Aakash
Medical | IIT-JEE | Foundations
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Time : 3 Hrs. **MM : 210**

MOCK TEST PAPER
for
JEE (Advanced)-2016
(Paper-1)
(*Complete Syllabus of Class XI & XII*)

GENERAL INSTRUCTIONS :

(i) Duration of Test is 3 hrs.

(ii) The Test booklet consists of 60 questions. The maximum marks are 210.

(iii) There are **three** parts in the question paper A, B and C consisting of **Physics**, **Chemistry** and **Mathematics** having 20 questions in each part of equal weightage.

(iv) **Section-I** contains 10 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **–1 mark** for wrong answer.

(v) **Section-II** contains 5 multiple choice questions which have one or more answers are correct. Each question carries **+4 marks** for correct answer. There are no negative marks in this section.

(vi) **Section-III** contains 5 questions. The answer to each question is single digit integer ranging from 0 to 9 (both inclusive) without being given any option. Each question carries **+4 marks** for correct answer. There are no negative marks in this section.

[PART-A : PHYSICS]

SECTION - I

Single Correct Answer Type

This section contains 10 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

Choose the correct answer :

1. The work done by gravitational force on a particle of mass m, if it is transferred from centre of the base of a uniform solid hemisphere of mass M to infinity is

(A) $-\frac{3}{4}\frac{GMm}{R}$ (B) $-\frac{3}{2}\frac{GMm}{R}$

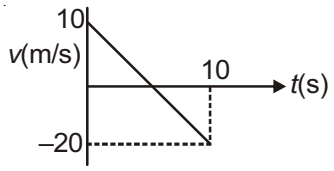
(C) $-\frac{1}{2}\frac{GMm}{R}$ (D) $-\frac{GMm}{R}$

2. A quantity 'x' is given by $\varepsilon_0 L\frac{\Delta V}{\Delta t}$, where ε_0 is the permittivity of free space, L is length, ΔV is potential difference and Δt is time interval. The dimensional formula for 'x' is the same as that of

(A) Resistance (B) Charge

(C) Voltage (D) Current

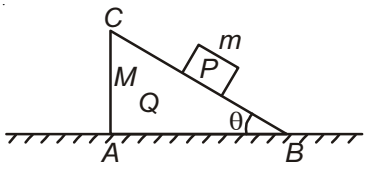
3. Velocity-time graph of a particle moving in a straight line is as shown in figure. Mass of the particle is 2 kg. Work done by all the forces acting on the particle in time interval between $t = 0$ to $t = 10$ s is



(A) 300 J (B) –300 J

(C) 400 J (D) –400 J

4. A block *Q* of mass *M* is placed on a horizontal frictionless surface *AB* and a body *P* of mass *m* is released on its frictionless slope. As *P* slides by a length *L* on this slope of inclination θ, find the displacement of mass *M*.



(A) $\frac{m}{M}L\cos\theta$ (B) $\frac{m}{M+m}L$

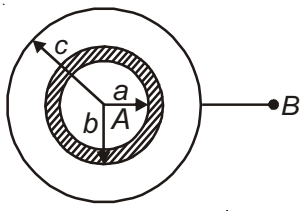
(C) $\frac{ML\cos\theta}{m+M}$ (D) $\frac{mL\cos\theta}{m+M}$

5. Two coaxial loops of radii r_1 and r_2 are separated by a distance *x* and carry current I_1 and I_2 respectively. The force between the loops will be

(A) $F=\frac{\mu_0\pi R_1^2R_2^2I_1I_2x}{2\left[R_1^2+x^2\right]^{-5/2}}$ (B) $F=\frac{2\mu_0\pi R_1^2R_2^2I_1I_2x}{\left[R_1^2+x^2\right]^{5/2}}$

(C) $F=\frac{3\mu_0\pi R_1^2R_2^2I_1I_2x}{2\left[R_1^2+x^2\right]^{5/2}}$ (D) $F=\frac{5\mu_0\pi R_1^2R_2^2I_1I_2x}{2\left[R_1^2+x^2\right]^{5/2}}$

6. Consider an assembly for three conducting concentric spherical shells of radii *a, b* and *c* as shown in figure. Suppose the space between the two inner shells is filled with a di-electric of dielectric constant *K*. Find the capacitance of the system between *A* and *B*.



(A) $\frac{4\pi\varepsilon_0abcK}{Ka(c-b)+c(b-a)}$ (B) $\frac{4\pi\varepsilon_0bc}{Ka(c-b)+c(b-a)}$

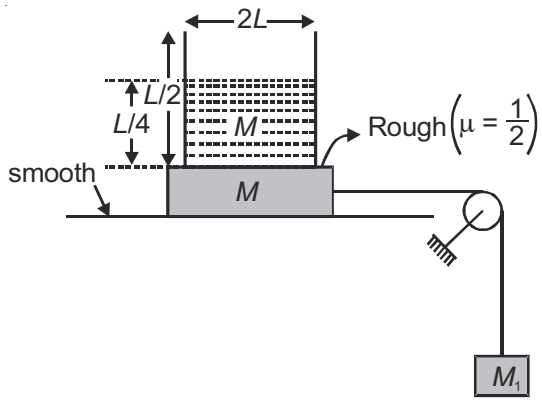
(C) $\frac{4\pi\varepsilon_0ca}{Ka(c-b)+c(b-a)}$ (D) $\frac{4\pi\varepsilon_0abc}{Ka(c-b)+c(b-a)}$

7. The frequency of K_α X-ray of a material is f_1 and that of K_β X-ray is f_2. Find the frequency of L_α X-ray of the same material.

(A) $f = f_2 - f_1$ (B) $f=\frac{f_1f_2}{f_1+f_2}$

(C) $f = f_1 + f_2$ (D) $f=\frac{f_1+f_2}{2}$

8. A water beaker containing water of total mass *M* is placed on a rough plank of mass *M* $\left(\mu=\frac{1}{2}\right)$, and the system is placed on smooth horizontal table as shown in the given figure. The maximum value of M_1 for which water will not spill out of the beaker is (pulley and string is ideal)



(A) *M* (B) 2*M*

(C) $\frac{2M}{3}$ (D) $\frac{M}{4}$

9. If temperature of an ideal gas in a closed container is doubled, then the mean free path of the molecules will be

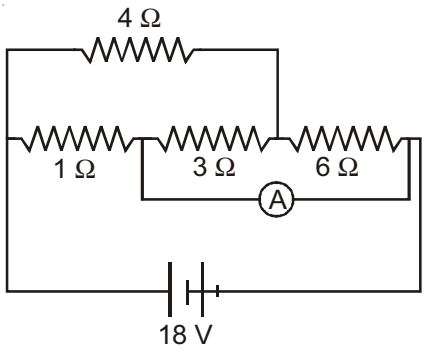
(A) Halved

(B) Doubled

(C) Same

(D) Four times of the initial value

10. The reading of ideal ammeter in the given circuit is



(A) 0 A (B) 20 A

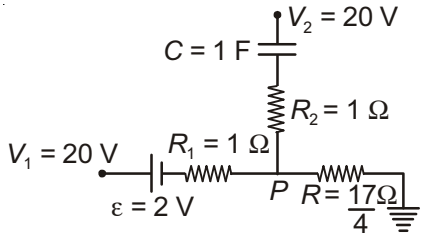
(C) 19 A (D) 21 A

SECTION - II

Multiple Correct Answers Type

This section contains 5 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

11. In the given figure as a part of a complicated circuit, charge given on the capacitor $q = 3(1 - e^{-t})C$, then at time $t = 0$



(A) The potential of point P is 17 volt

(B) Current in the branch of capacitor is 3 A

(C) Current in the branch of battery is 1 A

(D) Current through branch of R is 4 A

12. A particle of mass m is located in one dimensional potential field where potential energy of the particle has the form $u(x) = \frac{a}{x^2} - \frac{b}{x}$, where a and b are positive constants, then

(A) Equilibrium position is given by $x_0 = \frac{2a}{b}$

(B) Net unbalanced force on the particle is = $\frac{b^4}{8a^3}\Delta x$, where Δx is the displacement of the particle from equilibrium position

(C) Time period of the particle for small oscillations $T = 2\pi\sqrt{\frac{8ma^3}{b^4}}$

(D) Time period of the particle for small oscillation $T = \pi\sqrt{\frac{8ma^3}{b^4}}$

13. A tuning fork having frequency of 340 Hz is vibrated just above a cylindrical tube. The height of the tube is 120 cm. Water is slowly poured in it. Then (velocity of sound in air = 340 m/s)

(A) Length of air column in the pipe for resonance in its 3rd harmonic is 75 cm

(B) Length of air column in the pipe for resonance in its 5th harmonic is 125 cm

(C) The minimum height of water to be filled in tube for resonance in its 3rd harmonic is 45 cm

(D) The minimum height of water to be filled in tube for resonance in its 3rd harmonic is 35 cm

14. Two particles A and B move with constant velocities v_1 and v_2 along two mutually perpendicular straight lines towards the intersection point O. At moment $t = 0$ the particles were located at distances l_1 and l_2 from O respectively. Then

(A) The time after which they are nearest is $t = \frac{v_1 l_1 + v_2 l_2}{\left[v_1^2 + v_2^2\right]}$

(B) The time after which they are nearest is $t = \frac{v_1 l_2 - v_2 l_1}{\left[v_1^2 + v_2^2\right]}$

(C) The shortest distance between them is $L = \frac{l_1 v_2 - l_2 v_1}{\sqrt{v_1^2 + v_2^2}}$

(D) The shortest distance between them is $L = \frac{l_1 v_2 + l_2 v_1}{\sqrt{v_1^2 + v_2^2}}$

15. The separation between the two slits, in a Young's double slit experiment is d and the wavelength of light is λ. The ratio of intensity of light falling on the two slits is 4:1.

(A) If the intensity of light falling on slit 1 is reduced so that it becomes equal to that of slit 2 then intensities of the observed dark fringes will decrease

(B) If the intensity of light falling on slit 2 is increased so that it becomes equal to that of slit 1, the intensities of the observed dark fringes will decrease

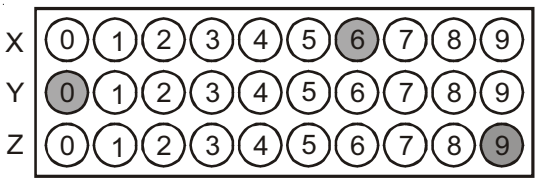
(C) If $d = \lambda$, the screen will contain one maximum

(D) If $\lambda < d < 2\lambda$, atleast one more maximum (besides the central maximum) will be observed on the screen

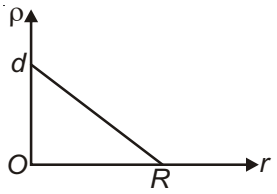
SECTION-III

Integer Answer Type

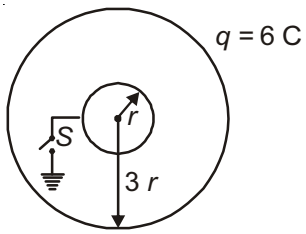
This section contains 5 questions. The answer to each of the question is a single digit integer ranging from 0 to 9 (both inclusive). The appropriate bubbles corresponding to the respective question numbers in the OMR have to be darkened. For example, if the correct answers to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then the correct darkening of bubbles will look like the following :



16. The nuclear charge is (Ze) non-uniformly distributed within a nucleus of radius R. The volume charge density is dependent of radial distance r from centre as shown. The value of $d = \frac{nZe}{\pi R^3}$, find n.

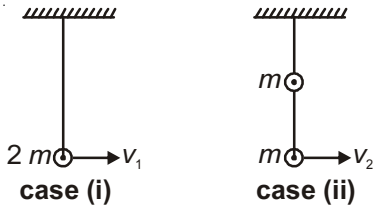


17. Figure shows two conducting thin concentric shells of radii r and $3r$. The outer shell carries charge q = 6 C. Inner shell is neutral. Find the charge (in C) that will flow from inner sphere to the earth after the switch S is closed.

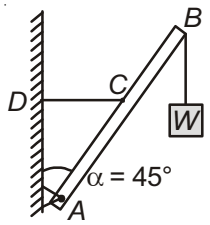


18. A car starts moving along a straight line path first with acceleration $a = \frac{25}{3}$ m/s^2, starting from rest. Then with uniform velocity and finally decelerating at the same rate a comes to rest. If the total time of journey is 15 s and the average velocity for entire journey is 72 km/h. Find the time in second for which the car moving with uniform velocity.

19. A mass 2 m is fixed at one end of a light rod of length l in **case (i)**, and in **case (ii)** the mass is rearranged with m at lower end and the other m at the middle. If v_1 and v_2 are the velocities required for the lower ends to just take up the horizontal positions, then $\frac{v_1}{v_2} = \sqrt{\frac{k}{6}}$, find k.



20. A rigid bar AB is supported in a vertical plane and carries a load W = 3.5 N at its free end. Neglecting the weight of the bar, find the tension in the string CD. (C is the centre of the rod AB)



[PART-B : CHEMISTRY]

SECTION - I

Single Correct Answer Type

This section contains 10 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

21. An organic compound contains 24.24% C, 71.72% Cl and remaining is H. The compound is

(A) CH_3Cl (B) C_2H_5Cl

(C) $C_2H_4Cl_2$ (D) CH_2Cl_2

22. For He^+, how many eV are needed for the transition $2s \rightarrow 2p$?

(A) 0 (B) 1.6 eV

(C) 3.4 eV (D) 1.7 eV

23. Screening constant (σ) for 1*s* electrons is 0.35 and for 2*s* electrons it is 0.3, then Z_{eff} for electron of He will be

(A) 2.35 (B) 2.3

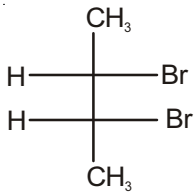
(C) 1.7 (D) 1.65

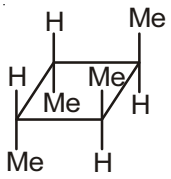
24. In which complex, dsp^2 hybridisation of central atom is present?

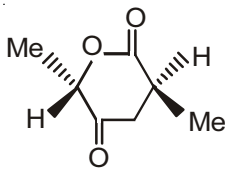
(A) $[Cu(NH_3)_4]^{2+}$ (B) $[PtCl_4]^{2-}$

(C) $[Ni(CO)_4]$ (D) Both (A) & (B)

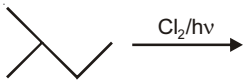
25. Which of the following compound has centre of symmetry?

(A) 

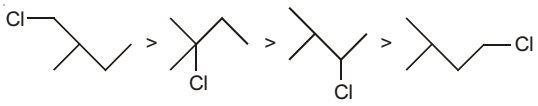
(B) 

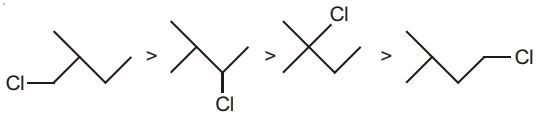
(C) 

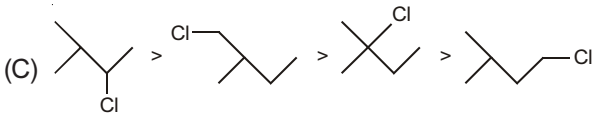
(D) All of these

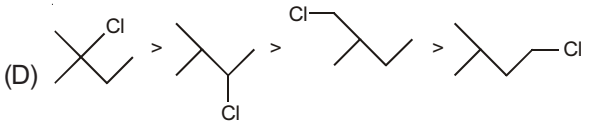
26. 

Product formation will be in the order of abundance

(A) 

(B) 

(C) 

(D) 

27. A compound on combustion gives gases which increase the mass of anhydrous $CaCl_2$ and which turns lime water milky and on excess supply milky water becomes clear. Oxidation state of carbon in the gaseous product will be

(A) +1 (B) +2

(C) +3 (D) +4

28. $Ag^+ + NH_3 \rightleftharpoons [Ag(NH_3)]^{-1}$; $K_1 = 3.5 \times 10^{-3}$

$[Ag(NH_3)]^+ + NH_3 \rightleftharpoons [Ag(NH_3)_2]^+$; $K_2 = 1.7 \times 10^{-3}$

then the formation constant of $[Ag(NH_3)_2]^+$ is

(A) 5.95×10^{-6} (B) 5.95×10^{6}

(C) 5.95×10^{-9} (D) None of these

29. N_2O_4 is 25% dissociated upto equilibrium at 37°C and 1 atmosphere pressure. Calculate the percentage dissociation at 0.1 atm and 37°C at new equilibrium state.

(A) 63 (B) 32

(C) 47 (D) 96

30. The correct order of equivalent conductance at infinite dilution of LiCl, NaCl and KCl is

(A) LiCl > NaCl > KCl (B) KCl > NaCl > LiCl

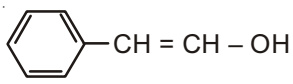
(C) NaCl > KCl > LiCl (D) LiCl > KCl > NaCl

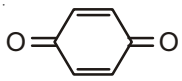
SECTION - II

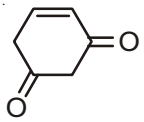
Multiple Correct Answers Type

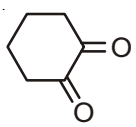
This section contains 5 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

31. Tautomerism is exhibited by

(A) 

(B) 

(C) 

(D) 

32. A new carbon-carbon bond formation is possible in

(A) Cannizzaro's reaction

(B) Friedel-crafts reaction

(C) Williamson's synthesis

(D) Reimer-tiemann reaction

33. Among the following compounds, which will react with acetone to give a product containing  ?

(A) $C_6H_5NH_2$ (B) $(CH_3)_3N$

(C) $C_6H_5NHC_6H_5$ (D) $C_6H_5NHNH_2$

34. The compound(s) that exhibit(s) geometrical isomerism is/are

(A) $[Pt(en)Cl_2]$ (B) $[Pt(en)_2]Cl_2$

(C) $[Pt(en)_2Cl_2]Cl_2$ (D) $[Pt(NH_3)Cl_2]$

35. The reagents, NH_4Cl and aqueous NH_3 will precipitate

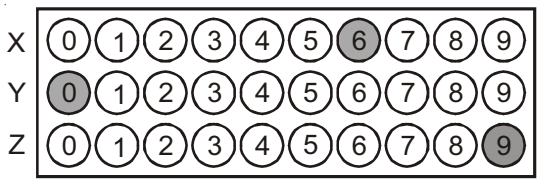
(A) Ca^{2+} (B) Al^{3+}

(C) Fe^{3+} (D) Mg^{2+}

SECTION-III

Integer Answer Type

This section contains 5 questions. The answer to each of the question is a single digit integer ranging from 0 to 9 (both inclusive). The appropriate bubbles corresponding to the respective question numbers in the OMR have to be darkened. For example, if the correct answers to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then the correct darkening of bubbles will look like the following :



36. What will be the ratio of volumes of 0.5 M H_2O_2 needed to react completely 1 M 1 L sodium thiosulphate in basic medium and in acidic medium?

37. A gas of He has all He^+ in 2^{nd} excited state. How many spectral lines are expected in its emission spectrum?

38. A vessel of volume 6 L at STP contains a gas of density 1.3 g/L. Some gas is taken out at the same temperature to lower the pressure to 0.22 atm. Estimate the mass of gas taken out in grams.

39. 3.9 g benzene(ℓ) undergoes combustion inside a bomb calorimeter of 20.9 kJ heat capacity at 27°C. Temperature rise is reported as 0.4°C. Determine the amount of heat transfer in the calorimeter at constant pressure 'in kcal'.

40. A mixture of air having 4 : 1 (mole ratio) mixture of N_2 and O_2 undergoes following change

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

If equilibrium pressure is 2 atm and K_p is 4, percent conversion of O_2 is 10x, then find x.

[PART-C : MATHEMATICS]

SECTION - I

Single Correct Answer Type

This section contains 10 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

41. If z is a complex number of argument $\frac{\pi}{4}$. Then the complex number given by $\frac{z^3 |\bar{z}|}{(\bar{z})^2 |z|^2}$ is equal to

(A) $\left(1+\frac{i}{\sqrt{2}}\right)$ (B) $\left(\frac{-1-i}{\sqrt{2}}\right)$

(C) $\left(\frac{1+i}{\sqrt{2}}\right)$ (D) $\left(-1+\frac{i}{\sqrt{2}}\right)$

42. If the locus of complex number z which satisfy the equation $\arg\left(\frac{z-p}{z-q}\right) = c$ is an arc of a circle, where $p, q \in z$ and $c \in R$. Then radius of the circle is

(A) $\frac{1}{2}|p+q|\operatorname{cosec} c$ (B) $\frac{1}{2}|p-q|\operatorname{cosec} c$

(C) $\frac{1}{2}|p+q|\cot c$ (D) $\frac{1}{2}|p-q|\cot c$

43. If $(1 + x + x^2)^n = a_0 + a_1x + a_2x^2 + \ldots + a_{2n}x^{2n}$ then which of the following is incorrect? (where $n \in N$)

(A) $a_0 - a_2 + a_4 - a_6 + \ldots = 0 \ \forall\ n = 4k + 1,\ k \in N$

(B) $a_1 - a_3 + a_5 - a_7 + \ldots = 0 \ \forall\ n = 4k,\ k \in N$

(C) $a_0a_2 - a_1a_3 + a_2a_4 - \ldots + a_{2n-2} \cdot a_{2n} = a_{n-1} \ \forall\ n \in N$

(D) $a_0a_2 - a_1a_3 + a_2a_4 - \ldots + a_{2n-2} \cdot a_{2n} = a_n \ \forall\ n \in N$

44. Fundamental period of the function

$$f(x)=\frac{\sin x}{\sqrt{1+\tan^2 x}}+\frac{\cos x}{\sqrt{1+\cot^2 x}} \text{ is}$$

(A) π (B) 2π

(C) 3π (D) 4π

45. The line $x\sin\theta - y\cos\theta = a$ touches the circle $x^2 + y^2 = a^2$, then

(A) $\theta\in\left[-\frac{\pi}{4},\frac{3\pi}{4}\right]$ (B) $\theta \in [0, 2\pi]$

(C) $\theta\in\left[-\frac{\pi}{2},\frac{\pi}{2}\right]$ (D) $\theta \in R$

46. Number of solutions of the equation $\sin\pi x + \sin\pi y = \sin\pi(x + y)$ and $|x| + |y| = \frac{1}{2}$ is/are

(A) 8 (B) 4

(C) 6 (D) Infinitely many

47. The value of $\lim\limits_{x\to 1}\frac{x\int_1^x f(t)dt}{x-1}$ is

(A) $f'(1)$ (B) $f(1) + f'(1)$

(C) $f(1)$ (D) $f(1) - f'(1)$

48. $\int_{-1}^{1}\left(\left[x^2\right]+\log\left(\frac{a+x}{a-x}\right)\right)dx$ is equal to (where $[\cdot]$ denotes greatest integer function)

(A) $2\log\left(\frac{1+a}{1-a}\right)$ (B) $1+2\log\left(\frac{1+a}{1-a}\right)$

(C) 0 (D) 1

49. $\int_0^{\pi/2}\frac{\sin^3 x\cdot\cos x}{\sin^4 x+\cos^4 x}dx$ is equal to

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$

(C) $\frac{\pi}{8}$ (D) $\frac{\pi}{16}$

50. A man travels from a point $A(1, 1, 1)$ along a straight line to reach the plane $2x + y + z = 1$ at the point P and then travels along a straight line to the point $B(2, 2, 4)$. If it is known that $AP + PB$ is minimum. Find the coordinate of point P.

(A) $\left(-\frac{1}{4},\frac{1}{2},-1\right)$ (B) $\left(\frac{1}{4},-\frac{1}{2},1\right)$

(C) $\left(-\frac{1}{4},\frac{1}{2},1\right)$ (D) $\left(\frac{1}{4},-\frac{1}{2},-1\right)$

SECTION - II

Multiple Correct Answers Type

This section contains 5 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

51. If $f(x)=\cos^{-1}x+\cos^{-1}\left(\frac{x}{2}+\frac{1}{2}\sqrt{3-3x^2}\right)$, then

(A) $f\left(\frac{1}{\sqrt{3}}\right)=\frac{\pi}{3}$

(B) $f\left(\frac{1}{3}\right)=2\cos^{-1}\frac{1}{3}-\frac{\pi}{3}$

(C) $f\left(-\frac{2}{3}\right)=2\cos^{-1}\left(-\frac{2}{3}\right)-\frac{\pi}{3}$

(D) $f\left(\frac{1}{\sqrt{2}}\right)=\frac{\pi}{3}$

52. The number of non-negative integral solutions of the inequation $x_1 + x_2 + x_3 + x_4 \le 21$ is

(A) ${}^{25}C_5$ (B) ${}^{25}C_4$

(C) ${}^{25}C_{20}$ (D) ${}^{25}C_{21}$

53. Let $\frac{-\pi}{2}<\theta<0$ and $b < 0$. If α and β ($\alpha < \beta$) are the two roots of the equation $(\cos\theta)x^2 + bx + \sin\theta = 0$, then

(A) $\alpha > 0, \beta < 0$

(B) $\alpha < 0, \beta > 0$

(C) $\alpha < 0 < \beta < |\alpha|$

(D) $\alpha < 0 < |\alpha| < |\beta|$

54. If $S = \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \frac{1}{256} + \ldots\ldots \text{to } \infty$, then

(A) $(0.04)^{\log_5 S} = 9$ (B) $\left(\frac{1}{27}\right)^{\log_3 S} = 27$

(C) $(0.04)^{\log_5 S} = \frac{1}{9}$ (D) $\left(\frac{1}{27}\right)^{\log_3 \frac{1}{S}} = \frac{1}{27}$

55. Two lines whose vector equations are

$\vec{r} = 2\hat{i} - \hat{j} + \hat{k} + \lambda\left(2\hat{i} + p\hat{j} + 5\hat{k}\right)$,

$\vec{r} = 3\hat{i} + 2\hat{j} + 3\hat{k} + \mu\left(3\hat{i} - p\hat{j} + p\hat{k}\right)$

are perpendicular to each other for all the values of λ and μ, then p is equal to

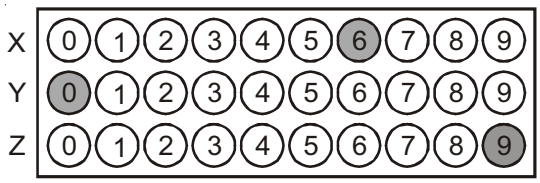
(A) 1 (B) –1

(C) –6 (D) 6

SECTION-III

Integer Answer Type

This section contains 5 questions. The answer to each of the question is a single digit integer, ranging from 0 to 9 (both inclusive). The appropriate bubbles corresponding to the respective question numbers in the OMR have to be darkened. For example, if the correct answers to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then the correct darkening of bubbles will look like the following :



56. Number of three digits number of the form xyz, where $x \le y \ge z$ is $110k$, then k is equal to _____.

57. The value of $\tan(\cot^{-1}2 + \cot^{-1}8 + \cot^{-1}18 + \cot^{-1}32 + \ldots\ldots \text{ upto } \infty)$ is _____.

58. If $\frac{1-\cos\alpha+\sin\alpha}{1+\sin\alpha} = \frac{1}{7}$, then the value of $\left(\frac{1+\cos\alpha+\sin\alpha}{2\sin\alpha}\right)$ is _____ .

59. If $ax^4 + bx^3 + cx^2 + dx + e = \begin{vmatrix} x^2+1 & 5x+3 & x-1 \\ x^2-2 & x+5 & 3x+1 \\ x^2+5x & x-2 & x+3 \end{vmatrix}$, then the value of a is _____.

60. Let $3x^2 + 8xy - 3y^2 = 0$ be the equation of pair of tangents drawn from origin to a circle of radius $\sqrt{2}$ units. Then, the distance of centre of the circle from the origin is _____.

❑ ❑ ❑

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Time : 3 Hrs. **MM : 210**

MOCK TEST PAPER
for
JEE (Advanced)-2016
(Paper-1)
(*Complete Syllabus of Class XI & XII*)

ANSWERS

Physics		Chemistry		Mathematics	
1.	(B)	21.	(C)	41.	(B)
2.	(D)	22.	(A)	42.	(B)
3.	(A)	23.	(D)	43.	(D)
4.	(D)	24.	(D)	44.	(B)
5.	(C)	25.	(D)	45.	(D)
6.	(A)	26.	(C)	46.	(C)
7.	(A)	27.	(D)	47.	(C)
8.	(C)	28.	(A)	48.	(C)
9.	(C)	29.	(A)	49.	(C)
10.	(B)	30.	(B)	50.	(C)
11.	(A, B, C ,D)	31.	(A, C, D)	51.	(A, B, C, D)
12.	(A, B, C)	32.	(B, D)	52.	(B, D)
13.	(A, B, C)	33.	(A, D)	53.	(B, D)
14.	(A, C)	34.	(C, D)	54.	(A, B, D)
15.	(A, B, C, D)	35.	(B, C)	55.	(B, D)
16.	(3)	36.	(8)	56.	(3)
17.	(2)	37.	(3)	57.	(1)
18.	(9)	38.	(6)	58.	(7)
19.	(5)	39.	(2)	59.	(8)
20.	(7)	40.	(8)	60.	(2)

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[HINTS & SOLUTIONS]

[PHYSICS]

1. Answer (B)

Potential at centre of a uniform solid sphere is $-\frac{3}{2}\frac{GM}{R}$.

Same potential will exist at the centre of base of a hemisphere.

So, $W_{GF} = -\Delta U$

$$= \frac{-3}{2}\frac{GMm}{R}$$

2. Answer (D)

$\varepsilon_0 L\frac{\Delta V}{\Delta t}$ is current

3. Answer (A)

From work-energy theorem,

$W = \Delta$K.E.

$$= K_2 - K_1 = \frac{1}{2}m\left(v_2^2 - v_1^2\right)$$

$$= \frac{1}{2}\times 2\left(400-100\right) = 300 \text{ J}$$

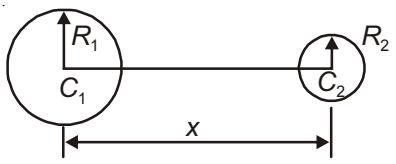
4. Answer (D)

x-co-ordinate of C.M. will remain unchanged

$\therefore \quad (M + m)x - mL\cos\theta = 0$

$\therefore \quad x = \frac{mL\cos\theta}{M+m}$ (Towards left)

5. Answer (C)



Magnetic moment of $M_2 = I_2A_2$

$$M_2 = I_2\pi R_2^2\hat{i}$$

Potential energy,

$$U = -\vec{M}_2.\vec{B}_1 = \frac{\mu_0}{4\pi}\frac{2\pi^2R_1^2R_2^2I_1I_2}{\left[R_1^2+x^2\right]^{3/2}}$$

$$F = -\frac{dU}{dx} = \frac{\mu_0}{4\pi}\left[2\pi^2R_1^2R_2^2I_1I_2\right]\frac{d}{dx}\left[R_1^2+x^2\right]^{-3/2}$$

$$\Rightarrow F = \frac{\mu_0}{4\pi}.\frac{6\pi^2R_1^2R_2^2I_1I_2}{\left(R_1^2+x^2\right)^{5/2}}x = \frac{3}{2}\frac{\mu_0\pi I_1I_2R_1^2R_2^2x}{\left(R_1^2+x^2\right)^{5/2}}$$

6. Answer (A)

$$C_1 = k\frac{4\pi\varepsilon_0 ab}{b-a}$$

$$C_2 = \frac{4\pi\varepsilon_0 bc}{c-b}$$

$$C = \frac{C_1C_2}{C_1+C_2}$$

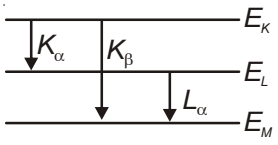
7. Answer (A)

$E_{K_\alpha} = E_K - E_L$

$E_{K_\beta} = E_K - E_M$

$E_{L_\alpha} = E_L - E_M$

$E_{K_\beta} = E_{K_\alpha} + E_{L_\alpha}$



$h\nu_{K_\beta} = h\nu_{K_\alpha} + h\nu_{L_\alpha}$

$\therefore \quad \nu_{L_\alpha} = f_2 - f_1$

8. Answer (C)

$\tan\theta = \dfrac{a}{g} = \dfrac{\frac{L}{2}}{2L} = \dfrac{1}{4}$

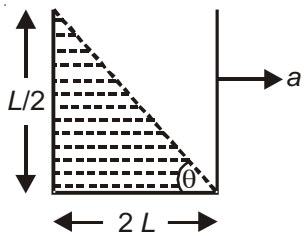
As $a < \mu g$ beaker does not slide against plank.

$\therefore$ From the given figure acceleration of the system can be written as

$a = \dfrac{M_1 g}{2M + M}$

$\dfrac{g}{4} = \dfrac{M_1}{2M + M_1} g$

$\Rightarrow \quad \dfrac{2M}{3} = M_1$



9. Answer (C)

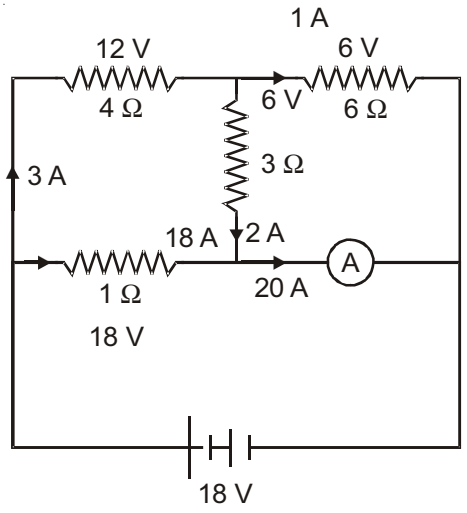
$\lambda \propto \dfrac{1}{nd^2}$

n = number of molecules per unit volume.

d = diameter of the molecule

As n & d are not changing and λ remains same.

10. Answer (B)



V across 1Ω is 18 V, hence i = 18 V.

V across 3Ω is $18 \times \dfrac{2}{6}$ = 6 V, hence i = 2 A

$\therefore$ Total current in ammeter is 18 + 2 = 20 A.

11. Answer (A, B, C, D)

$q = 3(1 - e^{-t})$; $i = +3e^t$

$t = 0$; $q = 0$; $i = 3$ A

$20 - v = \dfrac{q}{C} + 3 \Rightarrow v = 17$ volt

12. Answer (A, B, C)

$F = -\dfrac{du}{dx}; \quad x_0 = \dfrac{2a}{b}$

$F_{net} = \dfrac{2a}{(x_0 + \Delta x)^3} - \dfrac{b}{(x_0 + \Delta x)^2} = -\dfrac{b^4}{8a^3}\Delta x$

It is SHM $\omega^2 = \dfrac{b^4}{8ma^3}$

13. Answer (A, B, C)

$f = (2n-1)\dfrac{v}{4l}$

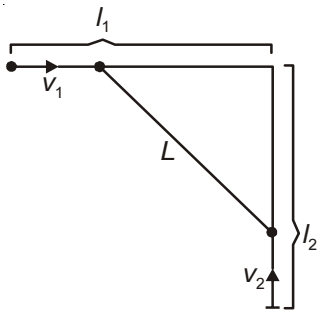
$L = \dfrac{(2n-1)v}{4f}$ $\quad n$ = 1, 3, 5 .....

L = 25, 75, 125 cm

$L + h$ = 120 cm

h = 45 cm

14. Answer (A, C)



use $L^2 = (l_1 - v_1 t)^2 + (l_2 - v_2 t)^2$.

$\Rightarrow \quad \dfrac{dL}{dt} = 0$

$\Rightarrow \quad t = \dfrac{v_1 l_1 + v_2 l_2}{(v_1^2 + v_2^2)}$ and $L_{min} = \dfrac{l_1 v_2 - l_2 v_1}{\sqrt{v_1^2 + v_2^2}}$

15. Answer (A, B, C, D)

(A) & (B) $\Rightarrow \frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{\frac{I_1}{I_2}}+1}{\sqrt{\frac{I_1}{I_2}}-1}\right)^2$

(C) The maximum path difference will be less than λ for $d = \lambda$. Thus, only one maximum will be observed. $d \sin\theta = x\lambda$. $\sin\theta = \frac{x\lambda}{d} \Rightarrow \sin\theta < 1$.

$\Rightarrow x < \frac{d}{\lambda}$

(D) The maximum path difference will exceed λ. So more than 1 maximum will be obtained.

$d \sin\theta = x\lambda$. $\sin\theta = \frac{x\lambda}{d} \Rightarrow \sin\theta < 1. \Rightarrow x < \frac{d}{\lambda}$

16. Answer (3)

$\rho = -\frac{d}{R}r + d$

We have $\int_0^R d\left(1-\frac{r}{R}\right)4\pi r^2 dr = Ze$

$d = \frac{3Ze}{\pi R^3} \Rightarrow n = 3$

17. Answer (2)

$v = \frac{Kq}{3r} + \frac{Kq_1}{r}; q_1 = \frac{-q}{3} = 2$

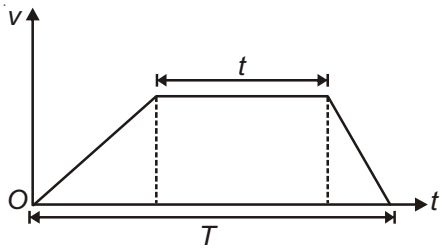
$\Rightarrow \quad q_1 = 2c$

18. Answer (9)

t be time of uniform motion;

$v = \frac{(T-t)}{2}a$

Distance covered = $\frac{1}{2}\times(T+t)v = \frac{1}{2}\times\frac{\left(T^2-t^2\right)}{2}a$



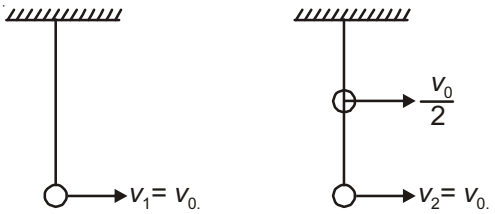
$s = \frac{1}{4}\left(T^2-t^2\right)a$

t = 9 s

19. Answer (5)

$-mg2l + \frac{1}{2}(2m)v_0^2 = 0$

$mgl + mg\frac{l}{2} = \frac{1}{2}mv_0^2 + \frac{1}{2}m\left(\frac{v_0}{2}\right)^2$



$v_1 = \sqrt{2gl}$

$v_2 = \sqrt{\frac{12}{5}gl}$

20. Answer (7)

$T\frac{l}{2}\sin(90-\alpha) = W\ l\sin\alpha$

$\Rightarrow \quad T = 2W\tan\alpha$ = 7N

[CHEMISTRY]

21. Answer (C)

Let compound = 100

$$\left.\begin{aligned} &C = 24.24\,g = \frac{24.24}{12} = 2.02\,mole \\ &Cl = 71.72\,g = \frac{71.72}{35.5} = 2.02\,mole \\ &H = 100-71.72-24.24 = 4.04\,g = \frac{4.04}{1}\,mole \end{aligned}\right\} C_2H_4Cl_2$$

22. Answer (A)

For He^+ ; $2s = 2p$

23. Answer (D)

$Z_{eff} = Z - \sigma = 2 - 0.35 = 1.65$

24. Answer (D)

Fact.

25. Answer (D)

26. Answer (C)

2° : 2 × 3.8 = 7.6 parts

1° : 6 × 1 = 6 parts (2 equivalent terminals)

3° : 1 × 5 = 5 parts

1° : 1 × 3 = 3 parts (1 different terminal)

27. Answer (D)

Compound is organic, so, the gaseous products are H_2O and CO_2. Oxidation state of carbon is "+4".

28. Answer (A)

$K = K_1 \times K_2 = 5.95 \times 10^{-6}$

29. Answer (A)

	$N_2O_4 \rightleftharpoons$	$2NO_2$	Total
	$1-\alpha$	2α	$1+\alpha$
P_i	$\frac{1-\alpha}{1+\alpha}p$	$\frac{2\alpha}{1+\alpha}p$	

$$K_p = \frac{4\alpha^2}{1-\alpha^2}\cdot p = \frac{4(0.25)^2}{1-(0.25)^2} = 0.26 \text{ atm}$$

When p = 0.1 atm

$$\Rightarrow \quad 0.26 = \frac{4\alpha^2(0.1)}{1-\alpha^2} \Rightarrow \alpha \approx 0.63 \text{ atm}$$

$\Rightarrow$ $100\alpha = 63\%$

30. Answer (B)

Cations have same charge but different size. Smaller ions are more hydrated and have smaller ionic speeds and hence smaller equivalent conductance.

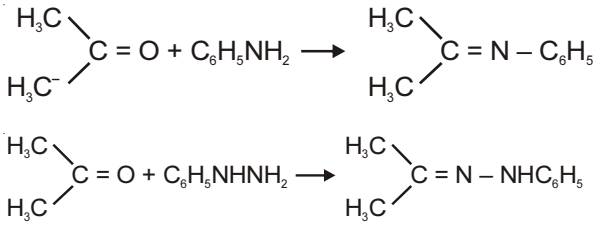
$\Rightarrow$ Equivalent conductance : KCl > NaCl > LiCl

31. Answer (A, C, D)

All those carbonyl compounds containing α – H to sp^2 carbon show keto-enol tautomerism.

32. Answer (B, D)

33. Answer (A, D)



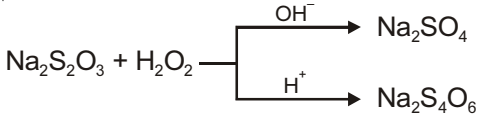
34. Answer (C, D)

Fact based

35. Answer (B, C)

Fact based

36. Answer (8)



Ratio of volumes of H_2O_2

= Ratio of valence factors of $Na_2S_2O_3$

$$= \frac{8}{1}$$

37. Answer (3)

For any shell $2\pi r = n\lambda$, n = number of wavelengths

Here n = 3

$$\text{Number of spectral lines (emission)} = \frac{2\times 3}{2} = 3$$

38. Answer (6)

Mass taken out = (n – n′) × M

(n and n′ are initial and final number of moles of gas in vessel)

$$= (n-n')\times\frac{\rho RT}{P}$$

$$= \frac{V}{RT}(P-P')\times\frac{\rho RT}{P}$$

$$= \frac{6\times 1.3\times(1-0.22)}{1} = 6.084 \text{ g} \approx 6$$

39. Answer (2)

Heat transfer = $\Delta H = \Delta U + P\Delta V + V\Delta P$

In bomb calorimeter,

$\Delta V = 0$

At constant pressure,

$\Delta P = 0$

$$\therefore \quad \Delta H = \Delta U - \frac{20.9\times 0.4}{4.18} = 2 \text{ kcal}$$

40. Answer (8)

$N_{2(g)}$	+ $O_{2(g)}$	$\rightleftharpoons$ $2NO_{(g)}$	
1.6 atm	0.4 atm	0	t = 0
1.6 – p	0.4 – p	2p	at equilibrium

$$K_p = \frac{2p\times 2p}{(1.6-p)(0.4-p)} = 4$$

$$\Rightarrow \quad \frac{4p^2}{p^2-2p+0.64} = 4$$

$\Rightarrow$ $4p^2 = 4p^2 - 8p + 2.56$

$\therefore$ p = 0.32 atm

$$\text{Percent conversion of } O_2 = \frac{0.32}{0.40}\times 100 = 80$$

$\Rightarrow$ 10x = 80

$\therefore$ x = 8

[MATHEMATICS]

41. Answer (B)

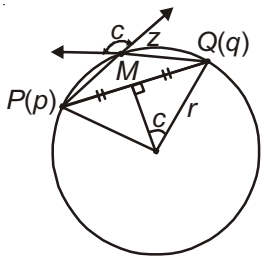
Let $z = re^{i\pi/4}$

$\therefore \quad \bar{z} = re^{-i\pi/4}$

$$\therefore \quad \frac{z^3 \,|\, \bar{z} \,|}{(\bar{z})^2 \,|\, z \,|^2} = \frac{r^3 e^{i\frac{3\pi}{4}} \times r}{r^2 e^{-i\frac{\pi}{2}} \times r^2} = e^{i\left(\frac{3\pi}{4}+\frac{\pi}{2}\right)}$$

$$= e^{i\left(\frac{3\pi}{2}-\frac{\pi}{4}\right)} = -\frac{1}{\sqrt{2}}(1+i)$$

42. Answer (B)



From figure

$$\because \quad \sin c = \frac{QM}{r}$$

$$\therefore \quad QM = r\sin c \quad \text{or} \quad r = QM\,\text{cosec}\, c$$

$$= \frac{1}{2} \,|\, p - q \,|\, \text{cosec}\, c$$

43. Answer (D)

$$\because \quad (1 + x + x^2)^n = \sum_{r=0}^{n} a_r x^r \qquad \ldots(i)$$

On putting, $x = i$

$(i)^n = (a_0 - a_2 + a_4 - a_6 + \ldots) + i(a_1 - a_3 + a_5 - \ldots)$

For, $n = 4k$; $k \in N$

$a_0 - a_2 + a_4 - a_6 + \ldots = 1$

and $a_1 - a_3 + a_5 - a_7 + \ldots = 0$

For, $n = 4k + 1$; $k \in N$

$a_0 - a_2 + a_4 - a_6 + \ldots = 0$

and $a_1 - a_3 + a_5 - a_7 + \ldots = 1$

On putting $\frac{1}{x}$ in place of x in (i)

$$\left(1 + \frac{1}{x} + \frac{1}{x^2}\right)^n = \sum_{r=0}^{n} a_r \left(\frac{1}{x}\right)^r \qquad \ldots(ii)$$

Now $\because (1 - x + x^2)^n = a_0 - a_1 x + a_2 x^2 + \ldots + a_{2n} x^{2n}$

and $\left(1 + \frac{1}{x} + \frac{1}{x^2}\right)^n = a_0 + \frac{a_1}{x} + \frac{a_2}{x^2} + \ldots + a_{2n}\frac{1}{x^{2n}}$

$\therefore \quad a_0 a_2 - a_1 a_3 + a_2 a_4 - \ldots + a_{2n-2} a_{2n}$

= Coefficient of x^{-2}

in the expansion of $(1 - x + x^2)^n \left(1 + \frac{1}{x} + \frac{1}{x^2}\right)^n$

= Coefficient of x^{-2}

in the expansion of $\left(\frac{1 + x^2 + x^4}{x^2}\right)^n$

= Coefficient of x^{2n-2}

in the expansion of $(1 + x^2 + x^4)^n$

= Coefficient of x^{2n-2}

in the expansion of $\sum_{r=0}^{2n} a_r x^{2r} = a_{n-1}$

44. Answer (B)

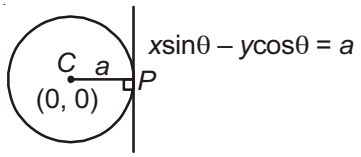
$$\because \quad f(x) = \frac{\sin x}{|\sec x|} + \frac{\cos x}{|\text{cosec} x|}$$

$= \sin x|\cos x| + \cos x|\sin x|$

$$= \begin{cases} \sin 2x & ; \quad 0 \le x < \frac{\pi}{2} \\ 0 & ; \quad \frac{\pi}{2} \le x < \pi \\ -\sin 2x & ; \quad \pi \le x < \frac{3\pi}{2} \\ 0 & ; \quad \frac{3\pi}{2} \le x < 2\pi \end{cases}$$

Obviously, $T = 2\pi$

45. Answer (D)



From question,

$$CP = \frac{|\, a \,|}{\sqrt{\cos^2\theta + \sin^2\theta}} = a \;\forall\, \theta \in R$$

So, the line $x\sin\theta - y\cos\theta$

$= a$ touches the circle $x^2 + y^2$

$= a^2$ always $\forall\ \theta \in R$.

46. Answer (C)

$\because$ $\sin\pi x + \sin\pi y = \sin(x + y)\pi$

or $2\sin\left(\frac{\pi(x+y)}{2}\right)\cos\left(\frac{\pi(x-y)}{2}\right)$

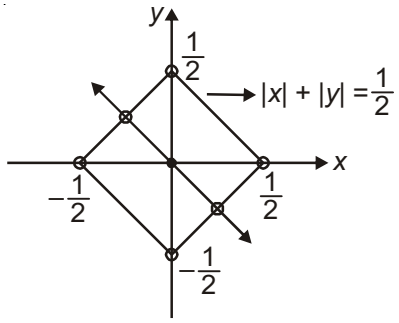
$= 2\sin\left(\frac{(x+y)\pi}{2}\right)\cos\left(\frac{(x+y)\pi}{2}\right)$

or $2\sin\left(\frac{\pi(x+y)}{2}\right)\left[\cos\left(\frac{\pi(x-y)}{2}\right)-\cos\left(\frac{\pi(x+y)}{2}\right)\right]=0$

or $2\sin\left(\frac{\pi(x+y)}{2}\right)\times 2\sin\left(\frac{\pi x}{2}\right)\sin\left(\frac{\pi y}{2}\right)=0$

$\Rightarrow$ $x + y = 2n_1$ or $x = 2n_2$

or $y = 2n_3$ where $n_1, n_2, n_3 \in I$



As, $x + y$ = even or x = even or y = even and

$\because$ $|x| + |y| = \frac{1}{2}$

$\therefore$ Number of possible solutions for the system of equation as shown in figure are 6.

i.e., $\left(\frac{1}{2}, 0\right), \left(-\frac{1}{2}, 0\right), \left(0, \frac{1}{2}\right), \left(0, -\frac{1}{2}\right),$

$\left(-\frac{1}{4}, \frac{1}{4}\right)$ and $\left(\frac{1}{4}, -\frac{1}{4}\right)$

47. Answer (C)

$$L = \lim_{x\to 1}\frac{x\int_1^x f(t)dt}{x-1}$$

$$= \lim_{x\to 1} xf(x) + \int_1^x f(t)dt$$

$= f(1)$

48. Answer (C)

$$\int_{-1}^{1}\left(\left[x^2\right]+\log\frac{(a+x)}{(a-x)}\right)dx$$

$$= \int_{-1}^{1}\left[x^2\right]dx + \int_{-1}^{1}\log\left(\frac{a+x}{a-x}\right)dx$$

$= 0 + 0$

$\because$ for $0 \le x^2 < 1$, $[x^2] = 0$

and $\log\frac{(a+x)}{(a-x)}$ is a odd function

49. Answer (C)

$$I = \int_0^{\pi/2}\frac{\sin^3 x\cdot\cos x}{\sin^4 x+\cos^4 x}dx = \int_0^{\pi/2}\frac{\cos^3 x\cdot\sin x}{\sin^4 x+\cos^4 x}dx$$

$$2I = \int_0^{\pi/2}\frac{\sin x\cos x\left(\sin^2 x+\cos^2 x\right)}{\sin^4 x+\cos^4 x}dx$$

$$2I = \int_0^{\pi/2}\frac{\frac{1}{2}(\sin 2x)}{1-\frac{1}{2}\sin^2 2x}dx$$

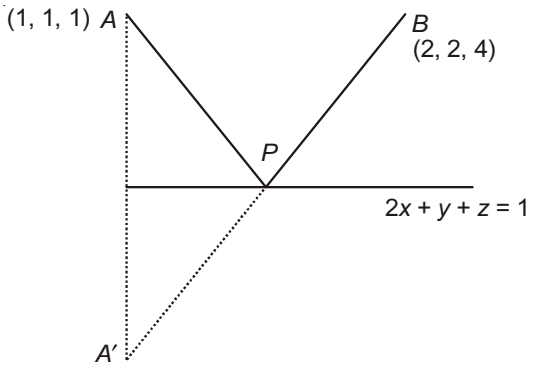
Let $\cos 2x = t$ and $-2\sin 2x dx = dt$

$$\frac{1}{2}\int_{-1}^{1}\frac{dt}{1+t^2} = \frac{1}{2}\left(\tan^{-1}t\right)_{-1}^{1} = \frac{1}{2}\left(\frac{\pi}{4}+\frac{\pi}{4}\right)$$

$\Rightarrow$ $2I = \frac{\pi}{4}$

$\Rightarrow$ $I = \frac{\pi}{8}$

50. Answer (C)



A' is the image of point A, then $AP + PB$ is minimum when coordinate of $A'PB$ form a straight line image of point A *i.e.*, A'

$$\frac{x-1}{2}=\frac{y-1}{1}=\frac{z-1}{1}=\frac{-2(2+1+1-1)}{6}$$

A' (–1, 0, 0)

Equation of line $A'B$ is $\frac{x+1}{3}=\frac{y}{2}=\frac{z}{4}=\lambda$

General point of line $(3\lambda - 1, 2\lambda, 4\lambda)$

To find the coordinate of point P, general point on line will satisfy the equation of plane

$2(3\lambda - 1) + 2\lambda + 4\lambda = 1$

$\Rightarrow\ 6\lambda - 2 + 2\lambda + 4\lambda = 1$

$\Rightarrow\ 12\lambda = 3$

$\Rightarrow\ \lambda = \frac{1}{4}$

51. Answer (A, B, C, D)

Let, $x = \cos\theta$, $\theta = \cos^{-1}x \Rightarrow 0 \le \theta \le \pi$

$$\therefore\ \cos^{-1}\left(\frac{x}{2}+\frac{1}{2}\sqrt{3-3x^2}\right)$$

$$=\cos^{-1}\left(\frac{\cos\theta}{2}+\frac{\sqrt{3}}{2}\sin\theta\right)$$

$$=\cos^{-1}\left(\cos\left(\theta-\frac{\pi}{3}\right)\right)$$

$$=\begin{cases}\theta-\frac{\pi}{3} & ;\ 0\le\theta-\frac{\pi}{3}\le\pi\\ -\left(\theta-\frac{\pi}{3}\right) & ;\ -\pi\le\theta-\frac{\pi}{3}<0\end{cases}$$

$$=\begin{cases}\cos^{-1}x-\frac{\pi}{3} & ;\ \frac{\pi}{3}\le\cos^{-1}x\le\pi\\ \frac{\pi}{3}-\cos^{-1}x & ;\ 0\le\cos^{-1}x<\frac{\pi}{3}\end{cases}$$

$$\therefore\ f(x)=\begin{cases}2\cos^{-1}x-\frac{\pi}{3} & ;\ -1\le x\le\frac{1}{2}\\ \frac{\pi}{3} & ;\ \frac{1}{2}<x\le 1\end{cases}$$

Obviously all the options are correct.

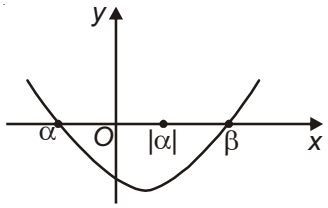
52. Answer (B, D)

Let x_5 be such that $x_1 + x_2 + x_3 + x_4 + x_5 = 21$

$\therefore$ Number of non-negative integral solution

$= {}^{21+5-1}C_{5-1} = {}^{25}C_4 = {}^{25}C_{21}$

53. Answer (B, D)



$\because$ The equation $(\cos\theta)x^2 + bx + \sin\theta = 0$ has two roots α and β, such that $\alpha+\beta=-\frac{b}{\cos\theta}>0$

($\because$ $b < 0$ and $\cos\theta > 0$ in the 4th quadrant)

Now $\alpha\beta = \tan\theta < 0$ $\because$ θ lies in 4th quadrant

So, finally $\alpha + \beta > 0$ and $\alpha\beta < 0$

($\because$ x-co-ordinate of turning point lies on the right side of x-axis)

$\therefore$ It can be easily said that $\alpha < 0 < |\alpha| < \beta$

54. Answer (A, B, D)

$$S=\frac{\frac{1}{4}}{1-\frac{1}{4}}=\frac{1/4}{3/4}=\frac{1}{3}$$

Now, $(0.04)^{\log_5 S}=(5^{-2})^{\log_5 S}=\frac{1}{S^2}=9$

$$\left(\frac{1}{27}\right)^{\log_3 S}=(3^{-3})^{\log_3 S}=S^{-3}=\frac{1}{S^3}=27$$

and $\left(\frac{1}{27}\right)^{\log_3\frac{1}{S}}=\left(\frac{1}{S}\right)^{-3}\Rightarrow S^3=\frac{1}{27}$

55. Answer (B, D)

$$\left(2\hat{i}+p\hat{j}+5\hat{k}\right)\cdot\left(3\hat{i}-p\hat{j}+p\hat{k}\right)=0$$

$\Rightarrow\ 6 - p^2 + 5p = 0$

$\Rightarrow\ p^2 - 5p - 6 = 0$

$\Rightarrow\ p = -1, 6$

56. Answer (3)

$x \le y \ge z$, $x \ne 0$

For $y = 0$, $\longrightarrow$ No number is possible

For $y = 1$, $\square$ $\boxed{1}$ $\square$

1 0 or 1

$\longrightarrow$ 1 × 2 numbers are possible

Similarly, For $y = 2$, $\square\ 2\ \square$ (1 or 2; 0 or 1 or 2)

$\longrightarrow 2 \times 3$ numbers are possible

Similarly, For $y = 9$, $\square\ 9\ \square$ (1 to 9; 0 to 9)

$\longrightarrow 9 \times 10$ numbers are possible

So, the total number of such numbers are

$$\sum_{r=1}^{9} r(r+1) = 330 = 3(110)$$

$\therefore\ k = 3$

57. Answer (1)

Let, $S_n = \cot^{-1}2 + \cot^{-1}8 + \cot^{-1}18 + \cot^{-1}32 + \ldots + \cot^{-1}2n^2$

$\therefore\ T_r = \cot^{-1}2r^2$

$$= \tan^{-1}\frac{1}{2r^2} = \tan^{-1}\frac{(2r+1)-(2r-1)}{1+(2r+1)(2r-1)}$$

$$= \tan^{-1}(2r+1) - \tan^{-1}(2r-1)$$

$\therefore\ S_n = \tan^{-1}3 - \tan^{-1}1 + \tan^{-1}5 - \tan^{-1}3 + \ldots + \tan^{-1}(2n+1) - \tan^{-1}(2n-1)$

$$= \tan^{-1}(2n+1) - \tan^{-1}1$$

$$\therefore\ S_{\infty} = \lim_{n\to\infty} S_n = \frac{\pi}{2} - \frac{\pi}{4} = \frac{\pi}{4}$$

$\therefore\ \tan(\cot^{-1}2 + \cot^{-1}8 + \cot^{-1}18 + \ldots + \text{upto } \infty)$

$$= \tan\frac{\pi}{4} = 1$$

58. Answer (7)

Let $k = \dfrac{1-\cos\alpha+\sin\alpha}{1+\sin\alpha} \times \dfrac{1+\sin\alpha+\cos\alpha}{1+\sin\alpha+\cos\alpha}$

$$= \frac{(1+\sin\alpha)^2 - \cos^2\alpha}{(1+\sin\alpha)(1+\sin\alpha+\cos\alpha)}$$

$$= \frac{2\sin\alpha(1+\sin\alpha)}{(1+\sin\alpha)(1+\sin\alpha+\cos\alpha)}$$

$$= \frac{2\sin\alpha}{1+\sin\alpha+\cos\alpha}$$

$$\therefore\ \frac{1+\sin\alpha+\cos\alpha}{2\sin\alpha} = \frac{1}{k} = \frac{1}{1/7} = 7$$

59. **Answer (8)**

On putting $\frac{1}{x}$ in place of x, we get

$ex^4 + dx^3 + cx^2 + bx + a$

$$= \begin{vmatrix} 1+x^2 & 5+3x & 1-x \\ 1-2x^2 & 1+5x & 3+x \\ 1+5x & 1-2x & 1+3x \end{vmatrix}$$

Now, on putting $x = 0$, we get

$$a = \begin{vmatrix} 1 & 5 & 1 \\ 1 & 1 & 3 \\ 1 & 1 & 1 \end{vmatrix}$$

$$= \begin{vmatrix} 0 & 4 & -2 \\ 0 & 0 & 2 \\ 1 & 1 & 1 \end{vmatrix}$$ Applying $R_1 \to R_1 - R_2$, $R_2 \to R_2 - R_3$

$= 8$

So, $a = 8$

60. Answer (2)

$3x^2 + 8xy - 3y^2 = 0$

$3x^2 + 9xy - xy - 3y^2 = 0$

or $3x(x+3y) - y(x+3y) = 0$

$\therefore\ (3x-y)(x+3y) = 0$

$\because\ \angle POQ = \frac{\pi}{2}$ (coefficient of x^2 + coefficient of $y^2 = 0$)

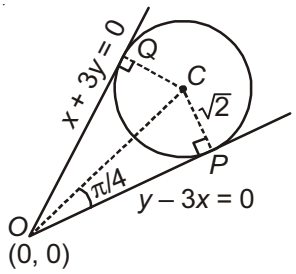
$\therefore\ \angle POC = \frac{1}{2}\angle POQ = \frac{\pi}{4}$

$\therefore\ \sin\frac{\pi}{4} = \frac{CP}{OC}$

$\Rightarrow\ CP = OC \times \frac{1}{\sqrt{2}}$

or $\sqrt{2} = OC \times \frac{1}{\sqrt{2}}$

$\therefore\ OC = 2$



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