Sample Papers

JEE Mains

Time: 3 Hours ***Maximum Marks: 360***

Topics Covered:

Physics	***:***	*11th & 12th Complete Syllabus*
Chemistry	***:***	*11th & 12th Complete Syllabus*
Mathematics	***:***	*11th & 12th Complete Syllabus*

Important Instructions :

1. *The test is of **3 hours** duration.*
2. *The Test consists of 90 questions. The maximum marks are **360**.*
3. *There are three parts in the question paper A, B, C consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each question is allotted 4 (four) marks for each correct response.*
4. *Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question. ¼ (one-fourth) marks of the total marks allotted to the question (i.e. 1 mark) will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
5. *There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 4 above.*
6. *For writing particulars/marking responses on Answer Sheet use **only Black/Blue Ball Point Pen** provided in the examination hall.*
7. *No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall/room.*

PART-A : PHYSICS

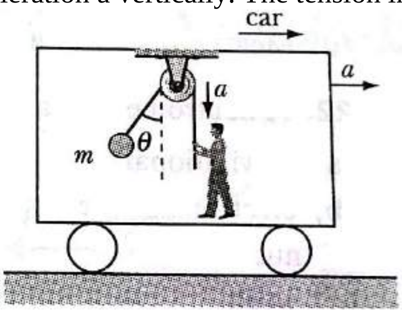
1. In a system of units, the relations between velocity, acceleration and force are given by $v_2 = \frac{v_1\varepsilon^2}{\tau}, a_2 = a_1\varepsilon\tau, F_2 = \frac{F_1}{\varepsilon\tau}$ where ε and τ are constants. Then in this new system, (where m is mass and L is length)
(A) $M_2 = \frac{M_1}{\varepsilon^2\tau^2}$ (B) $M_2 = \varepsilon^2\tau^2 M_1$ (C) $L_2 = \frac{L_1\varepsilon^2}{\tau^3}$ (D) $L_2 = \frac{L_1\tau^3}{\varepsilon^3}$

2. A bullet loses 1/20 of its velocity in passing through a plank. The least number of planks required to stop the bullet is
(A) 10 (B) 11 (C) 12 (D) 13

3. A target is made of two plates, one of wood and the other of iron. The thickness of the wooden plate is 4 cm and that of iron plate is 2 cm. A bullet fired goes through the wood first and then penetrates 1 cm into iron. A similar bullet fired with the same velocity from opposite direction goes through iron first and then penetrates 2 cm into wood. If a_1 and a_2 be the retardations offered to the bullet by wood and iron plates respectively then
(A) $a_1 = 2a_2$ (B) $a_2 = 2a_1$ (C) $a_1 = a_2$ (D) data insufficient

4. Take the z axis as vertical and the xy plane as horizontal. A particle A is projected at $4\sqrt{2}$ m/s at an angle of 45° to the horizontal, in the xz plane. Particle B is projected at 5 m/s at an angle $\theta = \tan^{-1}(4/3)$ to y axis, in the yz plane. Which of the following is not correct for the velocity of B with respect to A?
(A) Its initial magnitude is 5 m/s.
(B) Its magnitude will change with time.
(C) It lies in the xy plane.
(D) It will initially make an angle $(\theta + \pi/2)$ with the positive x axis.

5. A bob is hanging over a pulley inside a car through a string. The second end of the string is in the hand of a person standing in the car. The car is moving with constant acceleration a directed horizontally as shown in figure. Other end of the string is pulled with constant acceleration a vertically. The tension in the string is equal to

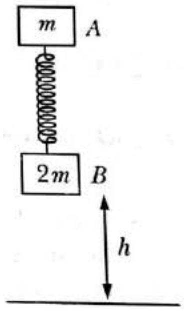


(A) $m\sqrt{g^2+a^2}$ (B) $m\sqrt{g^2+a^2} - ma$ (C) $m\sqrt{g^2+a^2} + ma$ (D) m(g + a)

6. A T.V. tower has a height of 150 m. The area of the region covered by T.V. broadcast is (radius of earth = 6.4×10^6 m) –
(A) $9.6\,\pi \times 10^8$ m^2 (B) $19.2\pi \times 10^8$ m^2 (C) $19.2\,\pi \times 10^7$ m^2 (D) $1.92\pi \times 10^3$ km^2

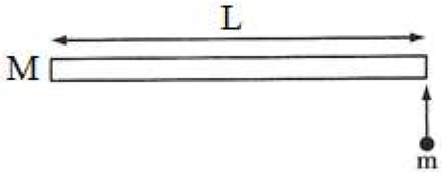
Space for Rough Work

7. From what minimum height h must the system be released when spring is unstretched so that after perfectly inelastic collision (e = 0) with ground, B may be lifted off the ground (spring constant = k) from figure.



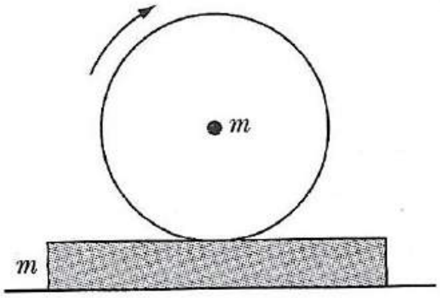
(A) mg/(4k) (B) 4mg/k (C) mg/(2k) (D) none of the above

8. A stick of length L and mass M lies on a frictionless horizontal surface on which it is free to move in any way. A ball of mass m moving with speed v collides elastically with the stick as shown in figure. If after the collision, the ball comes to rest, then what should be the mass of the ball?



(A) m = 2M (B) m = M (C) m = M/2 (D) m = M/4

9. A sphere of mass m is given some angular velocity about a horizontal axis through its centre, and gently placed on a plank of mass m as shown in figure. The coefficient of friction between the two is μ. The plank rests on a smooth horizontal surface. The initial acceleration of the sphere relative to the plank will be



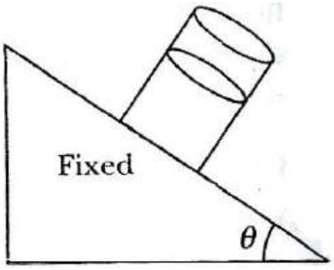
(A) zero (B) μg (C) (7/5)μg (D) 2μg

10. A small body of superdense material, whose mass is twice the mass of the Earth but whose size is very small compared to the size of the Earth, starts from rest at a height $H \ll R$ above the Earth's surface, and reaches the Earth's surface in time t. Then t is equal to

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

Space for Rough Work

11. A cylindrical vessel filled with water is released on an inclined surface of angle θ as shown in figure. The friction coefficient of surface with vessel is μ (< tanθ). Then the constant angle made by the surface of water with the incline will be



(A) $\tan^{-1}\mu$ (B) $\theta - \tan^{-1}\mu$ (C) $\theta + \tan^{-1}\mu$ (D) $\cot^{-1}\mu$

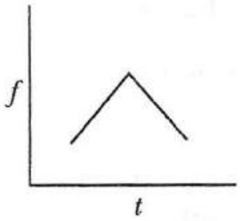
12. A thin uniform rod of length *l* is pivoted at its upper end. It is free to swing in a vertical plane. Its time period for oscillations of small amplitude is

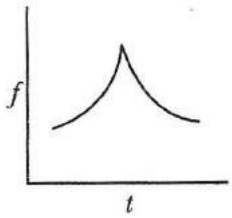
(A) $2\pi\sqrt{\ell / g}$ (B) $2\pi\sqrt{2\ell / 3g}$ (C) $2\pi\sqrt{3\ell / 2g}$ (D) $2\pi\sqrt{\ell / 2g}$

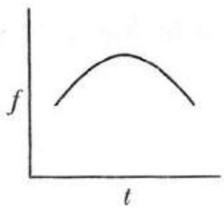
13. In a sonometer wire, the tension is maintained by suspending a 50.7 kg mass from the free end of the wire. The suspended mass has a volume of 0.0075 m^3. The fundamental frequency of the wire is 260 Hz. If the suspended mass is completely submerged in water, the fundamental frequency will become

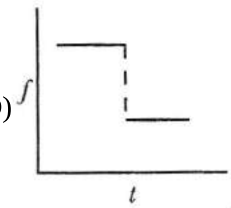
(A) 200 Hz (B) 220 Hz (C) 230 Hz (D) 240 Hz

14. A railway engine whistling at a constant frequency moves with a constant speed. It goes past a stationary observer standing beside the railway track. The frequency (f) of the sound heard by the observer is plotted against time (t). Which of the following best represents the resulting curve?

(A) 

(B) 

(C) 

(D) 

15. Sound of wavelength λ passes through a Quincke's tube, which is adjusted to give a maximum intensity I_0. Through what distance should the sliding tube be moved to give an intensity $I_0/2$?

(A) λ/2 (B) λ/3 (C) λ/4 (D) λ/8

16. A ring of radius r carries a charge Q, uniformly distributed along its circumference. What is the ratio of the electric field strength at a distance R to that at a distance $R/\sqrt{2}$ along the axis?

(A) $\frac{\sqrt{3}}{8}$ (B) $\frac{3\sqrt{3}}{8}$ (C) $\frac{3\sqrt{3}}{4\sqrt{2}}$ (D) $\frac{2\sqrt{2}}{3\sqrt{3}}$

17. Two concentric shells of radii 1 cm and 2 cm are charged to 3V and 5V, respectively. The charge on the inner shell is

(A) $-4/9 \times 10^{-11}$C (B) $4/9 \times 10^{-11}$C (C) $-2/9 \times 10^{-11}$C (D) $2/9 \times 10^{-11}$C

Space for Rough Work

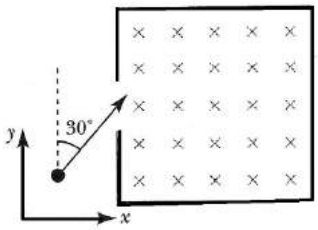
18. Four metallic plates each with a surface area of one side A are placed at a distance d from each other as shown in figure. The capacitance of the system is

(A) $\frac{\varepsilon_0 A}{d}$ (B) $\frac{2\varepsilon_0 A}{d}$ (C) $\frac{3\varepsilon_0 A}{d}$ (D) $\frac{4\varepsilon_0 A}{d}$

19. A non-conducting ring of radius R has charge Q distributed over it. If it rotates with an angular velocity ω about its axis, the equivalent electric current will be
(A) zero (B) Qω (C) Qω/2π (D) Qω/2πR

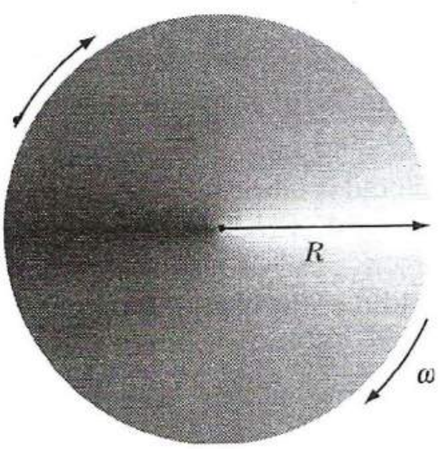
20 An n – p – n transistor circuit has α = 0.985. If I_c = 2mA, then value of I_b is -
(A) 0.03 mA (B) 0.003 mA (C) 0.66 mA (D) 0.015 mA

21. An electron enters a region that contains a magnetic field directed into the page as shown in figure. The velocity vector of the electron makes an angle of 30° with the +y axis. What is the direction of the magnetic force on the electron when it enters the field?



(A) At an angle of 60° above the positive x axis (B) At an angle of 30° below the positive x axis
(C) At an angle of 30° above the positive x axis (D) At an angle of 60° below the positive x axis

22. A phonograph record of radius R, which carries a uniformly distributed charge Q, is rotating with constant angular speed ω figure. Find the magnetic field at the center of the disk.



(A) $\frac{\mu_0 Qw}{R}$ (B) $\frac{\mu_0 Qw}{\pi R^2}$ (C) $\frac{\mu_0 Qw}{2\pi R}$ (D) $\frac{\mu_0 Qw}{\pi R}$

Space for Rough Work

23. A rod of length l with resistance R lies in a constant uniform magnetic field $\vec{B}$ perpendicular to the rod. The surface is frictionless. The magnitude of the force that must be applied by a person to pull the rod at constant speed v is

(A) 0 (B) Blv (C) Blv/R (D) B^2l^2v/R

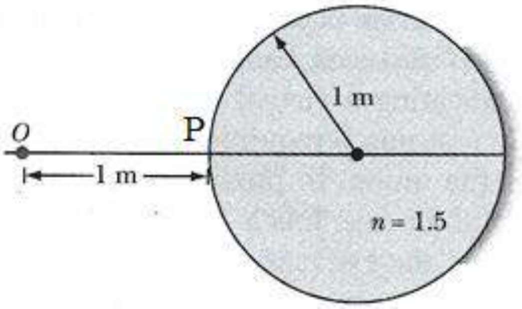
24. The distance advanced by screw of a screw gauge is 2mm in four rotation. Its cap is divided into 50 division. There is no zero error. If the screw reads 3 divisions on the main scale and 32 divisions on the cap, then the diameter of the wire is -

(A) 3.32 mm (B) 1.82 mm (C) 2.82 mm (D) 4.7 mm

25. The total length of potentiometer wire is 10 m. The distance between the null points on the potentiometer wire for two cells is 60 cm. If the difference between the emfs of the cells be 0.4 V, the potential gradient along the wire is –

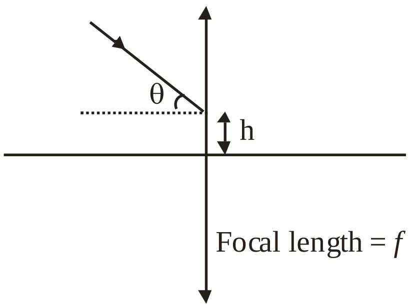
(A) $\frac{3}{2}$ V/m (B) $\frac{1}{3}$ V/m (C) $\frac{2}{3}$ V/m (D) $\frac{1}{2}$ V/m

26. A sphere of radius 1m and n = 1.5 is silvered at its back. A point object is kept at a distance of 1 m from the front face as shown in figure. What is the position of final image w.r.t. P?



(A) $\frac{13}{7}$ m; right side (B) $\frac{13}{7}$ m; left side (C) $\frac{7}{13}$ m; right side (D) $\frac{7}{13}$ m; left side

27. Find the point at which the given ray crosses the principal axis after refraction as shown in figure.
(where θ is very-very small)

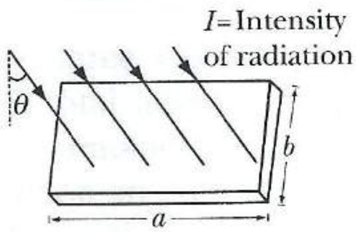


(A) $f\theta$ (B) $\frac{h}{\theta}$ (C) $\frac{hf}{h+f}$ (D) $\frac{hf}{h+f\theta}$

Space for Rough Work

28. A double-slit apparatus is immersed in a transparent liquid of refractive index 1.33. The slit separation is 1mm and the distance between the plane of slits and screen is 1.33m. The slits are illuminated by a parallel beam of light whose wavelength in air is 6300Å. Find the fringe width.
(A) 0.47 m (B) 0.63 m (C) 0.84 m (D) 1.11 m

29. A plank of mass "m" is lying on a smooth surface in situation as shown in figure. Assume that the plank slips over the surface and surface of plank exposed to radiation is black. Find the force on the plank due to radiation.



A light beam incident on a black body at an angle θ to the normal.
(A) $\frac{Iab}{c}$ (B) $\frac{Iab}{c}\cos\theta$ (C) $\frac{Iab}{c}\sin\theta$ (D) $\frac{Iab}{c}\tan\theta$

30. A 2.71 g sample of KCl from the chemistry stockroom is found to be radioactive, and it is decaying at a constant rate of 4490 Bq. The decays are traced to the element potassium and in particular to the isotope ^{40}K, which constitutes 1.17% of normal potassium. Calculate the half-life of this nuclide.
[Given M_K = 39.102 g/mol, M_{Cl} = 35.453 g/mol]
(A) 1.25×10^9 year (B) 1.25×10^{12} year (C) 4×10^{15} year (D) 4×10^9 year

Space for Rough Work

PART-B : CHEMISTRY

31. Which of the following statement does not hold true for the following reaction?

$xCu_3P + yCr_2O_7^{2-} + zH^+ \rightarrow Cu^{2+} + H_3PO_4 + Cr^{3+}$

(A) Cu in Cu_3P is oxidized to Cu^{2+} whereas P in Cu_3P is also oxidised to PO_4^{3-}.
(B) Cu in Cu_3P is oxidized to Cu^{2+} whereas P in Cu_3P is reduced to H_3PO_4.
(C) In the conversion of Cu_3P to Cu^{2+} and H_3PO_4, 11 electrons are involved.
(D) The value of x is 6.

32. Which of the following will have the least bond angle?
(A) CH_4 (B) NH_3 (C) PH_3 (D) H_2O

33. The color of $KMnO_4$ is due to:
(A) d-d transition (B) $L \rightarrow M$ charge transfer transition.
(C) σ-σ^* transition (D) $M \rightarrow L$ charge transfer transition.

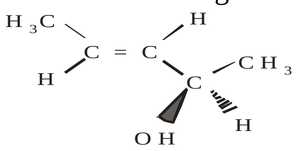
34. For which of the following elements it is difficult to disproportionate in +3 oxidation state?
(A) N (B) As (C) Sb (D) Bi

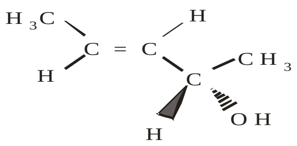
35. A solution when diluted with H_2O and boiled, it gives a white precipitate. On addition of excess NH_4Cl/NH_4OH, the volume of precipitate decreases leaving behind a white gelatinous precipitate. Identify the precipitate which dissolves in NH_4OH/NH_4Cl.
(A) $Zn(OH)_2$ (B) $Al(OH)_3$ (C) $Mg(OH)_2$ (D) $Ca(OH)_2$

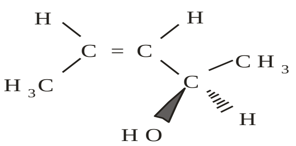
36. The electrophile involved in Reimer-Tiemann reaction is:
(A) $:CHCl$ (B) $\overset{\oplus}{C}HCl_2$ (C) $:CCl_2$ (D) $\bullet CCl_3$

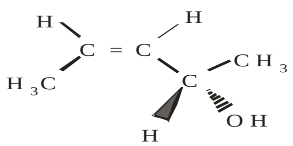
37. Williamson's synthesis involves:
(A) S_N1 mechanism (B) Nucleophilic addition (C) S_N2 mechanism (D) S_Ni mechanism

38. Which of the following molecules have (2R, 3-Z) configuration?

(A) 

(B) 

(C) 

(D) 

39. Which of the following solutions will have pH close to 1.0?
(A) 100mL of (M/10) HCl and 100mL of (M/10) NaOH. (B) 55mL of (M/10) HCl and 45mL of (M/10) NaOH.
(C) 10mL of (M/10) HCl and 90mL of (M/10) NaOH. (D) 75mL of (M/5) HCl and 25mL of (M/5) NaOH.

Space for Rough Work

40. Planar structure is shown by:

(A) CO_3^{2-} (B) BCl_3 (C) $N(SiH_3)_3$ (D) All of these

41. From which of the following species, it is easiest to remove one electron?

(A) O(g) (B) O^{2-}(g) (C) O^+(g) (D) O^-(g)

42. How many moles of HIO_4 are consumed by sucrose?

(A) 1 (B) 2 (C) 3 (D) 4

43. Graph between log $\frac{x}{m}$ and lop P is a straight line inclined at an angle $\theta = 45°$. When pressure is 0.5 atm and log K = 0.699, the amount of solute adsorbed per g of adsorbent will be:

(A) 0.397 g/g absorbent (B) 1.5 g/g absorbent (C) 2.5 g/g absorbent (D) 0.25 g/g absorbent

44. Which of the following pair is incorrectly matched?

(A) Van Arkel method-Zirconium (B) Kroll's process-Titanium

(C) Distillation-Zinc (D) Froth floatation-Cerussite

45. What is the hybridization of P in PCl_5(s)?

(A) sp^3, sp^3d^2 (B) sp^3d, sp^3d (C) sp^3, sp^3 (D) sp^3d, sp^3d^2

46. $N_2 + 3H_2 \rightleftharpoons 2NH_3$

Which is correct statement if N_2 is added at equilibrium condition?

(A) The equilibrium will shift to forward direction because according to II law of thermodynamics, the entropy must increases in the direction of spontaneous reaction.

(B) The condition for equilibrium is $G_{N_2} + 3G_{H_2} = 2G_{NH_3}$ where G is Gibbs free energy per mole of the gaseous species measured at that partial pressure. The condition of equilibrium is unaffected by the use of catalyst, which increases the rate of both the forward and backward reactions to the same extent.

(C) The catalyst will increase the rate of forward reaction by α and that of backward by β.

(D) Catalyst will not alter the rate of either of the reaction.

47. Two liquids X and Y forms an ideal solution at 300 K, vapour pressure of the solution containing 1 mole of X and 3 mole of Y is 550 mm Hg. At the same temperature, 1 mole of Y is further added to this solution and the vapour pressure of the solution increases by 10 mm Hg. Vapour pressure (in mm Hg) of X and Y in their pure states will be, respectively:

(A) 200 and 300 (B) 300 and 400 (C) 400 and 600 (D) 500 and 600

48. Order of a reaction can be:

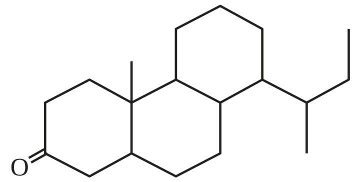
(A) Fractional (B) Zero (C) Integer (D) All the above

Space for Rough Work

49. A current of 2.0 A passed for 5 hours through a molten metal salt deposits 22.2 g of metal (At. wt. = 177). The oxidation state of the metal in the metal salt is:
(A) +1 (B) +2 (C) +3 (D) +4

50. If the co-ordination number of Ca^{2+} in CaF_2 is 8, then the coordination number of F^- ion would be:
(A) 3 (B) 4 (C) 6 (D) 8

51. Count the number of stereocentres in the molecule below:

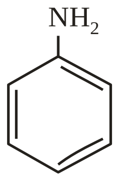


(A) Three (B) Five (C) Six (D) Seven

52. Densities of two gases having same molar mass are in the ratio 1 : 2 and their temperatures are in the ratio 2 : 1, then the ratio of their respective pressures is:
(A) 1 : 1 (B) 1 : 2 (C) 2 : 1 (D) 4 : 1

53. $H_3PO_4 + H_2O \rightleftharpoons H_3O^+ + H_2PO_4^-$; $pK_1 = 2.15$
$H_2PO_4^- + H_2O \rightleftharpoons H_3O^+ + HPO_4^{2-}$; $pK_2 = 7.20$
Hence pH of 0.01 M NaH_2PO_4 is:
(A) 9.35 (B) 4.675 (C) 2.675 (D) 7.350

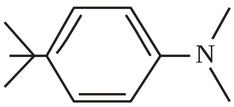
54. Which of the following is most planar?
(A) $P_3N_3Cl_3$ (B) $P_3N_3(Ph)_6$ (C) $P_3N_3F_6$ (D) $P_3N_3(CH_3)_6$

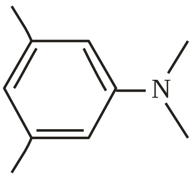
55. 

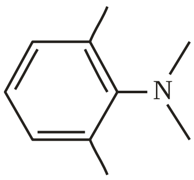
+ $CHCl_3$ + KOH $\longrightarrow$?

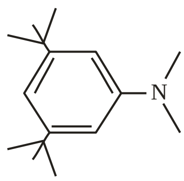
(A) Phenyl isocyanide (B) Benzyl amine (C) Benzyl chloride (D) None of these

56. Maximum extent of steric inhibition of resonance can be expected in:

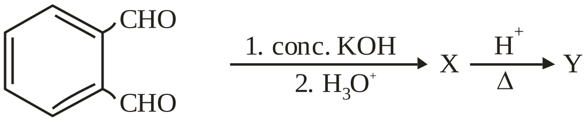
(A) 

(B) 

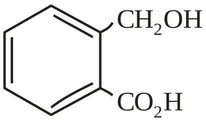
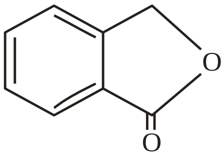
(C) 

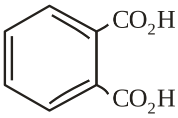
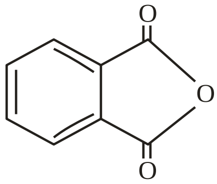
(D) 

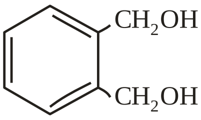
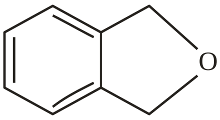
57. In the reaction sequence:

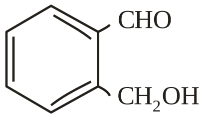
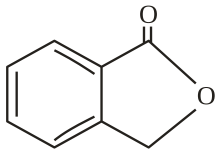


The major products X and Y respectively are:

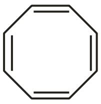
(A)  and 

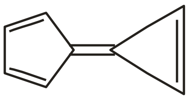
(B)  and 

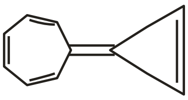
(C)  and 

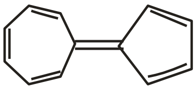
(D)  and 

58. Which of the following is correct?

(A)  is antiaromatic

(B)  is aromatic

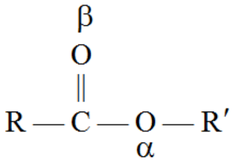
(C)  is aromatic

(D)  is non-aromatic

59. The hybridization of central atom in dimer of BH_3 and BeH_2 is:

(A) sp^2, sp^2 (B) sp^3, sp^2 (C) sp^3, sp^3 (D) sp^2, sp^3

60. Which is more basic oxygen in an ester?



(A) O denoted by α

(B) O denoted by β

(C) Both equally

(D) None of the oxygen atoms is basic

Space for Rough Work

PART-C : MATHEMATICS

61. Area of the quadrilateral with its vertices at foci of the conics $9x^2 - 16y^2 - 18x + 32y - 23 = 0$ and $25x^2 + 9y^2 - 50x - 18y + 33 = 0$ is

(A) $\frac{5}{6}$ (B) $\frac{8}{9}$ (C) $\frac{5}{3}$ (D) $\frac{16}{9}$

62. The number of ways to select two different natural numbers which are less than or equal to 100 and differ by at most 10 is

(A) 1034 (B) 945 (C) 935 (D) 1122

63. $\underset{x\to\frac{\pi}{4}}{\mathrm{Lt}} \dfrac{16\sqrt{2}-(\sin x+\cos x)^9}{1-\sin 2x}$ equals

(A) $18\sqrt{2}$ (B) $12\sqrt{2}$ (C) $32\sqrt{2}$ (D) $36\sqrt{2}$

64. If angle between line $\vec{r} = \hat{i} + 2\hat{k} + \lambda(4\hat{j} - 3\hat{k})$ and XY plane is α, and angle between the planes $x + 2y = 0$ and $2x + y = 0$ is β, then $\dfrac{\cos^2\alpha}{\sin^2\beta} =$

(A) 1 (B) $\frac{9}{16}$ (C) $\frac{16}{9}$ (D) $\frac{9}{25}$

65. The term independent of x in the product $(4 + x + 7x^2)\left(x - \frac{3}{x}\right)^{11}$ is

(A) $-{}^{11}C_6 3^5$ (B) ${}^{11}C_5 3^5$ (C) ${}^{11}C_6 3^6$ (D) None of these

66. The value of the definite integral $\int_{-1}^{1} \dfrac{dx}{(1+e^x)(1+x^2)}$ is

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{8}$ (D) 1

67. If for three non-zero and unequal real numbers a, b and c;

$\dfrac{1}{a+\omega}+\dfrac{1}{b+\omega}+\dfrac{1}{c+\omega}=2\omega^2$ and

$\dfrac{1}{a+\omega^2}+\dfrac{1}{b+\omega^2}+\dfrac{1}{c+\omega^2}=2\omega$, where

ω^2 and ω are the complex cube roots of unity, then $\dfrac{1}{a+1}+\dfrac{1}{b+1}+\dfrac{1}{c+1}=$

(A) 1 (B) 0 (C) 2 (D) 3

68. When a man climbs up one third of a ladder inclined at an angle θ to the ground, he observes an object on the ground at an angular depression of α. If the angular depression of same object when he climbs the ladder completely be β, then

(A) $2\cot\beta = \cot\theta + \cot\alpha$ (B) $3\cot\beta = \cot\theta + \cot\alpha$ (C) $\cot\beta = 3\cot\theta + \cot\alpha$ (D) $3\cot\beta = 2\cot\theta + \cot\alpha$

Space for Rough Work

69. In a geometric progression of all positive terms, any term is equal to the sum of its next two terms. Then the common ratio of this progression is

(A) 2cos18° (B) sin18° (C) cos18° (D) 2sin18°

70. If the foci of an ellipse subtend a right angle at either extremity of its minor axis, then its eccentricity

(A) must be $\frac{1}{\sqrt{2}}$ (B) can be $\frac{1}{2}$ or $\frac{\sqrt{3}}{2}$ (C) must be $\sqrt{\frac{2}{3}}$ (D) cannot be determined

71. The contrapositive of $p \to (\sim p \wedge q)$ is

(A) $\sim p \to (p \vee \sim q)$ (B) $(p \wedge \sim q) \to \sim p$ (C) $(p \vee \sim q) \to p$ (D) $(p \vee \sim q) \to \sim p$

72. If the line $\vec{r} = 2\hat{i} - \hat{j} + 3\hat{k} + \lambda(\hat{i} + \hat{j} + \sqrt{2}\hat{k})$ makes angles α, β, γ with xy, yz and zx planes respectively, then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$ is

(A) 3 (B) 2 (C) 1 (D) 0

73. Let f(x) be defined in [–2, 2] by $f(x) = \begin{cases} \max\{\sqrt{4-x^2}, \sqrt{1+x^2}\} & -2 \le x \le 0 \\ \min\{\sqrt{4-x^2}, \sqrt{1+x^2}\} & 0 < x \le 2 \end{cases}$. Then f(x) is

(A) Continuous & differentiable at all points
(B) Discontinuous at 1 point & non differentiable at more than 1 point
(C) Non differentiable at more than 1 point & continuous at all points
(D) None of these

74. Two parabola $y^2 = 4a(x - \lambda_1)$, and $x^2 = 4a(y - \lambda_2)$ always touch each other, where λ_1 and λ_2 being variable parameters. Then their points of contact lie on a

(A) Circle (B) Hyperbola (C) Ellipse (D) Parabola

75. $\{[(A' \cap B')' \cup C] \cap (A \cup C)\}'$ is equivalent to

(A) $A \cap C$ (B) $A' \cap C$ (C) $A' \cap C'$ (D) $A \cup B'$

76. If $\sum_{i=1}^{18}(x_i - 8) = 9$ and $\sum_{i=1}^{18}(x_i - 8)^2 = 45$ then the standard deviation of $x_1, x_2, \ldots x_{18}$ is

(A) $\frac{1}{2}$ (B) 2 (C) $\frac{3}{2}$ (D) $\frac{5}{2}$

77. $\int \frac{x\,dx}{\sqrt{x^4 + 4x^3 - 6x^2 + 4x + 1}}$ equals

(A) $\ell n\left[x + \frac{1}{x} + \sqrt{\left(x + \frac{1}{x} + 2\right)^2 - 12}\right] + C$ (B) $\left(x + \frac{1}{x}\right) + \ell n\left\{\left(x + \frac{1}{x} + 2\right)^2 - 12\right\} + C$

(C) $\frac{1}{2}\ell n\left[x + \frac{1}{x} + 2 + \sqrt{\left(x + \frac{1}{x} + 2\right)^2 - 12}\right] + C$ (D) $\left(x - \frac{1}{x}\right)^2 + \ell n\left\{\left(x - \frac{1}{x} + 12\right)^2 - 12\right\} + C$

Space for Rough Work

78. If $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+...\infty=\frac{\pi^2}{6}$, then $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+...$ equals

(A) $\frac{\pi^2}{8}$ (B) $\frac{\pi^2}{12}$ (C) $\frac{\pi^2}{3}$ (D) $\frac{\pi^2}{2}$

79. If the lines $lx + my + n = 0$, $mx + ny + l = 0$ and $nx + ly + m = 0$ are concurrent then

(A) $l + m + n = 0$ (B) $l - m - n = 0$ (C) $l + m - n = 0$ (D) $m + n - l = 0$

80. If A is a square matrix such that $A(\text{Adj.}A)=\begin{bmatrix}4&0&0\\0&4&0\\0&0&4\end{bmatrix}$, then $\frac{|\text{adj}(\text{adj}.A)|}{|\text{adj}.A|}$ is equal to

(A) 256 (B) 64 (C) 32 (D) 16

81. Let T_r be the r^{th} term of a sequence. If, for r = 1, 2, 3, …. , $3T_{r+1} = T_r$ and $T_7 = \frac{1}{243}$, then the value of $\sum_{r=1}^{\infty}(T_r.T_{r+1})$ is

(A) $\frac{9}{2}$ (B) $\frac{27}{8}$ (C) $\frac{81}{8}$ (D) $\frac{81}{4}$

82. If the tangent at (1, 1) on $y^2 = x(2 - x)^2$ meets the curve again at P, then 'P' is

(A) (4, 4) (B) (2, 0) (C) $\left(\frac{9}{4},\frac{3}{8}\right)$ (D) $\left(3,\sqrt{3}\right)$

83. The solution of differential equation $x\sec\left(\frac{y}{x}\right)(y\,dx+x\,dy)=y\,\text{cosec}\left(\frac{y}{x}\right)(x\,dy-y\,dx)$ is

(A) $xy=c\left|\text{cosec}\left(\frac{y}{x}\right)\right|$ (B) $xy^2\left|\sin\left(\frac{y}{x}\right)\right|=c$ (C) $\left|xy\,\text{cosec}\left(\frac{y}{x}\right)\right|=c$ (D) $xy=c\left|\sin\left(\frac{x}{y}\right)\right|$

84. If A and B are two events such that P(A) = $\frac{2}{5}$ and $P(A \cap B) = \frac{3}{20}$, then $P\left(A\,|\,(A'\cup B')\right)$ is equal to

(A) $\frac{8}{17}$ (B) $\frac{1}{4}$ (C) $\frac{11}{20}$ (D) $\frac{5}{17}$

85. Let $f : R^+ \to \{-1, 0, 1\}$ defined by $f(x) = \text{sgn}\,(x - x^4 + x^7 - x^8 - 1)$ where sgn denotes signum function. Then f(x) is

(A) many one and onto (B) many-one and into (C) one-one and onto (D) one-one and into

86. Area of region bounded by the curve $y=\frac{16-x^2}{4}$ and $y=\sec^{-1}\left[-\sin^2 x\right]$ (where [.] denotes greatest integer function) is

(A) $\frac{1}{3}(4-\pi)^{\frac{3}{2}}$ sq. units (B) $8(4-\pi)^{\frac{3}{2}}$ sq. units (C) $\frac{8}{3}(4-\pi)^{\frac{3}{2}}$ sq. units (D) $\frac{8}{3}(4-\pi)^{\frac{1}{2}}$ sq. units

Space for Rough Work

87. Let A = $\left[a_{ij}\right]_{3\times3}$, B = $\left[b_{ij}\right]_{3\times3}$, where $b_{ij} = 3^{i-j}a_{ij}$ and C = $\left[c_{ij}\right]_{3\times3}$, where $c_{ij} = 4^{i-j}b_{ij}$ be any three matrices. If det.A = 2 then 'det.B + det.C' is equal to

(A) 4 (B) 3 (C) 2 (D) 1

88. If x_1 and x_2 are two distinct of solutions the equation $\log_5\left(\log_{64}|x|+(25)^x-\frac{1}{2}\right)=2x$, then

(A) $x_1 = 2x_2$ (B) $x_1 + x_2 = 0$ (C) $x_1 = 3x_2$ (D) $x_1x_2 = 64$

89. Which of the following is always true about a function $f(x)$ on the interval [a, b] ?

(A) If $f(x) \geq 0$ on [a, b], then $\int_a^b f(x)dx \leq \int_a^b f^2(x)dx$

(B) If $f(x)$ is increasing on [a, b] then $f^2(x)$ is increasing on [a, b]

(C) If $f(x)$ attains a minimum at c where a < c < b, then $f'(c) = 0$

(D) none of these

90. The difference between the greatest and least possible values of $y = (\sin^{-1}x)^2 + (\cos^{-1}x)^2$ is

(A) $\frac{5}{8}\pi^2$ (B) $\frac{3}{4}\pi^2$ (C) $\frac{9}{8}\pi^2$ (D) $\frac{7}{8}\pi^2$

Space for Rough Work