10 New Pattern

Mock Tests for NTA

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   awarded for not attempted questio
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6. Any textual, printed or written mate
   allowed for the students appearing
7. All calculations / written work sho

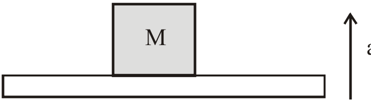
PHYSICS

PART-I (Multiple Choice Questions)

1. Two stars each of mass M and radius R are approaching each other for a head-on collision. They start approaching each other when their separation is $r >> R$. If their speeds at this separation are negligible, the speed v with which they collide would be

(a) $v = \sqrt{GM\left(\frac{1}{R} - \frac{1}{r}\right)}$

normal reaction between the block and platform is



(a) $-\dfrac{MgaT^2}{2}$

(b) $\dfrac{1}{2}M\,(g+a)\,aT^2$

(c) $\dfrac{1}{2}Ma^2T$

(d) Zero

3. A large number of water drops each of radius r combine to have a drop of radius R. If the surface tension is T and the mechanical equivalent of heat is J, then the rise in temperature will be

(a) $\dfrac{2T}{rJ}$

(b) $\dfrac{3T}{RJ}$

(c) $\dfrac{3T}{J}\left(\dfrac{1}{r}-\dfrac{1}{R}\right)$

(d) $\dfrac{2T}{J}\left(\dfrac{1}{r}-\dfrac{1}{R}\right)$

4. Three charges are placed at the vertices of an equilateral triangle of side 'a' as shown in the following figure. The force experienced by the charge placed

resultant magnetic induction at a point midway between them is ($\mu_0 = 4\pi \times 10^{-7}\,\text{Hm}^{-1}$)

(a) $\sqrt{2} \times 10^{-7}$ tesla

(b) $\sqrt{5} \times 10^{-7}$ tesla

(c) $\sqrt{2} \times 10^{-3}$ tesla

(d) $\sqrt{5} \times 10^{-3}$ tesla

7. Two boys are standing at the ends A and B of a ground where $AB = a$. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity v and catches the other boy in a time t, where t is

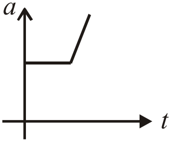
(a) $a/\sqrt{v^2 + v_1^2}$

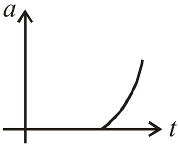
(b) $a/(v + v_1)$

(c) $a/(v - v_1)$

(d) $\sqrt{a^2/(v^2 - v_1^2)}$

8. A block is placed on a rough horizontal plane. A time dependent horizontal force $F = kt$ acts on the block. Here, k is a positive constant. The acceleration-time graph of the block is

(a) 

(b) 

11. A sinusoidal voltage of amplitude 25 volt and frequency 50Hz is applied to a half wave rectifier using P-n junction diode. No filter is used and the load resistor is 1000Ω. The forward resistance R_f of ideal diode is 10Ω. The percentage rectifier efficiency is

(a) 40% (b) 20%

(c) 30% (d) 15%

12. When photon of energy 4.25 *e*V strike the surface of a metal A, the ejected photoelectrons have maximum kinetic energy T_A eV and de-Brolie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photon of energy 4.70 eV is $T_B = (T_A - 1.50)$ *e*V. If the de-Broglie wavelength of these photoelectrons is $\lambda_B = 2\lambda_A$, then

(a) the work function of A is 3.40 *e*V

(b) the work function of B is 6.75 *e*V

(c) $T_A = 2.00\ eV$

(d) $T_B = 2.75\ eV$

13. Given is the graph between $\frac{PV}{T}$ and *P* for 1 g of oxygen gas at two different temperatures T_1 and T_2, as shown in figure. Given, density of oxygen = 1.427 kg m^{-3}. The value of *PV/T* at the point *A* and the relation between T_1 and T_2 are respectively

$\frac{PV}{T}\ \text{J k}^{-1}$

16. A gas is compressed isothermally to half its initial volume. The same gas is compressed separately through an adiabatic process until its volume is again reduced to half. Then :

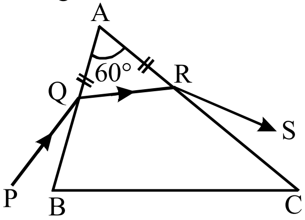
(a) Compressing the gas isothermally will require more work to be done.

(b) Compressing the gas through adiabatic process will require more work to be done.

(c) Compressing the gas isothermally or adiabatically will require the same amount of work.

(d) Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas.

17. A ray PQ incident on the refracting face BA is refracted in the prism BAC as shown in the figure and emerges from the other



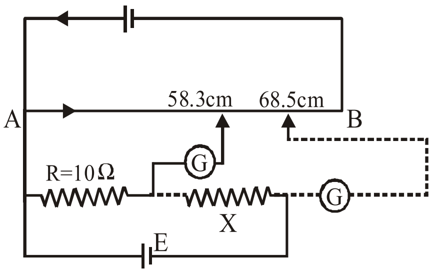
refracting face AC as RS such that AQ = AR. If the angle of prism A = 60° and the refractive index of the material of prism is $\sqrt{3}$, then the angle of deviation of the ray is

(a) 60°

(b) 45°

(c) 30°

(d) None of these



22. An automobile moves on a road with a speed of 54 km h^{-1}. The radius of its wheels is 0.45 m and the moment of inertia of the wheel about its axis of rotation is 3 kg m^2. If the vehicle is brought to rest in 15s, the magnitude of average torque (in kgm^2s^{-2}) transmitted by its brakes to the wheel is :

23. A coil of effective area 4 m^2 is placed at right angles to the magnetic induction B. The e.m.f. of 0.32 V is induced in the coil. When the field is reduced to 20% of its initial value in 0.5 sec. Find B (in wb/m^2).

24. A disc of radius $R = 10$ cm oscillates as a physical pendulum about an axis perpendicular to the plane of the disc at a distance r from its centre. If $r = \frac{R}{4}$, the approximate period of oscillation (in second) is (Take $g = 10\ m\ s^{-2}$)

25. Taking the wavelength of first Balmer line in hydrogen spectrum (n = 3 to n = 2) as 660 nm, the wavelength (in nm) of the 2[nd] Balmer line (n = 4 to n = 2) will be;

31. Select the rate law that corresponds to data shown for the following reaction

$A + B \longrightarrow$ products.

Exp.	**[A]**	**[B]**	**Initial rate**
1	0.012	0.035	0.1
2	0.024	0.070	0.8
3	0.024	0.035	0.1
4	0.012	0.070	0.8

(a) rate = $k\,[B]^3$

(b) rate = $k\,[B]^4$

(c) rate = $k\,[A]\,[B]^3$

(d) rate = $k\,[A]^2\,[B]^2$

32. The pH of 0.1 M solution of the following species increases in the order :

(a) $NaCl < NH_4Cl < NaCN < HCl$

(b) $HCl < NH_4Cl < NaCl < NaCN$

(c) $NaCN < NH_4Cl < NaCl < HCl$

(d) $HCl < NaCl < NaCN < NH_4Cl$

33. Aldehydes and ketones are distinguished by which of the following test ?

(a) Lucas test

(b) Tollen's test

(c) $KMnO_4$ solution (Baeyer's test)

(d) None of these

34. Which is not a true statement?

(a) α-Carbon of α-amino acid is asymmetric

(b) All proteins are found in L-form

(c) Human body can synthesize all proteins they need

38. When phenol is treated with excess bromine water. It gives
(a) *m*-Bromophenol
(b) *o*-and *p*-Bromophenols
(c) 2,4-Dibromophenol
(d) 2,4, 6-Tribromophenol.

39. Given below, catalyst and corresponding process/reaction are matched. The one with mismatch is
(a) $[RhCl(PPh_3)_2]$: Hydrogenation
(b) $TiCl_4 + Al(C_2H_5)_3$: Polymerization
(c) V_2O_5 : Haber-Bosch process
(d) Nickel : Hydrogenation

40. The molecule which has zero dipole moment is :
(a) CH_3Cl (b) NF_3
(c) BF_3 (d) ClO_2^-

41. One mole of NaCl (*s*) on melting absorbed 30.5 kJ one of heat and its entropy is increased by 28.8 $JK^{-1}mol^{-1}$. The melting point of NaCl is
(a) 1059 K (b) 30.5 K
(c) 28.8 K (d) 28800 K

42. Which alkene on ozonolysis gives CH_3CH_2CHO and $CH_3\underset{\underset{O}{\|}}{C}CH_3$?

(a) $CH_3CH_2CH = C\begin{matrix} \diagup CH_3 \\ \diagdown CH_3 \end{matrix}$
(b) $CH_3CH_2CH=CHCH_2CH_3$
(c) $CH_3\,CH_2\,CH = CH\,CH_3$
(d) $CH_3 - \underset{\underset{CH_3}{|}}{C} = CHCH_3$

MATHEMATICS

PART-I (Multiple Choice Questions)

51. If the coefficient of 4th term in the expansion of $\left(x+\frac{\alpha}{2x}\right)^n$ is 20, then the respective values of α and n are

(a) 2, 7 (b) 5, 8
(c) 3, 6 (d) 2, 6

52. If the roots of the quadratic equation $x^2 + px + q = 0$ are tan 30° and tan 15°, respectively, then the value of $2 + q - p$ is

(a) 2 (b) 3
(c) 0 (d) 1

53. If a^2, b^2, c^2 are in A.P. then $\frac{1}{b+c}, \frac{1}{c+a}, \frac{1}{a+b}$ are in-

(a) A.P.
(b) G.P.
(c) H.P.
(d) None of these

54. Let C be the circle with centre (0, 0) and radius 3 units. The equation of the locus of the mid points of the chords of the circle C that subtend an angle of $\frac{2\pi}{3}$ at its center is

(a) $x^2 + y^2 = \frac{3}{2}$

(b) $x^2 + y^2 = 1$

(c) $x^2 + y^2 = \frac{27}{4}$

(d) $x^2 + y^2 = \frac{9}{4}$

59. If $\dfrac{\tan 3\theta - 1}{\tan 3\theta + 1} = \sqrt{3}$, then the general value of θ is

(a) $\dfrac{n\pi}{3} - \dfrac{\pi}{12}$ (b) $n\pi + \dfrac{7\pi}{12}$

(c) $\dfrac{n\pi}{3} + \dfrac{7\pi}{36}$ (d) $n\pi + \dfrac{\pi}{12}$

60. Three normals are drawn to the parabola $y^2 = x$ through point $(a, 0)$. Then

(a) $a = 1/2$
(b) $a = 1/4$
(c) $a > 1/2$
(d) None of these

61. If four vertices of a regular octagon are chosen at random, then the probability that the quadrilateral formed by them is a rectangle is

(a) $\dfrac{1}{8}$ (b) $\dfrac{2}{21}$

(c) $\dfrac{1}{32}$ (d) $\dfrac{1}{35}$

62. The function

$f(x) = x^3 - 3x^2 - 24x + 5$ is an increasing function in the interval given below

(a) $(-\infty, -2) \cup (4, \infty)$

(b) $(-2, \infty)$

(c) $(-2, 4)$

(d) $(-\infty, 4)$

67. Let $f(x)=\begin{cases} x^p \sin\frac{1}{x}, & x \neq 0 \\ 0 & , x = 0 \end{cases}$ then

f(x) is continuous but not differentiable at $x = 0$ if

(a) $0 < p \leq 1$

(b) $1 \leq p < \infty$

(c) $-\infty < p < 0$

(d) $p = 0$

68. The length and foot of the perpendicular from the point (7, 14, 5) to the plane $2x+4y-z=2$, are

(a) $\sqrt{21}, (1, 2, 8)$

(b) $3\sqrt{21}, (3, 2, 8)$

(c) $21\sqrt{3}, (1, 2, 8)$

(d) $3\sqrt{21}, (1, 2, 8)$

69. If $\Delta(x)=\begin{vmatrix} e^x & \sin x \\ \cos x & \ln(1+x^2) \end{vmatrix}$, then

the value of $\lim\limits_{x\to 0}\frac{\Delta(x)}{x}$ is

(a) 0 (b) 2

(c) –1 (d) –2

70. The number of positive integral solutions of the equation

$\tan^{-1}x + \cot^{-1}y = \tan^{-1}3$, is

RESPONS

PHYSICS

1.	ⓐ ⓑ ⓒ ⓓ
2.	ⓐ ⓑ ⓒ ⓓ
3.	ⓐ ⓑ ⓒ ⓓ
4.	ⓐ ⓑ ⓒ ⓓ
5.	ⓐ ⓑ ⓒ ⓓ
6.	ⓐ ⓑ ⓒ ⓓ
7.	ⓐ ⓑ ⓒ ⓓ
8.	ⓐ ⓑ ⓒ ⓓ
9.	ⓐ ⓑ ⓒ ⓓ
10.	ⓐ ⓑ ⓒ ⓓ
11.	ⓐ ⓑ ⓒ ⓓ
12.	ⓐ ⓑ ⓒ ⓓ
13.	ⓐ ⓑ ⓒ ⓓ
14.	ⓐ ⓑ ⓒ ⓓ
15.	ⓐ ⓑ ⓒ ⓓ
16.	ⓐ ⓑ ⓒ ⓓ
17.	ⓐ ⓑ ⓒ ⓓ
18.	ⓐ ⓑ ⓒ ⓓ
19.	ⓐ ⓑ ⓒ ⓓ
20.	ⓐ ⓑ ⓒ ⓓ
21.	
22.	
23.	
24.	

CHEMIST

26.	ⓐ ⓑ
27.	ⓐ ⓑ
28.	ⓐ ⓑ
29.	ⓐ ⓑ
30.	ⓐ ⓑ
31.	ⓐ ⓑ
32.	ⓐ ⓑ
33.	ⓐ ⓑ
34.	ⓐ ⓑ
35.	ⓐ ⓑ
36.	ⓐ ⓑ
37.	ⓐ ⓑ
38.	ⓐ ⓑ
39.	ⓐ ⓑ
40.	ⓐ ⓑ
41.	ⓐ ⓑ
42.	ⓐ ⓑ
43.	ⓐ ⓑ
44.	ⓐ ⓑ
45.	ⓐ ⓑ
46.	
47.	
48.	
49.	

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PHYSICS

PART-I (Multiple Choice Questions)

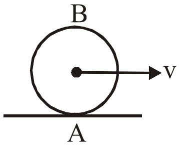
1. A bus is moving with a velocity of 10m/s on a straight road. A scooterist wishes to overtake the bus in 100 seconds. If the bus is at a distance of 1 km from the scooterist, at what velocity should the scooterist chase the bus?

(a) 50 m/sec (b) 40 m/sec

(c) 30 m/sec (d) 20 m/sec

2. The length of an elastic string is x when the tension is 5N. Its length is y when the tension is 7N. What will

4. A wheel is rolling on a plane road. The linear velocity of centre of mass is v. Then velocities of the points A and B on circumference of wheel relative to road will be



(a) $v_A = v, v_B = 0$
(b) $v_A = v_B = 0$
(c) $v_A = 0, v_B = v$
(d) $v_A = 0, v_B = 2v$

5. A metallic wire of density d is lying horizontal on the surface of water. The maximum length of wire so that it may not sink will be

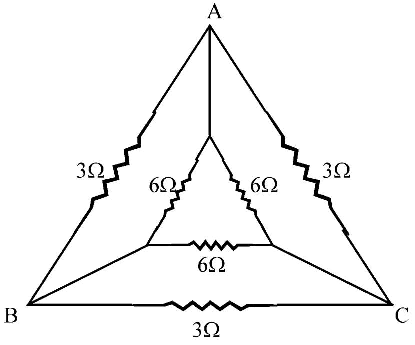
(a) $\sqrt{\frac{2Tg}{\pi d}}$ (b) $\sqrt{\frac{2\pi T}{dg}}$

(c) $\sqrt{\frac{2T}{\pi dg}}$ (d) any length

6. Two points of a rod move with velocities 3v and v perpendicular to the rod and in the same direction, separated by a distance r. Then the angular velocity of the rod is
(a) 3v/r (b) 4v/r
(c) 5v/r (d) 2v/r

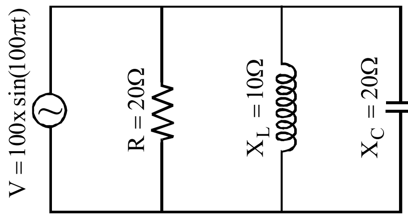
7. For hydrogen gas $C_p - C_v = a$ and for oxygen gas $C_p - C_v = b$. So, the relation between a and b is given by
(a) $a = 16\,b$ (b) $16a = b$
(c) $a = 4b$ (d) $a = b$

11. In the circuit shown the effective resistance between B and C is



(a) $3\,\Omega$ (b) $4\,\Omega$
(c) $4/3\,\Omega$ (d) $3/4\,\Omega$

12. In the given circuit, the current drawn from the source is



(a) 20 A (b) 10 A
(c) 5 A (d) $5\sqrt{2}$ A

13. A flat plate P of mass 'M' executes SHM in a horizontal plane by sliding over a frictionless surface with a frequency V. A block 'B' of mass 'm' rests on the plate as shown in figure. Coefficient of

(a) will not be there
(b) will not be there if the intensity of light reaching the screen from S_1 and S_2 are equal.
(c) will be there under all circumstances
(d) we will have only the central fringe

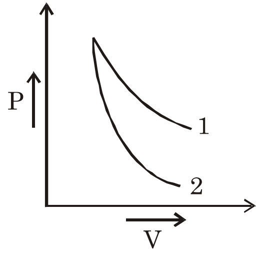
16. What is the ratio of the circumference of the first Bohr orbit for the electron in the hydrogen atom to the de Brogile wavelength of electrons having the same velocity as the electron in the first Bohr orbit of the hydrogen atom?

(a) 1 : 1 (b) 1 : 2
(c) 1 : 4 (d) 2 : 1

17. The radioactivity of a sample is R_1 at a time T_1 and R_2 at a time T_2. If the half life of the specimen is T, the number of atoms that have disintegrated in the time $(T_2 – T_1)$ is proportional to

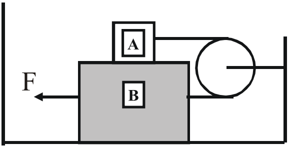
(a) $(R_1T_1 - R_2T_2)$
(b) $(R_1 - R_2)$
(c) $(R_1 - R_2)/T$
(d) $(R_1 - R_2) \times T$

18. P–V plots for two gases during adiabatic processes are shown in the figure. Plots 1 and 2 should correspond respectively to



PART-II (Numerical Answer Questions)

21. The masses of the blocks A and B are 0.5 kg and 1 kg respectively. These are arranged as shown in the figure and are connected by a massless string. The coefficient of friction between all contact surfaces is 0.4. The force (in N) necessary to move the block B with constant velocity will be ($g = 10 m/s^2$)



22. A body is thrown vertically upwards from the surface of earth in such a way that it reaches upto a height equal to $10R_e$. The velocity (in km/s) imparted to the body will be

23. A non-conducting partition divides a container into two equal compartments. One is filled with helium gas at 200 K and the other is filled with oxygen gas at 400 K. The number of molecules in each gas is the same. If the partition is removed to allow the gases to mix, the final temperature (in K) will be

24. A transformer is used to light a 140 W, 24 V bulb from a 240 V a.c. mains. The current in the main cable is 0.7 A. The efficiency (in %) of the transformer is

28. Reduction with aluminium isopropoxide in excess of isopropyl alcohol is called Meerwein Ponndorff-Verley reduction (MPV). What will be the final product when cyclohex-2-enone is selectively reduced in MPV reaction ?

(a) Cyclohexanol
(b) Cyclohex-2-enol
(c) Cyclohexanone
(d) Benzene

29. N_2 and O_2 are converted to mono cations N_2^+ and O_2^+ respectively, which of the following is wrong?

(a) In N_2^+, the N – N bond weakens
(b) In O_2^+, the O – O bond order increases
(c) In O_2^+, paramagnetism decreases
(d) N_2^+ becomes diamagnetic

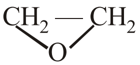
30. The reaction in which hydrogen peroxide acts as a reducing agent is

(a) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

(b) $2KI + H_2O_2 \rightarrow 2KOH + I_2$

(c) $2FeSO_4 + H_2SO_4 + H_2O_2 \rightarrow Fe_2(SO_4)_3 + 2H_2O$

(d) $Ag_2O + H_2O_2 \longrightarrow 2Ag + H_2O + O_2$

31. Reaction of  with RMgX leads to formation of

35. If s_0, s_1, s_2 and s_3 are the solubilities of AgCl in water, 0.01 M $CaCl_2$, 0.01 M NaCl and 0.05 M $AgNO_3$ solutions, respectively, then

(a) $s_0 > s_1 > s_2 > s_3$
(b) $s_0 > s_2 > s_1 > s_3$
(c) $s_0 > s_2 > s_3 > s_1$
(d) $s_0 > s_1 = s_2 > s_3$

36. An organic compound is treated with $NaNO_2$ and dil. HCl at 0°C. The resulting solution is added to an alkaline solution of β-naphthol where by a brilliant red dye is produced. It shows the presence of

(a) $-NO_2$ group
(b) aromatic $-NH_2$ group
(c) $-CONH_2$ group
(d) aliphatic $-NH_2$ group

37. Point out the incorrect statment among the following :

(a) The oxidation state of oxygen is +2 in OF_2.
(b) Acidic character follows the order $H_2O < H_2S < H_2Se < H_2Te$.
(c) The tendency to form multiple bonds increases in moving down the group from sulphur to tellurium (towards C and N)
(d) Sulphur has a strong tendency to catenate while oxygen shows this tendency to a limited extent.

41. When pink $[Co(H_2O)_6]^{2\oplus}$ is dehydrated the colour changes to blue. The correct explanation for the change is :

(a) The octahedral complex becomes square planar.
(b) A tetrahedral complex is formed.
(c) Distorted octahedral structure is obtained.
(d) Dehydration results in the formation of polymeric species.

42. Amongst the following the compound that is both paramagnetic and coloured is

(a) $K_2Cr_2O_7$
(b) $(NH_4)_2[TiCl_6]$
(c) $CoSO_4$
(d) $K_3[Cu(CN)_4]$

43. A reaction rate constant is given by $K = 1.2 \times 10^{10} e^{-2500/RT}$. It means

(a) log K vs T will give a straight line
(b) log K vs 1/T gives a straight line with a slope –2500/2.303 R
(c) half life of reaction will be more at higher temperature
(d) log K vs 1/T gives a straight line with a slope 2500/R

44. The correct statement among the following is :

(a) The alkali metals when strongly heated in oxygen form superoxides.
(b) Caesium is used in photoelectric cells.

49. The wave number of first line of Balmer series of hydrogen is 15200 cm^{-1}. Wht will be the wave number of first Balmer line of Li^{2+} ion?

50. A cylinder of gas supplied by Bharat Petroleum is assumed to contain 14 kg of butane. If a normal family requires 20,000 kJ of energy per day for cooking, butane gas in the cylinder last for .... Days.

(ΔH_c of C_4H_{10} = –2658 JK per mole)

MATHEMATICS

PART-I (Multiple Choice Questions)

51. If a, b, c, d and p are distinct non zero real numbers such that $(a^2 + b^2 + c^2)\, p^2 - 2(ab + bc + cd)p + (b^2 + c^2 + d^2) \le 0$ then a,b,c,d are in

(a) A.P.

(b) G.P.

(c) H.P.

(d) satisfy $ab = cd$

52. Which of the following is correct?

(a) If $a^2 + 4b^2 = 12ab$, then

$$\log(a + 2b) = \frac{1}{2}(\log a + \log b)$$

(b) If $\frac{\log x}{b - c} = \frac{\log y}{c - a} = \frac{\log z}{a - b}$,

then $x^a . y^b . z^c = abc$

(c)

$$\frac{1}{\log_{xy} xyz} + \frac{1}{\log_{yz} xyz} + \frac{1}{\log_{zx} xyz} = 2$$

(d) All are correct

trivial then the value of λ is given by

(a) $\lambda = -\frac{4}{5}$ (b) $\lambda \neq -\frac{4}{5}$

(c) $\lambda = 2$ (d) $\lambda \neq 2$

58. Let $f(x) = |x-1|$. Then

(a) $f(x^2) = (f(x))^2$

(b) $f(x+y) = f(x) + f(y)$

(c) $f(|x|) = |f(x)|$

(d) None of these

59. If

$$\sin^{-1}\frac{2a}{1+a^2} + \sin^{-1}\frac{2b}{1+b^2} = 2\tan^{-1}x,$$

then x is equal to

(a) $\frac{a-b}{1+ab}$ (b) $\frac{b}{1+ab}$

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

60. If AB = 0, then for the matrices

$$A = \begin{bmatrix} \cos^2\theta & \cos\theta\sin\theta \\ \cos\theta\sin\theta & \sin^2\theta \end{bmatrix}$$

and $B = \begin{bmatrix} \cos^2\phi & \cos\phi\sin\phi \\ \cos\phi\sin\phi & \sin^2\phi \end{bmatrix}$,

$\theta - \phi$ is

(a) an odd number of $\frac{\pi}{2}$

(b) an odd multiple of π

(c) an even multiple of $\frac{\pi}{2}$

(d) 0

66. The value of

$$\int_{-\pi/4}^{\pi/4} (x\,|\,x\,|+\sin^3 x + x\tan^2 x + 1)\,dx \text{ is}$$

(a) 0 (b) 1
(c) $\pi/4$ (d) $\pi/2$

67. Let $(1-x-2x^2)^6 = 1 + a_1x + a_2x^2 + \ldots. + a_{12}x^{12}$. Then

$$\frac{a_2}{2^2} + \frac{a_4}{2^4} + \frac{a_6}{2^6} + \ldots\ldots + \frac{a_{12}}{2^{12}} \text{ is}$$

equal to

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

68. The equation of a common tangent to $y^2 = 4x$ and the curve $x^2 + 4y^2 = 8$ can be

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

(b) $x + 2y + 4 = 0$

(c) $x - 2y = 4$

(d) $x + 2y = 4$

69. The function $f(x) = (x-3)^2$ satisfies all the conditions of mean value theorem in $\{3, 4\}$. A point on $y = (x-3)^2$, where the tangent is parallel to the chord joining (3, 0) and (4,1) is

(a) $\left(\frac{7}{2}, \frac{1}{2}\right)$ (b) $\left(\frac{7}{2}, \frac{1}{4}\right)$

(c) (1,4) (d) (4, 1)

70. If $x + y - z + xyz = 0$, then

$$\frac{2x}{1-x^2} + \frac{2y}{1-y^2} - \frac{2z}{1-z^2} \text{ is equal}$$

to

RESPONS

PHYSICS		CHEMIST	
1.	(a) (b) (c) (d)	26.	(a) (b) (
2.	(a) (b) (c) (d)	27.	(a) (b) (
3.	(a) (b) (c) (d)	28.	(a) (b) (
4.	(a) (b) (c) (d)	29.	(a) (b) (
5.	(a) (b) (c) (d)	30.	(a) (b) (
6.	(a) (b) (c) (d)	31.	(a) (b) (
7.	(a) (b) (c) (d)	32.	(a) (b) (
8.	(a) (b) (c) (d)	33.	(a) (b) (
9.	(a) (b) (c) (d)	34.	(a) (b) (
10.	(a) (b) (c) (d)	35.	(a) (b) (
11.	(a) (b) (c) (d)	36.	(a) (b) (
12.	(a) (b) (c) (d)	37.	(a) (b) (
13.	(a) (b) (c) (d)	38.	(a) (b) (
14.	(a) (b) (c) (d)	39.	(a) (b) (
15.	(a) (b) (c) (d)	40.	(a) (b) (
16.	(a) (b) (c) (d)	41.	(a) (b) (
17.	(a) (b) (c) (d)	42.	(a) (b) (
18.	(a) (b) (c) (d)	43.	(a) (b) (
19.	(a) (b) (c) (d)	44.	(a) (b) (
20.	(a) (b) (c) (d)	45.	(a) (b) (
21.		46.	
22.		47.	
23.		48.	
24.		49.	

MOCK T

INSTRU

1. This test will be a 3 hours Test.
2. This test consists of Physics, Cher equal weightage of 100 marks.
3. Each question is of 4 marks.
4. There are three sections in the ques to 25), Chemistry (Q.no.26 to 50) a section is divided into two parts, questions & Part II consists of 5 N
5. There will be only one correct choic each question 4 marks will be awa deducted for incorrect choice for I awarded for not attempted questio awarded for correct answer and zer
6. Any textual, printed or written mate allowed for the students appearing
7. All calculations / written work sho

PHYSICS

PART-I (Multiple Choice Questions)

1. Astronauts look down on earth surface from a space ship parked at an altitude of 500 km. They can resolve objects of the earth of the size (It can be assumed that the pupils diameter is 5mm and wavelength of light is 500 nm)

(a) 0.5m (b) 5m
(c) 50m (d) 500m

2. The wavelength of sodium light in air is 5890Å. The velocity of light in air is 3×10^{-8} ms^{-1}. The wavelength of light in a glass of refractive index 1.6, would be close to

(a) $MLT^{-1}A^{-1}$
(b) $MLT^{-2}A^{-2}$
(c) $M^{-1}L^{-3}T^{+4}A^{2}$
(d) $M^{2}L^{-2}T^{-2}A^{2}$

5. A black body at a temperature of 227ºC radiates heat at the rate of 20 cal m^{-2} s^{-1}. When its temperature rises to 727ºC the heat radiated will be

(a) 40 units (b) 160 units
(c) 320 units (d) 640 units

6. Two waves of wavelengths 99 cm and 100 cm both travelling with velocity 396 m/s are made to interfere. The number of beats produced by them per second are

(a) 1 (b) 2
(c) 4 (d) 8

7. A sphere of mass 'm' and radius 'r' is falling in the column of a viscous fluid. Terminal velocity attained by falling object is proportional to

(a) r^2 (b) $1/r$
(c) r (d) $-1/r^2$

8. There are two wires of the same length. The diameter of second wire is twice that of the first. On applying the same load to both the wires, the extension produced in them will be in ratio of

(a) 1 : 4 (b) 1 : 2
(c) 2 : 1 (d) 4 : 1

9. When a proton, anti-proton annihilate the energy released is

(a) 1.5×10^{-10} J
(b) 28.8×10^{-10} J
(c) 6×10^{-10} J
(d) 9×10^{-10} J

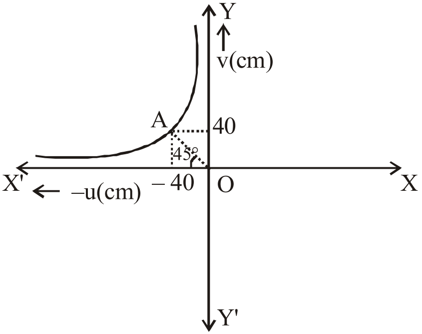
(a) $\rho = \dfrac{X\pi D}{4L}$

(b) $\rho = \dfrac{X\pi D^2}{4L}$

(c) $\rho = \dfrac{X^2\pi D^2}{4L}$

(d) $\rho = \dfrac{X\pi D^2}{4L^2}$

14. Consider the following u-v diagram regarding the experiment to determine the focal length of a convex lens.



At the point A, the values of u and v are equal. The focal length of the lens is

(a) 40 cm (b) 20 cm
(c) 10 cm (d) 15 cm

15. Two metallic plates A and B, each of area $5 \times 10^{-4} m^2$, are placed parallel to each other at a separation of 1 cm. Plate B carries a positive charge of 33.7×10^{-12}C. A mono-chromatic beam of light, with photons of energy 5 eV each, starts falling on plate A at t = 0 so that 10^{16} photons fall on it per square meter per second. Assume that one photoelectron is emitted for every 10^6 incident photons. Also assume

(a) $\left(\frac{K_1+K_2}{m}\right)^{\frac{1}{2}}$

(b) $\left[\frac{K_1K_2}{m(K_1+K_2)}\right]^{\frac{1}{2}}$

(c) $\left[\frac{K_1K_2}{(K_1-K_2)m}\right]^{\frac{1}{2}}$

(d) $\left[\frac{K_1^2+K_2^2}{(K_1+K_2)m}\right]^{\frac{1}{2}}$

19. A sphere is placed in front of a convex lens of focal length f. The radius of the sphere is much smaller compared to f. The image of the sphere would look spherical if the object distance is

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

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

20. Which of the following expressions corresponds to simple harmonic motion along a straight line, where x is the displacement and a, b, c are positive constants?

(a) $a+bx-cx^2$

(b) bx^2

(c) $a-bx+cx^2$

(d) $-bx$

PART-II (Numerical Answer Questions)

21. The source of sound generating a frequency of 3 kHz reaches an observer with a speed of 0.5 times in air. The frequency (in kHz) heard by the observer is

28. By what ratio the average velocity of the molecule in gas changes when the temperature is raised from 50 to 200ºC ?

(a) $\frac{1.21}{1}$ (b) $\frac{1.46}{1}$

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

29. How many H-atoms are present in 0.046 g of ethanol ?

(a) 6×10^{20} (b) 1.2×10^{21}

(c) 3×10^{21} (d) 3.6×10^{21}

30. A metal M reacts with N_2 to give a compound 'A' (M_3N). 'A' on heating at high temperature gives back 'M' and 'A' on reacting with H_2O gives a gas 'B'. 'B' turns $CuSO_4$ solution blue on passing through it. M and B can be :

(a) Al & NH_3 (b) Li & NH_3

(c) Na & NH_3 (d) Mg & NH_3

31. When ethanal reacts with CH_3MgBr and C_2H_5OH/dry HCl, the product formed are :

(a) ethyl alcohol and 2-propanol

(b) ethane and hemi acetal

(c) 2-propanol and acetal

(d) propane and methyl acetate

32. If the solutions of NaCl and $NaNO_3$ are mixed in one beaker and the temperature adjusted to 383° K, the contents of the beaker will most likely:

(a) freeze

(b) boil

(c) exhibit precipitation of $NaNO_3$

(d) exhibit a marked color change

33. Given the molecular formula of the hexa-coordinated complexes (i) $CoCl_3.6NH_3$, (ii) $CoCl_3.5NH_3$, (iii) $CoCl_3.4NH_3$

If the number of co-ordinated NH_3 molecules in i, ii and iii respectively

40. The relative abundance of two isotopes of atomic weight 85 and 87 is 75% and 25% respectively. The average atomic weight of element is

(a) 75.5 (b) 85.5
(c) 40.0 (d) 86.0

41. In Kjeldahl's method, nitrogen present in the organic compound is quantitatively converted into

(a) ammonium nitrite
(b) ammonium sulphate
(c) ammonium phosphate
(d) ammonium nitrate

42. An organic amino compound reacts with aqueous nitrous acid at low temperature to produce an oily nitrosoamine. The compound is:

(a) $CH_3\,NH_2$
(b) $CH_3CH_2NH_2$
(c) $CH_3CH_2NH.CH_2CH_3$
(d) $(CH_3\,CH_2)_3N$

43. Which reaction characteristics are changed by the addition of a catalyst to a reaction at constant temperature ?

(i) Activation energy
(ii) Equilibrium constant
(iii) Reaction enthalpy

(a) (i) only
(b) (iii) only
(c) (i) and (ii) only
(d) all of these

44. Which is not true for beryllium ?

(a) Beryllium is amphoteric
(b) It forms unusual carbide, Be_2C
(c) $Be(OH)_2$ is basic
(d) Beryllium halides are electron deficient

MATHEMATICS

PART-I (Multiple Choice Questions)

51. The function $f(x) = \tan^{-1}(\sin x + \cos x)$ is an increasing function in

(a) $\left(0, \frac{\pi}{2}\right)$ (b) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

(c) $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$ (d) $\left(-\frac{\pi}{2}, \frac{\pi}{4}\right)$

52. The degree of differential equation satisfying the relation

$$\sqrt{1+x^2} + \sqrt{1+y^2} = \lambda(x\sqrt{1+y^2} - y\sqrt{1+x^2})$$ is

(a) 1 (b) 2
(c) 3 (d) 4

53. $\int_0^2 [x^2]\,dx$, where [x] is the greatest integer $\leq x$ is

(a) $5+\sqrt{2}+\sqrt{3}$

(b) $-5+\sqrt{2}-\sqrt{3}$

(c) $5-\sqrt{2}-\sqrt{3}$

(d) $-4+\sqrt{3}-\sqrt{2}$

54. α, β be the roots of $x^2 - 3x + a = 0$ and γ, δ be the roots of $x^2 - 12x + b = 0$ and numbers $\alpha, \beta, \gamma, \delta$ (in order) form an increasing G.P. then

(a) $a = 3, b = 12$
(b) $a = 12, b = 3$
(c) $a = 2, b = 32$
(d) $a = 4, b = 16$

55. Assume R and S are (non-empty) relations in a set A. Which of the following relation given below is false

59. If $\begin{vmatrix} a+x & a-x & a-x \\ a-x & a+x & a-x \\ a-x & a-x & a+x \end{vmatrix} = 0$ then x is

(a) 0, 2a
(b) a, 2a
(c) 0, 3a
(d) None of these

60. The equation of a circle with origin as centre and passing through the vertices of an equilateral triangle whose median is of length 3a is

(a) $x^2 + y^2 = 9a^2$
(b) $x^2 + y^2 = 16a^2$
(c) $x^2 + y^2 = 4a^2$
(d) $x^2 + y^2 = a^2$

61. If a positive integer n is divisible by 9, then the sum of the digits of n is divisible by 9. So which statement is it contrapositive.

(a) (sum of digits of n is divisible by 9) $\Rightarrow$ (n is divisible by 9)
(b) (sum of digits of n is not divisible by 9) $\Rightarrow$ (n is not divisible by 9)
(c) (sum of digits of n is divisible by 9) $\Rightarrow$ (n is divisible by 9)
(d) none of these

62. Fifteen coupons are numbered 1, 2 ..... 15,respectively. Seven coupons are selected at random one at a time

66. $f(x)=\sin|x|.f(x)$ is not differentiable at

(a) $x=0$ only

(b) all x

(c) multiples of π

(d) multiples of $\frac{\pi}{2}$

67. $\int_{0}^{\pi/3} \frac{\cos x+\sin x}{\sqrt{1+\sin 2x}}\,dx$ is

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

(c) π (d) $\frac{\pi}{3}$

68. The angle between the pair of tangents drawn to the ellipse $3x^2+2y^2=5$ from the point $(1,2)$ is

(a) $\tan^{-1}\left(\frac{12}{5}\right)$

(b) $\tan^{-1}\left(6\sqrt{5}\right)$

(c) $\tan^{-1}\left(\frac{12}{\sqrt{5}}\right)$

(d) $\tan^{-1}\left(12\sqrt{5}\right)$

69. Let α and β be the roots of the equation $x^2+x+1=0$ the equation whose roots are α^{19}, β^{7} is

(a) $x^2-x-1=0$

(b) $x^2-x+1=0$

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

(d) $x^2+x+1=0$

RESPONS

PHYSICS		CHEMIST	
1.	ⓐⓑⓒⓓ	26.	ⓐⓑ
2.	ⓐⓑⓒⓓ	27.	ⓐⓑ
3.	ⓐⓑⓒⓓ	28.	ⓐⓑ
4.	ⓐⓑⓒⓓ	29.	ⓐⓑ
5.	ⓐⓑⓒⓓ	30.	ⓐⓑ
6.	ⓐⓑⓒⓓ	31.	ⓐⓑ
7.	ⓐⓑⓒⓓ	32.	ⓐⓑ
8.	ⓐⓑⓒⓓ	33.	ⓐⓑ
9.	ⓐⓑⓒⓓ	34.	ⓐⓑ
10.	ⓐⓑⓒⓓ	35.	ⓐⓑ
11.	ⓐⓑⓒⓓ	36.	ⓐⓑ
12.	ⓐⓑⓒⓓ	37.	ⓐⓑ
13.	ⓐⓑⓒⓓ	38.	ⓐⓑ
14.	ⓐⓑⓒⓓ	39.	ⓐⓑ
15.	ⓐⓑⓒⓓ	40.	ⓐⓑ
16.	ⓐⓑⓒⓓ	41.	ⓐⓑ
17.	ⓐⓑⓒⓓ	42.	ⓐⓑ
18.	ⓐⓑⓒⓓ	43.	ⓐⓑ
19.	ⓐⓑⓒⓓ	44.	ⓐⓑ
20.	ⓐⓑⓒⓓ	45.	ⓐⓑ
21.		46.	
22.		47.	
23.		48.	
24.		49.	

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PHYSICS

PART-I (Multiple Choice Questions)

1. A solid cylinder rolls down an inclined plane of height 3 m and reaches the bottom of plane with angular velocity of $2\sqrt{2}$ rad.s^{-1}. The radius of cylinder must be (Take $g = 10\,ms^{-2}$)

(a) 5 cm (b) 0.5 cm

(c) $\sqrt{10}cm$ (d) $\sqrt{5}m$

2. In the figure shown, a particle of mass m is released from the position A on a smooth track. When the particle reaches at B, then normal reaction on it by the track is

(b) $\rho = \rho_0 \left[1 + \frac{\rho_0 g y}{B}\right]$

(c) $\rho = \rho_0 \left[1 + \frac{B}{\rho_0 h g y}\right]$

(d) $\rho = \rho_0 \left[1 - \frac{B}{\rho_0 h g y}\right]$

4. The electric field in a certain region is given by $\vec{E} = (5\hat{i} - 3\hat{j})kV/m$. The potential difference $V_B - V_A$ between points A and B, having coordinates (4, 0, 3)m and (10, 3, 0)m respectively, is equal to

(a) 21 kV (b) –21 kV

(c) 39 kV (d) –39 kV

5. Two electric bulbs marked 25W – 220 V and 100W – 220V are connected in series to a 440 V supply. Which of the bulbs will fuse?

(a) Both (b) 100 W

(c) 25 W (d) Neither

6. Two long parallel wires P and Q are held perpendicular to the plane of the paper at a separation of 5 m. If P and Q carry currents of 2.5 A and 5 A respectively in the same direction, then the magnetic field at a point midway between P and Q is

(a) $\frac{\mu_0}{\pi}$ (b) $\sqrt{3}\frac{\mu_0}{\pi}$

(c) $\frac{\mu_0}{2\pi}$ (d) $\frac{3\mu_0}{2\pi}$

7. Two seconds after projection a projectile is travelling in a direction

10. Ultraviolet light of wavelength 300 nm and intensity 1.0 watt/m^2 falls on the surface of a photosensitive material. If 1% of the incident photons produce photoelectrons, then find the number of photoelectrons emitted from an area of 1.0 cm^2 of the surface.

(a) 9.61×10^{14} per sec
(b) 4.12×10^{13} per sec
(c) 1.51×10^{12} per sec
(d) 2.13×10^{11} per sec

11. If the wavelength of the first line of the Balmer series of hydrogen is 6561 Å, find the wavelength of the second line of the series.

(a) 13122 Å (b) 3280 Å
(c) 4860 Å (d) 2187 Å

12. The concentration of hole - electron pairs in pure silicon at T = 300 K is 7×10^{15} per cubic meter. Antimony is doped into silicon in a proportion of 1 atom in 10^7 Si atoms. Assuming that half of the impurity atoms contribute electron in the conduction band, calculate the factor by which the number of charge carriers increases due to doping. The number of silicon atoms per cubic meter is 5×10^{28}

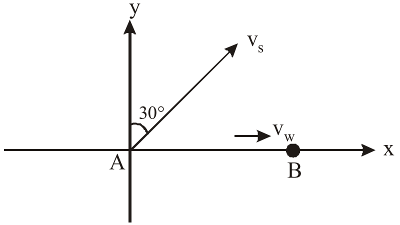
(a) 2.8×10^5 (b) 3.1×10^2
(c) 4.2×10^5 (d) 1.8×10^5

13. Shown below are the black body radiation curves at temperatures T_1 and T_2 $(T_2 > T_1)$. Which one of the following plots is correct?

equal quantities of O_2 and N_2. If the average speed of the O_2 molecules in vessel A is V_1, that of the N_2 molecules in vessel B is V_2, the average speed of the O_2 molecules in vessel C is

(a) $(V_1 + V_2)/2$
(b) V_1
(c) $(V_1 V_2)^{1/2}$
(d) $\sqrt{3kT/M}$

16. In the figure shown a source of sound of frequency 510 Hz moves with constant velocity $v_s = 20$ m/s in the direction shown. The wind is blowing at a constant velocity $v_w = 20$ m/s towards an observer who is at rest at point B. Corresponding to the sound emitted by the source at initial position A, the frequency detected by the observer is equal to (speed of sound relative to air = 330 m/s)



(a) 510 Hz (b) 500 Hz
(c) 525 Hz (d) 550 Hz

17. In fig, CODF is a semicircular loop of a conducting wire of resistance R and radius r. It is placed in a uniform magnetic field B, which is directed into the page (perpendicular to the plane of the loop).

20. A 2.0 cm tall object is placed 15 cm in front of a concave mirror of focal length 10 cm. What is the size and nature of the image

(a) 4 cm, real

(b) 4 cm, virtual

(c) 1.0 cm, real

(d) None of these

PART-II (Numerical Answer Questions)

21. An inclined plane making an angle of 30º with the horizontal is placed in a uniform electric field of intensity 100 V/m. A particle of mass 1 kg and charge 0.01 C is allowed to slide down from rest on the plane from a height of 1 m. If the coefficient of friction is 0.2, then find the time taken (in second) by the particle to reach the bottom.

22. A satellite is to be placed in equatorial geostationary orbit around earth for communication. The height (in metre) of such a satellite is

[$M_E = 6 \times 10^{24}$ kg, $R_E = 6400$ km, $T =$ 24 h, $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}]

23. A simple electric motor has an armature resistance of 1 Ω and runs from a dc source of 12 volt. When running unloaded it draws a current of 2 amp. When a certain load is connected, its speed becomes one-half of its unloaded value. What is the new value of current drawn (in ampere)?

27. Which of the following factors may be regarded as the main cause of lanthanoid contraction?

(a) Greater shielding of $5d$ electrons by $4f$ electrons.

(b) Poorer shielding of $5d$ electrons by $4f$ electrons.

(c) Effective shielding of one of $4f$ electrons by another in the subshell.

(d) Poor shielding of one of $4f$ electron by another in the subshell.

28. Isobutyl magnesium bromide with dry ether and ethyl alcohol gives :

(a) $\underset{\displaystyle CH_3}{CH_3\overset{|}{C}HCH_2OH}$ & CH_3CH_2MgBr

(b) $\underset{\displaystyle CH_3}{CH_3\overset{|}{C}HCH_3}$ & $MgBr(OC_2H_5)$

(c) $\underset{\displaystyle CH_3}{CH_3\overset{|}{C}HCH=CH_2}$ & $Mg(OH)Br$

(d) $\underset{\displaystyle CH_3}{CH_3\overset{|}{C}HCH_3}$ & CH_3CH_2OMgBr

29. The K_p/K_c ratio will be highest in case of

(a) $CO\,(g) + \frac{1}{2}\,O_2\,(g) \rightleftharpoons CO_2\,(g)$

(b) $H_2\,(g) + I_2\,(g) \rightleftharpoons 2HI\,(g)$

(c) $PCl_5\,(g) \rightleftharpoons PCl_3(g) + Cl_2\,(g)$

(d) $7H_2\,(g) + 2NO_2\,(g) \rightleftharpoons 2NH_3\,(g) + 4H_2O(g)$

of B, then the ratio of number of molecules of A and B are

(a) 1 : 2 (b) 2 : 1

(c) 1 : 4 (d) 4 : 1

35. The stability of +1 oxidation state among Al, Ga, In and Tl increases in the sequence :

(a) Ga < In < Al < Tl

(b) Al < Ga < In < Tl

(c) Tl < In < Ga < Al

(d) In < Tl < Ga < Al

36. Among the following four structures I to IV,

$$\begin{array}{c} \quad CH_3 \\ \quad | \\ C_2H_5 - CH - C_3H_7 \end{array},$$

(I)

$$\begin{array}{c} \qquad O \quad CH_3 \\ \qquad \| \quad\;\; | \\ CH_3 - C - CH - C_2H_5 \end{array},$$

(II)

$$\begin{array}{c} H \\ | \\ H - C^{+} \\ | \\ H \end{array},$$

(III)

$$\begin{array}{c} \quad CH_3 \\ \quad | \\ C_2H_5 - CH - C_2H_5 \end{array}$$

(IV)

it is true that

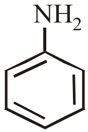
(a) only I and II are chiral compounds

(b) only III is a chiral compound

(c) only II and IV are chiral compounds

(d) all four are chiral compounds

42. In the reaction sequence



$\xrightarrow[0°C]{NaNO_2, HCl} A \xrightarrow{CuCN} B \xrightarrow{LiAlH_4} C$, the product 'C' is:

(a) benzonitrile
(b) benzaldehyde
(c) benzoic acid
(d) benzylamine

43. Nylon threads are made of

(a) polyester polymer
(b) polyamide polymer
(c) polyethylene polymer
(d) polyvinyl polymer

44. In the reaction of oxalate with permanganate in acidic medium, the number of electrons involved in producing one molecule of CO_2 is:

(a) 1 (b) 10
(c) 2 (d) 5

45. Momentum of radiations of wavelength 0.33 nm is :

(a) 2.01×10^{-21} kg m sec^{-1}
(b) 2.01×10^{-24} g m sec^{-1}
(c) 2.01×10^{-21} g m sec^{-1}
(d) 2.01×10^{-24} kg m sec^{-1}

PART-II (Numerical Answer Questions)

46. Calculate the difference in the heat of formation (in calories) of carbon monoxide at constant pressure and at constant volume at 27 °C.

47. Calculate number of molecules of Grignard reagent consumed by 1 molecule of following compound.

53. In the expansion of $\left(\frac{x}{2}-\frac{3}{x^2}\right)^{10}$, the coefficient of x^4 is

(a) $\frac{405}{256}$ (b) $\frac{504}{259}$

(c) $\frac{450}{263}$

(d) None of these

54. If the plane $3x + y + 2z + 6 = 0$ is parallel to the line $\frac{3x-1}{2b} = 3 - y = \frac{z-1}{a}$, then the value of $3a + 3b$ is

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

(c) 3 (d) 4

55. The domain of definition of the function

$\mathrm{f}(\mathrm{x}) = \sqrt{1+\log_e(1-\mathrm{x})}$ is

(a) $-\infty < \mathrm{x} \le 0$

(b) $-\infty < \mathrm{x} \le \frac{e-1}{e}$

(c) $-\infty < \mathrm{x} \le 1$

(d) $\mathrm{x} \ge 1 - \mathrm{e}$

56. The function $f(x) = [x]^2 - [x^2]$ (where $[y]$ is the greatest integer less than or equal to y), is discontinuous at

(a) All integers

(b) All integers except 0 and 1

(c) All integers except 0

(d) All integers except 1

57. The line $y = mx$ bisects the area enclosed by lines $x = 0$, $y = 0$ and $x = 3/2$ and the curve $y = 1 + 4x - x^2$. Then the value of m is

61. The value of

$$\cos\frac{2\pi}{7}+\cos\frac{4\pi}{7}+\cos\frac{6\pi}{7}\text{ is}$$

(a) 0 (b) 1

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

62. An integrating factor of the differential equation

$$\frac{dy}{dx}=y\tan x-y^2\sec x\text{ is equal to:}$$

(a) $\tan x$ (b) $\sec x$

(c) $\operatorname{cosec} x$ (d) $\cot x$

63. If $y = 2x$ is a chord of the circle $x^2+y^2=10x$, then the equation of the circle whose diameter is this chord, is -

(a) $x^2+y^2+2x+4y=0$

(b) $x^2+y^2+2x-4y=0$

(c) $x^2+y^2-2x-4y=0$

(d) None of these

64. Magnitudes of vectors $\vec{a},\vec{b},\vec{c}$ are 3, 4, 5 respectively. If $\vec{a}$ and $\vec{b}+\vec{c}$, $\vec{b}$ and $\vec{c}+\vec{a}$, $\vec{c}$ and $\vec{a}+\vec{b}$ are mutually perpendicular, then magnitude of $\vec{a}+\vec{b}+\vec{c}$ is

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

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

65. If $a+b+c=0$, then the solution of the equation

$$\begin{vmatrix} a-x & c & b \\ c & b-x & a \\ b & a & c-x \end{vmatrix}=0\text{ is}$$

69. If PQ is a double ordinate of hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ such that OPQ is an equilateral triangle, O being the centre of the hyperbola. Then the eccentricity e of the hyperbola satisfies

(a) $1<e<2/\sqrt{3}$ (b) $e=2/\sqrt{3}$

(c) $e=\sqrt{3}/2$ (d) $e>2/\sqrt{3}$

70. The equation of the lines on which the perpendiculars from the origin make $30°$ angle with x-axis and which form a triangle of area $\frac{50}{\sqrt{3}}$ with axes, are

(a) $x+\sqrt{3}y\pm 10=0$

(b) $\sqrt{3}x+y\pm 10=0$

(c) $x\pm\sqrt{3}y-10=0$

(d) None of these

RESPONS

PHYSICS		CHEMIST	
1.	ⓐⓑⓒⓓ	**26.**	ⓐⓑ
2.	ⓐⓑⓒⓓ	**27.**	ⓐⓑ
3.	ⓐⓑⓒⓓ	**28.**	ⓐⓑ
4.	ⓐⓑⓒⓓ	**29.**	ⓐⓑ
5.	ⓐⓑⓒⓓ	**30.**	ⓐⓑ
6.	ⓐⓑⓒⓓ	**31.**	ⓐⓑ
7.	ⓐⓑⓒⓓ	**32.**	ⓐⓑ
8.	ⓐⓑⓒⓓ	**33.**	ⓐⓑ
9.	ⓐⓑⓒⓓ	**34.**	ⓐⓑ
10.	ⓐⓑⓒⓓ	**35.**	ⓐⓑ
11.	ⓐⓑⓒⓓ	**36.**	ⓐⓑ
12.	ⓐⓑⓒⓓ	**37.**	ⓐⓑ
13.	ⓐⓑⓒⓓ	**38.**	ⓐⓑ
14.	ⓐⓑⓒⓓ	**39.**	ⓐⓑ
15.	ⓐⓑⓒⓓ	**40.**	ⓐⓑ
16.	ⓐⓑⓒⓓ	**41.**	ⓐⓑ
17.	ⓐⓑⓒⓓ	**42.**	ⓐⓑ
18.	ⓐⓑⓒⓓ	**43.**	ⓐⓑ
19.	ⓐⓑⓒⓓ	**44.**	ⓐⓑ
20.	ⓐⓑⓒⓓ	**45.**	ⓐⓑ
21.		**46.**	
22.		**47.**	
23.		**48.**	
24.		**49.**	

MOCK T

INSTRU

1. This test will be a 3 hours Test.
2. This test consists of Physics, Cher
   equal weightage of 100 marks.
3. Each question is of 4 marks.
4. There are three sections in the ques
   to 25), Chemistry (Q.no.26 to 50) a
   section is divided into two parts,
   questions & Part II consists of 5 N
5. There will be only one correct choic
   each question 4 marks will be awa
   deducted for incorrect choice for I
   awarded for not attempted questio
   awarded for correct answer and zer
6. Any textual, printed or written mate
   allowed for the students appearing
7. All calculations / written work sho

PHYSICS

PART-I (Multiple Choice Questions)

1. A sphericla ball A of mass 4 kg, moving along a straight line strikes another spherical ball B of mass $1kg$ at rest. After the collision, A and B move with velocities $\upsilon_1\ ms^{-1}$ and $\upsilon_2\ ms^{-1}$ respectively making angles of 30° and 60° with respect to the original direction of motion of A.

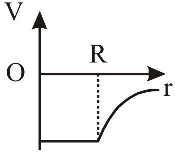
The ratio $\frac{\upsilon_1}{\upsilon 2}$ will be

(a) $\frac{\rho L^3}{8\pi^2}$ (b) $\frac{\rho L^3}{16\pi^2}$

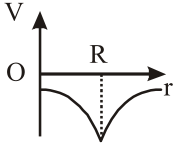
(c) $\frac{5\rho L^3}{16\pi^2}$ (d) $\frac{3\rho L^3}{8\pi^2}$

3. The diagram showing the variation of gravitational potential of earth with distance from the centre of earth is

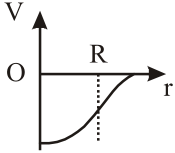
(a)



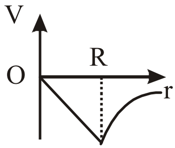
(b)



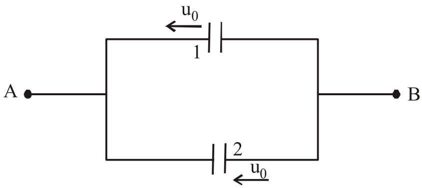
(c)



(d)



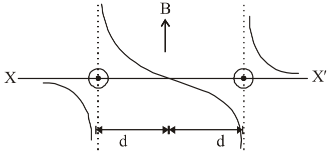
4. Two thin dielectric slabs of dielectric constants K_1 and K_2 ($K_1 < K_2$) are inserted between plates of a parallel plate capacitor, as shown in the figure. The variation system by connecting a battery across A and B and battery is removed. Now first plate of first capacitor and second plate of second capacitor starts moving with constant velocity u_0 towards left. Find the magnitude of current flowing in the loop during the process.

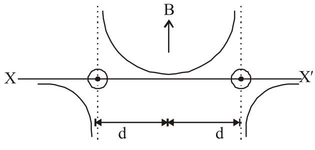


(a) $\frac{Q}{2d_0}u_0$ (b) $\frac{Q}{d_0}u_0$

(c) $\frac{2Q}{d_0}u_0$ (d) $\frac{Q}{3d_0}u_0$

6. Two long parallel wires are at a distance 2d apart. They carry steady equal currents flowing out of the plane of the paper as shown. The variation of the magnetic field B along the line XX' is given by

(a) 

(b) 

9. The speed of a projectile at its maximum height is $\frac{\sqrt{3}}{2}$ times its initial speed. If the range of the projectile is 'P' times the maximum height attained by it. P is-

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

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

10. All electrons ejected from a surface by incident light of wavelength 200nm can be stopped before travelling 1m in the direction of uniform electric field of 4N/C. The work function of the surface is

(a) 4 eV (b) 6.2 eV

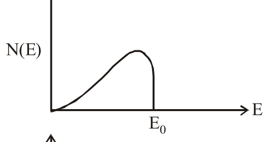
(c) 2 eV (d) 2.2 eV

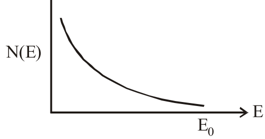
11. Find the ratio of longest wavelength and the shortest wavelength observed in the five spectral series of emission spectrum of hydrogen.

(a) $\frac{4}{3}$ (b) $\frac{525}{376}$

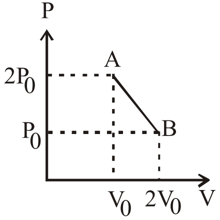
(c) 25 (d) $\frac{900}{11}$

12. The energy spectrum of β-particles [Number N(E) as a function of β-energy E] emitted from a radioactive source is

(a) 

(b) 

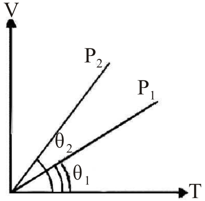
14. 'n' moles of an ideal gas undergoes a process A $\rightarrow$ B as shown in the figure. The maximum temperature of the gas during the process will be :



(a) $\frac{9P_0V_0}{2nR}$ (b) $\frac{9P_0V_0}{nR}$

(c) $\frac{9P_0V_0}{4nR}$ (d) $\frac{3P_0V_0}{2nR}$

15. In the given (V – T) diagram, what is the relation between pressure P_1 and P_2 ?



(a) $P_2 > P_1$

(b) $P_2 < P_1$

(c) Cannot be predicted

(d) $P_2 = P_1$

16. A particle executes simple harmonic motion with a time period of 16s. At time t = 2s, the particle crosses the mean position while at t = 4s, its velocity is 4 m/s^{-1}. The amplitude of motion in metre is

(a) $\sqrt{2}\pi$ (b) $16\sqrt{2}\pi$

(c) $24\sqrt{2}\pi$ (d) $\frac{32\sqrt{2}}{\pi}$

(b) At $t = \tau$, $q = CV/2$
(c) At $t = 2\tau$, $q = CV(1 - e^{-2})$

(d) At $t = \frac{\tau}{2}$, $q = CV(1 - e^{-1})$

19. An electromagnetic wave in vacuum has the electric and magnetic field $\vec{E}$ and $\vec{B}$, which are always perpendicular to each other. The direction of polarization is given by $\vec{X}$ and that of wave propagation by $\vec{k}$. Then

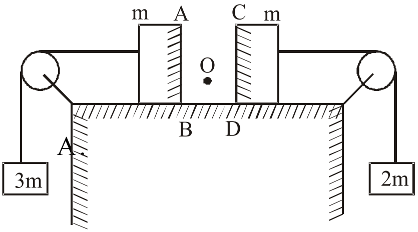
(a) $\vec{X} \parallel \vec{B}$ and $\vec{k} \parallel \vec{B} \times \vec{E}$

(b) $\vec{X} \parallel \vec{E}$ and $\vec{k} \parallel \vec{E} \times \vec{B}$

(c) $\vec{X} \parallel \vec{B}$ and $\vec{k} \parallel \vec{E} \times \vec{B}$

(d) $\vec{X} \parallel \vec{E}$ and $\vec{k} \parallel \vec{B} \times \vec{E}$

20. Two blocks each of mass m lie on a smooth table. They are attached to two other masses as shown in the figure. The pulleys and strings are light. An object O is kept at rest on the table. The sides AB and CD of the two blocks are made reflecting. The acceleration of two images formed in these two reflecting surfaces w.r.t. each other is 17g/A then find the value of



(a) 2
(b) 6
(c) 4
(d) 5

24. The displacement of a particle executing SHM is given by $y = 5\sin\left(4t + \frac{\pi}{3}\right)$. If T is the time period and mass of the particle is 2g, the kinetic energy (in joule) of the particle when $t = \frac{T}{4}$ is given by

25. A zener diode of voltage V_Z (= 6V) is used to maintain a constant voltage across a load resistance R_L (= 1000 Ω) by using a series resistance R_s (= 100Ω). If the e.m.f. of source is E (= 9 V), what is the power (in watt) being dissipated in Zener diode ?

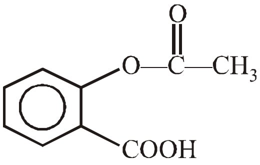
CHEMISTRY

PART-I (Multiple Choice Questions)

26. The compound that does not produce nitrogen gas by the thermal decomposition is :

(a) $Ba(N_3)_2$ (b) $(NH_4)_2Cr_2O_7$
(c) NH_4NO_2 (d) $(NH_4)_2SO_4$

27. The following compound is used as



(a) an anti-inflammatory compound
(b) analgesic
(c) hypnotic
(d) antiseptic

33. Consider the reaction

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

The equilibrium constant of the above reaction is K_P. If pure ammonia is left to dissociate, the partial pressure of ammonia at equilibrium is given by (Assume that $P_{NH_3} << P_{total}$ at equilibrium)

(a) $\dfrac{3^{3/2} K_P^{1/2} P^2}{16}$

(b) $\dfrac{K_P^{1/2} P^2}{16}$

(c) $\dfrac{K_P^{1/2} P^2}{4}$

(d) $\dfrac{3^{3/2} K_P^{1/2} P^2}{4}$

34. The property which distinguishes formic acid from acetic acid is

(a) only ammonium salt of formic acid on heating gives amide.

(b) when heated with alcohol/ H_2SO_4 only acetic acid forms ester.

(c) only acetic acid forms salts with alkali.

(d) only formic acid reduces Fehling's solution.

35. The standard emf of a cell, involving one electron change is found to be 0.591 V at 25°C. The equilibrium constant of the reaction is ($F = 96500\ C\ mol^{-1}$)

40. What happens when magnesium is burnt in air and the products X and Y are treated with water?

$$\begin{array}{ccccc} \mathrm{Mg} & \xrightarrow{\text{Air}} & X & + & Y \\ & & \Big\downarrow{\scriptstyle H_2O} & & \Big\downarrow{\scriptstyle H_2O} \\ & & P & & P+Q \end{array}$$

	X	**Y**	**P**	**Q**
(a)	MgO	$Mg(OH)_2$	$Mg(OH)_2$	N_2
(b)	MgO	Mg_3N_2	$Mg(OH)_2$	NH_3
(c)	MgO	Mg_3N_2	$Mg(OH)_2$	N_2
(d)	MgO	$MgCO_3$	$Mg(OH)_2$	CO_2

41. When a small quantity of $FeCl_3$ solution is added to the fresh precipitate of $Fe(OH)_3$, a colloidal sol is obtained.

The process through which this sol is formed is known as

(a) exchange of solvent
(b) chemical double decomposition
(c) peptization
(d) electrophoresis

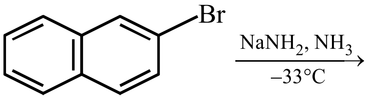
42. The molal elevation constant of water = 0.52 °C kg mol^{-1}. The boiling point of 1.0 molal aqueous KCl solution (assuming complete dissociation of KCl), therefore should be

(a) 100.52 °C (b) 101.04 °C
(c) 99.48 °C (d) 98.96 °C

43. The oxidation state of Cr in $[Cr(NH_3)_4Cl_2]^+$ is

(a) 0 (b) +1
(c) +2 (d) +3

48. How many isomeric naphthylamines are expected in the following reaction ?



49. At infinite dilution, the molar conductance of Ba^{2+} and Cl^- are 127 and 76 S cm^2 mol^{-1}. What is the molar conductivity of $BaCl_2$ at indefinite dilution?

50. The enthalpy of hydrogenation of cyclohexene is – 119.5 kJ mol^{-1}. If resonance energy of benzene is – 150.4 kJ mol^{-1}, calculate its enthalpy of hydrogenation in kJ.

MATHEMATICS

PART-I (Multiple Choice Questions)

51. If one root is square of the other root of the equation $x^2 + px + q = 0$, then the relation between p and q is

(a) $p^3 - (3p - 1)\,q + q^2 = 0$

(b) $p^3 - q(3p + 1) + q^2 = 0$

(c) $p^3 + q(3p - 1) + q^2 = 0$

(d) $p^3 + q(3p + 1) + q^2 = 0$

52. A chord AB drawn from the point $A(0, 3)$ on circle $x^2 + 4x + (y - 3)^2 = 0$ meets to M in such a way that $AM = 2AB$, then the locus of point M will be

(a) $P = 2, Q = -3, R = 4$
(b) $P = -5, Q = 2, R = 3$
(c) $P = 5, Q = -2, R = 3$
(d) $P = 5, Q = -6, R = 3$

56. The value of $\lim_{x \to 0^+} x^m (\log x)^n$, m, $n \in N$ is
(a) 0
(b) $\frac{m}{n}$
(c) mn
(d) None of these

57. The value of a in order that $f(x) = \sin x - \cos x - ax + b$ decreases for all real values is given by
(a) $a \geq \sqrt{2}$
(b) $a < \sqrt{2}$
(c) $a \geq 1$
(d) $a < 1$

58. If in ΔABC, $2b^2 = a^2 + c^2$, then $\frac{\sin 3B}{\sin B} =$

(a) $\frac{c^2 - a^2}{2ca}$
(b) $\frac{c^2 - a^2}{ca}$
(c) $\left(\frac{c^2 - a^2}{ca}\right)^2$
(d) $\left(\frac{c^2 - a^2}{2ca}\right)^2$

63. The area of the plane region bounded by the curves $x+2y^2=0$ and $x+3y^2=1$ is equal to

(a) 1/3 (b) 2/3

(c) 4/3 (d) 5/3

64. The inverse of the statement $(p \wedge \sim q) \rightarrow r$ is

(a) $\sim (p \vee \sim q) \rightarrow \sim r$

(b) $(\sim p \wedge q) \rightarrow \sim r$

(c) $(\sim p \vee q) \rightarrow \sim r$

(d) None of these

65. The coefficient of the term independent of x in the expansion of $(1+x+2x^3)\left(\frac{3}{2}x^2 - \frac{1}{3x}\right)^9$ is

(a) $\frac{1}{3}$ (b) $\frac{19}{54}$

(c) $\frac{17}{54}$ (d) $\frac{1}{4}$

66. The solution to the differential equation $\frac{dy}{dx} = \frac{yf'(x) - y^2}{f(x)}$ where $f(x)$ is a given function is

(a) $f(x) = y(x+c)$

(b) $f(x) = cxy$

(c) $f(x) = c(x+y)$

(d) $yf(x) = cx$

70. If $\vec{a} = (1, -1, 2)$, $\vec{b} = (-2, 3, 5)$, $\vec{c} = (2, -2, 4)$ and $\hat{i}$ is the unit vector in the x-direction, then $(\vec{a} - 2\vec{b} + 3\vec{c})\hat{i} =$

(a) 11 (b) 15

(c) 18 (d) 36

PART-II (Numerical Answer Questions)

71. Find the greatest angle of a triangle whose sides are $a, b, \sqrt{a^2 + b^2 + ab}$.

72. How many 3 × 3 matrices M with entries from {0, 1, 2} are there, for

RESPONS

PHYSICS		**CHEMIST**	
1.	(a) (b) (c) (d)	**26.**	(a) (b) (
2.	(a) (b) (c) (d)	**27.**	(a) (b) (
3.	(a) (b) (c) (d)	**28.**	(a) (b) (
4.	(a) (b) (c) (d)	**29.**	(a) (b) (
5.	(a) (b) (c) (d)	**30.**	(a) (b) (
6.	(a) (b) (c) (d)	**31.**	(a) (b) (
7.	(a) (b) (c) (d)	**32.**	(a) (b) (
8.	(a) (b) (c) (d)	**33.**	(a) (b) (
9.	(a) (b) (c) (d)	**34.**	(a) (b) (
10.	(a) (b) (c) (d)	**35.**	(a) (b) (
11.	(a) (b) (c) (d)	**36.**	(a) (b) (
12.	(a) (b) (c) (d)	**37.**	(a) (b) (
13.	(a) (b) (c) (d)	**38.**	(a) (b) (
14.	(a) (b) (c) (d)	**39.**	(a) (b) (
15.	(a) (b) (c) (d)	**40.**	(a) (b) (
16.	(a) (b) (c) (d)	**41.**	(a) (b) (
17.	(a) (b) (c) (d)	**42.**	(a) (b) (
18.	(a) (b) (c) (d)	**43.**	(a) (b) (
19.	(a) (b) (c) (d)	**44.**	(a) (b) (
20.	(a) (b) (c) (d)	**45.**	(a) (b) (
21.		**46.**	
22.		**47.**	
23.		**48.**	
24.		**49.**	

MOCK

PHY

1. **(b)** Since the speeds of the stars ar
hence the initial kinetic energy
total energy of the system is

$$E_i = KE + PE = 0 + \left(-\frac{GMM}{r} \right.$$

where M represents the mass c
tween them.
When two stars collide their ce
of a star *i.e.* $2R$.
Let v be the speed with which t
system at the instant of their c

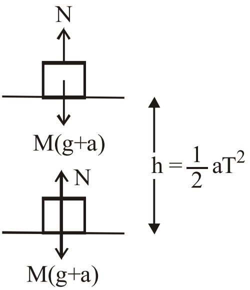
$$E_f = 2 \times \left(\frac{1}{2} Mv^2 \right) + \left(-\frac{GMM}{2R} \right.$$

According to law of conservati
$E_f = E_i$

$$Mv^2 - \frac{GM^2}{2R} = -\frac{GM^2}{r} \text{ or } v^2 =$$

$$\text{or } v = \sqrt{GM\left(\frac{1}{2R} - \frac{1}{r} \right)}$$

2. **(b)**

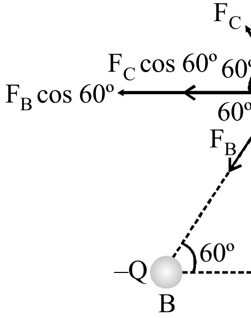


Work done by normal reaction

3. **(c)** Rise in temperature , $\Delta\theta = \frac{3T}{JSd}$

$$\therefore \Delta\theta = \frac{3T}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$$ (For

4. **(c)** $\left|\overrightarrow{F_B}\right| = \left|\overrightarrow{F_C}\right| = k\,.\,\frac{Q^2}{a^2}$

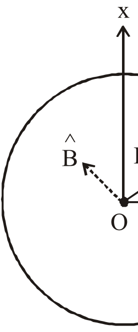


Hence force experienced by the
is zero.

5. **(a)** The magnitude of magnetic fie

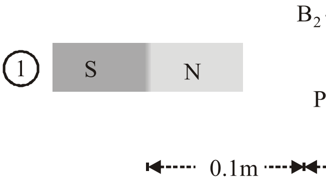
$$B = \frac{\mu_0 Jr}{2} = \frac{\mu_0 i}{2\pi R^2} \times \frac{R}{\sqrt{2}} = \frac{\mu}{2\sqrt{}}$$

(independent



$$\hat{B} = \frac{\hat{i} - \hat{k}}{\sqrt{2}}$$ (shown by dotted l

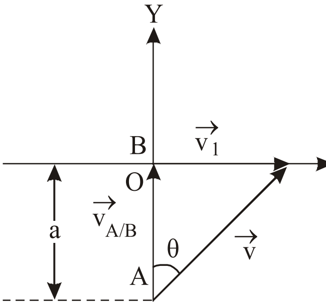
$$\therefore \quad \vec{B} = B\hat{B} = \frac{\mu_0 i}{4\pi R}(\hat{i} - \hat{k})$$

6. **(d)** 

From figure $B_{net} = \sqrt{B_a^2 + B_e^2}$

$$= \sqrt{\left(\frac{\mu_0}{4\pi}.\frac{2M}{d^3}\right)^2 + \left(\frac{\mu_0}{4\pi}.\frac{M}{d^3}\right)^2}$$

$$= \sqrt{5}.\frac{\mu_0}{4\pi}.\frac{M}{d^3} = \sqrt{5} \times 10^{-7} \times \frac{}{(0}$$

7. **(d)** 

Velocity of A relative to B is gi

$$\vec{v}_{A/B} = \vec{v}_A - \vec{v}_B = \vec{v} - \vec{v}_1$$

By taking x-components of equat

$$0 = v \sin\theta - v_1 \Rightarrow \sin\theta = \frac{v_1}{v}$$

Time taken by boy at A to catc

$$t = \frac{\text{Relative displacement alo}}{\text{Relative velocity along}}$$

$$= \frac{a}{v\cos\theta} = \frac{a}{v.\sqrt{1-\sin^2\theta}} = $$

$$= \frac{a}{v.\sqrt{\frac{v^2 - v_1^2}{v^2}}} = \frac{a}{\sqrt{v^2 - v_1^2}} =$$

8. **(c)**

9. **(b)** Joule is a unit of ernergy.

SI	**New**
$n_1 = 5$	$n_2 =$
$M_1 = 1$ kg	$M^2 =$
$L_1 = 1$ m	$L^2 =$
$T_1 = 1$ s	$T^2 =$

Dimensional formula of energy

$a = 1, b = 2, c = -2$

$$\text{As } n_2 = n_1 \left(\frac{M^1}{M^2}\right)^a \left(\frac{L^1}{L^2}\right)^b \left(\frac{T_1}{T_2}\right.$$

$$= 5\left(\frac{1kg}{\alpha\, kg}\right)^1 \left(\frac{1m}{\beta m}\right)^2 \left(\frac{1s}{\gamma s}\right)^{-2} =$$

10. **(d)**

11. **(a)** $I_m = \dfrac{V_m}{R_f + R_L} = \dfrac{25}{(10+1000)} =$

$$I_{dc} = \frac{I_m}{\pi} = \frac{24.75}{3.14} = 7.87 \text{ mA}$$

$$I_{rms} = \frac{I_m}{2} = \frac{24.75}{2} = 12.37 \text{ mA}$$

$P_{dc} = I_{dc}^2 \times R_L = (7.87 \times 10^{-3})^2$

Rectifier efficiency

$$\eta = \frac{P_{dc}}{P_{ac}} \times 100 = \frac{61.9}{154.54} \times 100$$

12. **(c)** $K_{max} = E - W_0$

$\therefore \quad T_A = 4.25 - (W_0)_A$

$T_B = (T_A - 1.5) = 4.70 - (W$

Equation (i) and (ii) gives (W_0)

De Broglie wave length $\lambda = \frac{}{\sqrt{2}}$

$$\Rightarrow \frac{\lambda_B}{\lambda_A} = \sqrt{\frac{K_A}{K_B}} \Rightarrow 2 = \sqrt{\frac{T_A}{T_B - 1}}$$

From equation (i) and (ii)

$W_A = 2.25\ eV$ and $W_B = 4.20\ eV$

13. **(c)** $PV = \mu RT = \frac{m}{M} RT$,

where m = mass of the gas

and $\frac{m}{M} = \mu$ = number of moles

$\frac{PV}{T} = \mu R =$ a constant for all

That is why, ideally it is a straig

$$\therefore \quad \frac{PV}{T} = \frac{1\text{g}}{32\text{g mol}^{-1}} \times 8.31\ \text{J}$$

Also, $T_1 > T_2$

14. **(c)** $f_{apparent} = \left(\frac{u + u/5}{u}\right) f = \frac{6}{5} f =$

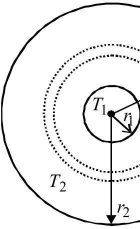
Wavelength remains constant

15. **(d)** Consider a shell of thickness (

inner and outer surfaces of this

$\frac{dQ}{dt}$ = rate of flow of heat thro

$= -4\pi K r^2 \frac{dT}{dr}$ $(\because\ A = 4\pi r^2$



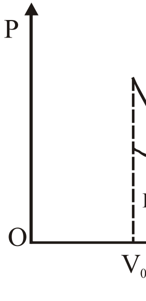
To measure the radial rate of l
since the area of the surface thr

Then, $\left(\frac{dQ}{dt}\right)\int_{r_1}^{r_2} \frac{1}{r^2}dr = -4\pi K \int_{T_1}^{T_2}$

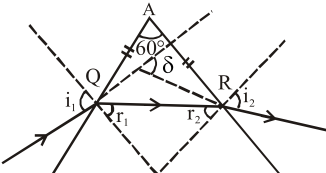
$$\frac{dQ}{dt}\left[\frac{1}{r_1} - \frac{1}{r_2}\right] = -4\pi K \Big[$$

or $$\frac{dQ}{dt} = \frac{-4\pi K r_1 r_2 (T_2 - T}{(r_2 - r_1)}$$

16. **(b)** W_{ext} = negative of area with vol
W(adiabatic) > W(isothermal)



17. **(a)**



Given AQ = AR and $\angle A = 60°$

$\therefore \quad \angle AQR = \angle ARQ = 60°$

$\therefore \quad r_1 = r_2 = 30°$

Applying Snell's law on face A

$1. \sin i_1 = \mu \sin r_1$

$\Rightarrow \sin i_1 = \sqrt{3} \sin 30° = \sqrt{3} \times \frac{1}{2}$

$\therefore \quad i_1 = 60°$

Similarly, $i_2 = 60°$

In a prism, deviation

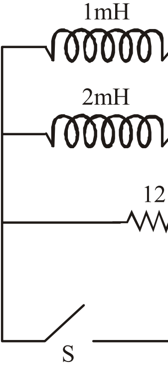
$\delta = i_1 + i_2 - A = 60° + 60° - 60° =$

18. (a) Both magnetic and electric fiel wave.

19. (a) At t = 0, current will flow only

$\therefore I_{min} = \frac{5}{12}$

At $t \to \infty$ both L_1 and $_2$ behav



$\therefore R_{eff} = \frac{3}{2}, \; I_{max} = \frac{10}{3}$

$\frac{I_{max}}{I_{min}} = 8$

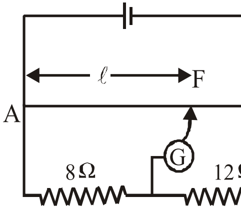
20. (d) For the first minima,

$\theta = \frac{\eta\lambda}{a} \quad \Rightarrow \quad \sin 30° = \frac{\lambda}{a} = \frac{1}{2}$

First secondary maxima will be

21. **(11.75)** Let E_1 and E_2 be potential

$$\frac{E_2}{E_1} = \frac{IX}{IR} = \frac{X}{R} \text{ or } X = \frac{E_2}{E_1} R$$



But $\frac{E_2}{E_1} = \frac{\ell_2}{\ell_1}$

so $X = \frac{\ell_2}{\ell_1} R = \frac{68.5}{58.3} \times 10$

22. **(6.66) Given :** Speed $V = 54\ kmh^{-1}$
Moment of inertia, $I = 3\ kgm^2$
Time $t = 15s$

$$\omega_i = \frac{V}{r} = \frac{15}{0.45} = \frac{100}{3} \quad \omega_f = 0$$

$$\omega_f = \omega_i + \alpha t$$

$$0 = \frac{100}{3} + (-\alpha)(15) \quad \Rightarrow$$

Average torque transmitted by b

$$\tau = (I)(\alpha) = 3 \times \frac{100}{45} = 6.66\ kgn$$

23. **(0.05)** Given : $A = 4\ m^2$, $e = 0.32$
B_1 is the initial magnetic induc
$B_2 = 0.2\ B_1$

$$e = \frac{d\phi}{dt} = \frac{A(B_1 - B_2)}{\Delta t} \text{ or } 0.32$$

0.16

24. **(0.94)** Time period of a physica

$$T=2\pi\sqrt{\frac{I}{mgh}}$$

where I is the moment of inertia
of the pendulum about an axis
through the pivot, m is the ma
from the pivot to the centre of
In this case, a solid disc of R os
axis perpendicular to the plane

$$\therefore\ I=\frac{mR^2}{2}+mr^2=\frac{mR^2}{2}+m\left(\frac{R}{4}\right.$$

$$=\frac{9mR^2}{16} \qquad \left(\because r=\frac{R}{4}\right)$$

Here, $R=10$ cm $=0.1$ m, $h=\frac{R}{4}$

$$\therefore\quad T=2\pi\sqrt{\frac{\frac{9mR^2}{16}}{\frac{mgR}{4}}}=2\pi\sqrt{\frac{9R}{4g}}$$

$$=2\pi\sqrt{\frac{9\times0.1}{4\times10}}=2\pi\times\frac{3}{2}\times\frac{1}{10}=0.9$$

25. **(488.9)** $\frac{1}{\lambda_1}=R\left(\frac{1}{2^2}-\frac{1}{3^2}\right)=$

$$\frac{1}{\lambda_2}=R\left(\frac{1}{2^2}-\frac{1}{4^2}\right)=\frac{3R}{16}$$

$$\therefore\frac{\lambda_2}{\lambda_1}=\frac{80}{108}$$

$$\lambda_2=\frac{80}{108}\lambda_1=\frac{80}{108}\times660=48$$

CHEM

27. **(b)** CuF_2 is both paramagnetic and

28. **(c)** s-character $\propto$ bond angle

For 25% s character (as in sp^3

33.3% s character (as in sp^2 hy

50% s character (as in sp hybri

Similarly, when the bond angle

will decrease accordingly.

Decrease in angle = 120° – 109.

Decrease in s-character = 33.3 –

Actual decrease in bond angle =

Expected decrease in s-charact

$$= \frac{8.3}{10.5} \times 4.5 = 3.56\%$$

Thus, the s-character should d

= 25 – 3.56 = 21.44%

29. **(d)** $CH_3 - COONH_4 \xrightarrow{\Delta} CH_3$

$\xrightarrow{\Delta / P_2O_5} \underset{(Y)}{CH_3 - CN} \xrightarrow{H_3}$

30. **(a)** Be – $1s^2 2s^2$; B – $1s^2 2s^2 2p^1$; C –

increases along the period. But

atoms with fully or partly fille

high ionisation energy.

31. **(a)** From data 1 and 3, it is clear th

remains unaffected. Hence ra

keeping [A] constant, [B] is d

$\propto [B]^3$.

32. **(b)** (i) HCl is a strong acid. Hen

(ii) NaCl is a salt of strong ac

and hence its pH is 7.

(iii) $NH_4Cl + H_2O \rightleftharpoons NH_4$

$\therefore$ The solution is acidic

(iv) $NaCN + H_2O \rightleftharpoons NaO$

$\therefore$ The solution is basic a

$\therefore$ Correct order for incre

$HCl < NH_4Cl < NaCl < Na$

34. (b) All proteins are not found in L
D or L

35. (a) $2CuSO_4 + 2Na_2CO_3 + H_2O$ —

36. (c) For metal, as temperature incre
ductivity decreases.

37. (d) In a unit cell, W atoms at the c

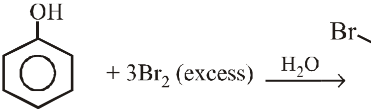
O-atoms at the centre of edges

Na-atoms at the centre of the c

$W : O : Na = 1 : 3 : 1$

Hence, formula $= NaWO_3$

38. (d) With Br_2 water, phenol gives 2



39. (c) V_2O_5 is used as catalyst in con

40. (c) The dipole moment of symmetr

Triangular plan

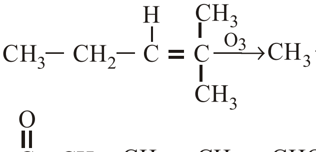
41. (a) $NaCl(s) \rightarrow NaCl(l)$

Given that : $\Delta H = 30.5\ kJ\ mol^{-1}$

$\Delta S = 28.8\ JK^{-1}mol^{-1} = 28.8 \times 10$

By using $\Delta S = \dfrac{\Delta H}{T} = \dfrac{30.5}{28.8 \times 10}$

42. (a)



44. (b) Radioactive decay follows firs

Decay constant $(\lambda) = \dfrac{0.693}{t_{1/2}} =$

Given, $R_0 = 100$ $\therefore$

and $t = \dfrac{2.303}{\lambda} \log \dfrac{[R]_0}{[R]} = \dfrac{2.3}{\left(\dfrac{0.6}{57\ldots}\right.}$

$= \dfrac{2.303 \times 5730}{0.693} \times 0.0969 = 184$

45. (d) Hybridisation

$\underset{d^2sp^3}{[Fe(CN)_6]^{4-}}, \underset{d^2sp^3}{[Mn(CN)_6]^{4-}},$

$\underset{d^2sp^3}{[Co(NH_3]^{3+}}, \underset{sp^3d^2}{[Ni(NH_3)_6]^{2+}}$

Hence $[Ni(NH_3)_6]^{2+}$ is outer

46. (409.5) According to combined gas e

$$\frac{PV}{T} = \frac{P_1V_1}{T_1}$$

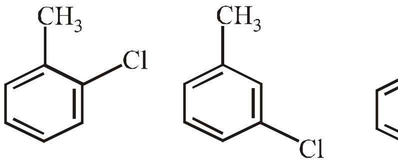
$P = 1$ atm, $P_1 = \dfrac{3}{4}$ atm (on redu

$V = v, V_1 = 2v, T = 273K, T_1 =$

$$\frac{1 \times v}{273} = \frac{3 \times 2v}{4 \times T_1}$$

$$T_1 = \frac{3 \times 2 \times 273}{4} = 409.5 \text{ K}$$

47. (4) C_7H_7Cl has 4 isomers



48. **(8.4)** Normality of $H_2O_2 = \frac{\text{vol.}}{}$

Volume of (1N) H_2O_2 solution

$\therefore$ Volume strength of 1.5 N

$= 1.5 \times 5.6 = 8.4$ volumes.

49. **(26)** ABAB.... is hexagonal close pa
% and, empty space = 26%.

50. **(3)** $M_2O_x \xrightarrow{\text{Reduction}} M$

Eq. of M_2O_x = eq. of Metal

$$\frac{\text{Wt. of } M_2O_x}{\text{Eq. wt. of } M_2O_x} = \frac{\text{Wt. of}}{\text{Eq. wt. o}}$$

$$\frac{4}{\frac{2\times 56 + x\times 16}{2x}} = \frac{2.8}{\frac{56}{x}}$$

On solving we get,

$$\Rightarrow \frac{4}{56+8x} = \frac{2.8}{56} \Rightarrow \frac{1}{14+2x}$$

Hence, the oxide is M_2O_3.

MATHE

51. **(d)** $T_4 = {}^nC_3\, x^{n-3}\left(\frac{\alpha}{2x}\right)^3 \Rightarrow {}^n$

If $n = 6$, then ${}^6C_3\left(\frac{\alpha}{2}\right)^3 = 20$

52. **(b)** Given equation is $x^2 + px + q$

Sum of roots $= \tan 30° + \tan 15$

Product of roots $= \tan 30° . \tan$

$$\tan 45° = \frac{\tan 30° + \tan 15°}{1 - \tan 30°.\tan 15°} =$$

$\Rightarrow -p = 1 - q \Rightarrow q - p = 1$

or $(a+c)(a+b), (b+c)(a+b$

A.P. $\Rightarrow \frac{1}{b+c}, \frac{1}{c+a}, \frac{1}{a+b}$ a

[dividing by $(a+b)(b+c)(c+$

54. **(d)** Let M(h, k) be the mid-point

of chord AB where

$$\angle ACB = \frac{2\pi}{3}$$

$$\therefore \angle ACM = \frac{\pi}{3}$$

Also $CM = 3\cos\frac{\pi}{3} = \frac{3}{2}$

$$\Rightarrow \sqrt{h^2+k^2} = \frac{3}{2} \Rightarrow h^2+k^2 =$$

$\therefore$ Locus of (h, k) is $x^2+y^2 =$

55. **(c)** $y = \tan^{-1}\left(\frac{\log_e(e/x^2)}{\log_e(ex^2)}\right) + \tan$

$$= \tan^{-1}\left(\frac{1-2\log_e x}{1+2\log_e x}\right) + \tan^{-1}\left(\right.$$

$= \tan^{-1}(a) - \tan^{-1}(2\log_e x)$

$+ \tan^{-1}(c) +$

$= \tan^{-1}(a) + \tan^{-1}(c)$

$$\therefore \frac{dy}{dx} = 0$$

56. **(d)** $\{x^2\} - 2\{x\} \geq 0$

$\Rightarrow \{x\}(\{x\}-2\} \geq 0$

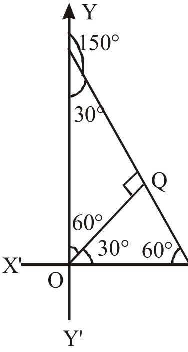
$\Rightarrow \{x\} \leq 0$ or $\{x\} \geq 2$

Second case is not possible.

Hence $\{x\} = 0$, as $\{x\} \leq [0, 1)$

Hence range of $f(x)$ contains c

57. **(d)** Here $p = 7$ and $\alpha = 30°$



or $\sqrt{3}\,x + y = 14$

58. **(c)** $I = \int \frac{dx}{\cos x + \sqrt{3}\sin x}$

$$I = \int \frac{dx}{2\left[\frac{1}{2}\cos x + \frac{\sqrt{3}}{2}\sin x\right]}$$

$$= \frac{1}{2}\int \frac{dx}{\left[\sin\frac{\pi}{6}\cos x + \cos\frac{\pi}{6}\sin x\right.}$$

$$\Rightarrow \; I = \frac{1}{2}\int \operatorname{cosec}\left(x + \frac{\pi}{6}\right) dx$$

$$\because \int \operatorname{cosec} x \, dx = \log|(\tan x/2$$

$$\therefore \; I = \frac{1}{2}\log\tan\left(\frac{x}{2} + \frac{\pi}{12}\right) + C$$

59. **(c)** Given $\frac{\tan 3\theta - 1}{\tan 3\theta + 1} = \sqrt{3}$

$$\Rightarrow \sqrt{3}(\tan 3\theta + 1) = \tan 3\theta - 1$$

$$\Rightarrow \sqrt{3}\tan 3\theta + \sqrt{3} = \tan 3\theta - 1$$

$\Rightarrow \tan 3\theta(\sqrt{3}-1) = -(1+\sqrt{3})$

$\Rightarrow \tan 3\theta = \dfrac{-(\sqrt{3}+1)}{(\sqrt{3}-1)} = \dfrac{-(1+}{-(1-}$

$\Rightarrow \tan 3\theta = \tan 105° = \tan \dfrac{7\pi}{12}$

[**Note :** $\tan\theta = \tan\alpha \Rightarrow \theta = n\pi$

$\therefore\ 3\theta = n\pi + \dfrac{7\pi}{12} \ \Rightarrow \theta = \dfrac{n\pi}{3} +$

60. **(c)** Equation of normal in slope fo
$y = mx - 2Am - Am^3$

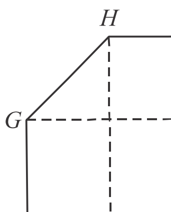
$= mx - 2\left(\dfrac{1}{4}\right)m - \left(\dfrac{1}{4}\right)m^3$

$\Rightarrow 4mx - 4y - m^3 - 2m = 0$
$\because (a, 0)$ lies on the normal. Th
$\Rightarrow m(m^2 + 2 - 4a) = 0$
$\Rightarrow m = 0$ or $m^2 + 2 - 4a = 0$
If $m = 0$, then from (i),
$y = 0$ i.e., x-axis is one normal.
If $m^2 + 2 - 4a = 0 \Rightarrow m^2 = 4a -$

$\Rightarrow 4a - 2 > 0 \Rightarrow a > \dfrac{1}{2}$.

61. **(d)** By the diagram only 2 rectangl
$\therefore$ number of favourable cases
Total number of cases = ^{8}

$\therefore$ required probability = $\dfrac{2}{^8C_4}$



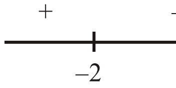
62. **(a)** $f(x) = x^3 - 3x^2 - 24x + 5$

For increasing, $f'(x) > 0, 3x^2$

$\Rightarrow x^2 - 2x - 8 > 0 \Rightarrow x^2 - 4x +$

$\Rightarrow (x+2)(x-4) > 0$.

Now, by the sign scheme for 3.



$\Rightarrow x \in (-\infty, -2) \cup (4, \infty)$

63. **(c)** Given that $y = y(x)$ and $x \cos$

For $x = 0$ in (i) we get $y = \pi$

Differentiating (i) with respect

$-x \sin y . y' + \cos y + y' \cos x -$

$$\Rightarrow y' = \frac{y \sin x - \cos y}{\cos x - x \sin y}$$

$\Rightarrow y'(0) = 1$ (Using $y(0) = \pi$)

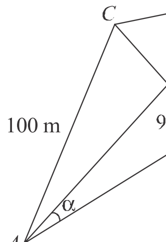
Differentiating (ii) with respec

$$(y' \sin x + y \cos x + \sin y .$$

$$y'' = \frac{-(-\sin x - \sin y - x \cos y}{(\cos x - x \sin}$$

$$\Rightarrow y''(0) = \frac{\pi(1) - 0}{1} = \pi.$$

64. **(b)** DP is a clock tower standing a



$\therefore \cot\beta = \sqrt{(\text{cosec}^2\beta - 1)} = \sqrt{(}$

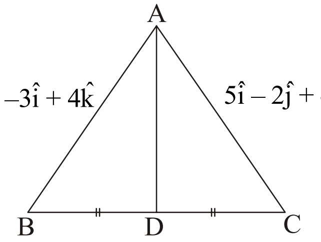
In the triangles *PAD* and *PBD*,

$AD = h\cot\alpha = 3.2\,h$ and $BD =$

In the right angled ΔABD, AB^2

$\Rightarrow 100^2 = [(3.2)^2 + (2.4)^2]\,h^2 =$

65. (b)



$$\overrightarrow{AD} = \frac{(-3+5)\hat{i} + (0-2)\hat{j} + (}{2}$$

$$= \frac{2\hat{i} - 2\hat{j} + 8\hat{k}}{2} = \hat{i} - \hat{j} + 4$$

$\therefore$ length of median

$$= |\overrightarrow{AD}| = \sqrt{(1)^2 + (-1)^2 + (4)^2}$$

66. (a) $\sim[p \vee (\sim p \vee q)] \equiv \sim p \wedge \sim (\sim$

$$\equiv \sim p \wedge (\sim(\sim p) \wedge \sim q)$$

$$\equiv \sim p \wedge (p \wedge \sim q).$$

67. (a) $f(x) = x^p \sin\frac{1}{x}, x \neq 0$ and f(x

Since at x = 0, f(x) is a continu

$$\therefore \lim_{x\to 0} f(x) = f(0) = 0$$

$$\Rightarrow \lim_{x\to 0} x^p \sin\frac{1}{x} = 0 \Rightarrow p > 0$$

f(x) is differentiable at x = 0, if

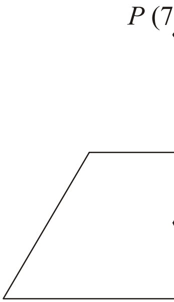
$$x^p \sin\frac{1}{}\ \ 0$$

$\Rightarrow \lim\limits_{x \to 0} x^{p-1} \sin \frac{1}{x}$ exists

$\Rightarrow p - 1 > 0$ or $p > 1$

$\therefore$ for $0 < p \leq 1$, f(x) is a contin

68. (d) Let *M* be the foot of perpendicu
PM is normal to the plane. So
through *P*(7, 14, 5) and has d.r



Therefore, its equation is $\frac{x-}{2}$

$\Rightarrow x = 2r + 7,\ y = 4r + 14,\ z$

Co-ordinates of *M* be $(2r + 7,$

Since M lies on the plane $2x +$

$2(2r+7) + 4(4r+14) - (-r +$

Co-ordinates of foot of perpen
PM = Length of perpendicular

$= \sqrt{(1-7)^2 + (2-14)^2 + (8}$

69. (c) $\Delta(x) = \begin{vmatrix} e^x & \sin x \\ \cos x & \ln(1+x^2) \end{vmatrix}$

$= e^x \ln$

So, $\lim\limits_{x \to 0} \frac{\Delta(x)}{x} = \lim\limits_{x \to 0} \frac{e^x \ln(1+}{}$

70. **(a)** $\tan^{-1} x + \tan^{-1} \frac{1}{y} = \tan^{-1} 3$

$$\Rightarrow \tan^{-1} \frac{x + \frac{1}{y}}{1 - \frac{x}{y}} = \tan^{-1} 3 \Rightarrow \frac{x}{y}$$

$\Rightarrow y = \frac{1+3x}{3-x} > 0$ [$\because$ x ar

$\Rightarrow x - 3 < 0 \Rightarrow x < 3$ or $x = 1$

$\therefore y = 2, 7$

solution set is $(x, y) \in \{(1, 2),$

71. **(64)** A selection of 3 balls so as to in
in the following 3 mutually ex
(i) 1 black ball and 2 others = 3
(ii) 2 black balls and one other
(iii) 3 black balls and no other
$\therefore$ Total number of ways = 45 +

72. (19.5)

Class	Frequency	C
5 – 10	5	
10 – 15	6	
15 – 20	15	
20 – 25	10	
25 – 30	5	
30 – 35	4	
35 – 40	2	
40 – 45	2	

Here N = 49. $\therefore \frac{N}{2} = \frac{49}{2}$

The cumulative frequency just
class is 15–20. Thus 15– 20 is t
= 11, $h = 5$

$\therefore$ median $= \ell + \frac{N/2 - F}{f} \times$

73. (3.75) α, β are roots of the equation 2

Therefore sum of roots $(\alpha + \beta$

And product of roots $(\alpha.\beta) =$

Now, $\begin{vmatrix} 0 & \beta & \beta \\ \alpha & 0 & \alpha \\ \beta & \alpha & 0 \end{vmatrix}$

$= 0\,|0 - \alpha^2| - \beta\,|0 - \alpha\beta| + \beta\,|\alpha$

$= \alpha\beta^2 + \beta\alpha^2 = \alpha\beta(\alpha + \beta)$

$= \frac{5}{2}\left(\frac{-3}{2}\right) = \frac{-15}{4} = -3.75$

74. (21.5) Let $I = \int_{-3}^{2} \{|x+1| + |x + 2| + |x$

Breaking points are

$x + 1 = 0 \Rightarrow x = -1$

$x + 2 = 0 \Rightarrow x = -2$

$x - 1 = 0 \Rightarrow x = 1$

$\therefore\ I = \int_{-3}^{-2} f(x)\,dx + \int_{-2}^{-1} f(x)\,dx$ -

where $f(x) = |x+1| + |x+2| +$

Now, $I_1 = \int_{-3}^{-2} [-(x+1) - (x+2$

$= -\left[\frac{x^2}{2} + x + \frac{x^2}{2} + 2x + \frac{x^2}{2} +\right.$

$I_2 = \int_{-2}^{-1} [-(x+1) + (x+2) - (x$

$$= \frac{-x^2}{2} + 2x \Big|_{-2}^{-1} = \left(\frac{-1}{2} - 2\right)$$

$$= -\frac{5}{2} + 6 = \frac{7}{2}$$

$$I_3 = \int_{-1}^{1} [(x+1)+(x+2)-(x-$$

$$= \int_{-1}^{1} (x+4)\,dx \ = \frac{x^2}{2} + 4x \Big|_{-}^{1}$$

$$I_4 = \int_{1}^{2} [(x+1)+(x+2)+(x-1$$

$$= \int_{1}^{2} (3x+2)\,dx = \frac{3x^2}{2} + 2x \Big|$$

$$\therefore \ I = I_1 + I_2 + I_3 + I_4$$

$$= \frac{7}{2} + \frac{7}{2} + 8 + \frac{13}{2} = \frac{43}{2}$$

$$= \frac{27+16}{2} = \frac{43}{2} = 21.5$$

75. (4.5) Given curves are, $y = 2x - x^2$
and $y = -x$
Putting the value of y in (i),

$$-x = 2x - x^2$$

$$\Rightarrow x(x-3) = 0 \Rightarrow x = 0, 3$$

$\therefore$ area under the curve

$$= \int_0^3 [(2x - x^2) - (-x)]\,dx$$

$$= \int_0^3 (3x - x^2)\,dx = \left[\frac{3x^2}{2} - \frac{x^3}{3}\right]_0^3$$

PHY

1. (d) Let the scooterist velocity be v
$1000+(10 \times 100)=v \times 100$
$\Rightarrow 100\,v = 2000 \Rightarrow v = \frac{2000}{100}$

2. (b) We have, $F = kx$
where, F, x and k are force, len
$\therefore \quad 5 = kx$
and $7 = ky$
Multiplying eq. (2) by 2
$14 = 2ky$
Subtracting eq. (1) from (3),
$14 - 5 = 2ky - kx$ or $9 = k(2y -$
Hence, required length $= 2y -$

3. (b) In the given equation $[\rho] = [b]$
$\therefore [b] = [\rho]/[x]$. But ρ is mass p
$[b] = ML^{-1}/L = ML^{-2}T^{0}$

4. (d) Point A is at rest w.r.t. motion,
horizontal velocities. Hence, v

5. (d) $mg = 2TL \Rightarrow \pi r^2 Ldg = 2TL \Rightarrow$
This relation is independent of

6. (d) $\omega_{rod} = \omega_{point} = \left(\frac{v_{rel}}{r}\right)$,
v_{rel} represents the velocity of
$= \frac{3v - v}{r}$ and 'r' being the dis
$= \frac{2v}{r}$

7. (d) Both are diatomic gases and C

8. (b) More the initial temperature m
Hence, $T_3 > T_2 > T_1$
O
The rate of cooling decreases
between body and surroundin

9. (c) $\frac{1}{C_\infty} = \frac{1}{C_\infty + C} + \frac{2}{C} = \frac{3C + 2C}{C_\alpha\left(C_\alpha + \right.}$

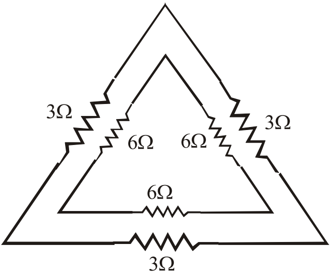
10. **(b)** R increases with increasing ter

$V = IR$

Slope of graph $= \frac{I}{V} = \frac{1}{R}$; Slo

is less. This concludes that T_1

11. **(c)** $R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$ (Parallel) $= \frac{4\times}{4+}$



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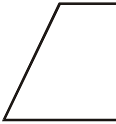


12. **(d)** $i_R = \frac{V_0}{R} = \frac{100}{20} = 5$, $i_L = \frac{V_0}{X_L}$

Current, $i = \sqrt{i_R^2 + (i_C - i_L)^2}$ =

13. **(a)** $f_{max} = \mu mg$, $a_{max} = \mu g$.

If A is the amplitude a_{max} = A

Therefore, $A = \frac{\mu g}{4\pi^2 V^2}$.

14. **(c)** Total time taken to travel dista

$\frac{d}{2n_1} + \frac{d}{2n_2} = d\left(\frac{n_1 + n_2}{2n_1 n_2}\right) =$

However, if A_{12} and A_{34} hav
phase of A_{12} and A_{34}, no fring

16. **(a)** $mvr = \frac{nh}{2\pi}$, $\lambda = \frac{h}{mv}$;

Using the two concept we get,

$$2\pi r = \frac{1 \times h}{mv}$$

$$\lambda = \frac{h}{mv}$$

Divide (2) by (1), $\frac{2\pi r}{\lambda} = \frac{h \times m}{mv \times}$

17. **(d)** 1. $\lambda = \frac{0.693}{t^{1/2}}$ 2. R

Radioactivity at T_1 is $R_1 = \lambda$ N
Radioactivity at T_2 is $R_2 = \lambda$ N
$\therefore$ Number of atoms decayed in

$(T_1 - T_2) = (N_1 - N_2)$ or $\frac{R_1 -}{\lambda}$

i.e., $\alpha\,(R_1 - R_2)T$

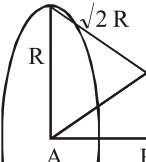
18. **(d)** In the graph given, slope of cu

$$\left(\frac{\gamma P}{V}\right)_2 > \left(\frac{\gamma P}{V}\right)_1 \Rightarrow \gamma_2 > \gamma_1$$

$$\gamma_{He} > \gamma_{O_2}$$

Since, $\gamma_{monoatomic} > \gamma_{diatomic}$
Hence, curve 2 corresponds
oxygen.

19. **(b)** $V_A = \frac{1}{4\pi \epsilon_0}\left[\frac{Q_1}{R} + \frac{Q_2}{\sqrt{2}R}\right]$;



$$V_A - V_B = \frac{1}{4\pi \in_0 R}\left[Q_1 + \frac{Q_2}{\sqrt{2}}\right.$$

Work done $= Q \times V = q \times (V_A -$

$$= \frac{q}{4\pi \in_0 R}\left[Q_1 + \frac{Q_2}{\sqrt{2}}\right.$$

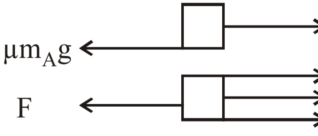
$$= \frac{q}{4\pi \in_0 R} \times \frac{1}{\sqrt{2}}\left[\sqrt{2}Q\right.$$

$$= \frac{q(Q_1 - Q_2)(\sqrt{2}-1)}{(\sqrt{2}\ 4\pi \in_0 R)}$$

20. **(b)** When there is no change in li
Change in volume in liquid re

$\Delta V_{app} = V\gamma'_{app}\,\Delta\theta = V(\gamma'_{real}$

21. **(10)** Here, $m_A = 0.5\text{kg}$; $m_B = 1\text{kg}$



Force on block A

$T = \mu m_A g$

Force acting on block B

$F = T + \mu m_A g + \mu(m_A + m_B)\,g$

From (1) & (2),

$F = \mu m_A g + \mu m_A g + \mu m_A g + \mu$

$F = 3\mu m_A g + \mu m_B g = \mu g(3m_A$

$= 0.4 \times 10 \times (3 \times 0.5 + 1) =$

22. **(10.6)**

Work done in going from a dis
of the earth, by a body of mas

$W = GMm\,(1/r_1 - 1/r_2)$,

For our case we should have

$1/2\,mv^2 = GMm\,[(1/R_e) - (1/1$

23. **(300)**

Here the number of molecules

$$T_{final} = \frac{T_1 + T_2}{2} = \frac{200 + 400}{2}$$

24. **(83.3)** Power of source = EI = 240 ×

$$\Rightarrow \text{Efficiency } = \frac{140}{166} \Rightarrow \eta = 83$$

25. **(0.5)** Magnetic induction at O due t

$$B_Y = \frac{\mu_0}{4\pi} \times \frac{2\pi I(2r)^2}{\left[(2r)^2 + d^2\right]^{3/2}}$$

Similarly, the magnetic induct

$$B_X = \frac{\mu_0}{4\pi} \times \frac{2\pi Ir^2}{\left[r^2 + (d/2)^2\right]^{3/2}}$$

From eq. (1) & (2) $\quad \frac{B_Y}{B_X}$

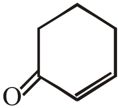
CHEM

26. **(b)** The molecule 2,3 - pentadiene
time it does not have any mirro

27. **(a)** In such a case there is no char

$$u = \sqrt{(3RT/M)} = \sqrt{(3PV/}$$

The increase in temperature = 4
also the increase in pressure = 4

28. **(b)**  $+(CH_3)_2CHOH -$

29. **(d)** In N_2^+, there is one unpaired e

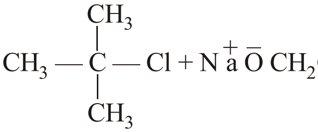
31. **(c)** We know that

$$H_2\underset{O}{C - CH_2} + RMgX -$$

32. **(c)** Tertiary amine do not have hy
not form an amide with acid ch

33. **(a)** No. of dipeptides = 2^n ; n= no.
be formed.

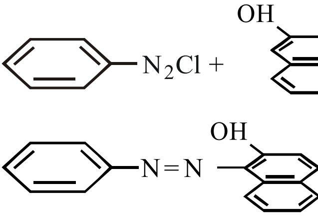
34. **(d)** Tertiary halides on treatment wi
undergo elimination resulting i
Synthesis)



35. **(b)** $s_0 = \sqrt{K_{sp}}\,; s_1 = K_{sp} / 0.02\ M$

Obviously $s_0 > s_2 > s_1 > s_3$

36. **(b)** $C_6H_5NH_2 + NaNO_2 + HCl -$



Red dye

37. **(c)** Multiple bonds formation tend
from sulphur to tellurium.
CS_2 (S = C = S) is moderately s
CSe_2 (Se = C = Se) decompose
CTe_2 (Te = C = Te) does not ex

38. **(d)** Liquation is the principle base

39. **(c)** In NO_2^+ odd (unpaired) elect
unpaired electrons are persen
one more electron each for p

40. **(a)** The two solutions are isotonic

41. **(b)** Hydrated $CoCl_2 . 6H_2O$ is p
$[Co(H_2O)_6]^{2+}$ ions. If this is p
coloured tetrahedral ions [Co(

$$\underset{\text{pink}}{[Co(H_2O)_6]^{2+}} \rightleftharpoons \underset{\text{blue}}{[Co(H_2O)}$$

42. **(c)** In $(NH_4)_2 [(TiCl_6)]$, Ti^{4+} $(3d^0$
In $K_2Cr_2O_7$, Cr^{6+} $(3p^6\ d^0)$ has n
In $CoSO_4$, Co^{2+} (d^7) has unpa
paramagnetic and coloured.
In $K_3[Cu(CN)_4]$, Cu^+ $(3d^{10})$, h

43. **(b)** $\log K = \log A - \frac{E_a}{2.303R} \frac{1}{T}$ (Ar

Plot of log K Vs 1/T gives a str

44. **(b)**
- Li does not form peroxide
- Solubility of carbonates down the group.
- The increasing order of $Li^+ > Na^+ > K^+ > Rb^+ > C$
- Cesium used in photoel statements (b) is the only

45. **(d)** Cell reaction $Zn + Cu^{++} \longrightarrow$

$$E_1 = E^\circ_{cell} - \frac{0.059}{2} \log \frac{0.01}{1.0}$$

$$E_2 = E^\circ_{cell} - \frac{0.059}{2} \log \frac{1.0}{0.01}$$

$\therefore E_2 = (E^\circ_{cell} - 0.059)\,V$. Thu

46. **(69.60)** $\frac{P^\circ - P_S}{P^\circ} = \frac{w/m}{W/M}$; (640–60

$40/640 = 2.175 \times 78/m \times 39.08$

$m = 2.175 \times 78 \times 640 / 39.08 \times 4$

47. **(0.17)** $\Delta x = (h/4\pi) \times m \times \Delta v$

48. **(3.8)** $K = \frac{[H_3O^+][HCO_3^-]}{[CO_2][H_2O]^2}$ As pH

$K = \frac{[H_3O^+][HCO_3^-]}{[CO_2][H_2O]^2}$ $(H_2O$

constant)

$\frac{[HCO_3^-]}{[CO_2]} = \frac{K}{[H_3O^+]} = \frac{3.8\times}{10}$

49. **(136800)** ν for hydrogen like speci
$= \nu_H \times Z^2 = 15200 \times 3^2 = 15200$

50. **(32.06)** Calorific value of butane $= \frac{}{m}$

Cylinder consist 14 Kg of buta

$\therefore$ 1g gives = 45.8 kJ/

$\therefore$ 14000 g gives = $14000 \times$

Family need 20,000 kJ/day

So gas full fill the requirement

MATHE

51. **(b)** $(a^2 + b^2 + c^2)p^2 - 2(ab + bc +$
$+ b^2 + c$

$\Rightarrow (a^2p^2 - 2abp + b^2) + (b^2p^2$
$+ (c^2p^2 -$

$\Rightarrow (ap - b)^2 + (bp - c)^2 + (cp -$

$\Rightarrow ap - b = 0,\ bp - c = 0\ \&\ cp$

52. (c)

(a) $\log(a+2b) = \frac{1}{2}\log(a+2b)^2$

$= \frac{1}{2}\log(a^2 + 4b^2 + 4ab)$

$= \frac{1}{2}\log(12ab + 4ab)$

$= \frac{1}{2}\log(2^4 . ab)$

$= \frac{1}{2}(4\log 2 + \log a + \log b)$

(b) Let $\frac{\log x}{b-c} = \frac{\log y}{c-a} = \frac{\log z}{a-b} = k$

$\Rightarrow \log x = k(b-c),\ \log y = k($

$\log z = k(a-b)$

$\therefore x^a \ . \ y^b \ . \ z^c = p^{k[a(b-c))+b($

$= p^{k(0)} = 1$

where p is any arbitrary base

(c) Given expression

$= \log_{xyz} xy + \log_{xyz} yz + \log_{x}$

$= \log_{xyz}(xy \ . \ yz \ . \ zx) \ = \log_{x}$

$= 2\log_{xyz}(xyz) = 2 \times 1 = 2$

53. (b) $\alpha + \beta + \gamma = \frac{\pi}{2} \ \Rightarrow \alpha + \gamma = \frac{\pi}{2} -$

so that $\cot(\alpha + \gamma) = \ \cot\left(\frac{\pi}{2} -\right.$

$\Rightarrow \frac{\cot\alpha\cot\gamma - 1}{\cot\alpha + \cot\gamma} = \frac{1}{\cot\beta}$

54. (c) We know, $1+\omega+\omega^2+...+\omega^{n-}$

But $\omega^n=\cos\left(\frac{n\pi}{n}\right)+i\sin\left(\frac{n\pi}{n}\right.$

$= \cos\pi+\mathrm{i}\sin\pi = -1$

and $1-\omega=2\sin^2\frac{\pi}{2n}-2i\sin$

$= -2i\sin\left(\frac{\pi}{2n}\right)\left[\cos\frac{\pi}{2n}+i\sin\right.$

Thus, $1+\omega+\omega^2+...+\omega^{n-1}$

$$=\frac{2}{-2i\sin\left(\frac{\pi}{2n}\right)\left[\cos\frac{\pi}{2n}+i\sin\frac{\pi}{2n}\right.}$$

$$=\frac{i\cos\frac{\pi}{2n}}{\sin\frac{\pi}{2n}}-i^2\frac{\sin\frac{\pi}{2n}}{\sin\frac{\pi}{2n}}=1+\mathrm{i}$$

55. (a) $C_1(1,0); C_2(0,-2)$

$r_1=\sqrt{1+15}=4,\ \ r_2=\sqrt{4-3}$

$C_1C_2=\sqrt{1+4}=\sqrt{5}$

$r_1-r_2=3 \Rightarrow C_1C_2<r_1-r_2$

Hence, C_2 lies inside C_1.

56. (d)

(a) We have $|AB|=|A||B|$

Also for a square matrix of orde
of the matrix A is multiplied by
common

$\therefore\ |3AB|=3^3|A||B|=27(-1$

(b) Since A is invertible, therefore

$$\Rightarrow \det(A)\det(A^{-1}) = 1$$

$$\Rightarrow \det(A^{-1}) = \frac{1}{\det(A)}$$

(c) $(A+B)^2 = (A+B)(A+B)$

$$= A^2 + AB + BA + \text{I}$$

$$= A^2 + 2AB + B^2 \text{ i}$$

57. **(b)** For trivial solution,

$$\begin{vmatrix} 1 & -2 & 1 \\ 2 & -1 & 3 \\ \lambda & 1 & -1 \end{vmatrix} \neq 0 \Rightarrow -5\lambda - 4$$

58. **(d)** $f(x) = |x-1| = \begin{cases} -x+1, & x < 1 \\ x-1, & x \geq 1 \end{cases}$

Consider $f(x^2) = (f(x))^2$

If it is true it should be $\forall\ x$

$\therefore$ Put $x = 2$

LHS $= f(2^2) = |4-1| = 3$

RHS $= (f(2))^2 = 1$

$\therefore$ (a) is not correct

Consider $f(x+y) = f(x) + f(y)$

Put $x = 2, y = 5$ we get

$f(7) = 6; f(2) + f(5) = 1 + 4 = 5$

$\therefore$ (b) is not correct

Consider $f(|x|) = |f(x)|$

Put $x = -5$ then $f(|-5|) = \text{f}(5) =$

$|f(-5)| = |-5-1| = 6$

$\therefore$ (c) is not correct.

Hence (d) is the correct alterna

59. **(d)** Let $a = \tan\ \theta$ and $b = \tan\phi$

$$\therefore\ \sin^{-1}\left[\frac{2a}{1+a^2}\right] = \sin^{-1}\left[\frac{2\text{t}}{1+\ldots}\right.$$

and $\sin^{-1}\left[\frac{2b}{1+b^2}\right] = \sin^{-1}\left[\frac{2}{1+}\right.$

$$= \sin^{-1}[\sin 2\phi] = 2\phi$$

Thus, $\sin^{-1}\left[\frac{2a}{1+a^2}\right] = 2\tan^{-1}$

$$\sin^{-1}\left[\frac{2b}{1+b^2}\right] = 2\tan^{-1}$$

$$\therefore \quad 2\tan^{-1}x = \sin^{-1}\left[\frac{2a}{1+a^2}\right]$$

$$= 2\tan^{-1}a + 2\,t$$

$$\Rightarrow \quad \tan^{-1}x = \tan^{-1}a + \tan^{-1}$$

$$\tan^{-1}x = \tan^{-1}\frac{a+b}{1-ab}$$

$$\therefore \quad x = \frac{a+b}{1-ab}$$

60. **(a)** We have,

$$AB = \begin{bmatrix} \cos^2\theta & \cos\theta\sin\theta \\ \cos\theta\sin\theta & \sin^2\theta \end{bmatrix}\Bigg[$$

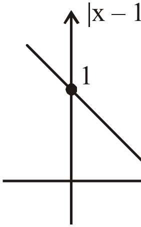
$$= \Bigg[\begin{matrix} \cos^2\theta\cos^2\phi + \cos\theta\cos\phi\,s \\ \cos\theta\sin\theta\cos^2\phi + \sin^2\theta\,c \end{matrix}$$

$$\begin{matrix} \cos^2\theta\cos\phi\sin\phi + c \\ \cos\theta\cos\phi\sin\theta\sin\phi \end{matrix}$$

$$= \cos(\theta-\phi)\Bigg[\begin{matrix} \cos\theta\cos\phi & \cos\theta \\ \sin\theta\cos\phi & \sin\theta \end{matrix}$$

Since $AB = 0$, $\therefore\ \cos(\theta-\phi) = 0$

61. **(c)** Since $|x|$ is not diff. at $x = 0$



$\Rightarrow |x-1|$ is not diff at $x = 1$.

$x^n |x|$ in n times diff. at $x = 0$

$\Rightarrow (x-1)^2 |x-1|$ is twice diff

but not thrice diff. at $x = 1$

62. **(c)** $f(x) = \dfrac{1}{x-1}$ is discontinuous at

$(gof)(x) = g(f(x)) = -\dfrac{(x-1)}{(2x-1)(x}$

Hence the set of points where (

63. **(a)** $\sum_{r=0}^{m} {}^{n+r}C_n = \sum_{r=0}^{m} {}^{n+r}C_r \quad (\because {}^{n}$

$= {}^{n}C_0 + {}^{n+1}C_1 + {}^{n+2}C_2 + {}^{n+}$

Using, ${}^{n}C_0 = 1 = {}^{n+1}C_1$

$= ({}^{n+1}C_0 + {}^{n+1}C_1) + {}^{n+2}C_2 +$

Using, ${}^{n}C_r + {}^{n}C_{r+1} = {}^{n+1}C_{r+1}$

$= ({}^{n+2}C_1 + {}^{n+2}C_2) + {}^{n+3}C_3$

Using this again and again, we

$= {}^{n+m}C_{m-1} + {}^{n+m}C_m$

$= {}^{n+m+1}C_m = {}^{n+m+1}C_{n+1}$

64. **(b)** As $x \to \dfrac{1}{3}$; $\{x+1\} \to \{1+1/3$

Similarly $\{x+2\} \to \dfrac{1}{3}$ as $x \to$

65. **(b)** Squaring both sides we get hi

66. **(d)** $I = \int_{\pi/4}^{\pi/4} (\underset{\text{odd f}}{\underset{\downarrow}{x|x|}} + \underset{\text{odd f}}{\underset{\downarrow}{\sin^3 x}} + \underset{\text{odd}}{\underset{\downarrow}{x \tan^2}}$

$I = \int_{-\pi/4}^{\pi/4} dx = \frac{\pi}{2}$ $\qquad [\because \int_{-a}^{a}$

67. **(b)** $(1-x-2x^2)^6 = (1+x)^6 (1-2x)^6$
$= 1 + a_1x + a_2x^2 + \ldots\ldots + a_{12}x^{12}$
Putting $x = 1/2$, we have
$a_4/2^4 + \ldots\ldots + a_{12}/2^{12}$
Putting $x = -1/2$, we have
$1 = 1 - a_1/2 + a_2/2^2 - a_3/2^3 + a_4/$
Adding (1) and (2), we have
$1 = 2(1 + a_2/2^2 + a_4/2^4 + \ldots\ldots +$
$\Rightarrow a_2/2^2 + a_4/2^4 + a_6/2^6 \ldots\ldots + a$

68. **(b)** $y^2 = 4x \;\&\; \frac{x^2}{8} + \frac{y^2}{2} = 1$

Equation of tangent to above

$y^2 = mx + \frac{1}{m}$ and $y = mx +$

Comparing $\frac{1}{m} = \sqrt{8m^2 + 2}$

$\Rightarrow m^2(8m^2 + 2) = 1$

seeing the options

$m = \pm\frac{1}{2}$ satisfy the equation

$\Rightarrow y = \pm\frac{1}{2}x \pm 2 \;\Rightarrow 2y = \pm x \pm$

i.e. $2y = x + 4 \;\&\; x + 2y + 4 = 0$

69. **(b)** Let the point be (x_1, y_1).

$2(x_1 - 3)$, but it is equal to 1.

Therefore, $2(x_1 - 3) = 1 \Rightarrow x_1$

$$y_1 = \left(\frac{7}{2} - 3\right)^2 = \frac{1}{4}.$$

Hence the point is $\left(\frac{7}{2}, \frac{1}{4}\right)$.

70. **(c)** $x = \tan A, y = \tan B, -z = \tan C.$

$\Rightarrow \tan A + \tan B + \tan C = \tan A$

$\Rightarrow A + B + C = \pi \quad \Rightarrow 2A + 2B$

$\Rightarrow \tan(2A + 2B) = \tan(2\pi - 2C)$

$\Rightarrow \tan 2A + \tan 2B + \tan 2C = \tan$

$$\Rightarrow \frac{2\tan A}{1-\tan^2 A} + \frac{2\tan B}{1-\tan^2 B} + \frac{2}{1-}$$

$$= \frac{2\tan A}{1-\tan^2 A} \cdot \frac{2\tan B}{1-\tan^2 B} \cdot \frac{2\tan}{1-\tan}$$

Put the value of $\tan A$, $\tan B$,

$$\Rightarrow \frac{2x}{1-x^2} + \frac{2y}{1-y^2} - \frac{2z}{1-z^2}$$

$$= -\frac{8xyz}{(1-x^2)(1-y^2)(1-z^2)}$$

71. **(12.25)** $4^2 + 4p + 12 = 0 \Rightarrow p = -$

The equation $x^2 + px + q = 0$ h

or $p^2 = 4q \Rightarrow q = \frac{49}{4}$

72. **(0.125)**

$\cos 36° \cos 42° \cos 78°$

$= \cos 36° \cos(60° - 18°) \cos(60°$

$$= \frac{\sqrt{5}+1}{4}\left(\cos^2 60° - \sin^2 18°\right)$$

$$= \left(\frac{\sqrt{5}+1}{4}\right)\frac{1}{4} - \left(\frac{\sqrt{5}+1}{4}\right)\left(\frac{5+1-}{16}\right.$$

$$= \left(\frac{\sqrt{5}+1}{16}\right) - \frac{\left(\sqrt{5}+1\right)\left(\sqrt{5}-1\right)^2}{64} = $$

$$= \frac{\sqrt{5}+1}{16}\left[\frac{4-6+2\sqrt{5}}{4}\right] = \frac{1}{8}$$

73. **(0.2)** The given expression is equal

$\cos(\cos^{-1} x + \sin^{-1} x + \sin^{-1} x$

$= \cos\left(\frac{\pi}{2} + \sin^{-1} x\right) = -\sin(\sin$

[Using $\cos^{-1} x + \sin^{-1} x = \frac{\pi}{2}$]

74. **(4)** Let $\tan\theta_1, \tan\theta_2$ be the roots of
$\tan\theta_1 + \tan\theta_2 = 4/2 = 2; \tan\theta_1 t$
Now $\tan(\theta_1 + \theta_2) = [(\tan\theta_1 + t$
$= 2/[1-(1/2)] = 4.$

75. **(2.25)** Given, in ΔABC $\begin{vmatrix} 1 & a & b \\ 1 & c & a \\ 1 & b & c \end{vmatrix}$

$\Rightarrow \quad 1(c^2 - ab) - a(c-a) + b(b$
$\Rightarrow \quad a^2 + b^2 + c^2 - ab - bc - c$
$\Rightarrow \quad 2a^2 + 2b^2 + 2c^2 - 2ab - 2$
$\Rightarrow \quad (a^2 + b^2 - 2ab) + (b^2 + c^2$
$\Rightarrow \quad (a-b)^2 + (b-c)^2 + (c-a$
Here, sum of squares of three m
$\Rightarrow \quad \Delta ABC$ is equilateral.

$\Rightarrow \angle A = \angle B = \angle C = 60°$

$\therefore \ \sin^2 A + \sin^2 B + \sin^2 C$

$= (\sin^2 60° + \sin^2 60° + \sin^2 6$

PHY

1. (c) Resolving power of eye $= \lambda / a$

$= \dfrac{500 \times 10^{-9}}{5 \times 10^{-3}} = 10^{-4}$ radians

Now, arc = angle × radius

$= 10^{-4} \times (500 \times 10^{3})\text{m} = 50\,\text{m}$

2. (b) Frequency does'nt depend on

$\dfrac{\mu_1}{\mu_2} = \dfrac{V_2}{V_1} = \dfrac{\lambda_2 f}{\lambda_1 f}$, or $\mu_2 \lambda_2 =$

$\mu_2 = 3680$ Å

3. (a) Total momentum will be conse
Initial momentum = Final mom

$M.v = m \times 0 + (M - m)v'$

$\therefore v' = \dfrac{Mv}{M - m}$

4. (c) Force, $F = \dfrac{1}{4\pi\varepsilon_0} \dfrac{q_1 q_2}{r^2}$

$\Rightarrow \varepsilon_0 = \dfrac{q_1 . q_2}{4\pi F r^2}$

So dimension of ε_0

$= \dfrac{[AT]^2}{[MLT^{-2}][L^2]} = [M^{-1}L^{-3}T$

5. (c) Heat radiated by black body

$E = \sigma A T^4 \Rightarrow E \,\alpha\, T^4$

or $\dfrac{E_1}{E_2} = \dfrac{T_1^{\,4}}{T_2^{\,4}}$

or $\dfrac{20}{E_2} = \left(\dfrac{500}{1000}\right)^4 = \left(\dfrac{1}{2}\right)^4 = \dfrac{}{1}$

$\Rightarrow E_2 = 16 \times 20 \text{ cal m}^{-2}\text{ s}^{-1}$
$= 320 \text{ cal m}^{-2}\text{s}^{-1}$

6. (c) Velocity of wave $v = n\lambda$

$$n_2 = \frac{v_2}{\lambda_2} = \frac{396}{100 \times 10^{-2}} = 396\text{H}$$

no. of beats = $n_1 - n_2 = 4$

7. **(a)** Terminal velocity attained by

$$V_t = \frac{3r^2(d-\rho)g}{a\eta}$$

thus, $V_t \propto r^2$

8. **(d)** Young's modulus, $Y = \frac{\text{Stress}}{\text{Strain}}$

or stress = Y. strain

or strain = Stress / Y

$$\text{or } \Delta l = \frac{Fl}{YA}\ ;\ \frac{\Delta l_1}{\Delta l_2} = \frac{F_1 l_1}{A_1 Y_1}\cdot\frac{A}{}$$

$l_1 = l_2$ & $Y_1 = Y_2$, $F_1 = F_2$

$$\Rightarrow \frac{\Delta l_1}{\Delta l_2} = \frac{\pi r_2{}^2}{\pi r_1{}^2} = \frac{4r^2}{r^2} = 4$$

9. **(b)** $E = mc^2 = (2 \times 1.6 \times 10^{-27}) \times ($

$= 28.8 \times 10^{-27} \times 10^{16}\,\text{J} = 28.8 \times$

$= 28.8 \times 10^{-10}\,\text{J}$

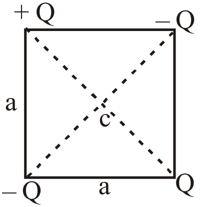
10. **(b)** $y = 2\sin\left(\frac{\pi t}{2} + \phi\right)$

velocity of particle $\frac{dy}{dt} = 2 \times \frac{\pi}{2}$

acceleration $\frac{d^2y}{dt} = -\frac{\pi^2}{2}\sin\Big($

Thus, $a_{max} = \frac{\pi^2}{2}$

11. **(a)**



12. **(a)** Let the body be depressed by
The extra upthrust created is x
acceleration created then,

$$x\rho Ag = mga \Rightarrow a = \frac{\rho A}{m}x$$

Since, acceleration α x. So it is

$$\text{So, } \omega^2 = \frac{\rho A}{m} \Rightarrow T = 2\pi\sqrt{\frac{m}{\rho A}}$$

$$T \, \alpha \, \frac{1}{\sqrt{A}}$$

13. **(b)** The specific resistance (ρ) is d

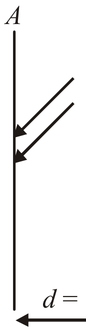
$$\rho = \frac{X\pi D^2}{4L}$$

where symbols have their usua

14. **(b)** Clearly the co-ordinates of A a

$$\therefore f = \frac{40}{2} = 20 \text{ cm.}$$

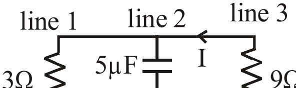
15. **(a)** Number of electrons falling on
$= 10^{16} \times (5 \times 10^{-4})$



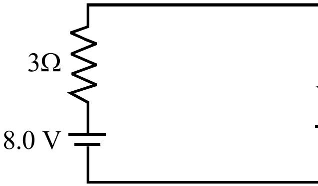
$\therefore$ Number of photoelectrons e
is

$$n_e = \frac{(5 \times 10^{-4}) \times 10^{16}}{10^6} \times 10 =$$

16. **(b)**



In steady state capacitor is fu
through line 2.
By simplyfing the circuit



Hence resultant potential diffe

Thus current $I = \dfrac{V}{R} = \dfrac{8.0}{3+9} =$

or, $\quad I = \dfrac{2}{3} = 0.67\ A$

17. **(c)** **Given:** Amplitude of electric fi
$E_0 = 4$ v/m
Absolute permitivity,
$\varepsilon_0 = 8.8 \times 10^{-12}\ c^2/N\text{-}m^2$
Average energy density $u_E =$
Applying formula,

Average energy density $u_E =$

$\Rightarrow \quad u_E = \dfrac{1}{4} \times 8.8 \times 10^{-12} \times (4)$
$= 35.2 \times 10^{-12}\ J/m^3$

18. **(a)** When springs are in parallel, t

$T = 2\pi\sqrt{\dfrac{m}{K_1 + K_2}} \Rightarrow \dfrac{2\pi}{T} = \omega =$

19. **(c)** Lateral magnitude = v/u;

Mag. along axis $= \left|\dfrac{dv}{du}\right| = \dfrac{u^2}{v^2} =$

20. **(d)** In linear S.H.M., the restoring
proportional to the displaceme

21. **(6)** According to Doppler's effect

$$f = \left(\frac{\nu \pm \nu_0}{\nu \pm \nu_s}\right) f$$

here $\upsilon_0 = 0$ and $\upsilon_s = 0.5\upsilon$

$$\therefore f = \left(\frac{\nu}{\nu - .5\nu}\right) 3 = 6\,\text{kHz}$$

22. **(300)** $\eta = \left(1 - \frac{T_c}{T_H}\right) \times 100$

$$\Rightarrow 70 = \left(1 - \frac{T_c}{1000}\right) \times 100$$

$$0.7 = 1 - \frac{T_c}{1000}$$

$$\therefore \frac{T_c}{1000} = 0.3 \text{ or } T_c = 300\text{K.}$$

23. **(11.2)** Escape velocity $v_e = \sqrt{2gR}$

thus, it doesn't depend on ma

24. **(0.4)** $r = 5\text{ cm.} = 5 \times 10^{-2}\text{m}$

$B_E = 0.5 \times 10^{-5}\ \text{W/m}^2$

we know that field due to coil

centre $B = \frac{\mu_0 I}{2r}$

it annuals the earth's megnetic

So, $\frac{\mu_0 I}{2r} = 0.5 \times 10^{-5}$

$$I = \frac{2R \times 0.5 \times 10^{-5}}{\mu} = \frac{5}{4\pi} A =$$

25. **(1.2×10^{-7})** Pressure of light on tot

$$P = \frac{2I}{C} \qquad (C =$$

$$P = \frac{F}{A} = \frac{2I}{C}$$

$$\Rightarrow F = \frac{2IA}{C} = \frac{2 \times 12 \times 1.5 \times 10}{}$$

26. **(d)** (a) $\underset{CH_2Cl}{\overset{CH_2Cl}{|}} \xrightarrow[\text{alcohol}]{\text{KOH}} \underset{CH}{\overset{CH}{|||}}$;

$\underset{CH}{\overset{CH_3Cl}{|}} \xrightarrow[\text{alcohol}]{\text{KOH}} \underset{CH}{\overset{CH}{|||}}$;

(b) Both are position isomers

(c) Since, they are isomers, p
same.

(d) $\underset{CH_2Cl}{\overset{CH_2Cl}{|}} \xrightarrow{\text{hydrolysis}}$ C

$\underset{CHCl_2}{\overset{CH_3}{|}}$ —

Hence, statement (d) is wrong.

27. **(d)** Sodium carbonate is the salt o

(NaOH). In solution, it is comp

CO_3^{2-} ion being the conjugate
hydrolysis in solution accordi

$CO_3^{2-} + H_2O \rightleftharpoons OH^- + H$

The OH^- ion produced being
hence the pH of the solution w

28. **(a)** According to the kinetic theo

molecules in the gas is given

the absolute temperature and
velocity can be taken as propo
temperature. Hence the ratio o

50ºC will be equal to $\sqrt{\frac{273+2}{273+5}}$

29. **(d)** No. of atoms of hydrogen in 0.

$= \frac{0.046}{46} \times 6 \times 10^{23} \times 6$

$= 1 \times 10^{-3} \times 6 \times 10^{23} \times 6 = 3.6 \times$

30. **(b)** Since the gas B turns $CuSO_4$ s

31. **(c)** (i) $CH_3-\overset{\overset{O}{\|}}{\underset{\underset{H}{|}}{C}} \xrightarrow[\text{(ii)}H_3O^+]{\text{(i)}CH_3MgBr}$

(ii) $CH_3-\overset{\overset{H}{|}}{C}=O+C_2H_5OH$

$CH_3-\overset{\overset{H}{|}}{\underset{\underset{O}{|}}{C}}$

Hemia

32. **(b)** The temperature of 383 K is
increase the boiling point of
temperature.

33. **(b)** Since each of (i), (ii) and (iii) ar
of the chlorines (chloride ions
and in (iii), two such chlorides a
chlorides in (i) is three in (ii) it
Primary valency means the val

34. **(b)** Polyethylene or Polyethene,
is made from a single monomer

35. **(d)** Energy requirements of the bo
through blood and glycogen s

36. **(c)** More the *s* - character, more is
correct order is $sp > sp^2 > sp^3$.

37. **(a)** The total number of electrons in
are 17, 16 and 18. Write down th
species and observe the numb
which are respectively 7, 6 and

38. **(c)** Deviation from ideal gas behav
and the gas is closed to its liqu
Thus, the conditions of –100°C
causes maximum deviation.

39. **(b)** Heat of neutralisation of strong

40. **(b)** Average atomic weight = 85(

41. **(b)** In Kjeldahl′s method of estima
most of the organic compo
ammonium sulphate. The (NH
excess of NaOH solution to giv

43. **(a)** Addition of a catalyst to a react
activation energy of the reactio
the reaction. The reaction r
equilibrium constant and the en

44. **(c)** $Be(OH)_2$ is amphoteric that mea

45. **(d)** Lithium, sodium and potassiu
reactive metals. When any o
reaction is so swift and intens
instantaneously. The reaction
quinch fires caused by these
Likewise CO_2 and nitrogen too
by asbestos blanket or by cove
prevents contact with oxyge
effective.

46. **(0.107)** $N_1 V_1 = N_2 V_2$

$N_{NaOH} = M_{NaOH} = 0.164$

$\Rightarrow 25 \times N = 32.63 \times 0.164$

$$N = \frac{32.63 \times .164}{25} = 0.214 \text{ N}$$

But $N_{H_2SO_4} = 2 \times M_{H_2SO_4}$

$$\Rightarrow M = \frac{\text{Normality}}{2} = \frac{0.214}{2} =$$

47. **(50)** Eq. of $KMnO_4$ used $= \frac{50 \times 1}{1000 \times 1}$

$\therefore$ Eq of FAS reacted = 0.005

$\therefore$ weight of FAS needed = 0.00

= 1

Thus, percentage purity of FA

48. **(4)** In a '*fcc*' crystal atoms are loc
8 corners.

On each face their is 1 atom w
atoms/ unit cell = 6/2 = 3

Again the corner atom is share
8 = 1

No. of atoms/unit cell = 1 + 3 =

49. **(800)** As $AgNO_3$ dissociates compl
therefore in 0.1 M $AgNO_3$ solu

$AgNO_3 \longrightarrow Ag^+ + NO_3^-$

$$K_{sp} = [Ag^+]^2[CO_3^{2-}]$$
$$= 8 = (0.1 + 2s)^2 \times s$$
$$= 0.01\ s = 8\ ; (0.1 + 2s \approx$$
$$s = 800$$

50. **(317)** $\underset{x}{CH_4} + \underset{2x}{2O_2} \rightarrow CO_2 + 2H_2O$

$\underset{(5-x)}{C_3H_8} + \underset{5(5-x)}{5O_2} \rightarrow 3CO_2 + 4H_2$

$2x + 5(5-x) = 16 \Rightarrow x = 3\ L$

$\therefore$ Heat released $= \dfrac{3}{22.4} \times 890 -$

MATHE

51. **(d)** Given $f(x) = \tan^{-1}(\sin x + \cos x$

$$f'(x) = \frac{1}{1 + (\sin x + \cos x)^2}.(\cos$$

$$= \frac{\sqrt{2}.\left(\frac{1}{\sqrt{2}}\cos x - \frac{1}{\sqrt{2}}\sin x\right)}{1 + (\sin x + \cos x)^2}$$

$$\therefore\ f'(x) = \frac{\sqrt{2}\cos\left(x + \frac{\pi}{4}\right)}{1 + (\sin x + \cos x)^2}$$

if $f'(x) > 0$ then $f(x)$ is increasin
Hence $f(x)$ is increasing, if

$$-\frac{\pi}{2} < x + \frac{\pi}{4} < \frac{\pi}{2} \Rightarrow -\frac{3\pi}{4} < x$$

Hence, $f(x)$ is increasing when

52. **(a)** $\sqrt{1 + x^2} + \sqrt{1 + y^2} = \lambda(x\sqrt{1 +$

$$\Rightarrow \sqrt{1 + x^2}(1 + \lambda y) = \sqrt{1 + y^2}\ ($$

$$\Rightarrow \frac{x^2+1}{y^2+1}=\frac{\lambda^2x^2-2\lambda x+1}{\lambda^2y^2+2\lambda y+1}$$

$$\Rightarrow (y^2+1)(\lambda^2x^2-2\lambda x+1)$$

$$= (x^2+1)(\lambda^2y^2+2\lambda y+1$$

$$\Rightarrow \lambda^2x^2y^2-2\lambda xy^2+y^2+\lambda^2$$

$$= \lambda^2x^2y^2+2\lambda x^2y+x^2$$

$$\Rightarrow \lambda^2(x^2-y^2)-2\lambda(xy^2+x^2$$

$$\Rightarrow \lambda^2(x+y)(x-y)-2\lambda\ [xy$$

$$\Rightarrow \lambda(x+y)[\lambda(x-y)-2xy-$$

$$\Rightarrow (x+y)[\lambda(x-y)-2xy-2]$$

$$\Rightarrow \lambda(x-y)-2xy-2=0$$

$$\Rightarrow \frac{2xy+2}{x-y}=\lambda \quad \Rightarrow \frac{xy+1}{x-y}=$$

$$\Rightarrow \frac{\left(x\frac{dy}{dx}+y\right)(x-y)-(xy+}{(x-y)^2}$$

This is the first order differenti

Hence degree of the differentia

53. **(c)** $I=\int_0^2[x^2]dx$

The function $[x^2]$ varies as foll

$$\begin{cases} 0 \text{ if } 0 \le x^2 < 1, \text{ or } 0 \le \\ 1 \text{ if } 1 \le x^2 < 2 \text{ or } 1 \le x \end{cases}$$

$$\Rightarrow I = \int_0^1 0.dx + \int_1^{\sqrt{2}} 1.dx + \int_{\sqrt{2}}^{\sqrt{3}} 2.dx$$

$$= 0 + (\sqrt{2} - 1) + 2(\sqrt{3} - \sqrt{2}) +$$

$$= \sqrt{2} - 1 + 2\sqrt{3} - 2\sqrt{2} + 6 - 3\sqrt{}$$

54. (c) $\alpha + \beta = 3; \alpha\beta = a$; $\gamma + \delta = +$

$\alpha, \beta, \gamma, \delta$ are in increasing G.P.

$\beta = \alpha x, \gamma = \alpha x^2, \delta = \alpha x^3$

$\alpha + \beta = \alpha + \alpha x = 3 = \alpha(1 + x)$

$\gamma + \delta = \alpha x^2 + \alpha x^3 = 12 = \alpha x^2($

Divding $\frac{3}{12} = \frac{\alpha(1+x)}{\alpha x^2(1+x)}$ or

$\Rightarrow \beta = 2\alpha$ and $\alpha + 2\alpha = 3 \Rightarrow$

$\therefore a = \alpha\beta = 2$

$\gamma = \alpha x^2 = 1 \times 2^2 = 4; \delta = \alpha x^3$

$\therefore b = \gamma\delta = 4 \times 8 = 32$

55. (a) Consider the example: Let A =

R = {(1, 1), (1,2)} and S = {(2, 2

Clearly R and S are transitive r

$R \cup S$ = {(1, 1), (2, 2), (1, 2), (2,

$R \cup S$ is not transitive as (1,3)

56. (d) $I = \int \log 2x\, dx = \int \log 2x.1.dx$

Using Integration by parts

$I = \log 2x.\, x - \int \frac{2}{2x}.\int 1.dx$

57. **(a)** For k = 0,
it is obvious from the given interval that graph will be increasing from – 1 to 1
Similar graphs can be obtained for all values of k.

58. **(a)** It can be also solved by compa

with the linear equation $\frac{dy}{dx}+$

The integrating factor, I.F. = e

Therefore, $y\,\text{I.F} = \int 2e^{2x}.\text{I.F} +$

$$y.e^{x} = \int 2e^{2x}.e^{x} + C$$

$$y.e^{x} = 2\int e^{3x} + C = \frac{2}{3}e^{3x} + C$$

59. **(c)** $\Delta = \begin{vmatrix} a+x & a-x & a-x \\ a-x & a+x & a-x \\ a-x & a-x & a+x \end{vmatrix} = ($

$$\Rightarrow \Delta = \begin{vmatrix} 3a-x & a-x & a-x \\ 3a-x & a+x & a-x \\ 3a-x & a-x & a+x \end{vmatrix}$$

$$= (3a-x)\begin{vmatrix} 1 & a-x & a-x \\ 1 & a+x & a-x \\ 1 & a-x & a+x \end{vmatrix} =$$

Using $R_2 \to R_2 - R_1$ and R_3

$$\Rightarrow \Delta = (3a-x)\begin{vmatrix} 1 & a-x & a- \\ 0 & 2x & \\ 0 & 0 & 2 \end{vmatrix}$$

or, $4x^2(3a-x) = 0 \Rightarrow x = 0$ or

$= \frac{2}{3} \times 3a = 2a$

Centre of the (given) circle is C

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

61. **(b)** Its contropositive is 'sum of d

$\Rightarrow$ n is not divisible by 9

62. **(c)** $n = 7$

Prob. of getting any no. out 1,

$\therefore \quad q = 6/5$

$P(x = 7) = {}^7C_7 p^7 q^0$

$= \left(\frac{9}{15}\right)^7 = \left(\frac{3}{5}\right)^7$

63. **(a)** For $x \geq a$, the equation becom

$x^2 - 2a(x-a) - 3a^2 = 0 \Rightarrow x = ($

for $x \leq a$, the equation become

$x^2 - 2a[-(x-a)] - 3a^2 = 0 \Rightarrow x^2$

$\Rightarrow x = -(1+\sqrt{6})a, \; (-1+\sqrt{6})$

This shows $(-1+\sqrt{6})a$ is one

64. **(c)** $X \cap (X \cup Y)^c = X \cap (X^c \cap$

$= \phi \cap Y^c = \phi$

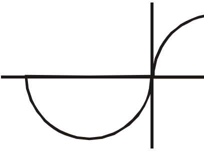
65. **(a)** $y = \log_2 \{\log_2(x)\} = \log_2\{\log$

$\Rightarrow y = \log_e\{\log_e x.\log_2 e\}.\log_2 e$

$\Rightarrow \frac{dy}{dx} = \log_2 e \frac{d}{dx}[\log_e\{\log_e$

$\Rightarrow \frac{dy}{dx} = \log_2 e.\frac{1}{\log_e x.\log_2 e}$

66. **(c)** The function breaks at $x = 0$ a
differentiable at all other point
pts.



At $x = 0$, for $f(x)$ to be contino

$\lim_{x \to 0} f(0^-) = f(x = 0) = \lim_{x \to 0} f$

$f(x) = 0$ at $x = 0$

$RHL = \lim_{x \to 0} \sin(x + h) = \sin\ h$

$L.H.L. = \lim_{x \to 0} \sin(x - h) = \sin$

Hence, not differentiable at $x =$
Similarly, $f(x)$ is not differentia
$1, 2$..............

67. **(d)** $\int_0^{\pi/3} \frac{\cos x + \sin x}{\sqrt{1 + \sin 2x}} dx$

$= \int_0^{\pi/3} \frac{\cos x + \sin x}{\sqrt{\sin^2 x + \cos^2 x + 2\sin}}$

$= \int_0^{\pi/3} \frac{\cos x + \sin x}{\sqrt{(\cos x + \sin x)^2}} dx = \int_0^{\pi}$

68. **(c)** The equation of the pair of tan

$(3x^2 + 2y^2 - 5)(3.1^2 + 2.2^2 -$

$9x^2 - 4y^2 - 24xy + 40y + 30x -$

further angle, θ between the

$\tan\theta = \frac{2\sqrt{h^2 - ab}}{a + b} = \frac{2\sqrt{(12)}}{9}$

69. **(d)** The roots of the equation $x^2 +$
$\& \beta = \omega^2$
$\alpha^{19} = \omega^{19} = (\omega^3)^6\omega = \omega; \beta^7 = ($
Hence the equation is $x^2 + x +$

70. **(c)** $\sin^{-1}(1-x) = \left(\frac{\pi}{2} - \sin^{-1} x\right) -$

$\sin^{-1}(1-x) = \frac{\pi}{2} - 2\sin^{-1} x$

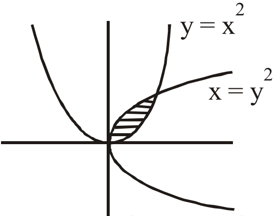
Taking sum of both sides

$1 - x = \sin\left(\frac{\pi}{2} - 2\sin^{-1} x\right) = \text{c}$

$= \cos 2\theta$, where $\sin^{-1} x = \theta$

$1 - x = 1 - 2\sin^2\theta = 1 - 2x^2$ o

71. **(0.33)**

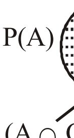


Solving, $y = x^2$ and $x = y^2$
$y = y^4$ or $y(y^3 - 1) = 0 \Rightarrow y =$
$\therefore$ Point of intersection are (0,

To find the shaded area, $A = \int$

$= \frac{2}{3}\left[x^{3/2}\right]_0^1 - \left[\frac{x^3}{3}\right]_0^1 = \frac{2}{3} - \frac{1}{3}$

72. **(0.63)**



$\text{Req. prob.} = P(A) + P(B) + P(C$

$= \frac{1}{4} + \frac{1}{4} + \frac{1}{4} - 0 - 0 - \frac{1}{8} + 0 =$

73. (1) $T_{r+1} = {}^6C_r x^{6-r}\left(\frac{1}{x^2}\right)^r = {}^6C_r(x)^6$

For coefficient of x^6, $6-r-2r =$
This means the term is the first

$\Rightarrow T_1 = {}^6C_0 x^6 = 1.x^6$

$\Rightarrow$ coefficient of $x^6 = 1$

74. (3) For $f(x)$ to be continuous, $\lim_{x\to}$

$f(0) = k \quad \lim_{x\to 0} f(x) = \lim_{x\to 0} = \frac{\sin}{\sin}$

$\Rightarrow k = 3$

75. (1.33) Line is $\perp$ to $3x + y = 3$

$\therefore$ Slope of line, $m = \frac{1}{3}$

Equation is, $y = mx + c = \frac{x}{3}$

It passes through $(2, 2) \Rightarrow 2$

$\Rightarrow \quad c = \frac{4}{3}$

$\Rightarrow y - \frac{x}{3} = 4/3 \Rightarrow 3y - x = 4$

$\therefore$ y-intercept $= 4/3$

1. **(d)** $v=\sqrt{\dfrac{2gh}{1+\dfrac{I}{mr^2}}}=\sqrt{\dfrac{2\times10\times3}{1+\dfrac{mr^2}{2\times mr^2}}}$

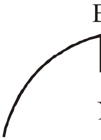
$\Rightarrow v=r\omega\Rightarrow r=\dfrac{v}{\omega}=\dfrac{\sqrt{40}}{2\sqrt{2}}=\sqrt{}$

2. **(a)** By conservation of energy

$\mathrm{mg\,(3h)=mg\,(2h)+\dfrac{1}{2}mv^2}$ (v

$\mathrm{mgh=\dfrac{1}{2}mv^2}$; $\mathrm{v=\sqrt{2gh}}$

From free body diagram of bloc



$\mathrm{N+mg=\dfrac{mv^2}{h}=2mg}$; $\mathrm{N=}$

3. **(b)** Bulk modulus, $B=-V_0\dfrac{\Delta p}{\Delta V}\Rightarrow$

$\Rightarrow V=V_0\left[1-\dfrac{\Delta p}{B}\right]$

$\therefore$ Density, $\rho=\rho_0\left[1-\dfrac{\Delta p}{B}\right]^{-1}=$

where, $\Delta p=p-p_0=h\rho_0 g$

= pressure difference between

4. **(b)** Here, $\vec{E} = 5\hat{i} - 3\hat{j}\text{kV/m}$

$$V_B - V_A = -\int_{r_A}^{r_B} \vec{E} \, . \, \partial r$$

$$= -\int_{(4,0,3)}^{(10,3,0)} \left(5\hat{i} - 3\hat{j}\right).\left(\partial x\hat{i} + \partial y\hat{j}\right.$$

$$= -\int_{4}^{10} 5\partial x - \int_{0}^{3} (-3)\,\partial y + 0 = -5[$$

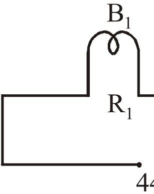
$$= -5(10-4) + 3(3-0) = -30 + 9$$

5. **(c)** The current upto which bulb of

$$I_1 = \frac{W_1}{V_1} = \frac{25}{220} \text{ Amp}$$

Similarly, $I_2 = \frac{W_2}{V_2} = \frac{100}{220}$ Am

The current flowing through th



$$I = \frac{440}{R_{eff}}$$

$$R_{eff} = R_1 + R_2$$

$$R_1 = \frac{V_1^2}{P_1} = \frac{(220)^2}{25}; \quad R_2 = \frac{V_2^2}{P}$$

$$I = \frac{440}{\frac{(220)^2}{25} + \frac{(220)^2}{100}} = \frac{}{(220)^2}$$

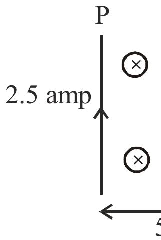
$$I = \frac{40}{220} \text{ Amp}$$

6. (c) When the current flows in both
field at half way due to the wire

$$\vec{B}_p = \frac{\mu_0 I_1}{2\pi \frac{5}{2}} = \frac{\mu_0 I_1}{\pi \cdot 5} = \frac{\mu_0}{2\pi}$$

(where $I_1 = 5$ amp)

The direction of $\vec{B}_p$ is downw



Magnetic field at half way due

$$\vec{B}_Q = \frac{\mu_0 I_2}{2\pi \frac{5}{2}} = \frac{\mu_0}{\pi}$$ [upwar

[where $I_2 = 5$amp.]

Net magnetic field at half way

$$\vec{B} = \vec{B}_P + \vec{B}_Q = -\frac{\mu_0}{2\pi} + \frac{\mu_0}{\pi} = \frac{\mu}{2}$$

Hence, net magnetic field at mi

7. (b)

8. (a) Limiting friction between block

$= \mu_s m_A g = 0.6 \times 10 \times 9.8 = 58.8$ N

But applied force on block A is

Now kinetic friction works betw

$F_k = \mu_k m_A g = 0.4 \times 10 \times 9.8 = 39$

This kinetic friction helps to m

9. **(a)** $V_p = \dfrac{dx_p}{dt} = a + 2bt$

and $V_Q = \dfrac{dx_Q}{dt} = f - 2t$, Given,

$\therefore a + 2bt = f - 2t \Rightarrow t = \dfrac{f-a}{2(b+1)}$

10. **(c)** Intensity of light

$I = \dfrac{\text{Watt}}{\text{Area}} = \dfrac{nhc}{A\lambda} \Rightarrow$ Number of

$\therefore$ Number of photoelectrons e

$= \dfrac{1}{100} \times \dfrac{1 \times 10^{-4} \times 300 \times 10^{-9}}{6.6 \times 10^{-34} \times 3 \times 10^{8}} =$

11. **(c)** The wavelength of spectral line

by $\dfrac{1}{\lambda} = R\left[\dfrac{1}{2^2} - \dfrac{1}{n^2}\right]$

For first line of Balmer series, n

$\Rightarrow \dfrac{1}{\lambda_1} = R\left[\dfrac{1}{2^2} - \dfrac{1}{3^2}\right] = \dfrac{5R}{36}$; Fo

$\Rightarrow \dfrac{1}{\lambda_2} = R\left[\dfrac{1}{2^2} - \dfrac{1}{4^2}\right] = \dfrac{3R}{16}$

$\therefore \dfrac{\lambda_2}{\lambda_1} = \dfrac{20}{27} \Rightarrow \lambda_2 = \dfrac{20}{27} \times 6561$

12. **(d)** In pure semiconductor electron

$n_{initial} = n_h + n_e = 14 \times 10^{15}$ after

$N_D = \dfrac{5 \times 10^{28}}{10^7} = 5 \times 10^{21}$ and n

So, $n_{final} = n_h + n_e$

$\Rightarrow \quad n_{final} \approx n_e \approx 2.5 \times 10^{21}$

$\text{Factor} = \dfrac{n_{final} - n_{initial}}{n_{initial}}$

13. (a) According to Wien's displacem

$\lambda_m \propto \frac{1}{T} \Rightarrow \lambda m_2 < \lambda_{m_1}$ [$\because T_1 <$

Therefore I-λ graph for T_2 has l will shift towards left side.

14. (b) At resonance, amplitude of osci
$\Rightarrow 2\omega^2 - 36\omega + 9$ is minimum
$\Rightarrow 4\omega - 36 = 0$ (derivative is zer
$\Rightarrow \omega = 9$

15. (b) Average speed of gas molecules

molecules mass. So the average

16. (c) Apparent frequency

$$n' = n\frac{(u + v_w)}{(u + v_w - v_s \cos 60°)} =$$

$$= 510 \times \frac{350}{340} = 525 \text{ Hz}$$

17. (c) The area swept by radius OC in
time T/2 is thus $(\pi r^2 B/2)$. The
$\left[\because\ T = \frac{2\pi}{\omega}\right]$
The induced current is then I =

18. (a) The Instantaneous value of vo
E = 100 sin (100t) V
We get
$E_0 = 100V$, $\omega = 100$ rad s^{-1}
The rms value of voltage is

$$E_{rms} = \frac{E_0}{\sqrt{2}} = \frac{100}{\sqrt{2}}V = 70.7V$$

The instantaneous value of cur

$$I = 100\sin\left(100t + \frac{\pi}{3}\right)mA$$

Compare it with
$I = I_0 \sin(\omega t + \phi)$
we get
$I_0 = 100$ mA, $\omega = 100$ rad s^{-1}
The rms value of current is

19. **(c)** Incident momentum, $p = \frac{E}{c}$

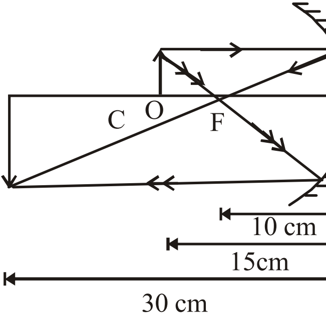
For perfectly reflecting surface

$$\Delta p = 2p = \frac{2E}{c}$$

$$F = \frac{\Delta p}{\Delta t} = \frac{2E}{ct}$$

$$P = \frac{F}{A} = \frac{2E}{ctA}$$

20. **(a)**



According to New Cartesian si
Object distance u = – 15 cm
Focal length of a concave lens,
Height of the object h_0 = 2.0 cm

According to mirror formula, $\frac{1}{v}$

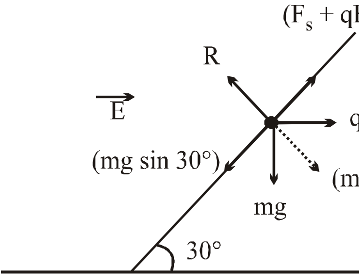
$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-10} - \frac{1}{-15} \Rightarrow v =$$

This image is formed 30 cm fro
It is real image.

Magnification of the mirror, m

$$\Rightarrow \frac{-(-30)}{-15} = \frac{h_1}{2} \Rightarrow h_1 = -4\ c$$

21. (1.319)



From the figure

$R = mg\cos 30^{\circ} + qE\sin 30^{\circ}$

$= \frac{10\sqrt{3}}{2} + \frac{0.01 \times 100}{2}$

$= 5\sqrt{3} + 0.5 = 9.16\,\text{N}$

Frictional force $F_s = \mu R = 0.2 \times 9$

Resultant force along the plane

$F = mg\sin 30^{\circ} - (F_s + qE\cos 3$

$= 5 - \Big(1.832 + 0.01 \times 100 \times \frac{1}{}$

$= 5 - 2.698 = 2.3\text{N}$

$\therefore$ Acceleration along the plane

Distance along the plane $= 1 \times$

$s = ut + (1/2)\,ft^2,\ u = 0$

$\therefore\ t = \left(\frac{2s}{f}\right)^{1/2} = \left(\frac{2 \times 2}{2.3}\right)^{1/2}$

$= 1.319$ sec

22. (3.57×10^{7})

Time period of satellite,

$T = \frac{2\pi(R_E + h)}{\sqrt{\frac{GM_E}{}}} = \frac{2\pi(R_E + h)^{3/}}{\sqrt{GM_E}}$

$$T^2 = \frac{4\pi^2 (R_E + h)^3}{GM_E}$$

$$(R_E + h)^3 = \frac{GM_E T^2}{4\pi^2}$$

$$(R_E + h) = \left(\frac{GM_E T^2}{4\pi^2}\right)^{1/3}$$

or $h = \left(\frac{GM_E T^2}{4\pi^2}\right)^{1/3} - R_E$

Here, $M_E = 6 \times 10^{24}$ kg
$R_E = 6400$ km $= 6400 \times 10^3$ m $=$ 6
$T = 24$ h $= 24 \times 60 \times 60$ s $=$ 8640
$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
On substituting the given valu

$$h = \left(\frac{6.67 \times 10^{-11} \times 6 \times 10^{24} \times (864}{4 \times (3.14)^2}\right.$$

$= 4.21 \times 10^7 - 6.4 \times 10^6 = 3.57 \times$

23. **(7)** Let initial e.m.f. induced = e.

$\therefore$ Initial current $i = \frac{E - e}{R}$ i.e.,

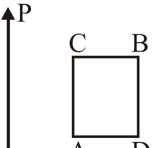
This gives e = 12 – 2 = 10 volt.
when speed is halved, the valu

$$\frac{e}{2} = \frac{10}{2} = 5 \text{ volt}$$

$\therefore$ New value of current

$$i' = \frac{E - e}{R} = \frac{12 - 5}{1} = 7 \text{ A}$$

24. **(40)**



$\Delta Q_{ACB} = \Delta W_{ACB} + \Delta U_{ACB}$

$\Rightarrow 60\text{ J} = 30\text{ J} + \Delta U_{ACB}$

$\Rightarrow U_{ACB} = 30\text{ J}$

$\therefore\ \Delta U_{ADB} = \Delta U_{ACB} = 30\text{ J}$

$\Delta Q_{ADB} = \Delta U_{ADB} + \Delta W_{ADB}$

$= 10\text{ J} + 30\text{ J} = 40\text{ J}$

25. (1.324)

Energy produced in one day = 1

$\eta = 0.8 = \dfrac{\text{output energy}}{\text{input energy}} = \dfrac{10^6}{\text{in}}$

So input energy = $\dfrac{10^6 \times 24 \times 6}{0.8}$

Energy released in one fission

$= 200 \times 10^6 \times 1.6 \times 10^{-19} = 3.2$

No. of fissions per day = $\dfrac{10.8}{3.2 \times}$

Mass of U^{235} consumed per da

= no. of nuclei disintegrating p

$= 3.375 \times 10^{21} \times 235 \times 1.67 \times 10$

CHEM

26. (b) When the temperature is incre which increases the kinetic en increase the number of collisio be enhanced.

27. (b) In lanthanides, there is poorer resulting in greater attraction contraction of the atomic radii

28. (b) $(CH_3)_2\, CHCH_2MgBr \xrightarrow{C_2H_5OH}$

29. (c) Using the relation $K_p = K_c . (RT$

Thus $\frac{K_p}{K_c}$ will be highest for t

The Δn values for various reac

(a) $\Delta n = 1 - \left(1 + \frac{1}{2}\right) = -\frac{1}{2}$

(b) $\Delta n = 2 - (1 + 1) = 0$

(c) $\Delta n = (1 + 1) - 1 = 1$

(d) $\Delta n = (2 + 4) - (7 + 2) = -3$

Thus, maximum value of $\Delta n =$

30. (d) According to Fajan's rule :

$$\text{Covalent character} \propto \frac{1}{\text{size of}}$$

$$\propto \text{size of a}$$

Among the given species orde

$N^{3+} < O^{2+} < Pb^{2+} < Ba^{2+}$

Order of size of anions $O^{2-} > C$

Hence the order of covalent ch

$NCl_3 > Cl_2O > PbCl_2 > BaCl$

$\therefore$ $BaCl_2$ is most ionic in natur

31. (c)

Element	%	Relative
C	49.3	49.3 1.5
H	6.84	6.84
O	43.86	43.86

$\therefore$ Empirical formula $= C_3H_5O_2$

Empirical formula mass

$= (3 \times 12) + (5 \times 1) + (2 \times 16) =$

Molecular mass $= 2 \times$ Vapour

$= 2 \times 73 = 146$

$$n = \frac{\text{molecular mass}}{\text{empirical formula mass}} =$$

Molecular formula = Empirical

=

33. **(b)** $\Delta G = \Delta H - T\Delta S$

At equilibrium, $\Delta G = 0$

$\Rightarrow 0 = (170 \times 10^3 \text{ J}) - T(170 \text{ JK}$

$\Rightarrow T = 1000 \text{ K}$

For spontaneity, ΔG is – ve, wh

34. **(b)** According to gas law

$$PV = nRT,\ n = \frac{PV}{RT}$$

$$\frac{n_A}{n_B} = \frac{\frac{P_1V_1}{RT_1}}{\frac{P_2V_2}{RT_2}}; \frac{n_A}{n_B} = \frac{P_1V_1}{T_1} \times \frac{T_2}{P_2V_2}$$

$$\frac{n_A}{n_B} = \frac{2P \times 2V}{2T} \times \frac{T}{PV}; \frac{n_A}{n_B} = \frac{2}{1}$$

35. **(b)** Due to inent pair effect oxidati
the group in *p*-block.

36. **(a)** Carbon atom is connected with

37. **(c)** Sr^{90} is harmfull radiological po

38. **(d)** Here, A_2B_3 can also be written
Since, *hcp* has six atoms, so '
void.

Total tetrahedral voids = 12

∴ Fraction of tetrahedral voic

$A = 4/12 = \frac{1}{3}$

39. **(c)** $CH_3-\underset{|}{\overset{CH_3}{CH}}-\overset{CH_3}{\underset{|}{CH}}-CH_3$. Sinc
hence it will give only two mon

$ClCH_2-\overset{CH_3}{CH}-\overset{CH_3}{CH}-CH_3$

1–Chloro–2,3–dimethyl butane

$\overset{CH_3}{|}\quad \overset{CH_3}{|}$

40. (c) Let solubility of $PbCl_2 = s$

$$\underset{s}{PbCl_2} \rightleftharpoons \underset{s}{Pb^{2+}} + \underset{2s}{2C}$$

Moles

$$K_{sp} = [Pb^{2+}][Cl^-]^2$$

$\therefore$ $1.7 \times 10^{-5} = (s)(2s)^2$

or $1.7 \times 10^{-5} = 4s^3$

$\therefore$ $$s = \sqrt[3]{\frac{1.7 \times 10^{-5}}{4}}$$

41. (d) d^4 in high spin octahedral com

e_g ↑ —

t_{2g} ↑ ↑ ↑

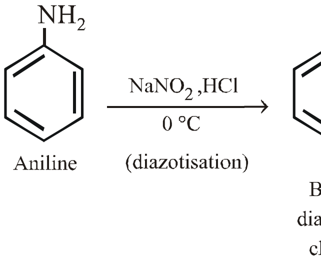
$CFSE = (-0.4x + 0.6y)\Delta_0$

Where, $x \rightarrow$ electrons in t_{2g} or

$y \rightarrow$ electrons in e_g or

$CFSE = [0.6 \times 1] + [-0.4 \times 3] =$

42. (d)



43. (b) Nylon is a polyamide polymer

44. (a) Reaction involved:

$$\overset{+3}{C_2}O_4^{2-} \longrightarrow$$
$\uparrow$

45. (d) $\lambda = \dfrac{h}{mv}$

$\therefore \quad mv = \dfrac{h}{\lambda} = \dfrac{6.625 \times 10^{-34}}{0.33 \times 10^{-9}} = 2.01$

46. (300) ΔH = Heat of formation at c

ΔE = Heat of formation at co
$T = 27\,°C = 27 + 273 = 300$ K.
R = 2 cal/degree/mole.

$C(s) + \dfrac{1}{2}O_2(g) \longrightarrow CO(g$

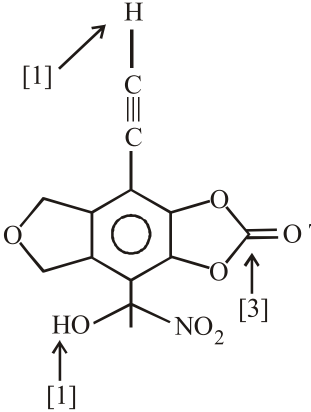
$\Delta n = n_p - n_r = 1 - \dfrac{1}{2} = \dfrac{1}{2}$

$\Delta H = \Delta E + \Delta n_g RT$ or ΔH

$= \dfrac{1}{2} \times 2 \times 300$

$\therefore$ Heat of formation of CO at
at 27 °C will differ from one an

47. (5)



48. (32) $O_2\% = 20\%$
Metal% = 80%.
100g of metal oxide contains 8
$\therefore$ Eq. wt. of metal = mass of m

49. (4) The total number of isomers fo
$[Cu^{II}(NH_3)_4][Pt^{II}Cl_4]$ is fo
These four isomers are
$[Cu(NH_3)_3Cl]\,[Pt(NH_3)Cl_3$
$[Cu(NH_3)Cl_3]\,[Pt(NH_3)_3Cl]$
$[CuCl_4][Pt(NH_3)_4]$
and $\left[Cu(NH_3)_4\right]\left[PtCl_4\right]$.
The isomer $[Cu\,(NH_3)_2\,Cl_2][$
parts being neutral.

50. (3) 10 volume solution of H_2O_2 n
give 10 L of oxygen at STP.

$$\underset{\substack{2\times 34g\\=68g}}{2H_2O_2(l)} \longrightarrow \underset{22.7\text{ L at STP}}{O_2(g)} + H_2O(l)$$

Thus, 22.4L of O_2 is produced

is produced from $\dfrac{68\times 10}{22.4}$ g

$= 29.9gH_2O_2 = 30$ g
Therefore, strength of H_2O_2 in
$= 30$ g/L $= 3\%$ H_2O_2 solution.

MATHE

51. (a) Since $\left(7+4\sqrt{3}\right)\left(7-4\sqrt{3}\right)=1$
$\therefore$ The given equation becom

$y+\dfrac{1}{y}=14$ where $y=\left(7-4\sqrt{\right.}$

$\Rightarrow y^2-14y+1=0 \Rightarrow y=7\pm$
Now $y=7+4\sqrt{3} \Rightarrow x^2-4x+$
Also $y=7-4\sqrt{3} \Rightarrow x^2-4x+$

52. (a) $f(x)=x^{3/2}+x^{-3/2}-4\left(x+\dfrac{1}{x}\right.$

Let $\sqrt{x}+\frac{1}{\sqrt{x}}=t\ (x>0)$

Let $g(t)=t^3-3t-4t^2+8$

$g(t)=t^3-4t^2-3t+8$

$g'(t)=3t^2-8t-3=(t-3)($

$g'(t)=0 \Rightarrow t=3\ (t\neq -1/3)$

$g''(t)=6t-8$

$g''(3)=10>0 \Rightarrow g(3)$ is minin

$g(3)=27-9-36+8=-10$

53. (a) term of $\left(\frac{x}{2}-\frac{3}{x^2}\right)^{10}$ is ${}^{10}C_t\left(\frac{x}{2}\right.$

Here, $x^{-t+10-2t}=x^4 \Rightarrow -3t+10$

Hence coefficient of x^4 is ${}^{10}C_2$

54. (b) Given plane $3x+y+2z+6=0$

and line $\frac{x-1/3}{2b/3}=\frac{y-3}{-1}=\frac{z-1}{a}$

Since plane is parallel to line, t

$3\left(\frac{2b}{3}\right)+(1)(-1)+2(a)=0$

$\Rightarrow 2b-1+2a=0 \Rightarrow a+b=1/$

Now, $3a+3b=3/2$

55. (b) $f(x)=\sqrt{1+\log_e(1-x)}$ value c

$1+\log_e(1-x)\geq 0$ and $1-x>$

$\Rightarrow \log_e(1-x)\geq -1$ and $x<1$

$\Rightarrow \log_e(1-x)\geq \log_e e^{-1}$ and x

$\Rightarrow 1-x\geq \frac{1}{e}$ and $x<1 \Rightarrow x\leq \frac{e}{}$

56. (c) $f(x)=[x]^2-[x^2]$

Check continuity at x = 0

$\lim_{x\to 0^+} f(x)=\lim_{x\to 0^+}[x]^2-[x^2]$

$\lim f(x)=\lim [x]^2-[x^2]$

Thus, discontinuous at x = 0

Check continuity at x = 1

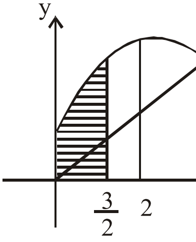
$$\lim_{x \to 1^+} f(x) = 1 - 1 = 0$$

$$\lim_{x \to 1^-} f(x) = 0 - 0 = 0$$

Also $f(1) = 0$

Hence continuous at x = 1.

57. (a) $y = 1 + 4x - x^2 = 5 - (x-2)^2$



We have $\int_0^{3/2} (1 + 4x - x^2)dx =$

$$= \frac{3}{2} + 2\left(\frac{9}{4}\right) - \frac{1}{3}\left(\frac{27}{8}\right) = m \cdot \frac{9}{4}$$

On solving we get $m = \frac{13}{6}$

58. (b) Series 3 + 33 + 333 + ...+ n ter

Given series can be written as,

$$= \frac{1}{3}[9 + 99 + 999 + ... + n \text{ term}$$

$$= \frac{1}{3}[(10-1) + (100-1) + (100$$

$$= \frac{1}{3}[10 + 10^2 + ... + 10^n] - \frac{1}{3}[1$$

$$= \frac{1}{3} . \frac{10(10^n - 1)}{10 - 1} - \frac{1}{3}n = \frac{1}{3}\left[\frac{10}{}\right.$$

59. (a) Let $I = \int \frac{1}{1+\sin x} dx = \int \frac{}{1+\frac{}{1-}}$

$$\int \frac{\left(1+\tan^2 \frac{x}{2}\right)dx}{1+\tan^2 \frac{x}{2} + 2\tan\frac{x}{2}} = \int \frac{}{1+}$$

Substitute

$$\tan\frac{x}{2} = t \Rightarrow \frac{1}{2}\sec^2\frac{x}{2}dx =$$

Then

$$I = \int \frac{2dt}{1+t^2+2t} = 2\int \frac{dt}{(1+t)^2} =$$

$$= \frac{-2}{1+\tan\frac{x}{2}} + C = 1 - \frac{2}{1+\tan\frac{x}{2}}$$

Where b = $C - 1$, a new consta

$$= -\frac{1-\tan\frac{x}{2}}{1+\tan\frac{x}{2}} + b = -\tan\left(\frac{\pi}{4} -\right.$$

Clearly $a = -\frac{\pi}{4}$ and $b \in \mathbf{R}$

60. (d) Given expression can be writte

$$y = \tan^{-1}\left[\frac{2^x(2-1)}{1+2^x.2^{x+1}}\right] = \tan^{-1}\left[\right.$$

$$= \tan^{-1}(2^{x+1}) - \tan^{-1}(2^x)$$

$$\Rightarrow \frac{dy}{dx} = \frac{2^{x+1}\log 2}{1+2^{2(x+1)}} - \frac{2^x \log 2}{1+2^{2x}}$$

61. **(d)** We have, $\cos\frac{2\pi}{7}+\cos\frac{4\pi}{7}+c$

$$=\frac{1}{2\sin\frac{\pi}{7}}\left[2\sin\frac{\pi}{7}\cos\frac{2\pi}{7}+2\sin\right.$$

$$=\frac{1}{2\sin\frac{\pi}{7}}\left[\left(\sin\frac{3\pi}{7}-\sin\frac{\pi}{7}\right)+\left(\sin\frac{5\pi}{7}\right.\right.$$

$$=-\frac{1}{2} \qquad \left[\because \sin\right.$$

62. **(b)** Consider the differential equat

$$\frac{dy}{dx}=y\tan x-y^2\sec x$$

Divide by y^2 on both the sides

$$\frac{1}{y^2}\left(\frac{dy}{dx}\right)=\frac{\tan x}{y}-\sec x$$

Let $\frac{1}{y}=z$

Differentiating both sides, we

$$\frac{-1}{y^2}\cdot\frac{dy}{dx}=\frac{dz}{dx}$$

Put value of $\frac{1}{y^2}\frac{dy}{dx}$ in the equ

$$-\left(\frac{dz}{dx}\right)-(\tan x)z=-\sec$$

$$\Rightarrow \left(\frac{dz}{dx}\right)+(\tan x)z=\sec x$$

This is the linear diff equation

This is of the form $\frac{dz}{dx}+P.z=$

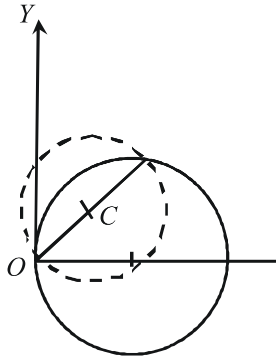
$\therefore$ In the given question

$$\text{I.F.} = e^{\int \tan x\, dx} = e^{\log(\sec x)} =$$

63. (c) Here equation of the circle

$(x^2 + y^2 - 10x) + \lambda(y - 2x) = 0$

Now centre $C(5 + \lambda, -\lambda/2)$ lies



$$\therefore \frac{-\lambda}{2} = 2(5 + \lambda)$$

$\therefore \lambda = -4$

Hence $x^2 + y^2 = 10x + 4y - 8x$

or $\quad x^2 + y^2 - 2x - 4y = 0$

64. (c) Since, $\vec{a}$ and $\vec{b} + \vec{c}$ are mutual

$\therefore \quad \vec{a}.(\vec{b} + \vec{c}) = 0 \Rightarrow \vec{a}.\vec{b} + \vec{c}$

Similarly, $\vec{b}.\vec{c} + \vec{a}.\vec{b} = 0$

and $\vec{c}.\vec{a} + \vec{b}.\vec{c} = 0$

On adding eqs. (i), (ii) and (iii)

$2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 0$

Now, $|\vec{a} + \vec{b} + \vec{c}|^2 = |\vec{a}|^2 + |\vec{b}|$

$= |\vec{a}|^2| + |\vec{b}|^2 + |\vec{c}|^2$

$= 9 + 16 + 25 \quad (\because |\vec{a}| = 3, |\vec{b}$

65. **(c)** $\begin{vmatrix} a-x & c & b \\ c & b-x & a \\ b & a & c-x \end{vmatrix} = 0$

$\Rightarrow \begin{vmatrix} a+b+c-x & c & b \\ a+b+c-x & b-x & a \\ a+b+c-x & a & c-x \end{vmatrix}$

$\Rightarrow (\Sigma a - x) \begin{vmatrix} 1 & c & b \\ 1 & b-x & a \\ 1 & a & c-x \end{vmatrix}$

$\Rightarrow x = \Sigma a = 0$

or $1\{(b-x)(c-x)-a^2\}-c\{c-x-$

(by expan

or $x^2-(a^2+b^2+c^2)+(ab+b$

or $x^2 - \Sigma a^2 + \Sigma ab = 0$

or $x^2 - (\Sigma a^2) - \dfrac{1}{2}(\Sigma a^2) = 0$

$[\because\ a+b+c=0 \Rightarrow (a+b+c)$

$\Rightarrow \Sigma a^2 + 2\Sigma ab = 0 \Rightarrow \Sigma ab = -$

or $\qquad x = \pm\sqrt{\dfrac{3}{2}\Sigma a^2}$

$\therefore$ the solution is $x = 0$ or $\pm$

66. **(b)** $I_1 = \int_0^1 2^{x^2} dx,\ I_2 = \int_0^1 2^{x^3} dx,\ I_3 =$

$\forall$

$\Rightarrow \int_0^1 2^{x^2} dx > \int_0^1 2^{x^3} dx \Rightarrow I_1 >$

67. **(c)** Given, $f(x) = |x|$ and $g(x) =$

For $-\frac{8}{5} < x < \frac{8}{5}$; $0 \le f(x) < \frac{8}{5}$

Now, for $\quad 0 \le f(x) < 1,$

$g(f(x)) = [f(x) - 3] = -3$

for $1 \le f(x) < 1.6$

$g(f(x)) = -2 \qquad [\because -2 \le$

$\therefore$ required set is $\{-3, -2\}$.

68. **(d)** We know that $P(A \cup B) \ge \max$

$P(A \cap B) \le \min \{P(A), P(B)\} =$

and $P(A \cap B) = P(A) + P(B) -$

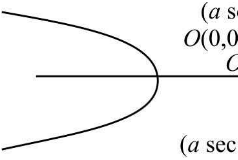
$\Rightarrow \frac{1}{6} \le P(A \cap B) \le \frac{1}{2}$

$P(A' \cap B) = P(B) - P(A \cap B)$

$\therefore \frac{2}{3} - \frac{1}{2} \le P(A' \cap B) \le \frac{2}{3} -$

$\Rightarrow \frac{1}{6} \le P(A' \cap B) \le \frac{1}{2}$

69. **(d)** Let $P(a \sec \theta, b \tan \theta)$ and $Q(a$
ordinates and $C(0, 0)$, is the ce
Now $PQ = 2b \tan \theta$



$\therefore\ OQ = OP = PQ,$

$\therefore\ 4b^2 \tan^2\theta = a^2\sec^2\theta + b^2$ ta

$\Rightarrow 3b^2\tan^2\theta = a^2\sec^2\theta \Rightarrow 3b$

$\Rightarrow 3a^2(e^2-1)\sin^2\theta = a^2,$

$\Rightarrow 3(e^2-1)\sin^2\theta = 1$

$\Rightarrow \dfrac{1}{3(e^2-1)} = \sin^2\theta < 1, \quad (\because$

$\Rightarrow \dfrac{1}{e^2-1} < 3 \Rightarrow e^2 - 1 > \dfrac{1}{3} \Rightarrow$

70. **(b)** Let p be the length of the perpe
Then its equation in normal fo

$x\cos 30° + y\sin 30° = p \Rightarrow \sqrt{3}$

This meets the coordinate axe

$\therefore$ Hence, area of $\Delta OAB = \dfrac{1}{2}\Big($

$= \dfrac{2p^2}{\sqrt{3}}$

$\because$ are a of triangle is $\dfrac{50}{\sqrt{3}}$.

$\therefore\ \dfrac{2p^2}{\sqrt{3}} = \dfrac{50}{\sqrt{3}} \Rightarrow p = \pm 5.$

Hence the lines are $\sqrt{3}x + y \pm$

71. **(6)** The first equation can be writt

$2\sin\dfrac{1}{2}(x+y)\cos\dfrac{1}{2}(x-y)$

$= 2\sin\dfrac{1}{2}(x+y)\cos\dfrac{1}{2}($

$\therefore$ Either $\sin\dfrac{1}{2}(x+y) = 0$ or sin or $x-y=-1$ which gives $\left(\frac{1}{2}, -\right.$

Again solving with $x=0$, we g
$(\pm1, 0)$ as the other solution. T
and y.

72. (120) Using L-Hospital's rule,

$$\lim_{x\to0}\left\{\frac{\sin x - x + \frac{x^3}{6}}{x^5}\right\} = \lim_{x\to0} \frac{co}{}$$

$$= \lim_{x\to0}\frac{-\sin x + \frac{6x}{6}}{20x^3} = \lim_{x\to0}\frac{-\cos}{60}$$

$$= \lim_{x\to0}\frac{\sin x}{120x} = \lim_{x\to0}\frac{\cos x}{120} = \frac{1}{12}$$

73. (750) Let edge of the cube be x cm.

Volume of the cube be $x^3\text{cm}^3$.

Given, $\frac{dx}{dt} = 10$ cm/sec

Now, $v = x^3 \Rightarrow \frac{dv}{dt} = 3x^2\frac{dx}{dt}$

$$\Rightarrow \frac{dv}{dt} = 3(5)^2(10)\,cm^3/\text{sec} =$$

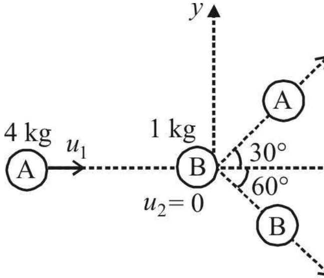
74. (0) Given $2x = -1 + \sqrt{3}i \quad \Rightarrow \quad x =$

Now $(1-\omega^2+\omega)^6 - (1-\omega+\omega$
$= (-\omega^2-\omega^2)^6 - (-\omega-\omega)^6 \qquad ($
$= (-2\omega^2)^6 - (-2\omega)^6 = (-2)^6(\omega^3)$
$= (-2)^6 - (-2)^6 = 0 \qquad (\because$

75. (13986)

The non-zero perfect square di
1 can occur at units place in 3
$\therefore$ Sum due to 1 at units place i
sum due to 1 at tens place is 1
sum due to 1 at hundreds place

1. **(a)**



Apply the law of conservatio
perpendicular to the direction
$0 + 0 = 4v_1 \sin 30° - v_2 \sin 60°$
$4v_1 \sin 30° = v_2 \sin 60°$

$$\frac{v_1}{v_2} = \frac{\sin 60°}{4 \sin 30°} = \frac{\sqrt{3}}{4}$$

2. **(d)** Mass per unit length of the wi
Mass of L length, $M = \rho L$
and since the wire of length L i

$$2\pi R = L \Rightarrow R = \frac{L}{2\pi}$$

Moment of inertia of loop abo

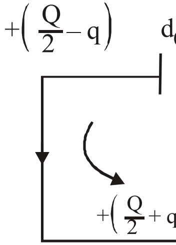
$$= \frac{3}{2}\rho L\left(\frac{L}{2\pi}\right)^2 = \frac{3\rho L^3}{8\pi^2}$$

3. **(c)** $V_{in} = \frac{-GM}{2R}\left[3 - \left(\frac{r}{R}\right)^2\right],$

$$V_{surface} = \frac{-GM}{R}, V_{out} = \frac{-GM}{r}$$

4. **(c)** Electric field, $E \propto \frac{1}{V}$

5. **(a)** Let each plate moves a distanc
Let q charge flows in the loop. U



$$\frac{\left(\frac{Q}{2}-q\right)(d_0+x)}{\epsilon_0\ A}-\frac{\left(\frac{Q}{2}+q\right)(}{\epsilon_0\ A}$$

$$\therefore\ q=\frac{Qx}{2d_0}\ ;\ I=\frac{dq}{dt}=\frac{Q}{2d_0}\Big($$

6. **(a)** The magnetic field varies inver

That is, $B\propto\frac{1}{d}$

so, graph (a) is the correct one

7. **(d)** Applying dimensional method

$v_c=\eta^x\rho^y r^z$

$[M^0LT^{-1}]=[ML^{-1}T^{-1}]^x\,[ML^{-3}$

Equating powers both sides

$x+y=0;\ -x=-1\ \therefore\ x=1$

$1+y=0\ \therefore\ y=-1$

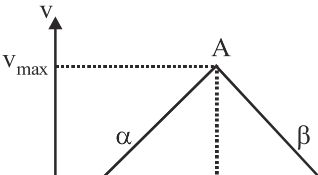
$-x-3y+z=1$

$-1-3(-1)+z=1$

$-1+3+z=1$

$\therefore\ z=-1$

8. **(d)**



In fig., $AA_1 = v_{max.} = \alpha t_1 = \beta t_2$

But $t = t_1 + t_2 = \frac{v_{max}}{\alpha} + \frac{v_{max}}{\beta}$

$$= v_{max}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right) = v_{max}$$

or, $v_{max} = t\left(\frac{\alpha\beta}{\alpha + \beta}\right)$

9. **(c)** Given, $u\cos\theta = \frac{\sqrt{3}u}{2}$

$\Rightarrow \cos\theta = \frac{\sqrt{3}}{2} \Rightarrow \theta = 30°$

Range (R) $= \frac{u^2 \sin 2\theta}{g} = \frac{u^2 \sin}{g}$

Maximum height $= \frac{u^2 \sin^2\theta}{2g} =$

Now, Range = P × H

$\Rightarrow \frac{\sqrt{3}u^2}{2g} = P \times \frac{u^2}{8g} \Rightarrow P = 4$

10. **(d)** The electron ejected with max
field E =4N/C after travelling a

$\frac{1}{2}mv_{max}^2 = eEd = 4eV$

The energy of incident photon

From equation of photo electri

$\frac{1}{2}mv_{max}^2 = h\nu - \phi_0$

$\therefore \phi_0 = 6.2 - 4 = 2.2$ eV

11. **(d)** Shortest wavelength comes fro
comes from $n_1 = 6$ to $n_2 = 5$ in

$$\frac{1}{\lambda_{max}} = R\left(\frac{1}{5^2} - \frac{1}{6^2}\right) = R\left(\frac{36}{25}\right.$$

$$\therefore \frac{\lambda_{max}}{\lambda_{min}} = \frac{900}{11}$$

12. **(c)** The range of energy of β-partic

13. **(c)** According to Newton's law decreasing with time non-line

14. **(c)** The equation for the line is 

$$P = \frac{-P_0}{V_0}V + 3P \text{ [slope} = \frac{-P_0}{V_0}$$

$$PV_0 + P_0V = 3P_0V_0$$

But $PV = nRT$

$$\therefore P = \frac{nRT}{V}$$

From (i) and (ii)

$$\frac{nRT}{V}V_0 + P_0V = 3P_0V_0$$

$$\therefore nRT\,V_0 + P_0V^2 = 3P_0V_0$$

For temperature to be maximur

Differentiating e.q. (iii) by 'V' v

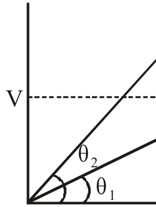
$$nRV_0\frac{dT}{\quad} + P_0(2V) = 3P_0V_0$$

$$\frac{dT}{dV} = \frac{3P_0V_0 - 2P_0V}{nRV_0} = 0$$

$$V = \frac{3V_0}{2} \qquad \therefore\ P = \frac{3P_0}{2}$$

$$\therefore T_{max} = \frac{9P_oV_o}{4nR} \quad \text{[From (iii)]}$$

15. **(b)** $P_1 > P_2$



As V = constant $\Rightarrow P \propto T$

Hence from V–T graph $P_1 > P_2$

16. **(d)** At t = 2 sec, the particle cross

At t = 4 sec, its velocity is 4 m

For simple harmonic motion,

$$\therefore\ y = a\sin\left(\frac{2\pi}{T}\right)t$$

$$y_1 = a\sin\left[\left(\frac{2\pi}{16}\right)\times 2\right] = a\sin\Big($$

After 4 sec or after 2 sec from

velocity = 4 ms^{-1}

$$\therefore \text{Velocity} = \omega\sqrt{a^2 - y_1^2}$$

$$\Rightarrow\ 4 = \left(\frac{2\pi}{16}\right)\sqrt{a^2 - \frac{a^2}{2}}$$

17. **(d)** Here, induced e.m.f.

$$e = \int_{2\ell}^{3\ell} (\omega x) B dx = B\omega \frac{[(3\ell)^2 - (}{2}$$

$$= \frac{5B\ell^2\omega}{2}$$

18. **(c)** Charge on the capacitor at any

$q = CV(1 - e^{t/\tau})$

at $t = 2\tau$

$q = CV(1 - e^{-2})$

19. **(b)** $\because$ The E.M. wave are transver

$$= \frac{\vec{k} \times \vec{E}}{\mu\omega} = \vec{H}$$

where $\vec{H} = \dfrac{\vec{B}}{\mu}$

and $\dfrac{\vec{k} \times \vec{H}}{\omega\varepsilon} = -\vec{E}$

$\vec{k}$ is $\perp$ $\vec{H}$ and $\vec{k}$ is also $\perp$ t

or In other words $\vec{X} \parallel \vec{E}$ and

20. **(b)** Acceleration of block AB = $\dfrac{}{3\text{r}}$

Acceleration of block CD = $\dfrac{}{2\text{r}}$

Acceleration of image in mir

$$2\left(\frac{-3g}{4}\right) = \frac{-3}{2}g$$

Acceleration of image in mirro

$\therefore$ Acceleration of the two ima

21. **(2.5)** If C_e be the effective capacitar

$$V_C = \frac{1}{2}V_0$$

$$\frac{q}{C_e} = \frac{q_0}{2C_e}$$

$$\Rightarrow \quad q_0(1 - e^{-t/RC_e}) = \frac{q_0}{2} \Rightarrow t = R$$

For parallel grouping

$$C_e = \frac{2C}{2}$$

$$\therefore \quad t_2 = 2RC \ln 2$$

For series grouping,

$$C_e = \frac{C}{2}$$

$$\therefore \quad t_1 = \frac{RC}{2}\ln 2$$

$$\therefore \quad \frac{t_2}{t_1} = \frac{1}{4} \Rightarrow t_2 = 2.5s$$

22. **(22)** $v_e = 11$ Km/s.

$R_p = 2R$ $\qquad \rho' = \rho$

$$\because g = \frac{GM}{R^2} = \frac{G.\frac{4}{3}\pi R^3 \rho}{R^2} = 4$$

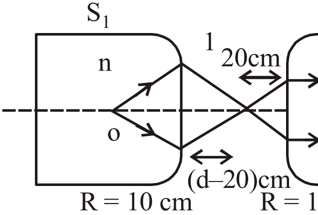
$$g_p = \frac{G\frac{4}{3}\pi {R_p}^3 \rho}{{R_p}^2} = 4\pi G R_p \rho$$

$$= 2 \times (4\pi G R \rho) = 2 \times g$$

$$v_e' = \sqrt{2 g_p R_p} = \sqrt{2 \times 2g \times 2R}$$

$$= 2 \times 11 = 22 \text{ km/s}$$

23. **(70)**



At glass rod S_2

$1 \rightarrow n$ refraction

$$\frac{n}{\infty} - \frac{1}{u_2} = \frac{n-1}{+10}$$

$\Rightarrow u_2 = -20\text{cm}$

At glass rod S_1

For $n \rightarrow 1$ refraction

$v_1 = d - 20$

$$\frac{1}{d-20} - \frac{n}{(-50)} = \frac{1-n}{-10}$$

$$\frac{1}{d-20} - \frac{n}{(-50)} = \frac{1-n}{-10}$$

$$\frac{1}{d-20} + \frac{n}{50} = +\frac{1}{20}$$

$d = 70$ cm

24. **(0.3)** The displacement of particle,

$$y = 5\sin\left(4t + \frac{\pi}{3}\right)$$

Velocity of particle, $\frac{dy}{dt} = \frac{5d}{dt}$

$$= 5\cos\left(4t + \frac{\pi}{3}\right)4 = 20\cos\left(\right.$$

Velocity at $t = \left(\frac{T}{4}\right)$

$$\left(\frac{dy}{\right.$$

$$\Rightarrow\ u = 20\cos\left(T + \frac{\pi}{3}\right)$$

Comparing the given equatior

$(\omega t + \phi)$, we get $\omega = 4$.

$$\text{As}\ \ \omega = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{\omega} \Rightarrow T =$$

Now, putting value of T in Eq.

$$u = 20\cos\left(\frac{\pi}{2} + \frac{\pi}{3}\right) = -20\sin$$

$$= -20 \times \frac{\sqrt{3}}{2} = -10 \times \sqrt{3}$$

The kinetic energy of particle,

$$KE = \frac{1}{2}mu^2$$

$$\because\ m = 2g = 2 \times 10^{-3}\,kg$$

$$= \frac{1}{2} \times 2 \times 10^{-3} \times \left(-10\sqrt{3}\right.$$

$$= 10^{-3} \times 100 \times 3 = 3 \times 10^{-1} \Rightarrow$$

25. **(0.144)** Here, $E = 9V$; $V_z = 6$; $R_L =$

Potential drop across series re

$V = E - V_Z = 9 - 6 = 3V$

Current through series resistar

$$I = \frac{V}{R} = \frac{3}{100} = 0.03\,A$$

Current through load resistanc

$$I_L = \frac{V_Z}{R_L} = \frac{6}{1000} = 0.006\,A$$

Current through Zener diode i

$I_Z = I - I_L = 0.03 - 0.006 = 0.02$

Power dissipated in Zener dio

26. **(d)** (a) $Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$

(b) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} Cr_2C$

(c) $NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H$

(d) $(NH_4)_2SO_4 \xrightarrow{\Delta} 2NH_3$

NH_3 is evolved in case of (d) .

27. **(b)** Aspirin is analgesic and antipy

28. **(b)** $\Delta H = E_{a(f)} - E_{a(b)}$

Thus energy of activation for reaction is exothermic or endot

If reaction is exothermic, ΔH

If reaction is endothermic, Δ

29. **(c)** Liquation process, Mond's p refining processes that are ap metal under treatment and natu process is used for the extract from native ores. The metal is r it to distillation, where the mer

Ore + Hg $\rightarrow$ Amalgam $\xrightarrow{\text{Distill}}$

30. **(b)** PbO_2 is a powerful oxidizing acids.

$2PbO_2 + 4H$

31. **(d)** Soap helps to lower the surfac to the dust particles and grea water.

32. **(d)** H_3BO_3 acts as a Lewis acid an

33. **(a)** $\underset{P_0 - 2x}{2NH_3(g)} \rightleftharpoons \underset{x}{N_2(g)} + \underset{3x}{3H_2(}$

$$\Rightarrow P^2_{NH_3} = 3^3 x^4 K_p$$

$$\Rightarrow P_{NH_3} = 3^{\frac{3}{2}} x^2 K_p^{\frac{1}{2}}$$

$$= \frac{3^{\frac{3}{2}} . P^2 K_p^{\frac{1}{2}}}{16}$$

34. **(d)** We can distinguish between fo
on Fehling's solution. Formic
acetic acid does not give red p

35. **(c)** $E^\circ_{cell} = \frac{0.0591}{n} \log K_{eq}$

$$\therefore 0.591 = \frac{0.0591}{1} \log K_{eq}$$

$$\text{or } \log K_{eq} = \frac{0.591}{0.0591} = 10$$

$$\text{or } K_{eq} = 1 \times 10^{10}$$

36. **(d)** $Hg_2Cl_2 + 2NH_4OH \longrightarrow Hg_2$

37. **(c)** In a DNA molecule, A = T (Tw
C ≡ G (Thre
Purine → Adenine (A), Guanin
Pyrimidine → Cytosine (C), Th
So the complimentary sequenc

38. **(c)** $-CH_3$ group is *o, p*–directing.

39. **(b)** Sodium cyanide (Na + C + N –
(Lassaigne's test)

40. **(b)** Magnesium reacts with air to
water the oxide gives hydroxide

$$\underset{}{2Mg + O_2 \rightarrow} \underset{(X)}{2MgO}$$

$$3Mg + N_2 \rightarrow \underset{(Y)}{Mg_3N_2}$$

$$MgO + H_2O \rightarrow Mg(OH)_2$$

41. **(c)** Peptization involves conversio
loidal particles using a suitabl

42. **(b)** $\Delta T_b = K_b \times m \times i = 0.52 \times 1 \times 2$
$\therefore\ \Delta T_b = 100 + 1.04 = 101.04\,°C$

43. **(d)** Oxidation state of Cr in $[Cr(N$

Let it be x, $1 \times x + 4 \times 0 + 2 \times ($

44. **(a)** Higher the value of reduction p
whereas lower the value of redu
power.

45. **(b)** $k = \dfrac{2.303}{t}\log\dfrac{a}{(a-x)}$

$(a-x)$ is the concentration lef

$2.7 \times 10^{-3} = \dfrac{2.303}{100}\log\dfrac{0.29}{(a-x)}$

$\Rightarrow \dfrac{0.27}{2.303} = \log\dfrac{0.29}{(a-x)} \Rightarrow 0.11$

$\Rightarrow (a-x) = 0.22\,M.$

46. **(0)** It is zero order reaction

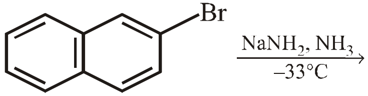
47. **(38)** $M(NO_3)_n \to M_2(SO_4)_n\ (n =$

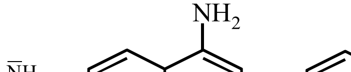
g eq. $M(NO_3)_n$ = g eq. of $M_2(S$

$\dfrac{1.0}{E(M)+E(NO_3^-)} = \dfrac{0.8}{E(M)+E(}$

$\Rightarrow \dfrac{1}{E+\dfrac{62}{1}} = \dfrac{0.86}{E+\dfrac{96}{2}} \Rightarrow E = 38g$

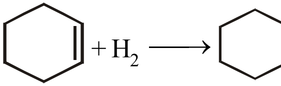
48. **(2)**

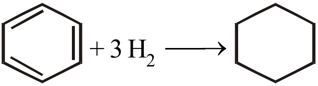




49. **(279)** $\wedge^{\infty}_{BaCl_2} = \frac{1}{2}\lambda^{\infty}_{Ba^{2+}} + 2\lambda^{\infty}_{C}$

$= 127 + 2 \times 76 = 279\ S\ cm^2\ mol$

50. **(–208.1)** 



The resonance energy provide
so it has to be overcome, for h
So $\Delta H = -358.5 - (-150.4) = -$

MATHE

51. **(a)** The equation is $x^2 + px + q = 0$
Let α be one of the root, then
From the principle of quadrati
$\alpha^2 + \alpha = -p$
and $\alpha^3 = q$
From eq (1) + eq (2):
$\alpha^3 + \alpha^2 + \alpha = q - p$
$\Rightarrow \quad \alpha(\alpha^2 + \alpha + 1) = q - p$
$\Rightarrow \quad \alpha(-p + 1) = q - p$ [since

$$\Rightarrow \quad \alpha = \frac{q-p}{1-p} = \frac{p-q}{p-1}$$

Putting this value of α in equa

$$\left(\frac{p-q}{p-1}\right)^2 + \left(\frac{p-q}{p-1}\right) = -p$$

$$\Rightarrow \quad \frac{p^2 - 2pq + q^2}{(p-1)^2} + \frac{p-q}{(p-1)} =$$

$$\Rightarrow \quad \frac{p^2 - 2pq + q^2 + (p-1)(p}{(p-1)^2}$$

$\Rightarrow \quad p^2 - 2pq + q^2 + p^2 - pq -$

52. **(b)** Let $M(h, k)$

Given, $AM = 2\,AB$

$\Rightarrow AB + BM = 2AB$

$\Rightarrow AB = BM$

So B is mid point of AM

$$B = \left(\frac{h}{2}, \frac{k+3}{2}\right)$$

$\because$ Point B lies on the circle.

$\therefore$ B satisfies the equation of cir

$$\left(\frac{h}{2}\right)^2 + 4\left(\frac{h}{2}\right) + \left(\frac{k+3}{2} - 3\right)^2 =$$

$$\Rightarrow \frac{h^2}{4} + \frac{8h}{4} + \frac{(k-3)^2}{4} = 0$$

or $x^2 + y^2 + 8x - 6y + 9 = 0$, whic

53. **(b)** We have $f(x) = \begin{cases} (x-1)\sin\left(\right. \\ 0 \end{cases}$

$$Rf'(1) = \lim_{h \to 0} \frac{f(1+h) - f(1)}{h}$$

$$= \lim_{h \to 0} \frac{h\sin\frac{1}{h} - 0}{h} = \lim_{h \to 0}$$

which does not exist.

$\therefore f$ is not differentiable at $x =$

Also $f'(0) = \left[\sin\frac{1}{(x-1)} - \frac{x}{(x}\right.$

$= -\sin 1 + \cos 1$

$\therefore f$ is differentiable at $x = 0$

54. **(b)** $n(\text{A}) = 40\%$ of $10{,}000 = 4{,}000$

$n(\text{B}) = 20\%$ of $10{,}000 = 2{,}000$

$n(\text{C}) = 10\%$ of $10{,}000 = 1{,}000$

$n(A \cap B) = 5\%$ of $10{,}000 = 500$

$n(A \cap B \cap C) = 2\%$ of $10,000$

We want to find $n(A \cap B^c \cap C$

$= n(A) - n[A \cap (B \cup C)]$

$= n(A) - n[(A \cap B) \cup (A \cap C)$

$= n(A) - [n(A \cap B) + n(A \cap C$

$= 4000 - [500 + 400 - 200] = 40$

55. **(d)** Given function $f(x) = Pe^{2x} +$

Given conditions $f(0) = -1,\ f'$

and $\int_0^{\log 4} [f(x) - Rx]dx = \frac{39}{2}$

differentiate equation (i)

$f'(x) = 2Pe^{2x} + Qe^{x} + R$

Put $x = \log 2$ in equation (ii)

$f'(\log 2) = 2Pe^{2\log 2} + Qe^{\log 2}$

$31 = 8P + 2Q + R$

and, put $x = 0$ in equation (i)

$f(0) = Pe^{2 \times 0} + Qe^{0} + R.0$

$= P + Q - 1 = P + Q$

$\Rightarrow\ P = -1 - Q$

Thus $\int\limits_0^{\log 4} [f(x) - Rx]dx = \frac{39}{2}$

$\Rightarrow \int\limits_0^{\log 4} [Pe^{2x} + Qe^{x} + Rx - R$

$\Rightarrow \int\limits_0^{\log 4} [Pe^{2x} + Qe^{x}]dx = \frac{39}{2}$

$\Rightarrow \left[\frac{Pe^{2x}}{2} + Qe^{x}\right]_0^{\log 4} = \frac{39}{2}$

$\Rightarrow \quad \frac{15P}{2} + 3Q = \frac{39}{2}$

From (iv) and (v), we get

$\frac{15P}{2} + 3(-1-P) = \frac{39}{2}$

$\Rightarrow \quad \frac{9P}{2} = \frac{45}{2} \quad \Rightarrow \quad P = 5$

and $Q = -1 - P = -1 - 5 = -6$

and from equation (iii)

$31 = 8 \times 5 + 2 \times -6 + R$

$31 = 40 - 12 + R$

$\therefore \quad P = 5; Q = -6, R = 3$

56. (a) $\lim\limits_{x \to 0^+} x^m (\log x)^n = \lim\limits_{x \to 0^+} \frac{(\log x}{x^{-}}$

$= \lim\limits_{x \to 0^+} \frac{n(\log x)^{(n-1)} \frac{1}{x}}{-mx^{-m-1}}$ [Us

$= \lim\limits_{x \to 0^+} \frac{n(\log x)^{(n-1)}}{-mx^{-m}}, \left(\frac{\infty}{\infty}\right.$ For

$= \lim\limits_{x \to 0^+} \frac{n(n-1)(\log x)^{(n-2)} \frac{1}{x}}{(-m)^2 x^{-m-1}}$

$= \lim\limits_{x \to 0^+} \frac{n(n-1)(\log x)^{n-2}}{m^2 x^{-m}}, \left(\right.$

....

....

$= \lim\limits_{x \to 0^+} \frac{n!}{(-m)^n x^{-m}} = 0$

57. (a) We have ; $f(x) = \sin x - \cos x$

$\Rightarrow f'(x) = \cos x + \sin x - a$

As the max. value of (cos x + s

The above is possible when a

58. (d) $\frac{\sin 3B}{\sin B} = \frac{3\sin B - 4\sin^3 B}{\sin B} =$

$= 3 - 4 + 4\cos^2 B = -1 + \frac{4(a^2}{}$

$= -1 + \frac{\left(\frac{a^2+c^2}{2}\right)^2}{(ac)^2} = -1 + \frac{(a^2}{4(}$

$= \frac{(a^2+c^2)^2 - 4a^2c^2}{4(ac)^2} = \left(\frac{c^2 - }{2ac}\right.$

59. (a) We have, $y = (1+x)^y + \sin^{-1}($

when $x = 0$, we have $y = 1$

Differentiating (i) w.r.t. x we ge

$\frac{dy}{dx} = (1+x)^y \left\{\frac{dy}{dx}\log(1+x) + \right.$

$\Rightarrow \left(\frac{dy}{dx}\right)_{(0,1)} = 1 \Rightarrow -\left(\frac{dx}{dy}\right)_{(0,1)}$

So the equation of the normal

$y - 1 = -1(x - 0) \Rightarrow x + y = 1$

60. (b) Parametric equation of the hyp
and equation of circle is $x^2 + y$
Put $x = ct$ and $y = c/t$ in (i)

$(ct)^2 + \left(\frac{c}{t}\right)^2 = a^2$

$c^2 t^4 + c^2 - a^2 t^2 = 0$

61. **(b)** Integration by parts is given a

$$\int \underset{\text{I}}{u}\,\underset{\text{II}}{v}\,dx = u\int v\,dx - \int\left[\frac{d}{dx}(u)\right.$$

Let $I = \int 32x^3(\log x)^2\,dx$

Integrate it by parts, using IL

and x^3 as II^{nd} function

$$= 32\left\{(\log x)^2\,\frac{x^4}{4} - \int 2\log x\,\frac{1}{x}\right.$$

$$= \frac{32}{4}x^4(\log x)^2 - 16\int x^3\log x$$

$$= 8x^4(\log x)^2 - 16\left\{\log x.\frac{x^4}{4} - \right.$$

$$= 8x^4(\log x)^2 - 4x^4\log x + 4\int$$

$$= 8x^4(\log x)^2 - 4x^4\log x + x^4$$

$$= x^4\left\{8(\log x)^2 - 4\log x + 1\right\} +$$

62. **(a)** Let $u = \tan^{-1}\frac{2x}{1-x^2}$

and $v = \sin^{-1}\frac{2x}{1+x^2}$

In equation (i) put, $x = \tan\theta$

$$\therefore\quad u = \tan^{-1}\left[\frac{2\tan\theta}{1-\tan^2\theta}\right] = \tan$$

$$\Rightarrow u = 2\theta \quad\Rightarrow\quad \frac{du}{d\theta} = 2$$

In equation (ii), put $x = \tan\theta$

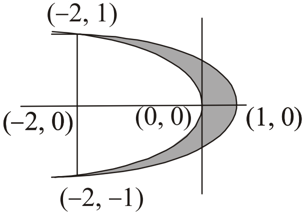
$$\therefore\ v = \sin^{-1}\left[\frac{2\tan\theta}{\quad}\right] = \sin$$

From equations (iii) and (iv),

$$\frac{du}{dv} = \frac{du}{d\theta} \times \frac{d\theta}{dv} = 2 \times \frac{1}{2} = 1$$

$\therefore$ required differential coeffici

63. (c)



Parabola : $y^2 = \frac{-x}{2}$ and $y^2 =$

On solving, we get $x = -2, y =$

$\therefore$ required Area $= 2\left[\frac{1}{\sqrt{3}} \int_{-2}^{1} \sqrt{(1\right.$

$= 2\left\{\left[\frac{1}{\sqrt{3}} \times \frac{-2}{3}(1-x)^{3/2}\right]_{-2}^{1} - \left[\right.\right.$

$= 2\left\{\left(\frac{2}{3\sqrt{3}}.3\sqrt{3}\right) - \left(\frac{2}{3\sqrt{2}}.2\sqrt{2}\right.\right.$

64. (c) The inverse of the proposition

$\sim (p \wedge \sim q) \rightarrow \sim r$

$\equiv \sim p \vee \sim (\sim q) \rightarrow \sim r$

$\equiv \sim p \vee q \rightarrow \sim r$

65. (c) The rth term in the expansion o

$$T_{r+1} = {}^9C_r \left(\frac{3}{2}x^2\right)^{9-r} \left(-\frac{1}{3x}\right)^r$$

The coefficient of the term indepen

$$\left(\frac{3}{2}x^2-\frac{1}{3x}\right)^9$$

= Sum of the coefficient of the term

$$\left(\frac{3}{2}x^2-\frac{1}{3x}\right)^9.$$

For x^0 in (i) above, $18-3r=0 \Rightarrow r=$
for x^{-1} in (i) above, there exists no
For x^{-3} in (i), $18-3r=-3 \Rightarrow r=7$
$\therefore$ for term independent of x, in (ii)

$$= 1\times {}^9C_6(-1)^6\left(\frac{3}{2}\right)^{9-6}\left(\frac{1}{3}\right)^6+2\times {}^9C$$

$$=\frac{9.8.7}{1.2.3}.\frac{3^3}{2^3}.\frac{1}{3^6}+2\frac{9.8}{1.2}(-1)\frac{3^2}{2^2}.\frac{1}{3^7}=$$

66. **(a)** We have $\frac{dy}{dx}=\frac{f'(x)}{f(x)}y-\frac{y^2}{f(x)}$

Divide by y^2

$$y^{-2}\frac{dy}{dx}-y^{-1}\frac{f'(x)}{f(x)}=-\frac{1}{f(x)}$$

Put $y^{-1}=z\Rightarrow -y^{-2}\frac{dy}{dx}=\frac{dz}{dx}$

$$-\frac{dz}{dx}-\frac{f'(x)}{f(x)}(z)=-\frac{1}{f(x)}\quad\Rightarrow$$

$$\text{I.F.}=e^{\int\frac{f'(x)}{f(x)}dx}=e^{\log f(x)}=f($$

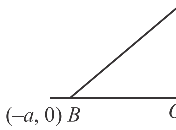
$\therefore$ The solution is $z(f(x))=\int$

67. **(d)** Given $\angle A - \angle B = \theta \Rightarrow \tan (A$

$$\Rightarrow \frac{\tan A - \tan B}{1 + \tan A - \tan B} = \tan\theta \quad ...$$

In right angled triangle CDA,

$$\tan A = \frac{k}{a-h}$$



Similarly in triangle CDB,

$$\tan B = \frac{k}{a+h}$$

Substitute the values of tan A

$h^2 - k^2 + 2hk \cot\theta = a^2$

Hence the locus is $x^2 - y^2 + 2x$

68. **(a)** Equation of planes passi

$3x - y - 4z = 0$ and $x + 3y +$

$$(3x - y - 4z) + \lambda(x + 3y + 6) =$$

$$(3 + \lambda)x + (3\lambda - 1) - 4z + 6\lambda =$$

Given, distances of plane (i) fr

$$\therefore \frac{6\lambda}{\sqrt{(3+\lambda)^2 + (3\lambda - 1)^2 + (-4)^2}}$$

or $36\lambda^2 = 10\lambda^2 + 26$ or $\lambda = \pm$

Put the value of λ in (i),

$\therefore (3x - y - 4z) \pm (x + 3y + 6) =$

or $4x + 2y - 4z + 6 = 0$ or $2x$

and $2x - 4y - 4z - 6 = 0$ or x

Thus the required planes are x

69. **(a)** Since, angles of Δ are in AP.

Use cosine law in ΔABC

$$\cos 60° = \frac{(10)^2 + (9)^2 - x^2}{2.(10).(9)} =$$

$\Rightarrow x^2 = 91 \Rightarrow x = \sqrt{91}.$

70. (a) $\vec{a} = (1, -1, 2)$, $\vec{b} = (-2, 3, 5)$,

So, $\vec{a} = (1, -1, 2) \equiv \hat{i} - \hat{j} + 2\hat{k}$

$= (-2, 3, 5) \equiv -2\hat{i} + 3\hat{j} + 5\hat{k}$

and $\vec{c} = (2, -2, 4) \equiv 2\hat{i} - 2\hat{j} +$

$\Rightarrow \vec{a} - 2\vec{b} + 3\vec{c} = (\hat{i} - \hat{j} + 2\hat{k}) -$

$= 11\hat{i} - 13\hat{j} + 4\hat{k}$ and $(\vec{a} - 2\vec{b}$

71. (120) As the greater side of a triang

$\therefore$ The angle (say C) opposite t

in this case.

Now, $\cos C = \dfrac{a^2 + b^2 - c^2}{2ab}$

$= \dfrac{a^2 + b^2 - (a^2 + b^2 + ab)}{2ab}$ [

$= \dfrac{-ab}{2ab} = \dfrac{-1}{2}$; $C = 120°$

72. (198) $\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} \begin{bmatrix} a & d & g \\ b & e & h \\ c & f & i \end{bmatrix}$

Sum of diagonal elements,

$a^2 + b^2 + c^2 + d^2 + e^2 + f^2 + g^2 +$

Case – I: Five (1's) and four (0

${}^9C_5 = 126$

Case – II: One (2) and one (1)

73. (2) We know that, $|z_1 - z_2| \geq || z_1$

Here $| z_1 | = 12$ and $| z_2 - 3 - 4i |$

but $| z_2 - (3 + 4i) | \geq | | z_2 | - | 3 +$

$\Rightarrow \quad 5 \geq | z_2 | - 5$

$\Rightarrow \quad | z_2 | \leq 10$

Also from (i) $| z_1 - z_2 |$ will hav

i.e. 10

$\therefore \quad | z_1 - z_2 | \geq 12 - 10 = 2$

Thus min. value of $| z_1 - z_2 |$ is

74. (1875) $x_1 x_2 x_3 x_4 x_5 = 2 \times 3 \times 5^2 \times 7$ w

We can assign entire 5^2 to just

$5^2 = 5 \times 5$ to two variables in

${}^5C_1 + {}^5C_2 = 5 + 10 = 15$ ways

Required number of solutions =

75. (0.55) Total number of cases obtain

numbers out of $100 = {}^{100}C_2$.

Out of hundred (1, 2, ...,100

6, 9, 12, ..., 99, which are 33

is multiplied with any one of r

33 are multiplied, then the res

number of numbers which are

are divisible by $3 = {}^{33}C_1 \times {}^{67}C$

Hence the required probability

$$= \frac{{}^{33}C_1 \times {}^{67}C_1 + {}^{33}C_2}{{}^{100}C_2} = \frac{273}{495}$$