 m s^{-1}

(c) 6.25×10^5 m s^{-1} (d) None

3. **A body is under the influence of a force such that it delivers a constant power P. The variation of position with time of body as**

(a) $t^{\frac{1}{2}}$ (b) $t^{\frac{3}{2}}$

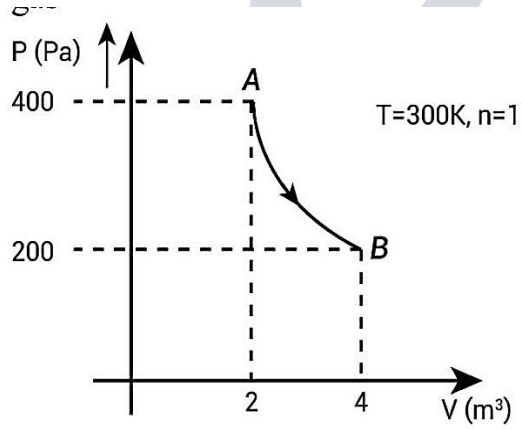
(c) $t^{\frac{5}{2}}$ (d) None

4. **When a metal is illuminated by light of wavelength λ, the stopping potential is V_0 and for wavelength 2λ, it is $3V_0$. Then the threshold wavelength is?**

(a) $\frac{2\lambda}{3}$ (b) $\frac{4\lambda}{5}$

(c) $\frac{\lambda}{3}$ (d) $\frac{5\lambda}{2}$

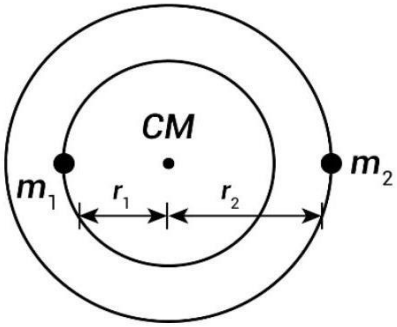
5. **A gas is taken through an isothermal process as shown. Find the work done by the gas**



(a) 240 J (b) 360 J

(c) 560 J (d) None

6. **Two stars of masses m_1 and m_2 form a binary system, revolving around each other in circular orbits of radii r_1 and r_2 respectively. Time period of revolution for this system is**



(a) $2\pi\sqrt{\frac{(r_1+r_2)^3}{G(m_1+m_2)}}$ (b) $2\pi\sqrt{\frac{(r_1+r_2)r_2^2}{G(m_1+m_2)}}$

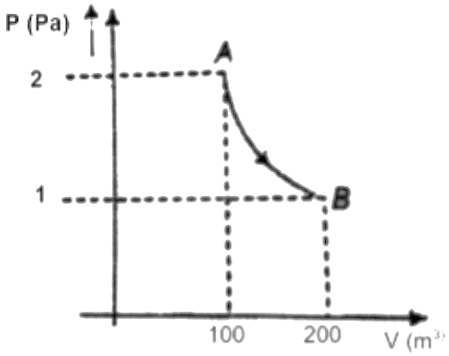
(c) $\frac{2\pi(r_1+r_2)^{\frac{3}{2}}}{\sqrt{G(m_1+m_2)}}$ (d) $\frac{2\pi(r_1+r_2)^2 r_1}{G(m_1+m_2)}$

7. 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) $\frac{T_2l_2+T_1l_1}{T_2+T_1}$ (b) $\frac{T_2l_2-T_1l_1}{T_2-T_1}$

(c) $\frac{T_2l_1+T_1l_2}{T_2+T_1}$ (d) $\frac{T_2l_1-T_1l_2}{T_2-T_1}$

8. Find work done in the process $A \rightarrow B$ (isothermal) by gas?



(a) $100\ln 2$ (b) $-100\ln 2$

(c) $200\ln 2$ (d) $-200\ln 2$

9. A body rotating have an angular velocity of 300rpm and its angular acceleration is $\frac{\pi}{20}(\text{rad/s}^2)$. Resolutions done by this body in 10sec is

(a) $\frac{205}{4}$(rev) (b) $\frac{307}{3}$(rev)

(c) 75(rev) (d) $\frac{189}{2}$(rev)

10. A boy at the airport takes time t_1 to walk on escalator if the escalator is at rest and takes time t_2 if boy is at rest on moving escalator. Then find the time taken to walk on the escalator for same path?

(a) $|t_1 - t_2|$ (b) $\frac{t_1+t_2}{2}$

(c) $\frac{2t_1t_2}{t_1+t_2}$ (d) $\frac{t_1t_2}{t_1+t_2}$

11. A particle is performing SHM along X-axis, such that its velocity is v1, when its displacement from mean position is X_1 and V_2 when its displacement from mean position is X_2. Time period of oscillation is

(a) $\frac{1}{2\pi}\sqrt{\frac{x_2-x_1}{(v_1-v_2)}}$ (b) $2\pi\sqrt{\frac{(x_1^2+x_2^2)}{(v_2^2+v_1^2)}}$

(c) $2\pi\sqrt{\frac{(x_2^2-x_1^2)}{(v_1^2-v_2^2)}}$ (d) $2\pi\sqrt{\frac{(x_1x_2-x_1^2)}{(v_1v_2-v_1^2)}}$

12. An electron $(9\times10^{-31}\text{ kg}, 1.6\times10^{-19}\text{C})$ is accelerated by a voltage of 40kV. What is the wavelength? $h = 6.6\times10^{-34}$ SI units.

13. For a medium, the magnetic susceptibility is 499. The permeability of free space is $4\pi\times10^{-7}$ SI units. Then the permeability of the medium is?

(a) $2\pi\times10^{-4}$ SI units (b) $2\pi\times10^{-7}$ SI units

(c) $\frac{5\pi}{4}\times10^{-7}$ SI units (d) $\frac{4\pi}{5}\times10^{-4}$ SI units

14. A particle has 4 times its initial kinetic energy. Find the percentage change in momentum?

(a) 100% (b) 200%

(c) 300% (d) 400%

15. Electrons with de-Broglie wavelength λ, fall on a target in an x-ray tube. The cutoff wavelength of emitted x-ray is

(a) $\frac{2mc\lambda^2}{h}$ (b) $\frac{2h}{mc}$

(c) $\frac{h}{mc}$ (d) None

16. An element has $\frac{1}{16}^{\text{th}}$ of initial activity in 20sec. Half life of the nuclei is

(a) 5sec (b) $\frac{4}{3}$sec

(c) 2.5sec (d) 7.5sec

17. A solid cylinder and ring are released from rest in top of inclined plane. Find ratio of their velocities when they reach bottom, assuming pure rolling

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

(c) $\sqrt{\frac{7}{5}}$ (d) $\sqrt{\frac{4}{3}}$

18. The angle of Dip in a plane at an angle of 30° with Geographical meridian is 45°. The value of true Dip is

(a) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (b) $\tan^{-1}\left(\frac{1}{2}\right)$

(c) $30°$ (d) $60°$

PART-II CHEMISTRY

19. Which gas retard the rate of photosynthesis?

(a) CO (b) NO_2

(c) CO_2 (d) CFC

20. Sodium will not react normally with Options:

(a) Ammonia gas (b) Ethyne

(c) But-2-yne (d) All of these

21. The hybridisation of NO_2^-, NO_2^+ and NH_4^+ are respectively Options:

(a) sp^2, sp, sp^3 (b) sp, sp, sp^3

(c) sp^2, sp, sp (d) sp^2, sp^2, sp^3

22. What is added with HNO_3 in carius method?

(a) Silver nitrate (b) Copper nitrate

(c) Copper sulphate (d) None of these

23. $4\ s^2 4p^1$: Diagonally next period in p-block. Identify element Options:

(a) Al (b) Sb

(c) Cd (d) Sn

24. Cu^{2+} salts reacts with KI and forms:

(a) Cu_2I_2 (b) CuI

(c) CuI_2 (d) None of these

25. In nitration, HNO_3 and H_2SO_4 act as:

(a) Both acid

(b) Both base

(c) HNO_3: Acid & H_2SO_4: Base

(d) HNO_3: Base & H_2SO_4: Acid

26. The common monomer present in novolac and bakelite is:

(a) Acetaldehyde (b) Methanal

(c) Phenol (d) Ethylene glycol

27. Rate of hydrolysis: Ester, Acid chloride, Acid anhydride Options:

(a) Acid chloride > Acid anhydride > Ester
(b) Ester > Acid chloride > Acid anhydride

(c) Acid anhydride > Ester > Acid chloride

(d) Acid chloride < Acid anhydride < Ester

28. What is the difference in the number of unpaired electrons in $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$

(a) 4 (b) 1

(c) 0 (d) 2

29. Radioactive substance becomes 1/16th of original in 80 minutes, Find the half-life Options:

(a) 20 min (b) 40 min

(c) 60 min (d) 80 min

30. Bakelite is formed by cross linking of which of the following? Options:

(a) Novolac (b) Buna-s

(c) Dacron (d) PHBV

31. In FCC, 50% tetrahedral void is filled. Find the effective number of atoms in the cell if made using the same atoms?

(a) 2 (b) 4

(c) 6 (d) 8

32. Which of the following do not have magnetic moment of 1.73 B.M? Options:

(a) O_2^+ (b) O_2^-

(c) $[Cu(NH_3)_4]Cl_2$ (d) CuI

33. If equimolar mixture of NaOH and Na_2CO_3 weight 4 g then weight of NaOH is:

(a) 1.595 (b) 1.095

(c) 2.904 (d) 2.945

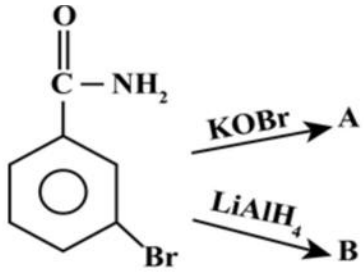
34. $PCl_5 \rightarrow PCl_3 + Cl_2$

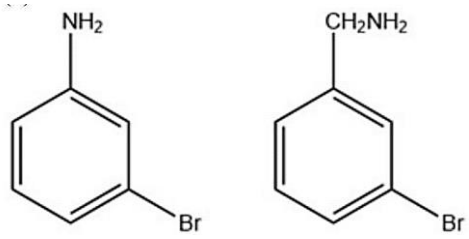
The above first order reaction has initial moles as 10 and after 20 min final moles are 2. Find the rate constant. (Given: $\log 5 = 0.693$)

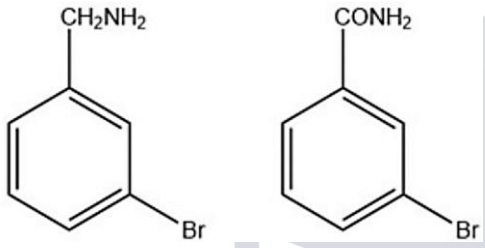
(a) 0.08 min^{-1} (b) 0.16 min^{-1}

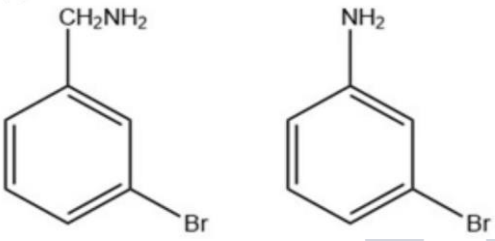
(c) 0.24 min^{-1} (d) 0.02 min^{-1}

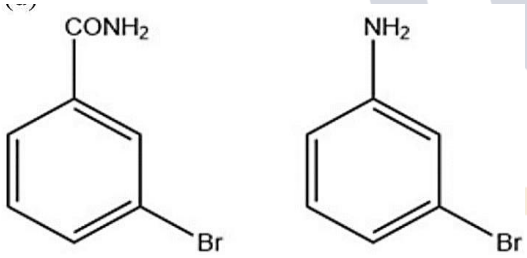
35. What are A and B respectively in the following reactions?



(a) 

(b) 

(c) 

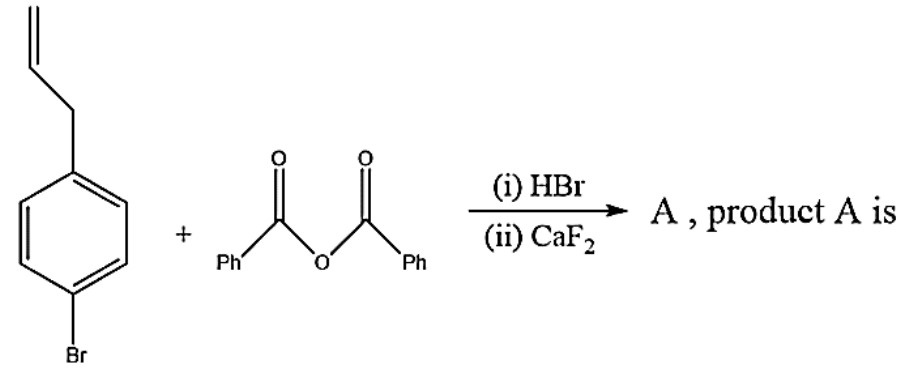
(d) 

36. Spin only magnetic moment of Fe^{2+} with weak field ligand is Options:

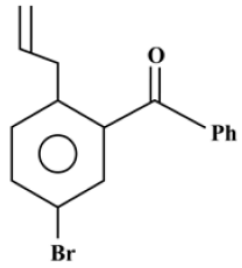
(a) 4.90 (b) 1.73

(c) 2.80 (d) 0

37.



A , product A is

(a)


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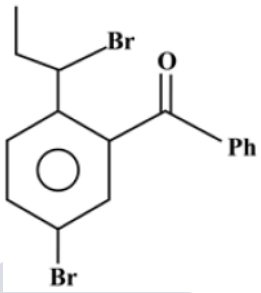

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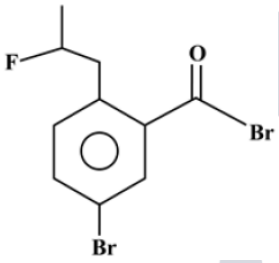
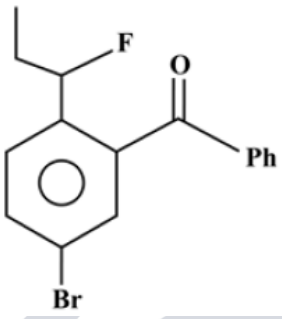
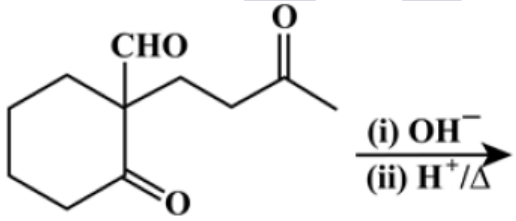
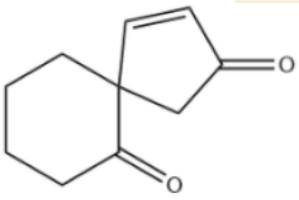
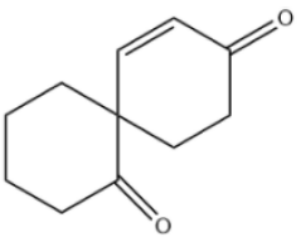


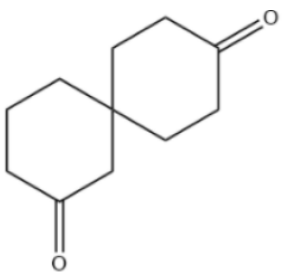
(d)


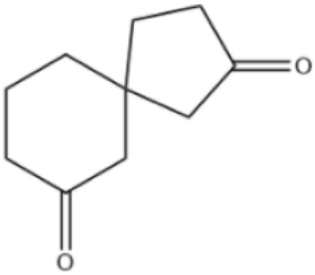
38. What is the final product of the following reaction?



(a)


(b)


(c)


(d)


PART-III MATHEMATICS

39. For the natural numbers m, n, if $(1-y)^m(1+y)^n = 1 + a_1y + a_2y^2 + \cdots + a_{m+n}y^{m+n}$ and $a_1 = a_2 = 10$, then the value of $(m+n)$ is equal to:

(a) 88 (b) 64

(c) 100 (d) 80

40. The value of $\tan\left(2\tan^{-1}\left(\frac{3}{5}\right) + \sin^{-1}\left(\frac{5}{13}\right)\right)$ is equal to :

(a) $\frac{-181}{69}$ (b) $\frac{220}{21}$

(c) $\frac{-291}{76}$ (d) $\frac{151}{63}$

41. Let r_1 and r_2 be the radii of the largest and smallest circles, respectively, which pass through the point $(-4, 1)$ and having their centres on the circumference of the circle $x^2 + y^2 + 2x + 4y - 4 = 0$. If $\frac{r_1}{r_2} = a + b\sqrt{2}$, then $a + b$ is equal to:

(a) 3 (b) 11

(c) 5 (d) 7

42. Consider the following three statements:

(A) If $3 + 3 = 7$ then $4 + 3 = 8$.

(B) If $5 + 3 = 8$ then earth is flat.

(C) If both (A) and (B) are true then $5 + 6 = 17$.

Then, which of the following statements is correct?

(a) (A) is false, but (B) and (C) are true

(b) (A) and (C) are true while (B) is false

(c) (A) is true while (B) and (C) are false

(d) (A) and (B) are false while (C) is true

43. The lines $x = ay - 1 = z - 2$ and $x = 3y - 2 = bz - 2, (ab \neq 0)$ are coplanar, if :

(a) $b = 1, a \in R - \{0\}$ (b) $a = 1, b \in R - \{0\}$

(c) $a = 2, b = 2$ (d) $a = 2, b = 3$

44. If $[x]$ denotes the greatest integer less than or equal to x, then the value of the integral $\int_{-\pi/2}^{\pi/2}[[x] - \sin x]dx$ is equal to:

(a) $-\pi$ (b) π

(c) 0 (d) 1

45. If the real part of the complex number $(1 - \cos\theta + 2i\sin\theta)^{-1}$ is $\frac{1}{5}$ for $\theta \in (0, \pi)$, then the value of the integral $\int_0^{\theta} \sin x dx$ is equal to :

(a) 1 (b) 2

(c) -1 (d) 0

46. Let $f: \mathbb{R} - \left\{\frac{\alpha}{6}\right\} \to R$ be defined by $f(x) = \frac{5x+3}{6x-\alpha}$.

Then the value of α for which $(fof)(x) = x$, for all $x \in R - \left\{\frac{\alpha}{6}\right\}$, is:

(a) No such α exists (b) 5

(c) 8 (d) 6

47. If $f: R \to R$ is given by $f(x) = x + 1$, then the value of

$\lim_{n\to\infty}\frac{1}{n}\left[f(0)+f\left(\frac{5}{n}\right)+f\left(\frac{10}{n}\right)+\cdots..+f\left(\frac{5(n-1)}{n}\right)\right]$,is:

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

(c) $\frac{1}{2}$ (d) $\frac{7}{2}$

48. Let A, B and C be three events such that the probability that exactly one of A and B occurs is $(1-k)$, the probability that exactly one of B and C occurs is $(1-2k)$, the probability that exactly one of C and A occurs is $(1-k)$ and the probability of all A, B and C occur simultaneously is k^2, where $0<k<1$. Then the probability that at least one of A, B and C occur is:

(a) greater than $\frac{1}{8}$ but less than $\frac{1}{4}$ (b) greater than $\frac{1}{2}$

(c) greater than $\frac{1}{4}$ but less than $\frac{1}{2}$ (d) exactly equal to $\frac{1}{2}$

49. The sum of all the local minimum values of the twice differentiable function $f:R\to R$ defined by $f(x)=x^3-3x^2-\frac{3f''(b)}{2}x+f''(a)$ is :

(a) -22 (b) 5

(c) -27 (d) 0

50. Let in a right-angled triangle, the smallest angle be θ. If a triangle formed by taking the reciprocal of its sides is also a right angled triangle, then $\sin\theta$ is equal to:

(a) $\frac{\sqrt{5}+1}{4}$ (b) $\frac{\sqrt{5}-1}{2}$

(c) $\frac{\sqrt{2}-1}{2}$ (d) $\frac{\sqrt{5}-1}{4}$

51. Let $y=y(x)$ satisfies the equation $\frac{dy}{dx}-|A|=0$, for all $x>0$, where $A=\begin{bmatrix} y & \sin x & 1 \\ 0 & -1 & 1 \\ 2 & 0 & \frac{1}{x}\end{bmatrix}$. If $y(\pi)=\pi+2$, then the value of $y\left(\frac{\pi}{2}\right)$ is:

(a) $\frac{\pi}{2}+\frac{4}{\pi}$ (b) $\frac{\pi}{2}-\frac{1}{\pi}$

(c) $\frac{3\pi}{2}-\frac{1}{\pi}$ (d) $\frac{\pi}{2}-\frac{4}{\pi}$

52. Consider the line L given by the equation $\frac{x-3}{2}=\frac{y-1}{1}=\frac{z-2}{1}$. Let Q be the mirror image of the point $(2,3,-1)$ with respect to L. Let a plane P be such that it passes through Q, and the line L is perpendicular to P. Then which of the following points is on the plane P?

(a) $(-1,1,2)$ (b) $(1,1,1)$

(c) $(1,1,2)$ (d) $(1,2,2)$

53. If the mean and variance of six observations $7,10,11,15,a,b$ are 10 and $\frac{20}{3}$, respectively, then the value of $|a-b|$ is equal to:

(a) 9 (b) 11

(c) 7 (d) 1

54. Let $g(t)=\int_{-\pi/2}^{\pi/2}\cos\left(\frac{\pi}{4}t+f(x)\right)dx$, where

$f(x)=\log_e\left(x+\sqrt{x^2+1}\right), x\in R$. Then which one of the following is correct ?

(a) $g(a)=g(0)$ (b) $\sqrt{2}g(a)=g(0)$

(c) $g(a)=\sqrt{2}g(0)$ (d) $g(a)+g(0)=0$

55. Let P be a variable point on the parabola $y=4x^2+1$. Then, the locus of the mid-point of the point P and the foot of the perpendicular drawn from the point P to the line $y=x$ is:

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

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

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

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

56. The value of $k \in R$, for which the following system of linear equations

$3x-y+4z=3$,

$x+2y-3z=-2$,

$6x+5y+kz=-3$,

has infinitely many solutions, is:

(a) 3 (b) -5

(c) 5 (d) -3

57. If sum of the first 21 terms of the series $\log_{9^{1/2}} x+\log_{9^{1/3}} x+\log_{9^{1/4}} x+\cdots$, where $x>0$ is 504, then x is equal to

(a) 243 (b) 9

(c) 7 (d) 81

58. In a triangle ABC, if $|\overrightarrow{BC}|=3$, $|\overrightarrow{CA}|=5$ and $|\overrightarrow{BA}|=7$, then the projection of the vector $\overrightarrow{BA}$ on $\overrightarrow{BC}$ is equat to

(a) $\frac{19}{2}$ (b) $\frac{13}{2}$

(c) $\frac{11}{2}$ (d) $\frac{15}{2}$

59. Let $A=\{a_{ij}\}$ be a 3×3 matrix, where

$$a_{ij}=\begin{cases}(-1)^{j-i} & \text{if } i<j\\ 2 & \text{if } i=j\\ (-1)^{i+j} & \text{if } i>j\end{cases}$$

then $\det\left(3\,\text{Adj}\left(2A^{-1}\right)\right)$ is equal to

60. The number of solutions of the equation $\log_{(x+1)}\left(2x^2+7x+5\right)+\log_{(2x+5)}(x+1)^2-4=0$, $x>0$, is

61. Let a curve $y=y(x)$ be given by the solution of the differential equation

$$\cos\left(\frac{1}{2}\cos^{-1}(e^{-x})\right)dx=\sqrt{e^{2x}-1}\,dy$$

If it intersects y-axis at $y=-1$, and the intersection point of the curve with x-axis is $(\alpha,0)$, then e^{α} is equal to

62. For $p>0$, a vector $\vec{v}_2=2\hat{i}+(p+1)\hat{j}$ is obtained by rotating the vector $\vec{v}_1=\sqrt{3}p\hat{i}+\hat{j}$ by an angle θ about origin in counter clockwise direction. If $\tan\theta=\frac{(\alpha\sqrt{3}-2)}{(4\sqrt{3}+3)}$, then the value of α is equal to

63. Consider a triangle having vertices $A(-2,3)$, $B(1,9)$ and $C(3,8)$. If a line L passing through the circum-centre of triangle ABC, bisects line BC, and intersects y-axis at point $\left(0,\frac{\alpha}{2}\right)$, then the value of real number α is

64. If the point on the curve $y^2=6x$, nearest to the point $\left(3,\frac{3}{2}\right)$ is (α,β), then $2(\alpha+\beta)$ is equal to

65. Let a function $g:[0,4] \to R$ be defined as

$$g(x) = \begin{cases} \max\limits_{0 \le t \le x} \{t^3 - 6t^2 + 9t - 3\} & , 0 \le x \le 3 \\ 4 - x & , 3 < x \le 4 \end{cases},$$

then the number of points in the interval $(0,4)$ where g(x) is NOT differentiable, is

66. For $k \in N$, let

$$\frac{1}{\alpha(\alpha+1)(\alpha+2)\ldots\ldots(\alpha+20)} = \sum_{K=0}^{20} \frac{A_k}{\alpha+k},$$

where $\alpha > 0$. Then the value of $100\left(\frac{A_{14}+A_{15}}{A_{13}}\right)^2$ is equal to

67. Let $\{a_n\}_{n=1}^{\infty}$ be a sequence such that $a_1 = 1, a_2 = 1$ and $a_{n+2} = 2a_{n+1} + a_n$ for all $n \ge 1$. Then the value of $47\sum_{n=1}^{\infty} \frac{a_n}{2^{3n}}$ is equal to

68. If $\lim_{x \to 0} \frac{\alpha x e^x - \beta \log_e(1+x) + \gamma x^2 e^{-x}}{x \sin^2 x} = 10, \alpha, \beta, \gamma \in R$, then the value of $\alpha + \beta + \gamma$ is