



Aakash

Medical | IIT-JEE | Foundations

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Time : 3 Hrs.

MOCK TEST PAPER

MM : 198

for

JEE (Advanced)-2016

(Paper-2)

(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 198.
- (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 8 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 three paragraphs. Based upon each paragraph 2 multiple choice questions have to be answered. Each question has only one correct answer and carries **+3 marks** for correct answer and **-1 mark** for wrong answer.
- (vi) **Section-III** contains 6 multiple choice questions which have one or more answers are correct. Each question carries **+4 marks** for correct answer(s). There are no negative marks in this section.

[PART-A : PHYSICS]

SECTION - I

Single Correct Answer Type

This section contains 8 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. If percentage error in a , b , c and d are 1%, 2%, 3% and 4% respectively, which of the following has error 7%?

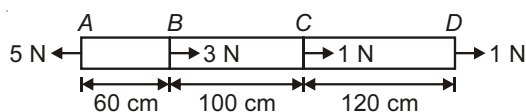
(A) $\frac{a^2 b^2}{c}$

(B) $\frac{d}{a^3}$

(C) $\frac{c^2 d}{b}$

(D) $d^2 a$

2. A brass bar having cross-sectional area 10 cm^2 is subjected to axial forces as shown in figure. Total elongation of the bar is (Take $Y = 8 \times 10^{12} \text{ N cm}^{-2}$)



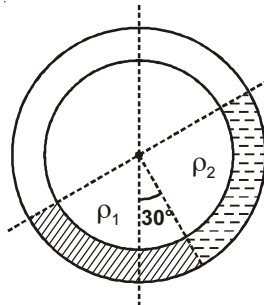
(A) 0.0775 cm

(B) 0.75 cm

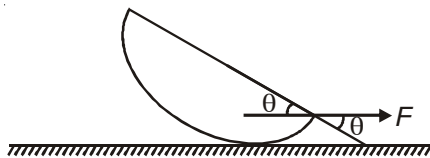
(C) 7.5 cm

(D) 75 cm

3. A thin uniform circular tube is kept in a vertical plane. Equal volumes of two immiscible liquid whose densities are ρ_1 and ρ_2 fill half of the tube as shown. In equilibrium the radius passing through the interface makes an angle of 30° with vertical. The ratio of densities (ρ_1/ρ_2) is equal to

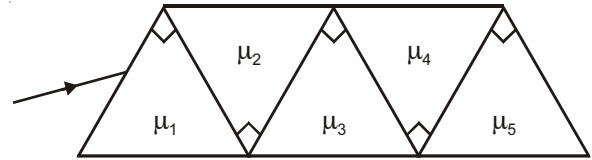


- (A) $\frac{\sqrt{3}-1}{2-\sqrt{3}}$ (B) $\frac{\sqrt{3}+1}{2+\sqrt{3}}$
 (C) $\frac{\sqrt{3}-1}{\sqrt{3}+1}$ (D) $\frac{\sqrt{3}+1}{\sqrt{3}-1}$
4. A man crosses the river, perpendicular to river flow in time t second and travels an equal distance, down the stream, in T second. The ratio of man's speed in still water to the speed of river water will be
- (A) $\frac{t^2 - T^2}{t^2 + T^2}$ (B) $\frac{T^2 - t^2}{T^2 + t^2}$
 (C) $\frac{t^2 + T^2}{t^2 - T^2}$ (D) $\frac{T^2 + t^2}{T^2 - t^2}$
5. A uniform solid hemisphere of radius r and mass M is pulled horizontally by means of a string so that it moves with a uniform velocity. If μ is the coefficient of friction between the hemisphere and surface, find the angle of inclination of the hemisphere. (The centre of mass of a hemisphere is located at a distance $3r/8$ from the centre)

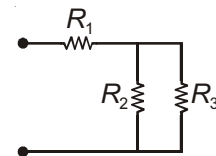


- (A) $\sin^{-1}\left[\frac{\mu}{3+8\mu}\right]$ (B) $\sin^{-1}\left[\frac{2\mu}{3+8\mu}\right]$
 (C) $\sin^{-1}\left[\frac{\mu}{3+\mu}\right]$ (D) $\sin^{-1}\left[\frac{8\mu}{3+8\mu}\right]$

6. The diagram shows five isosceles right angled prism. A light ray incident at 90° at the first face emerges at same angle with the normal from the last face. Find the relation between the refractive indices



- (A) $\mu_1^2 + \mu_2^2 + \mu_3^2 = 2 + \mu_4^2 + \mu_5^2$
 (B) $\mu_1^2 + \mu_3^2 + \mu_5^2 = 2 + \mu_2^2 + \mu_4^2$
 (C) $\mu_1^2 + \mu_2^2 + \mu_3^2 = 3 + \mu_4^2 + \mu_5^2$
 (D) $\mu_1^2 + \mu_3^2 + \mu_5^2 = 3 + \mu_2^2 + \mu_4^2$
7. A particle of mass m , moves around in a circular orbit, in a centre symmetric potential field $U(r) = \frac{kr^2}{2}$. Using Bohr's quantization rule, the permissible energy levels are
- (A) $\frac{1}{4\pi} \sqrt{\frac{k}{m}}$
 (B) $\frac{nh}{2\pi} \sqrt{\frac{k}{m}}$
 (C) $\frac{1}{2\pi} \sqrt{\frac{nhk}{m}}$
 (D) $\frac{nh}{2\pi}$
8. For ensuring dissipation of same energy in all three resistances [R_1, R_2, R_3] connected as shown in figure, their values must be related as



- (A) $R_1 = R_2 = R_3$
 (B) $R_2 = R_3$ and $R_1 = 4R_2$
 (C) $R_2 = R_3$ and $R_1 = \frac{1}{4}R_2$
 (D) $R_1 = R_2 + R_3$

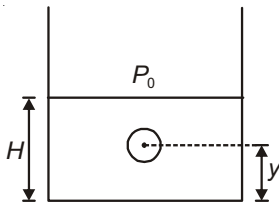
SECTION-II

Paragraph Type

This section contains three paragraphs with 2 questions on each paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 9 & 10

A small spherical monoatomic ideal gas bubble ($\gamma = \frac{5}{3}$) is trapped inside a liquid of density ρ_l , (see figure). Assume that the bubble does not exchange any heat with the liquid. The bubble contains n moles of gas. The temperature of the gas when the bubble is at the bottom is T_0 . The height of the liquid is H and the atmospheric pressure is P_0 . (Neglect surface tension).

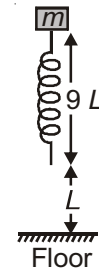


9. When the gas bubble is at a height y from the bottom, its temperature is
- (A) $T_0 \left(\frac{P_0 + \rho_l g H}{P_0 + \rho_l g y} \right)^{\frac{2}{3}}$
- (B) $T_0 \left(\frac{P_0 + \rho_l g H}{P_0 + \rho_l g y} \right)^{\frac{3}{5}}$
- (C) $T_0 \left(\frac{P_0 + \rho_l g (H - y)}{P_0 + \rho_l g H} \right)^{\frac{2}{5}}$
- (D) $T_0 \left(\frac{P_0 + \rho_l g (H - y)}{P_0 + \rho_l g H} \right)^{\frac{3}{5}}$
10. The buoyancy force acting on the gas bubble is (Assume R is the universal gas constant)

- (A) $\rho_l n R g T_0 \frac{(P_0 + \rho_l g H)^{\frac{2}{5}}}{(P_0 + \rho_l g y)^{\frac{1}{5}}}$
- (B) $\frac{\rho_l n R g T_0}{(P_0 + \rho_l g H)^{\frac{2}{5}} (P_0 + \rho_l g (H - y))^{\frac{3}{5}}}$
- (C) $\rho_l n R g T_0 \frac{(P_0 + \rho_l g H)^{\frac{3}{5}}}{(P_0 + \rho_l g y)^{\frac{8}{5}}}$
- (D) $\frac{\rho_l n R g T_0}{(P_0 + \rho_l g H)^{\frac{3}{5}} (P_0 + \rho_l g (H - y))^{\frac{2}{5}}}$

Paragraph for Question Nos. 11 & 12

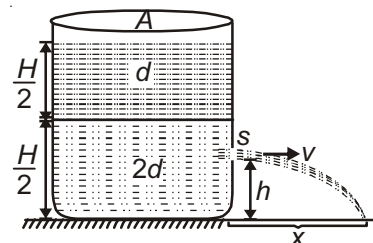
A block of mass m is attached with massless vertical spring of spring constant $k = \frac{4mg}{L}$ and natural length $9L$. The lower end of spring is free and it is at a height of L from floor as shown in figure. The spring mass system is released from rest from the position shown in figure and the lower end of the spring sticks to the floor.



11. The maximum speed attained by the block in process of oscillation is
- (A) \sqrt{gL} (B) $\sqrt{3gL}$
- (C) $\frac{3}{2}\sqrt{gL}$ (D) $\sqrt{\frac{3}{2}gL}$
12. Find the time duration for which the spring remains compressed till the block reaches its lowest position
- (A) $\pi\sqrt{\frac{L}{2g}} + \sqrt{\frac{L}{4g}} \sin^{-1} \frac{1}{3}$ (B) $\pi\sqrt{\frac{L}{2g}} + \sqrt{\frac{L}{4g}} \sin^{-1} \frac{2}{3}$
- (C) $\frac{\pi}{4}\sqrt{\frac{L}{g}} + \sqrt{\frac{L}{4g}} \sin^{-1} \frac{1}{3}$ (D) $\frac{\pi}{2}\sqrt{\frac{L}{2g}} + \sqrt{\frac{L}{4g}} \sin^{-1} \frac{2}{3}$

Paragraph for Question Nos. 13 & 14

A container of large uniform cross-sectional area A resting on a horizontal surface holds two immiscible, non-viscous and incompressible liquids of densities d and $2d$, each of height $\frac{H}{2}$ as shown in figure. The container is open to atmosphere. A tiny hole of area s ($s \ll A$) is punched on the vertical of container at a height h [$h < \frac{H}{2}$].



13. Initial speed of efflux of liquid at the hole is

- (A) $\sqrt{\frac{g}{2}(3H - 4h)}$ (B) $\sqrt{g(3H - 4h)}$
 (C) $\sqrt{2g(3H - 4h)}$ (D) $\sqrt{\frac{g}{3}(3H - 4h)}$

14. The horizontal distance travelled (x) by the liquid is

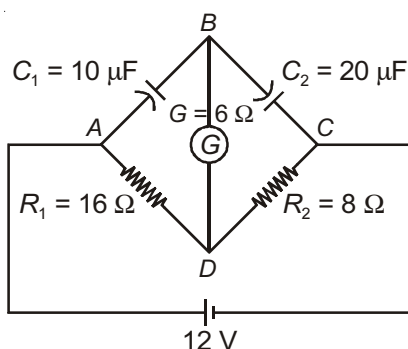
- (A) $\sqrt{\frac{(3H - 4h)}{2}}g$ (B) $\sqrt{\frac{(3H - 4h)}{2}}h$
 (C) $\sqrt{(3H - 4h)h}$ (D) $\sqrt{\frac{(3H - 4h)h}{3}}$

SECTION - III

Multiple Correct Answers Type

This section contains 6 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.

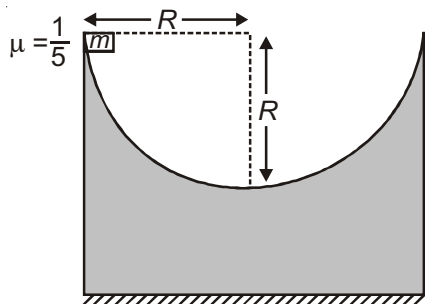
15. In the circuit shown in figure. If the galvanometer resistance is 6Ω , then in the steady state



- (A) No current flows through galvanometer
 (B) The current through R_2 is 4 A
 (C) The charge on C_1 is $80 \mu\text{C}$
 (D) The charge on C_2 is $40 \mu\text{C}$

16. A particle of mass m , is released freely on rough semicircular track having co-efficient of friction $\mu = \frac{1}{5}$. Which of the following statement/s is/are incorrect?

$\mu = \frac{1}{5}$. Which of the following statement/s is/are incorrect?

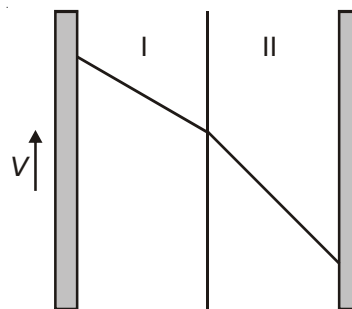


- (A) Tangential acceleration at the top is $\frac{2\sqrt{2}}{5}g$
 (B) Work done by frictional force in moving from top to bottom is $-\frac{mgR}{5}$

(C) Work done by frictional force in moving from top to bottom is $\frac{mgR}{5}$

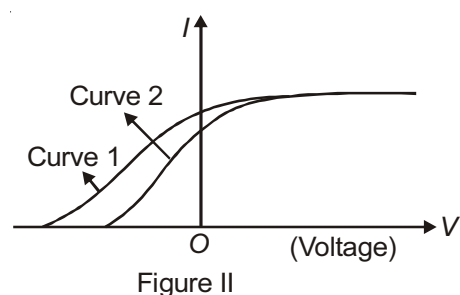
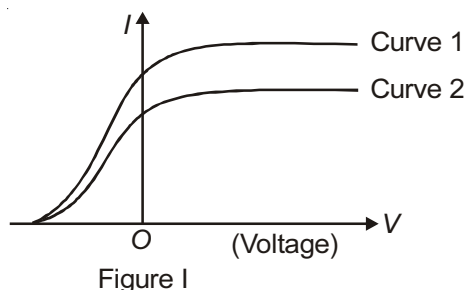
(D) Work done by normal reaction in moving from top to bottom is zero

17. A parallel plate capacitor is filled with a dielectric upto one-half of the distance between the plates. The manner in which the potential between the plates varies is illustrated in the figure. Then find the variation of potential with the distance after the dielectric is taken out of the capacitor, when charge on plates is conserved and potential difference across the capacitor is conserved



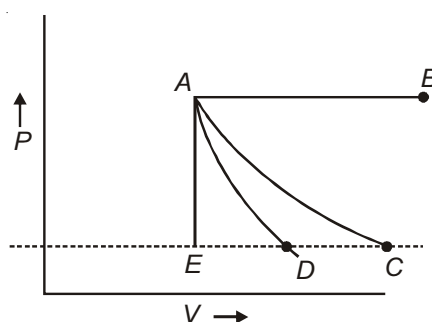
- (A) (B)
 (C) (D)

18. Graphs represent dependence of photoelectric current on voltage between the cathode and anode. Curves 1 and 2 are for two different sources in figure I and of same source in figure II



- (A) In figure I, the sources are having same emission frequency and different intensities
 (B) In figure I, the sources are having same frequency and same intensities
 (C) In figure II, the photocathode has higher work function for curve 1 than curve 2
 (D) In figure II, the photocathode has lower work function for curve 1 than curve 2
19. If two identical conducting spheres carrying equal charges are placed at a separation comparable to their dimensions, then

- (A) The force of interaction between them will be greater when they carry like charges
 (B) The force of interaction between them will be greater when they carry unlike charges
 (C) The distribution of charge will be the same when they are like or unlike charges
 (D) The distribution of charge will not be the same when they are like or unlike charges
20. Four different thermodynamic process for some working substance starting from state A are shown in pressure P versus volume V graph. Which of the following statement/s is/are correct?



- (A) Work done in each process can be related as $W_{AC} > W_{AD} > W_{AB} > W_{AE}$
 (B) Temperature at points E, D, C can be related as $T_E < T_D < T_C$
 (C) If process equation for AD is $PV^{\alpha_{AD}} = \text{constant}$ and for AC is $PV^{\alpha_{AC}} = \text{constant}$ then $\alpha_{AD} > \alpha_{AC}$
 (D) If the process equation for AD and AE are $PV^{\alpha_{AD}} = \text{constant}$ and $PV^{\alpha_{AE}} = \text{constant}$ respectively, then $\alpha_{AD} > \alpha_{AE}$

[PART-B : CHEMISTRY]

SECTION - I

Single Correct Answer Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

21. Correct acidic order is

- (A) $\text{H}_3\text{PO}_2 > \text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_4$
 (B) $\text{H}_3\text{PO}_2 = \text{H}_3\text{PO}_3 = \text{H}_3\text{PO}_4$
 (C) $\text{H}_3\text{PO}_2 < \text{H}_3\text{PO}_3 < \text{H}_3\text{PO}_4$
 (D) $\text{H}_3\text{PO}_2 < \text{H}_3\text{PO}_4 > \text{H}_3\text{PO}_3$

22. Extraction of Zn involves

- (A) Roasting and bessemerisation
 (B) Roasting and smelting
 (C) Smelting and calcination
 (D) Calcination and bessemerisation

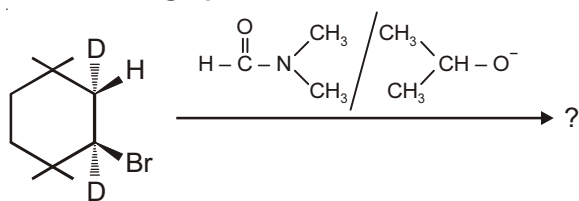
23. Increasing order of stability of the +2 oxidation state of the ions
 (A) $\text{Ca}^{2+} < \text{Ba}^{2+} < \text{Sr}^{2+}$ (B) $\text{Pb}^{2+} < \text{Ge}^{2+} < \text{Sn}^{2+}$
 (C) $\text{Ge}^{2+} < \text{Sn}^{2+} < \text{Pb}^{2+}$ (D) $\text{Cu}^{2+} < \text{Au}^{2+} < \text{Ag}^{2+}$
24. Two hybrid orbitals have a bond angle of 120° . The percentage of s-character in the hybrid orbital is nearly
 (A) 25% (B) 33%
 (C) 50% (D) 66%
25. Optical isomerism is not shown by
 (A) $[\text{Cu}(\text{Cl})(\text{NH}_3)(\text{H}_2\text{O})(\text{CO})]$
 (B) $\text{cis} [\text{Pt}(\text{gly})_2]^{2+}$
 (C) $[\text{Co}(\text{en})_3]^{3+}$
 (D) $[\text{Co}(\text{en})_2\text{Cl}_2]$
26. In an ionic compound $\text{A}^+ \text{X}^-$, the degree of covalent bonding is greatest when
 (A) A^+ and X^- ion are small
 (B) A^+ is small and X^- is large
 (C) A^+ and X^- ion are approximately of the same size
 (D) X^- is small and A^+ is large
27. How many products will form when 'Ba' is heated above 675 K in dry air?
 (A) 1 (B) 2
 (C) 3 (D) 4
28. Intermolecular dehydration of H_2SO_4 forms
 (A) SO_3 (B) $\text{H}_2\text{S}_2\text{O}_7$
 (C) SO_2 (D) $\text{H}_2\text{S}_2\text{O}_3$

SECTION-II

Paragraph Type

This section contains three paragraphs with 2 questions on each paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

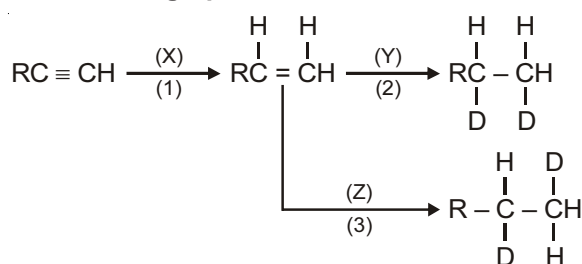
Paragraph for Question Nos. 29 & 30



29. Product of the reaction will be via
 (A) $\text{S}_{\text{N}}2$ (B) $\text{E}2$
 (C) $\text{E}1$ (D) $\text{S}_{\text{N}}1$
30. Correct among the following is

- (A) Major product is
- (B) Major product is
- (C) Major product is
- (D) Major product is

Paragraph for Question Nos. 31 & 32



31. Incorrect among the following
 (A) X is heterogeneous catalyst
 (B) Y is heterogeneous catalyst
 (C) Z is heterogeneous catalyst
 (D) Both (A) & (B)
32. Z cannot be
 (A) Li/NH_3 (B) $\text{Na}/\text{liq. NH}_3$
 (C) Lindlar's catalyst (D) Both (A) & (B)

Paragraph for Question Nos. 33 & 34


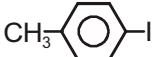
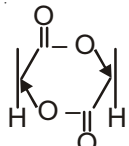
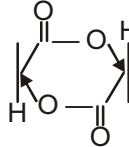
VSEPR-theory can be used to describe the shapes of SO_3^{2-} , SO_3 and SO_4^{2-} . From their shapes, it appears that some or all of them are capable of exhibiting the phenomenon of resonance.

33. Which of the following will have the strongest S – O bond?
 (A) SO_3^{2-} (B) SO_3
 (C) SO_4^{2-} (D) All have equal strength
34. Which of the following will have the atoms lying in the same plane?
 (A) SO_3^{2-} (B) SO_3
 (C) SO_4^{2-} (D) None of these

SECTION - III

Multiple Correct Answers Type

This section contains 6 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.

35. **Incorrect** among the following is
- (A)  is most reactive towards electrophilic aromatic substitution among halobenzenes
- (B)  undergoes ArS_N2 very spontaneously
- (C) Aryl and allyl halides are very good substrates for 1st order nucleophilic substitution
- (D) Kinetic isotopic effect is observed in most of the electrophilic aromatic substitution reactions
36. $CH_3 - \underset{\text{OH}}{\text{CH}} - \overset{\text{O}}{\parallel}{\text{C}} - \text{OH} \xrightarrow{\Delta} ?$
- (A) Product formed is $CH_2 = \underset{\text{O}}{\parallel}{\text{C}} - \text{OH}$
- (B) Product formed is 
- (C) Product formed is 
- (D) Resultant reaction mixture is optically active
37. In Victor-Meyer test
- (A) Correct sequence of reagents is $P/I_2, AgNO_2, HNO_2, NaOH$
- (B) HI causes nucleophilic substitution on alcohols
- (C) $AgNO_2$ forms ppt. of AgI
- (D) Colour formation is due to AgI
38. Benzophenone does not respond to $NaHSO_3$ because of its
- (A) Resonance stabilisation
- (B) Less reactivity towards nucleophilic addition
- (C) Hindered carbonyl carbon
- (D) Planar geometry
39. Among the following, which statement(s) is/are correct?
- (A) $CH_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{OH}$ will not respond to haloform test
- (B) Schiff's reagent and Schiff's base are different compounds
- (C) Fehling solution is a good reagent to detect aromatic aldehydes
- (D) Both aldehydes and ketones can react with 2, 4 dinitrophenylhydrazine reagent
40. White phosphorous (P_4) has
- (A) 6 P – P single bonds
- (B) 4 P – P single bonds
- (C) 4 lone pair of electrons
- (D) P – P – P angle of 60°

[PART-C : MATHEMATICS]

SECTION - I

Single Correct Answer Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

41. Let f be a continuous function on R such that $f\left(\frac{1}{2n}\right) = (\cos e^n) e^{-n^2} + \frac{2n^2}{n^2+1}$, then the value of $f(0)$ is
- (A) $\frac{1}{2}$ (B) 1
- (C) 2 (D) 3
42. Let f and g be functions satisfying $f(x) = e^x g(x)$, $f(x+y) = f(x) + f(y)$, $g(0) = 0$, $g'(0) = 5$. If g and g' are continuous at $x = 0$, then
- (A) $f(x) = x \quad \forall x \in R$
- (B) $f(x) = xe^x \quad \forall x \in R$
- (C) $f(x) = 5x \quad \forall x \in R$
- (D) $f(x) = e^x + 5x \quad \forall x \in R$

43. Domain of the function $f(x) = \cos^{-1} \frac{x-1}{2} + \log_6(7-x)$ is
 (A) (0, 7) (B) [-1, 3]
 (C) [-1, 2) (D) (-2, 2)
44. If $f(x) = \begin{vmatrix} \cos x & -x & 1 \\ 3\sin x & -x^2 & 3x \\ \tan x & -x & 1 \end{vmatrix}$, then the value of $\lim_{x \rightarrow 0} \frac{f(x)}{x}$ is
 (A) 0 (B) $-\frac{1}{3}$
 (C) 2 (D) $-\frac{3}{4}$
45. A box contains four white and five black balls. A person draws two balls at random one by one without replacement. The probability that the balls drawn are of same colour is
 (A) $\frac{5}{18}$ (B) $\frac{1}{6}$
 (C) $\frac{4}{9}$ (D) $\frac{1}{3}$
46. If two vertices of a triangle are (4, -2) and (-3, 4) and the orthocentre lies at the origin, the coordinates of the third vertex of triangle are
 (A) (8, 13) (B) (-7, -5)
 (C) (-12, -14) (D) (11, 13)
47. The function $f(x) = [x] \sin \frac{\pi x}{2}$ is discontinuous at where [] denotes the greatest integer function
 (A) All x
 (B) All integer x
 (C) All odd integers
 (D) All even integers
48. Let $P(x)$ be a polynomial of degree 4 having extremum at $x = 0, 2$ and such that $\lim_{x \rightarrow 0} \left(2 + \frac{P(x)}{x^2} \right) = 5$, then the value of $P(2)$ is
 (A) $\frac{3}{4}$ (B) $\frac{8}{3}$
 (C) $\frac{7}{5}$ (D) $\frac{5}{6}$

SECTION-II

Paragraph Type

This section contains three paragraphs with 2 questions on each paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 49 & 50

Consider the equation $\cos^n x - \sin^n x = 1$, where n is any natural number and $0 \leq x \leq 2\pi$. Then answer the following questions.

49. Maximum possible number of solutions of the equation, where $n = 2m, m \in N$, is
 (A) 0 (B) 1
 (C) 2 (D) 3
50. Maximum possible number of solution of the equation, when $n = 2m + 1, m \in N$, is
 (A) 0 (B) 1
 (C) 2 (D) 3

Paragraph for Question Nos. 51 & 52

Consider all possible permutations of the letters of the word INDIANOIL.

51. The number of all possible permutations containing the word INDIA is
 (A) 4! (B) $\frac{4!5!}{2!}$
 (C) 5! (D) $\frac{9!}{2!3!}$

52. The number of permutations in which N, O, I, L occurs only in even position is
 (A) 4! (B) $\frac{4!5!}{2!}$
 (C) 5! (D) $\frac{9!}{2!3!}$

Paragraph for Question Nos. 53 & 54

For $n \in N (1 + x + x^2)^n = \sum_{r=0}^{2n} a_r x^r$

53. If n is not a multiple of 3, and $\sum_{r=0}^n (-1)^r a_r {}^n C_r = k ({}^n C_{[n/3]})$ where [] denoted the greater integer $\leq x$, then k equals
 (A) 1 (B) 0
 (C) 3 (D) -1
54. $a_0^2 - a_1^2 + a_2^2 - a_3^2 + \dots + a_{2n}^2$
 (A) a_n (B) $\frac{a_n}{2}$
 (C) a_{2n} (D) $2a_n$

SECTION - III

Multiple Correct Answers Type

This section contains 6 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.

55. Let, $f(x)$ be a function defined by $f(x) = 4x^3 - 3x - \cos \alpha$; $\alpha \in R - (2n + 1)\pi$; $n \in Z$, then
- (A) $f(x) = 0$ must have a root in $\left(-\infty, -\frac{1}{2}\right)$
- (B) $f(x) = 0$ must have a root in $\left(\frac{1}{2}, \infty\right)$
- (C) $f(x) = 0$ have at least one root in $\left(-\frac{1}{2}, \frac{1}{2}\right)$
- (D) For some values of α , $x = \cos\left(\frac{1}{3}\cos^{-1}(\cos \alpha)\right)$ can be a root of equation $f(x) = 0$
56. If the complex numbers z_1 and z_2 satisfy the equation $|z_1|^2 z_2 - |z_2|^2 z_1 = z_1 - z_2$, then
- (A) $z_1 = z_2$ (B) $z_1 \bar{z}_2 = 1$
- (C) $\bar{z}_1 z_2 = 1$ (D) $|z_1 z_2| = 1$
57. If $\sin^{-1}x + \sin^{-1}y = a$ and $\cos^{-1}x - \cos^{-1}y = b$, then
- (A) $\frac{x+y}{x-y} = \tan \frac{a}{b} \tan \frac{b}{2}$ (B) $\frac{x+y}{y-x} = \tan \frac{a}{2} \cot \frac{b}{2}$
- (C) $2xy = \cos b - \cos a$ (D) $xy = \sin a - \sin b$
58. The numbers 1, 3, 9 can be the terms (not necessarily be consecutive) of
- (A) At most one G.P.
- (B) At most one A.P.
- (C) Infinite number of A.Ps
- (D) Infinite number of G.Ps
59. If $S_n = 81 + 54 + 36 + 24 + \dots$ n terms, then
- $$\frac{S_n - 4S_{n-1} + 6S_{n-2} - 4S_{n-3} + S_{n-4}}{S_{n-1} - 4S_{n-2} + 6S_{n-3} - 4S_{n-4} + S_{n-5}}$$
- (A) Is a natural number
- (B) Is a proper fraction
- (C) Depends on the value of n
- (D) Is independent of n
60. The tangent PT and the normal PN to the parabola $y^2 = 4ax$ at a point P on it meet its axis at point T and N respectively. The locus of the centroid of the triangle PTN is a parabola whose
- (A) Vertex is $\left(\frac{2a}{3}, 0\right)$ (B) Directrix is $x = \frac{a}{3}$
- (C) Latus rectum is $\frac{2a}{3}$ (D) Focus is $(a, 0)$





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MOCK TEST PAPER

MM : 198

for

JEE (Advanced)-2016

(Paper-2)

(Complete Syllabus of Class XI & XII)

ANSWERS

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



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[HINTS & SOLUTIONS]

[PHYSICS]

1. Answer (B)

$$\frac{\Delta x}{x} \times 100 = \frac{2 \times \Delta a}{a} \times 100 + \frac{\Delta b}{b} \times 100 = \frac{\Delta c}{c}$$

$$\frac{\Delta x}{x} \times 100 = \frac{\Delta d}{d} \times 100 + 3 \frac{\Delta a}{a} \times 100$$

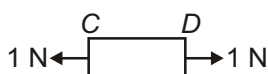
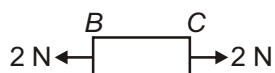
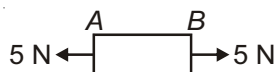
2. Answer (A)

Given $A = 10 \text{ cm}^2$, $Y = 8 \times 10^2 \text{ N cm}^{-2}$

Let Δl = total elongation of the bar. For the sake of simplicity the force of 3 N acting at B may be split into two forces of 5 N and 2 N as shown in figure. Similarly, the force of it acting at C may be split into two forces of 2 N and 1 N.

Using the equation,

$$\Delta t = \frac{1}{Ay} (F_1 l_1 + F_2 l_2 + F_3 l_3) \text{ with usual notations}$$



$$\Delta t = \frac{1}{10 \times 8 \times 10^2} (5 \times 60 + 2 \times 100 + 1 \times 120)$$

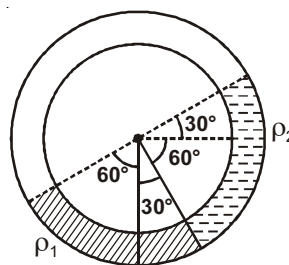
$$= 0.0775 \text{ cm}$$

3. Answer (D)

Equating pressure at bottom.

$$\rho_0 + \rho_1 g R (1 - \cos 60^\circ)$$

$$= \rho_0 + \rho_2 g R (\sin 30^\circ + \sin 60^\circ) + \rho_1 g R (1 - \cos 30^\circ)$$

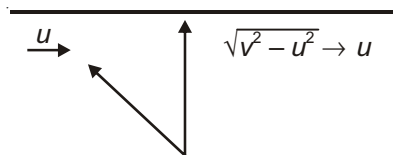


$$\rho_1 R \left[1 - \frac{1}{2} \right] = \rho_2 R \left[\frac{\sqrt{3} + 1}{2} \right] + \rho_1 R \left[\frac{2 - \sqrt{3}}{2} \right]$$

$$\frac{\rho_1}{\rho_2} = \left[\frac{\sqrt{3} + 1}{\sqrt{3} - 1} \right]$$

4. Answer (C)

Velocity of man downstream = $v + u$



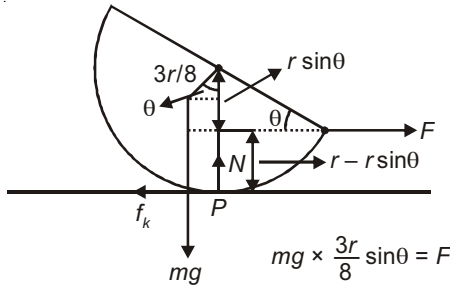
As given $t\sqrt{v^2 - u^2} = (v + u)T$

$$\Rightarrow (v^2 - u^2)t^2 = (v + u)^2 T^2$$

$$\Rightarrow \frac{v - u}{v + u} = \frac{T^2}{t^2} \Rightarrow \frac{v}{u} = \frac{t^2 + T^2}{t^2 - T^2}$$

5. Answer (D)

The hemisphere is moving with uniform velocity. Hence it is in equilibrium (both rotational as well as translational)



$$N = mg \quad \dots(i)$$

$$F = \mu N \quad \dots(ii)$$

Taking the torque due to all the forces about the point P, we get,

Net clockwise torque of applied force F = anti-clockwise torque of mg about bottom-most point.

$$\therefore F(r - r \sin \theta) = mg \left[\frac{3r}{8} \sin \theta \right] \quad \dots(iii)$$

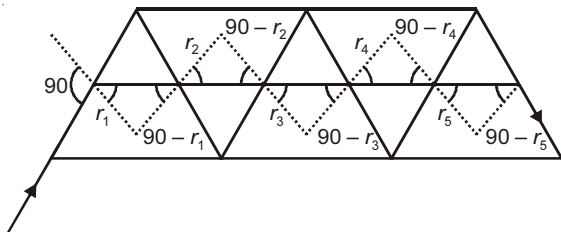
Solving these three equations,

$$\text{we get } \sin \theta = \frac{8\mu}{3 + 8\mu}$$

6. Answer (B)

$$1 \times \sin 90 = \mu_1 \sin r_1$$

$$\mu_1 \sin(90 - r_1) = \mu_2 \sin(r_2)$$



$$\mu_2 \sin(90 - r_2) = \mu_3 \sin r_3$$

$$\mu_3 \sin(90 - r_3) = \mu_4 \sin r_4$$

$$\mu_4 \sin(90 - r_4) = \mu_5 \sin r_5$$

$$\mu_5 \sin(90 - r_5) = 1 \sin 90$$

7. Answer (B)

$$F = \frac{d}{dr} u(r) = kr = \frac{mv^2}{r} \text{ or } mv = \sqrt{kr^2 m}$$

$$mvr = \frac{nh}{2\pi}$$

$$2\pi r \sqrt{kr^2 m} = nh$$

$$r = \left(\frac{nh}{2\pi \sqrt{km}} \right)^{1/2} \text{ and } mv^2 = kr^2$$

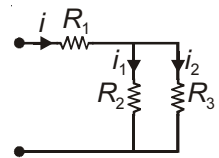
$$BE = KE + PE = \frac{nh}{2\pi} \sqrt{\frac{k}{m}}$$

8. Answer (C)

$$H = \frac{v^2 t}{R}; R_2 = R_3$$

$$i^2 R_1 t = i_1^2 R_2 t$$

$$i_1 = \left[\frac{R_3}{R_2 + R_3} \right] i = \frac{i}{2}$$



$$\text{Thus } i^2 R_1 t = \frac{i^2}{4} R_2 t; R_1 = \frac{R_2}{4}$$

9. Answer (C)

$$T_1 P_1^{1-\gamma} = T_2 P_2^{1-\gamma}$$

$$T_2 = T_0 \left[\frac{(P_0 + \rho_l g(H - y))}{P_0 + \rho_l gH} \right]^{2/5}$$

10. Answer (B)

$$F_b = \text{volume of bubble } \rho_l g$$

$$= \frac{nRT_2}{P_2} \rho_l g$$

$$F_b = \frac{\rho_l n R g T_0}{(P_0 + \rho_l g H)^{2/5} (P_0 + \rho_l g(H - y))^{3/5}}$$

11. Answer (C)

$$\frac{4mg}{L} x = mg, \quad x = \frac{L}{4}$$

$$mg \left(L + \frac{L}{4} \right) = \frac{1}{2} m V_{\max}^2 + \frac{1}{2} \times kx^2$$

$$\frac{5mgL}{4} = \frac{1}{2} m V_{\max}^2 + \frac{1}{2} \times \frac{4mg}{L} \times \left(\frac{L}{4} \right)^2$$

$$\Rightarrow \frac{5mgL}{4} = \frac{1}{2}mV_{\max}^2 + \frac{mgL}{8}$$

$$\Rightarrow \frac{10mgL}{8} - \frac{mgL}{8} = \frac{1}{2}mV_{\max}^2$$

$$\Rightarrow \frac{9mgL}{4} = \frac{1}{2}mV_{\max}^2$$

$$\Rightarrow V_{\max} = \frac{3}{2}\sqrt{gL}$$

12. Answer (C)

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{4mg}{L \times m}} = \sqrt{\frac{4g}{L}}$$

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{2\sqrt{\frac{g}{L}}} = \pi\sqrt{\frac{L}{g}}$$

$$\frac{T}{4} = \frac{\pi}{4}\sqrt{\frac{L}{g}}$$

Using conservation of mechanical energy (Let x is the maximum compression in the springs)

$$\Rightarrow mgL + mgx = \frac{1}{2} \times \frac{4mg}{L} \times x^2$$

$$\Rightarrow L^2mg + Lx = 2x^2$$

$$\Rightarrow 2x^2 - Lx - L^2 = 0$$

$$\Rightarrow x = \frac{L \pm \sqrt{L^2 + 8L^2}}{4}$$

$$x = \frac{L \pm 3L}{4} \text{ i.e., } \frac{4L}{4}, \frac{-2L}{4}$$

$\therefore x = L$ (since x cannot be -ve)

Compression from mean position y

$$\therefore y = \frac{3L}{4}$$

$$\therefore x = a \sin \omega t$$

$$= \frac{3L}{4} \sin \omega t$$

$$\sin \omega t = \frac{1}{3}, \quad \omega t = \sin^{-1} \frac{1}{3}$$

$$\therefore t_2 = \frac{1}{\omega} \sin^{-1} \frac{1}{3} \Rightarrow t_2 = \sqrt{\frac{L}{4g}} \sin^{-1} \frac{1}{3}$$

For amplitude of SHM

$$V_{\max} = AW$$

$$\frac{3}{2}\sqrt{gL} = A\sqrt{\frac{4g}{L}} \Rightarrow A = \frac{3L}{4}$$

Then required time

$$t = \frac{T}{4} + t_2$$

$$= \frac{\pi}{4}\sqrt{\frac{L}{g}} + \sqrt{\frac{L}{4g}} \sin^{-1} \left(\frac{1}{3} \right)$$

13. Answer (A)

According to Bernoulli's principle

$$P_0 + \frac{H}{2} \rho g + \left[\frac{H}{2} - h \right] 2\rho g = \frac{1}{2} 2\rho v^2 + P_0$$

$$\Rightarrow Hg + 2Hg - 4hg = 2v^2$$

$$\therefore v = \sqrt{g \left(\frac{3H - 4h}{2} \right)}$$

14. Answer (C)

$$x = v.t = \sqrt{\left(\frac{3H - 4h}{2} \right) g} \cdot \sqrt{\frac{2h}{g}} = \sqrt{(3H - 4h)h}$$

15. Answer (A, C)

No current flows in steady state through capacitor.

$$\text{Current through resistance} = \frac{12}{24} = 0.5 \text{ A}$$

P.D. across A and C = 12 V

$$Q_1 = C_1 V_1 = C_2 V_2$$

$$\frac{V_1}{V_2} = \frac{C_2}{C_1} = 2 \text{ and } V_1 + V_2 = 12$$

$$V_1 = 8 \text{ V}, V_2 = 4 \text{ V}$$

$$Q_1 = C_1 V_1 = 80 \mu\text{C} = Q_2$$

16. Answer (A, B, C)

$$\text{As } N = mg \cos \theta + \frac{mv^2}{r}$$

$$\text{So, } a = g \sin \theta - \mu \left(g \cos \theta + \frac{v^2}{5} \right)$$

$$w_n = 0 \text{ (} f_n \perp \text{ displacement)}$$

17. Answer (A, D)

$$E = -\frac{dv}{dx}$$

Here dielectric is placed in first region.

If removal of dielectric don't alter the charge on capacitor and potential behaves as in 2nd region prior to removal of dielectric.

Removal of dielectric don't alter potential while the slope of straight line will acquire a value intermediate between the one it had in the dielectric and in air prior to removal of dielectric.

18. Answer (A, C)

We have,

$$\text{work function } W = h\nu - eV_C$$

More the stopping potential, less will be the work function.

19. Answer (B, D)

In the case of unlike charged spheres the separation between the centres of charges will reduced.

20. Answer (B, C)

(A) As work done area under graph

$$W_{AB} > W_{AC} > W_{AD} > W_{AE} = 0$$

(B) As pressure is constant

$$T \propto V$$

$$\therefore T_E < T_D < T_C$$

(C & D) α of polytropic process depends on magnitude of slope

For process AB, α_{AB} is zero

For process AE, α_{AE} is infinite

As the magnitude of slope is continuously increasing

$$\alpha_{AB} < \alpha_{AC} < \alpha_{AD} < \alpha_{AE}$$

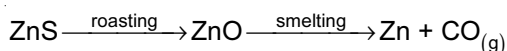
[CHEMISTRY]

21. Answer (A)

Acidic order \propto number of (= O) / (-OH) bond

22. Answer (B)

ZnS is the main ore



23. Answer (C)

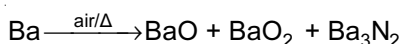
24. Answer (B)

25. Answer (B)

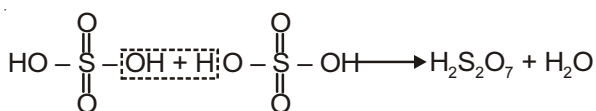
cis[Pt(gly)₂] has a plane of symmetry so, it cannot show optical isomerism.

26. Answer (B)

27. Answer (C)



28. Answer (B)



29. Answer (B)

Due to strong base in presence of aprotic less polar solvent.

30. Answer (A)

E2 is antiplanar.

31. Answer (C)

'Z' is homogeneous catalyst that causes anti-addition.


32. Answer (C)

Lindlar's catalyst is heterogeneous catalyst and gives syn addition.

33. Answer (B)

34. Answer (B)

35. Answer (B, C, D)

-F is reactive due to effective 2p - 2p resonance.

No arylhalide undergo ArS_N2 spontaneously.

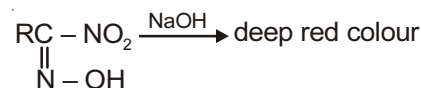
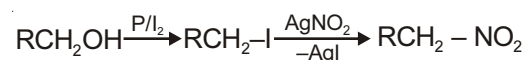
Aryl halides do not undergo ArS_N1.

C - H bond strength < C - D bond strength.

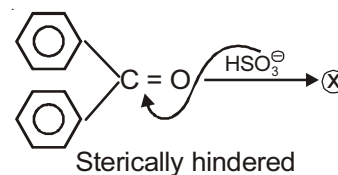
36. Answer (B, C)

α - hydroxy carboxylic acids on heating produce cis & trans lactides, cis lactides are optically active.

37. Answer (A, B, C)



38. Answer (A, B, C)



39. Answer (A, B, D)

40. Answer (A, C, D)

[MATHEMATICS]

41. Answer (C)

Taking limit $n \rightarrow \infty$ both the sides, we get,

$$\lim_{n \rightarrow \infty} f\left(\frac{1}{2n}\right) = \lim_{n \rightarrow \infty} \left(\frac{\operatorname{cose}^n}{e^{n^2}} + \frac{2n^2}{n^2+1} \right)$$

$$\Rightarrow f(0) = 0 + 2$$

$$\therefore f(0) = 2$$

42. Answer (C)

$$\therefore f(x+y) = f(x) + f(y)$$

By using partial derivative and differentiating w.r.t. x , (treating y as a constant)

$$\text{We get, } f'(x+y) = f'(x)$$

On putting $x = 0, y = x$ we get,

$$\boxed{f'(x) = f'(0) \forall x \in R}$$

Now,

$$\therefore f(x) = e^x \cdot g(x)$$

$$\therefore f'(x) = e^x \cdot g'(x) + g(x) \cdot e^x$$

$$\therefore f'(0) = g'(0) + g(0)$$

$$\Rightarrow f'(0) = 5 \quad (\because g(0) = 0 \text{ and } g'(0) = 5)$$

$$\Rightarrow f'(x) = 5 \forall x \in R$$

$$\therefore \frac{df(x)}{dx} = 5$$

$$\therefore \int df(x) = \int 5 dx$$

$$\text{or, } f(x) = 5x + c$$

on putting $x = 0$

$$f(0) = c$$

$$\therefore f(0) = e^0 \cdot g(0) = 0$$

$$\Rightarrow c = 0$$

$$\therefore f(x) = 5x, \forall x \in R$$

43. Answer (B)

$$-1 \leq \frac{x-1}{2} \leq 1 \text{ and } 7-x > 0$$

$$\text{or, } -2 \leq x-1 \leq 2 \text{ and } x < 7$$

$$-1 \leq x \leq 3 \text{ and } x < 7$$

$$\Rightarrow x \in [-1, 3]$$

44. Answer (A)

$$L = \lim_{x \rightarrow 0} \frac{f(x)}{x} = \lim_{x \rightarrow 0} f'(x) = f'(0)$$

$$\therefore f'(x) = \begin{vmatrix} -\sin x & -1 & 0 \\ 3\sin x & -x^2 & 3x \\ \tan x & -x & +1 \end{vmatrix}$$

$$+ \begin{vmatrix} \cos x & -x & 1 \\ 3\cos x & -2x & 3 \\ \tan x & -x & 1 \end{vmatrix} + \begin{vmatrix} \cos x & -x & 1 \\ 3\sin x & -x^2 & 3x \\ \sec^2 x & -1 & 0 \end{vmatrix}$$

$$\therefore f'(0) = \begin{vmatrix} 0 & -1 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{vmatrix} + \begin{vmatrix} 1 & 0 & 1 \\ 3 & 0 & 3 \\ 0 & 0 & 1 \end{vmatrix} + \begin{vmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & -1 & 0 \end{vmatrix} = 0$$

45. Answer (C)

The required probability

$$P(E) = P(W) \times P\left(\frac{W}{W}\right) + P(B) \times P\left(\frac{B}{B}\right)$$

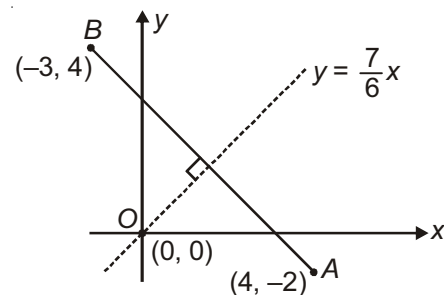
$$= \frac{4}{9} \times \frac{3}{8} + \frac{5}{9} \times \frac{4}{8}$$

$$= \frac{1}{6} + \frac{5}{18}$$

$$= \frac{8}{18} = \frac{4}{9}$$

46. Answer (C)

Third vertex must lie on the line perpendicular to the line AB and passing through (0, 0)



$$\therefore m_{AB} = \frac{4+2}{-3-4} = -\frac{6}{7}$$

$$\therefore m_{\perp} = \frac{7}{6}$$

47. Answer (C)

57. Answer (B, C)

Adding the equations, we get

$$\frac{\pi}{2} + \sin^{-1}y - \cos^{-1}y = a + b$$

or, $\sin^{-1}y + \cos^{-1}y + \sin^{-1}y - \cos^{-1}y = a + b$

$\Rightarrow 2\sin^{-1}y = a + b$

$\therefore \sin^{-1}y = \frac{a+b}{2}$... (i)

Now,

$\therefore \sin^{-1}x + \sin^{-1}y = a$ (from question)

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

or, $\sin^{-1}x = \frac{a-b}{2}$... (ii)

$\Rightarrow x = \sin\left(\frac{a-b}{2}\right)$ and $y = \sin\left(\frac{a+b}{2}\right)$

Now, $x+y = 2\sin\frac{a}{2}\cos\frac{b}{2}$

$x-y = -2\cos\frac{a}{2}\sin\frac{b}{2}$

$\Rightarrow \frac{x+y}{y-x} = \tan\frac{a}{2}\cot\frac{b}{2}$

Now, $xy = \sin\left(\frac{a-b}{2}\right)\sin\left(\frac{a+b}{2}\right)$

$= \sin^2\frac{a}{2} - \sin^2\frac{b}{2}$

$= \frac{1-\cos a}{2} - \frac{1-\cos b}{2}$

$= \frac{\cos b - \cos a}{2}$

$\Rightarrow \boxed{2xy = \cos b - \cos a}$

58. Answer (C, D)

Let a_1 be the first term and d be the common difference of A.P. whose $(m+1)^{th}$, $(n+1)^{th}$ and $(r+1)^{th}$ terms are 1, 3 and 9 respectively.

Therefore,

$a_1 + md = 1$

$a_1 + nd = 3$

and $a_1 + rd = 9$

$$\Rightarrow \left. \begin{aligned} (n-m)d &= 2 \\ (r-n)d &= 6 \\ \text{and } (r-m)d &= 8 \end{aligned} \right\} \Rightarrow \frac{n-m}{2} = \frac{r-n}{6} = \frac{r-m}{8}$$

As there are infinite number of such m, n and r are possible.

\therefore Infinite number of such A.P. are possible.

Similarly, we can find infinite number of such G.Ps whose terms are 1, 3 and 9.

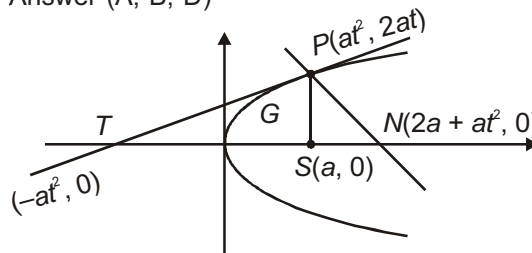
59. Answer (B, D)

$$\frac{(S_n - S_{n-1}) - 3(S_{n-1} - S_{n-2}) + 3(S_{n-2} - S_{n-3}) - (S_{n-3} - S_{n-4})}{(S_{n-1} - S_{n-2}) - 3(S_{n-2} - S_{n-3}) + 3(S_{n-3} - S_{n-4}) - (S_{n-4} - S_{n-5})}$$

$$= \frac{T_n - 3T_{n-1} + 3T_{n-2} - T_{n-3}}{T_{n-1} - 3T_{n-2} + 3T_{n-3} - T_{n-4}} = r = \frac{2}{3}$$

r of the original sequence = $\frac{2}{3}$ and the original series is G.P.

60. Answer (A, B, D)



We have $ST = SN$

PS is a medium $\Rightarrow PG : GS = 2 : 1$

$\Rightarrow G = \left(\frac{2a + at^2}{3}, \frac{2at}{3}\right) = (G, K)$

$3k - 2a = at^2$ and $\frac{3k}{2a} = t \Rightarrow 3h - 2a = \frac{9k^2}{4a}$

\therefore Locus of (h, k) is $y^2 = \frac{4a}{3}\left(k - \frac{2a}{3}\right)$

Vertex = $\left(\frac{2a}{3}, 0\right)$

directrix $\Rightarrow x - \frac{a}{3} = 0$

latus rectum = $\frac{49}{3}$

Focus = $(a, 0)$

