Sample Papers

JEE Advanced

Time: 3 Hours ***Maximum Marks: 183***

Topics Covered:

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

Read the Important Instructions Carefully:

1. *You are allowed to take away the Question Paper at the end of the examination.*
2. *Do not tamper with or mutilate the ORS. Do not use the OMR for rough work.*
3. *Use a **BLACK BALL POINT PEN** to darken the bubbles on the ORS.*
4. *The OMR is machine-gradable. Ensure that the bubbles are darken in the correct way.*
5. *Darken the bubbles **ONLY IF** you are sure of the answer. There is **NO WAY** to erase or "un-darken" a darkened bubble.*

PART-I : PHYSICS

SECTION-1 (MAXIMUM MARKS : 28)

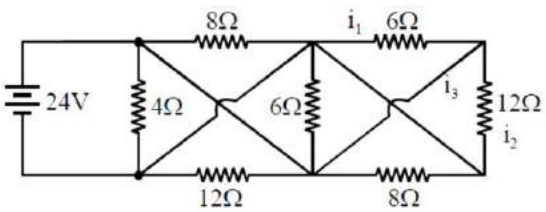
- *This section contains **SEVEN** questions*
- *Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct*
- *For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS*
- *For each question, marks will be awarded in one of the following categories:*

Full Marks	:	***+4***	***If only the bubble(s) corresponding to all the correct option(s) is(are) darkened***
Partial Marks	:	***+1***	***For darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened***
Zero Marks	:	***0***	***If none of the bubbles is darkened***
Negative Marks	:	***–2***	***In all other cases***

- *For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will results in +4 marks; darkening only (A) and (D) will result in +2 marks; and darkening (A) and (B) results in –2 marks, as a wrong option is also darkened*

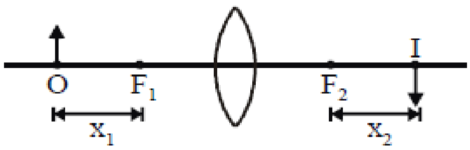
1. The equations: $y_1 = a \sin(\omega t - kx)$ and $y_2 = -a \sin(\omega t + kx)$ are for two waves, then the waves will:
(A) Move in the same direction with equal amplitude
(B) Move in opposite direction with the same speed and the same frequency
(C) Produce beats by superposition
(D) Produce stationary waves by superposition

2. Choose the correct statement(s):



(A) i_1 = 4A, towards left
(B) i_1 = 4A, towards right
(C) i_2 = 2A, down
(D) i_3 = 6A

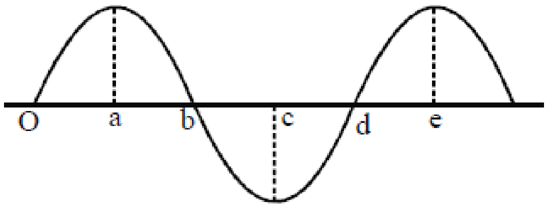
3. An object O is placed at a point distance x_1 from the focus F_1 of a converging lens of focal length f and its image I is formed at distance x_2 from the focus F_2 as shown in figure, then:



(A) magnitude of transverse magnification is $\left|\frac{f}{x_1}\right|$
(B) magnitude of transverse magnification is $\left|\frac{x_2}{f}\right|$
(C) $x_1 \times x_2 = f^2$
(D) $x_1 + x_2 \geq 2f$

Space for Rough Work

4. The rope shown at an instant is carrying a wave travelling towards right, created by a source vibrating at frequency n Hz. Here a, b, c, d and e are x co-ordinates. Choose the correct statement(s)



(A) The speed of the wave is $4n \times (b - a)$

(B) The particle at x = a will be in the same phase as particle at x = d after $\frac{4}{3n}$ sec.

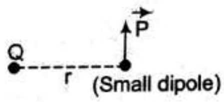
(C) The phase difference between particles at x = b and x = e is $\frac{3\pi}{2}$

(D) Particles at x = a and x = e vibrate in same phase

5. Lenses are constructed by a material of refractive index 1.50.Themagnitude of the radii of curvature are 20 cm and 30 cm. Choose the focal lengths of all the possible lenses with the above specifications:

(A) + 24 cm (B) –24 cm (C) +120 cm (D) –120 cm

6. For the situation shown in the figure (r >> length of dipole) mark out the correct statement(s).



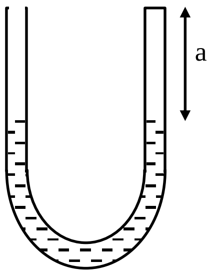
(A) Force acting on the dipole is zero

(B) Force acting on the dipole is approximately $\frac{pQ}{4\pi\varepsilon_0 r^3}$

(C) Torque acting on the dipole is $\frac{pQ}{4\pi\varepsilon_0 r^2}$ in clockwise direction

(D) Torque acting on the dipole is $\frac{pQ}{4\pi\varepsilon_0 r^2}$ in anti-clockwise direction

7. A long U tube is filled with a liquid of density ‘ρ’ such that length of the tube above liquid is ‘a’ in both arm. One side of tube (right arm) is sealed and the tube is inverted (‘P_0’ atmospheric pressure).



(A) Liquid will spill out the left tube if a < $\frac{P_0}{4\rho g}$

(B) Liquid will not spill out the left tube for any value of ‘a’

(C) Liquid surface in left arm will not move if a = $\frac{P_0}{2\rho g}$

(D) Liquid surface in right arm will come down

Space for Rough Work

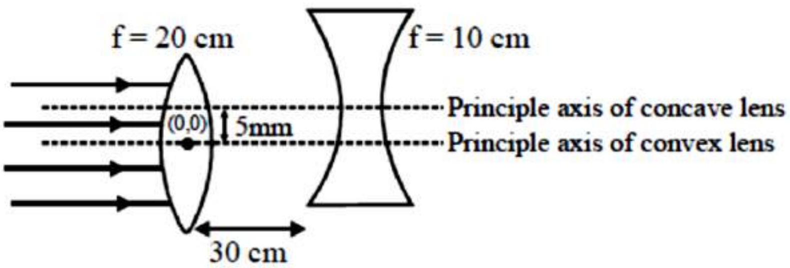
SECTION-2 (MAXIMUM MARKS : 15)

- *This section contains **FIVE** questions*
- *The answer to each question is a **SINGLE DIGIT INTEGER** ranging 0 to 9, both inclusive*
- *For each question, darken the bubble corresponding to the correct integer in the ORS*
- *For each question, marks will be awarded in one of the following categories:*

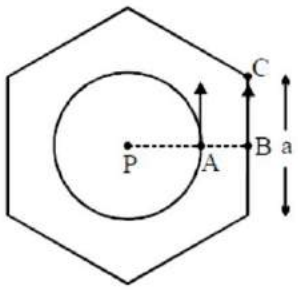
Full Marks	:	***+3***	***If only the bubble corresponding to the correct answer is darkened***
Zero Marks	:	***0***	***If all other cases***

8. A stretched rope having linear mass density 5×10^{-2} kgm^{-1} is under a tension of 80N. Power (in Watts) $= 648n\pi^2 \times 10^{-2}$ has to be supplied to the rope to generate harmonic waves at a frequency of 60Hz and an amplitude of 6 cm. Find the value of n.

9. If the optical axis of convex and concave lenses are separated by a distance 5mm shown in the figure. If the coordinates of final image formed by the combination of lenses is (x, y) when the parallel beam of light is incident on convex lens. If origin is at the optical centre of convex lens, find $\frac{x}{5y}$.



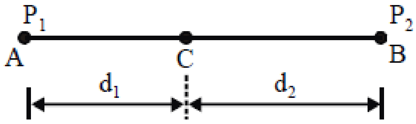
10. A boy is moving along a circular track in anticlockwise sense. A girl moves along a regular hexagonal path. The centres of hexagonal track and a circular track coincide as shown in the figure. The girl and the boy starts from point B and A such that P, A & B always lie on the same radial line. The velocity of boy is 1m/s. Given side length of regular hexagon is "a" and radius of circular path is $\frac{a}{\sqrt{3}}$. Find the speed of Girl at point C.



11. An RLC circuit with R = 100Ω is connected across ac source of 200V and angular frequency 300 rad/s. When only capacitance is removed, the current lags behind voltage by 60°. When only inductance is removed, the current leads the voltage by 60°. The current in the circuit is: (in Ampere)

Space for Rough Work

12. As shown in the figure, Two Loudspeakers are located at point A and B. Both are vibrating in phase at a frequency f and P_1 and P_2 are their respective power outputs. Point C lies on a line joining the two loudspeakers at a distance of d_1 from A and d_2 from B. With both speakers switched on what is the intensity (in W/m^2) at point C. Take velocity of sound = $300 ms^{-1}$, frequency f = 100Hz. d_1 = 1m and d_2 = 1.5 m. $P_1 = 8\pi$ watts and $P_2 = 18\pi$ watts. Also, assume that loudspeakers behave like point isotropic sources. (emit sound uniformly in all directions).



SECTION-3 (MAXIMUM MARKS : 18)

- *This section contains **SIX** questions of matching type*
- *This section contains **TWO** tables (each having 3 columns and 4 rows)*
- *Based on each table, there are **THREE** questions*
- *Each question has **FOUR** options (A), (B), (C), and (D). **ONLY ONE** of these four options is correct*
- *For each question, darken the bubble corresponding to the correct option in the ORS*
- *For each question, marks will be awarded in one of the following categories:*

Full Marks : ***+3*** ***If only the bubble corresponding to the correct option is darkened***

Zero Marks : ***0*** ***If none of the bubbles is darkened***

Negative Marks : ***–1*** ***In all other cases***

Answer Q.13, Q.14 and Q.15 by appropriately matching the information given in the three columns of the following table.

A charged particle is projected with velocity $\vec{v} = u\hat{i}$ from the origin, in a region having electric field $\vec{E}$ and magnetic field $\vec{B}$ both. Value of $\vec{B}$ and $\vec{E}$ are given in column 1 and column 2 respectively and path of the particle is given in column 3.

Column 1 (Magnetic field)		Column 2 (Electric field)		Column 3 (Path of particle)	
(I)	$\vec{B} = 0$	(i)	$\vec{E} = 0$	(P)	Circular path
(II)	$\vec{B} = B_0\hat{i} + B_0\hat{j}$	(ii)	$\vec{E} = E_0\hat{i}$	(Q)	Helical path
(III)	$\vec{B} = B_0\hat{j} + B_0\hat{k}$	(iii)	$\vec{E} = B_0u(\hat{j} - \hat{k})$	(R)	Cycloid
(IV)	$\vec{B} = B_0\hat{k}$	(iv)	$\vec{E} = E_0\hat{k}$	(S)	Straight line

13. In which of the following combination particle moves with uniform speed?
(A) (I) (i) (P) (B) (II) (ii) (S) (C) (III) (iii) (S) (D) None of these

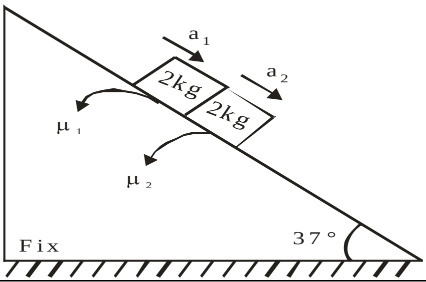
14. In which of the following combination particle moves with non-uniform speed?
(A) (IV) (i) (P) (B) (III) (i) (P) (C) (IV) (iv) (R) (D) (IV) (iv) (Q)

15. Which of the following combination is correct?
(A) (II) (ii) (R) (B) (II) (i) (Q) (C) (IV) (i) (S) (D) None of these

Space for Rough Work

Answer Q.16, Q.17 and Q.18 by appropriately matching the information given in the three columns of the following table.

In below figure two blocks are placed on fixed inclined plane and friction coefficient between the blocks and inclined plane are μ_1 and μ_2 respectively as shown in figure. Value of μ_1 and μ_2 are given in column 1 and value of a_1 and a_2 are given in column 2 and column 3 respectively.



Column 1		Column 2		Column 3	
(I)	$\mu_1 = 0.8$ $\mu_2 = 0.8$	(i)	$a_1 = 2\ m/s^2$	(P)	$a_2 = 2\ m/s^2$
(II)	$\mu_1 = 0.5$ $\mu_2 = 0.5$	(ii)	$a_1 = 0.8\ m/s^2$	(Q)	$a_2 = 0.8\ m/s^2$
(III)	$\mu_1 = 0.5$ $\mu_2 = 0.2$	(iii)	$a_1 = 4.4\ m/s^2$	(R)	$a_2 = 4.4\ m/s^2$
(IV)	$\mu_1 = 0.5$ $\mu_2 = 0.8$	(iv)	$a_1 = 0$	(S)	$a_2 = 0$

16. In which of the following combination both blocks will move together and normal between them is zero?
(A) (I) (ii) (P) (B) (II) (i) (P) (C) (I) (i) (P) (D) (IV) (ii) (Q)

17. In which of the following combination both blocks will move together and normal force between them is non-zero?
(A) (II) (i) (P) (B) (III) (ii) (Q) (C) (I) (ii) (Q) (D) (IV) (ii) (Q)

18. Which of the following combination is correct?
(A) (III) (i) (Q) (B) (III) (iv) (Q) (C) (III) (i) (R) (D) (III) (ii) (R)

Space for Rough Work

PART-II : CHEMISTRY

SECTION-1 (MAXIMUM MARKS : 28)

- *This section contains **SEVEN** questions*
- *Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct*
- *For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS*
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Zero Marks	:	***0***	***If none of the bubbles is darkened***
Negative Marks	:	***–2***	***In all other cases***

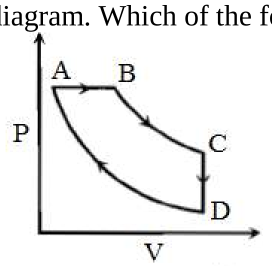
- *For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will results in +4 marks; darkening only (A) and (D) will result in +2 marks; and darkening (A) and (B) results in –2 marks, as a wrong option is also darkened*

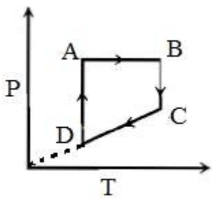
19. The oxidation states of S in sodium tetrathionate ($Na_2S_4O_6$) and $Na_2S_2O_3$ is:
(A) +5 (B) –2 (C) +6 (D) 0

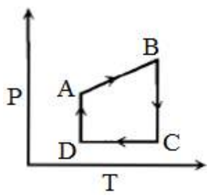
20. The formal charges on different atoms in lewis structure of N_3^- are
(A) –1, +1, –1 (B) –1, +1, 0 (C) –2, +1, 0 (D) 0, +1, –2

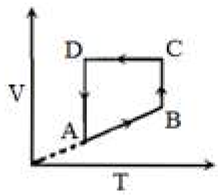
21. Which of the following statement(s) is/are true for diboarane?
(A) B_2H_6 is electron-deficient molecule
(B) Hybridization of B atom is sp^3 and molecule is non-planar
(C) Bridge bonding is found in B_2H_6
(D) The electronic distribution of the bridge bond (B–H–B) has a banana-like appearance and is also called banana bond

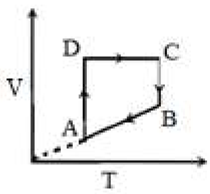
22. A cyclic process ABCD is shown in the P-V diagram. Which of the following curves represents the same process?



(A) 

(B) 

(C) 

(D) 

23. In which of the following alkyl halide a hydride shift occur upon addition of water?
(A) $CH_3-C(Br)(CH_3)-CH_2-CH_3$
(B) $CH_3-CH(CH_3)-CH(Br)-CH_3$
(C) $CH_3-CH(CH_2-Br)-CH_2-CH_3$
(D) $CH_3-CH(CH_3)-CH_2-CH_2Br$

Space for Rough Work

24. $A + B \underset{K_2}{\overset{K_1}{\rightleftharpoons}} C \xrightarrow{K_3} D$

Which of the following expression is/are correct?

(A) $\frac{d[C]}{dt} = K_1[A][B]$

(B) $\frac{d[C]}{dt} = K_1[A][B] - K_2[C] - K_3[D]$

(C) $\frac{-d[A]}{dt} = K_1[A][B] + K_2[C]$

(D) $\frac{d[D]}{dt} = K_3[C]$

25. Which of the following is/are product(s) of reaction of aldehyde with amines?

(A) Imines (B) Enamines (C) Oximes (D) Hydrazone

SECTION-2 (MAXIMUM MARKS : 15)

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Zero Marks : 0 If all other cases

26. The coagulation of 100 mL of gold sol is prevented by addition of 0.25 g of starch to it before adding 1 ml of 10% NaCl solution. If the gold number of starch is x then $\frac{x}{5}$ is:

27. The number of compounds having P-O-P bond in the following compounds:
$H_4P_2O_7$, $(HPO_3)_n$, $(HPO_3)_3$, $H_4P_2O_5$, $H_4P_2O_6$, H_3PO_3, H_3PO_4, H_3PO_2

28. When 1 mole of $CrCl_3.6H_2O$ is treated with $AgNO_3$, x mole of AgCl are obtained. The formula of the compound is $[Cr(H_2O)_6]Cl_3$, y is oxidation number of Cr and z is coordination number of compound. Find the value of 2x + y – z.

29. $Fe^{+2} + 2e^- \longrightarrow Fe$ ......(i)

$Fe^{+3} + e^- \longrightarrow Fe^{+2}$ ......(ii)

The standard potential corresponding to reaction (i) and (ii) are E_1 and E_2. The value of standard potential corresponding to the reaction $Fe^{+3} + 3e^- \longrightarrow Fe$ is $\frac{xE_1 + yE_2}{z}$, then find the value of x + y + z.

30. The number of polar aprotic solvent in the following solvents
Acetone, Dimethsulfoxide, Dimethylformamide, water, HMPA, Ethanol, Acetic acid, DMA.

Space for Rough Work

SECTION-3 (MAXIMUM MARKS : 18)

- *This section contains **SIX** questions of matching type*
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- *Each question has **FOUR** options (A), (B), (C), and (D). **ONLY ONE** of these four options is correct*
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  Zero Marks : 0 If none of the bubbles is darkened

  Negative Marks : −1 In all other cases

Answer Q.31, Q. 32 and Q.33 by appropriately matching the information given in the three columns of the following table.

Column 1: Name and formula of compound
Column 2: Name of the reaction.
Column 3: Major product of reaction.

Column 1		**Column 2**		**Column 3**	
(I)	$R-\overset{\overset{\displaystyle O}{\|\|}}{C}-NH_2$	(i)	Nucleophilic addition elimination reaction with R′MgX	(P)	$R-N\equiv C$
(II)	$R-NH_2$	(ii)	Aldol condensation	(Q)	$R-NH_2$
(III)	$R-\overset{\overset{\displaystyle O}{\|\|}}{C}-Cl$	(iii)	Hoffmann-bromamide reaction	(R)	$R-\overset{\overset{\displaystyle O}{\|\|}}{C}-R'$
(IV)	$CH_3-\overset{\overset{\displaystyle O}{\|\|}}{C}-H$	(iv)	Carbylamine reaction	(S)	$CH_3-CH=CH-\overset{\overset{\displaystyle O}{\|\|}}{C}-H$

31. The only correct combination in which the reaction intermediate is Carbene:
(A) (I) (iv) (P) (B) (I) (iii) (Q) (C) (II) (iii) (P) (D) (II) (iv) (P)

32. The only correct combination in which enolate is formed:
(A) (III) (ii) (S) (B) (IV) (ii) (S) (C) (IV) (ii) (R) (D) (IV) (iii) (P)

33. The only correct combination in which the reaction intermediate is nitrene:
(A) (I) (iii) (P) (B) (II) (iii) (Q) (C) (I) (iii) (Q) (D) (II) (iv) (Q)

Space for Rough Work

Answer Q.34, Q.35 and Q.36 by appropriately matching the information given in the three columns of the following table.

Column 1: Compound
Column 2: Oxidation state
Column 3: Type of linkage

Column 1		**Column 2**		**Column 3**	
(I)	$Na_2S_2O_3$	(i)	+5	(P)	S–O–S
(II)	$Na_2S_4O_6$	(ii)	–2	(Q)	–S–S–
(III)	$H_2S_2O_7$	(iii)	+6	(R)	–O–O–
(IV)	$H_2S_2O_8$	(iv)	+4	(S)	S = S

34. The only correct combination for Marshall's Acid.
(A) (IV) (iii) (P) (B) (IV) (iii) (R) (C) (IV) (iii) (P) (D) (III) (ii) (R)

35. The only correct combination in which the oxidation state of one of the S is zero:
(A) (II) (i) (P) (B) (I) (i) (P) (C) (II) (i) (Q) (D) (I) (i) (Q)

36. The only correct combination in which the hybridization of one of the S atom is sp^2:
(A) (I) (ii) (Q) (B) (II) (i) (Q) (C) (I) (ii) (S) (D) (II) (i) (S)

Space for Rough Work

PART-III : MATHEMATICS

SECTION-1 (MAXIMUM MARKS : 28)

- *This section contains **SEVEN** questions*
- *Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct*
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Full Marks	:	***+4***	***If only the bubble(s) corresponding to all the correct option(s) is(are) darkened***
Partial Marks	:	***+1***	***For darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened***
Zero Marks	:	***0***	***If none of the bubbles is darkened***
Negative Marks	:	***–2***	***In all other cases***

- *For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will results in +4 marks; darkening only (A) and (D) will result in +2 marks; and darkening (A) and (B) results in –2 marks, as a wrong option is also darkened*

37. Let f(x) be a real valued function defined on: $R \to R$ such that $f(x) = [x]^2 + [x + 1] - 3$, where [x] denotes greatest integer less than or equal to x, then which of the following option(s) is/are correct?

(A) f(x) is many-one and into function
(B) f(x) is many-one and onto function
(C) range of f(x) is $[0, \infty)$
(D) f(x) = 0 for infinite number of values of x

38. If (b + c), (c + a), (a + b) are in H.P., then which of the following hold(s) good?

(A) $\frac{b+c}{a}, \frac{c+a}{b}, \frac{a+b}{c}$ are in A.P.
(B) $\frac{b+c}{a}, \frac{c+a}{b}, \frac{a+b}{c}$ are in H.P.
(C) a^2, b^2, c^2 are in A.P.
(D) a^2, b^2, c^2 are in H.P.

39. Let x_1, x_2, x_3, x_4 be four non-zero numbers satisfying the equation

$\tan^{-1}\left(\frac{a}{x}\right) + \tan^{-1}\left(\frac{b}{x}\right) + \tan^{-1}\left(\frac{c}{x}\right) + \tan^{-1}\left(\frac{d}{x}\right) = \frac{\pi}{2}$, then which of the following relation hold(s) good?

(A) $\sum_{i=1}^{4}(x_i) = a + b + c + d$

(B) $\sum_{i=1}^{4}\left(\frac{1}{x_i}\right) = 0$

(C) $\prod_{i=1}^{4}(x_i) = abcd$

(D) $(x_1 + x_2 + x_3)(x_2 + x_3 + x_4)(x_3 + x_4 + x_1)(x_4 + x_1 + x_2) = abcd$

40. If y(x) satisfies the differential equation $\frac{dy}{dx} = \sin 2x + 3y \cot x$ and $y\left(\frac{\pi}{2}\right) = 2$, then which of the following statement(s) is/are correct?

(A) $y\left(\frac{\pi}{6}\right) = 0$
(B) $y'\left(\frac{\pi}{3}\right) = \frac{9 - 3\sqrt{2}}{2}$
(C) y(x) increases in interval $\left(\frac{\pi}{6}, \frac{\pi}{3}\right)$
(D) The value of definite integral $\int_{-\frac{\pi}{2}}^{\pi/2} y(x)dx$ equals π.

Space for Rough Work

41. Consider the system of equations
$ax + y + z = 1$
$x + ay + z = 1$
$x + y + az = 1$, then which of the following statement(s) is/are correct?
(A) if $a = 2$, then the system has unique solution
(B) if $a = 1$, then the system has infinite solutions
(C) if $a = -2$, then the system has no solution
(D) if $a = 2$, then the system has infinite solutions

42. A, B, C and D are four points such that $\vec{AB} = m(2\hat{i} - 6\hat{j} + 2\hat{k}), \vec{BC} = m(\hat{i} - 2\hat{j})$ and $\vec{CD} = n(-6\hat{i} + 15\hat{j} - 3\hat{k})$. If $\vec{CD}$ intersects $\vec{AB}$ at some point E, then which of the following option(s) is/are correct?
(A) $m \geq \frac{1}{2}$
(B) $n \geq \frac{1}{3}$
(C) $m = n$
(D) $m = \frac{1}{4}$

43. Which of the following limit is equal to 0?
(A) $\lim\limits_{x\to 0^+}(x^{x^x} - x^x)$
(B) $\lim\limits_{x\to 0^+} x^2 \ln\left(\sqrt{\frac{1}{x}}\right)$
(C) $\lim\limits_{x\to 0^+}(x)^{\ln(x+1)}$
(D) $\lim\limits_{x\to 0}\left(\frac{10^x - 2^x - 5^x + 1^x}{x + \tan x}\right)$

SECTION-2 (MAXIMUM MARKS : 15)

- *This section contains **FIVE** questions*
- *The answer to each question is a **SINGLE DIGIT INTEGER** ranging 0 to 9, both inclusive*
- *For each question, darken the bubble corresponding to the correct integer in the ORS*
- *For each question, marks will be awarded in one of the following categories:*

Full Marks : +3 If only the bubble corresponding to the correct answer is darkened
Zero Marks : 0 If all other cases

44. Find the number of solutions of the equation $\sin 2\theta + \cos 2\theta + 4\sin\theta = 1 + 4\cos\theta$ lying in the interval $[-2\pi, 2\pi]$.

45. Let $A = [a_{ij}]$ be a square matrix of order 2 where $a_{ij} \in \{0, 1, 2, 3, 4, 6\}$. The number of matrices A with distinct element such that $AA^{-1} = I$, where I is the unit matrix of order 2, is $(a^3 + 1)$. Find the value of a.

46. Line $x + 2y = 4$ is translated by $\sqrt{5}$ units closer to the origin and then rotated by angle $\tan^{-1}\left(\frac{1}{2}\right)$ in the clockwise direction about the point where the shifted line cuts the x-axis. Find the distance of new line from point M(3, 3).

47. If ω is the imaginary cube root of unity, then find the member of ordered pairs of integers (a, b) such that $|a\omega + b| = 1$.

48. Two numbers x and y are chosen at random (without replacement) from amongst the numbers 1, 2, 3,……, 2004. The probability that $(x^3 + y^3)$ is divisible by 3 is $\frac{p}{q}$ (p and q are co-prime). Find the value of (p + q).

Space for Rough Work

SECTION-3 (MAXIMUM MARKS : 18)

- *This section contains **SIX** questions of matching type*
- *This section contains **TWO** tables (each having 3 columns and 4 rows)*
- *Based on each table, there are **THREE** questions*
- *Each question has **FOUR** options (A), (B), (C), and (D). **ONLY ONE** of these four options is correct*
- *For each question, darken the bubble corresponding to the correct option in the ORS*
- *For each question, marks will be awarded in one of the following categories:*

Full Marks : +3 If only the bubble corresponding to the correct option is darkened

Zero Marks : 0 If none of the bubbles is darkened

Negative Marks : –1 In all other cases

Answer Q.49, Q. 50 and Q.51 by appropriately matching the information given in the three columns of the following table.

Let S_1 and S_2 be circles of radii 1 and r (r > 1) respectively touching the coordinate axes.
Column-1: Conditions between circles S_1 and S_2
Column-2: Values of r for conditions in Column-1.
Column-3: Number of common tangents between S_1 and S_2 for conditions in column-1.

Column 1		Column 2		Column 3	
(I)	S_1 passes through the centre of S_2.	(i)	3	(P)	1
(II)	S_1 and S_2 touch each other	(ii)	$\frac{2+\sqrt{2}}{2}$	(Q)	2
(III)	S_1 and S_2 are orthogonal	(iii)	$2+\sqrt{3}$	(R)	3
(IV)	S_1 and S_2 have longest common chord	(iv)	$3+2\sqrt{2}$	(S)	4

49. Which of the following options is the only CORRECT combination?
(A) (I) (ii) (Q) (B) (I) (ii) (P) (C) (I) (ii) (R) (D) (II) (ii) (S)

50. Which of the following options is the only CORRECT combination?
(A) (II) (ii) (P) (B) (III) (iv) (S) (C) (II) (iv) (R) (D) (II) (iv) (S)

51. Which of the following options is the only CORRECT combination?
(A) (III) (iii) (R) (B) (IV) (ii) (Q) (C) (III) (i) (P) (D) (IV) (i) (Q)

Space for Rough Work

Answer Q.52, Q. 53 and Q.54 by appropriately matching the information given in the three columns of the following table.

Let $f(x) = x^2e^{-3x} - \lambda$
Column-1: contains values of λ.
Column-2: contains number of zeroes of f(x).
Column-3: contains monotonic nature of f(x).

Column 1		**Column 2**		**Column 3**	
(I)	$\lambda \in (-\infty, 0)$	(i)	0	(P)	f(x) is increasing in $\left(0, \frac{2}{3}\right)$
(II)	$\lambda \in \left(0, \frac{4}{9e^2}\right)$	(ii)	1	(Q)	f(x) is increasing in $\left(\frac{4}{3}, \infty\right)$
(III)	$\lambda \in \left(\frac{4}{9e^2}, \infty\right)$	(iii)	2	(R)	f(x) is increasing in $\left(\frac{8}{3}, \infty\right)$
(IV)	$\lambda = \frac{4}{9e^2}$	(iv)	3	(S)	f(x) is decreasing in $(-\infty, -2)$

52. Which of the following options is the only CORRECT combination?
(A) (II) (ii) (P) (B) (III) (ii) (R) (C) (IV) (iii) (Q) (D) (IV) (ii) (S)

53. Which of the following options is the only CORRECT combination?
(A) (II) (ii) (S) (B) (II) (iv) (P) (C) (III) (i) (P) (D) (II) (ii) (Q)

54. Which of the following options is the only CORRECT combination?
(A) (I) (i) (S) (B) (III) (ii) (R) (C) (I) (ii) (S) (D) (III) (iii) (P)

Space for Rough Work