# 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 OMR. Do not use the OMR for rough work.*
3. *Use a **BLACK BALL POINT PEN** to darken the bubbles on the OMR.*
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 : 21)

- *This section contains **SEVEN** 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 all the correct option in the OMR*
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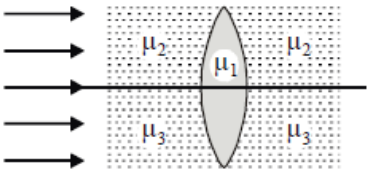
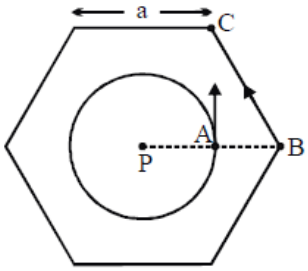
| ***Full Marks*** | ***:*** | ***+3*** | ***If only the bubble corresponding to all the correct option is darkened*** |
| ***Zero Marks*** | ***:*** | ***0*** | ***If none of the bubbles is darkened*** |
| ***Negative Marks*** | ***:*** | ***–1*** | ***In all other cases*** |

1. An equi convex lens is made of a material of refractive index $\mu_1$ and is placed inside two liquids of refractive indices $\mu_2$ and $\mu_3$ as shown with $\mu_2 > \mu_1 > \mu_3$. A wide, parallel beam of light is incident on the lens from the left. The lens will give rise to:




(A) A single convergent beam
(B) Two different convergent beams
(C) Two different divergent beams
(D) A convergent and divergent beam

2. A boy is moving along a circular track in anticlockwise sense. A point sound source moves along a regular hexagonal path. The centres of hexagonal track and the circular track coincide as shown in the figure. The source and boy starts from point B and A respectively such that P, A & B always lie on the same radial line. At what point, the frequency heard by the boy is minimum?

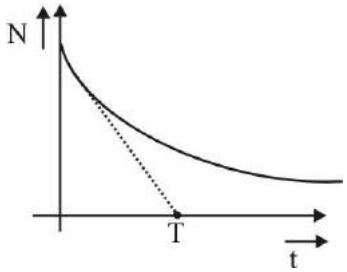



(A) Just before C
(B) Just after C
(C) At the mid-point of BC
(D) None of these

3. A person speaking normally produces a sound Intensity of 40 dB at a distance of 1m. If the threshold Intensity for reasonable audibility is 20 dB, the maximum distance at which he can be heard clearly is:
(A) 4m (B) 5m (C) 10m (D) 20m

***Space for Rough Work***

4. A radioactive sample undergoes decay as per the following graph. Dotted line represents the slope of the curve at t = 0. If this dotted line intersects the time axis at t = T, choose the correct alternative (Given $t_{1/2}$ = half life, $t_{avg}$ = mean life)

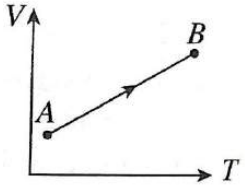



(A) $t_{1/2} > T$ (B) $t_{avg} = T$ (C) $t_{1/2} = T$ (D) $t_{avg} > T$

5. The focal lengths of a converging lens for red, yellow and violet light are 100 cm, 98 cm and 96 cm respectively. Find the approximate dispersive power of the material of the lens:
(A) 0.02 (B) 0.04 (C) 0.06 (D) 0.07

6. A 2 cm diameter coin rests flat on the bottom of a bowl in which the water is 20 cm deep $\left(\mu_m = \frac{4}{3}\right)$. If the coin is viewed directly from above, what is its apparent diameter?
(A) 2 cm (B) 1.5 cm (C) 2.67 cm (D) 1.67 cm

7. An ideal gas undergoes a process AB as shown in figure. Which of the following is true for the gas?




(A) pressure (P) decreases (B) density (d) increases
(C) ratio P/d remains constant (D) ratio P/d increases

## SECTION-2 (MAXIMUM MARKS : 28)

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- *For each question, marks will be awarded in <u>one of the following categories</u>:*

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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*

***Space for Rough Work***

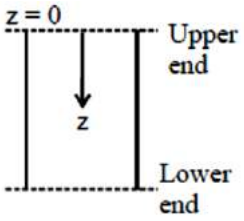
8. Two tuning forks of frequency 250Hz and 256Hz produce beats. If a maximum intensity is observed at t = 0. At what time instant(s), the minimum intensity is observed at the same place?

(A) $\frac{1}{18}$sec. (B) $\frac{1}{4}$sec. (C) $\frac{1}{3}$sec. (D) $\frac{1}{12}$sec.

9. A long straight wire carries a current along the x-axis. Consider the points A(0, 1, 0), B(0, 1, 1), C(1, 0, 1) and D(1, 1, 1). Which of the following pairs of points will have magnetic fields of the same magnitude?

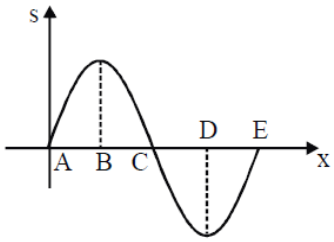
(A) A and B (B) A and C (C) B and C (D) B and D

10. In an organ pipe (which may be closed or open) of 99 cm length, standing wave is set up whose equation is given by, longitudinal displacement(s) = 0.3 mm $\cos\left[\left(\frac{2\pi}{0.8}\right)(z+0.01\text{m})\right]\cos 400t$ where z is measured from the top of tube in metres and t is in seconds. Take end correction = 1 cm. Choose the correct statement(s).




(A) The upper end and lower end of tube are open and closed respectively
(B) The upper end and lower end of tube are closed and open respectively
(C) The air column is vibrating in third harmonic
(D) The air column is vibrating in second overtone

11. A sound wave is traveling along positive x-direction. Displacement(s) of particles from their mean position at any time t is shown in the figure. Choose the correct alternative(s):




(A) Particle located at E has its velocity in negative y-direction.
(B) Particle located at D has zero velocity.
(C) Particles located near C are under compression.
(D) Change in pressure from equilibrium value at D is zero.

12. Choose the correct statement(s)

(A) There is a phase change of $\pi$ in the pressure wave when it is reflected by an open end in an organ pipe.
(B) In standing wave, all the particles between two successive nodes reach their extreme positions simultaneously.
(C) Equation y = 2A cos kx cos $\omega$t represents a standing wave.
(D) In a travelling wave in stretched string, kinetic energy and potential energy per unit volume are both zero at maximum displacement from mean position.

13. An electron in hydrogen atom first jumps from second excited state to first excited state and then from first excited state to ground state. Let the ratio of wavelength, momentum and energy of photons emitted in these two cases be a, b and c respectively. Then

(A) c = 1/a (B) a = 9/4 (C) b = 5/27 (D) c = 5/27

***Space for Rough Work***

14. The $K_\alpha$ X-ray of molybdenum has wavelength 71 pm. If the energy of a molybdenum atom with a K electron knocked out is 23.32 keV, Which of the following will not be the energy of this atom when an L electron is knocked out?
(A) 23.32 keV (B) 5.82 keV (C) 13.2 keV (D) 17.5 keV

## SECTION-3 (MAXIMUM MARKS : 12)

- *This section contains **TWO** paragraphs*
- *Based on each paragraph, there are **TWO** questions*
- *Each question has **FOUR** options (A), (B), (C), and (D). **ONLY ONE** of these four options is correct*
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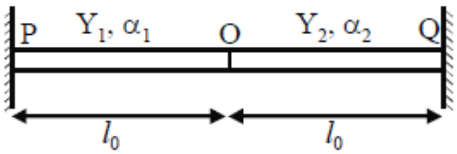
***Zero Marks** : **0** **If none of the bubbles is darkened***

### PARAGRAPH-01

Two wires P and Q of same cross-sectional area A= 10 $mm^2$ and the same length $l_0$ = 1 m but made of different materials are joined together and their ends are rigidly clamp between two walls with negligible tension. Their respective Young's modulus and the coefficients of linear expansion are as $Y_1$, $\alpha_1$ and $Y_2$, $\alpha_2$ respectively.
Given $Y_1 = 2 \times 10^9$ N/$m^2$, $\alpha_1 = 3 \times 10^{-4}$/°C, $Y_2 = 10^9$ N/$m^2$, $\alpha_2 = 6 \times 10^{-4}$ /°C,

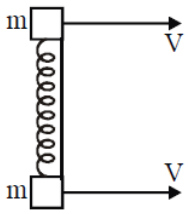



15. If the temperature of system is reduced by 20°C the tension developed in wire P is
(A) 60 N (B) 120 N (C) 40 N (D) 180 N

16. Displacement of joint O is
(A) 1 mm (B) 0.5 mm (C) 2 mm (D) zero

### PARAGRAPH-02

Two blocks of same mass m are connected to each other by spring of spring constant k. Initially spring is compressed by $x_0$ and blocks are connected by string. Whole system is placed on a smooth horizontal table. Now both blocks are given same horizontal velocity v perpendicular to spring and string is cut simultaneously. During subsequent motion of blocks.




17. Find the speed of blocks when extension in spring is maximum
(A) v (B) $\frac{v}{2}$ (C) zero (D) None of these

18. Find the speed of blocks when spring is in its natural length position.
(A) $\sqrt{\left[v^2 - \frac{kx_0^2}{2m}\right]}$ (B) $\sqrt{\left[v^2 + \frac{kx_0^2}{2m}\right]}$ (C) $\sqrt{\left[v^2 + \frac{kx_0^2}{4m}\right]}$ (D) v

***Space for Rough Work***

# PART-II : CHEMISTRY

## SECTION-1 (MAXIMUM MARKS : 21)

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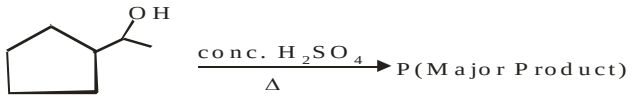
19. For the redox reaction,

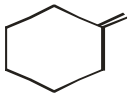
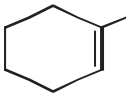
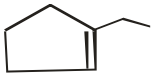
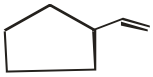
$$xC_2O_4^{-2} + yMnO_4^- + zH^+ \rightarrow Mn^{+2} + H_2O + CO_2$$

x, y and z respectively are:

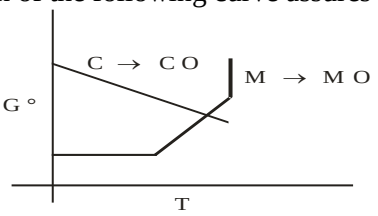
(A) 2, 5, 16 (B) 5, 2, 10 (C) 5, 2, 16 (D) 5, 5, 16

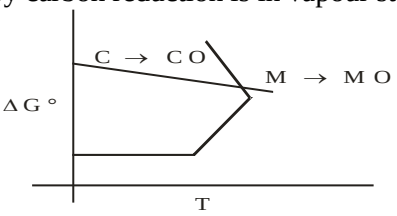
20. What is the major product of the following reaction?

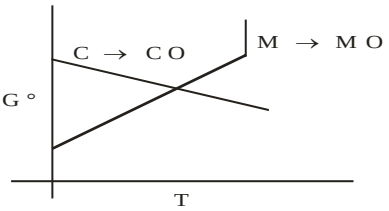


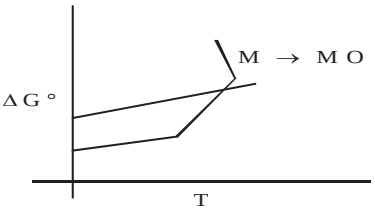

(A)  (B)  (C)  (D) 

21. Which of the following curve assures that the metal obtained by carbon reduction is in vapour state?

(A) 


(B) 


(C) 


(D) 


22. NX is produced by the following step of reactions

$M + X_2 \rightarrow MX_2$

$3MX_2 + X_2 \rightarrow M_3X_8$

$M_3X_8 + N_2CO_3 \rightarrow NX + CO_2 + M_3O_4$

How much metal(M) is consumed to produce 206 g of NX? (at wt of M = 56, N = 23, X = 80)

(A) 42g (B) 56g (C) $\frac{14}{3}$g (D) $\frac{7}{4}$g

***Space for Rough Work***

23.

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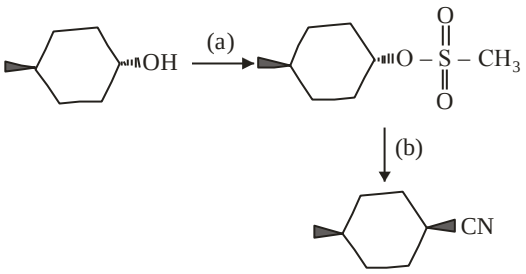


Identify (a) and (b)

(A) (a) = methane sulphonate (b) = NaCN/DMF

(B) (a) = TsCl (b) = NaCN/DMF

(C) (a) = Methanesulfonyl chloride (b) = $R - \overset{+}{N} \equiv \overset{\ominus}{C}$/ DMF

(D) (a) = Methanesulfonyl chloride (b) = NaCN/DMF

24. Which of the following shape of molecule is not obtained from the trigonal bipyramidal electron geometry of the central atom.

(A) See-saw (B) T-shape (C) Linear (D) Square pyramidal

25. Ester $\xrightarrow{2 \text{ eq RMgX}}$ P , product P is:

(A) Ketone (B) Aldehyde (C) 3° alcohol (D) 2° alcohol

## SECTION-2 (MAXIMUM MARKS : 28)

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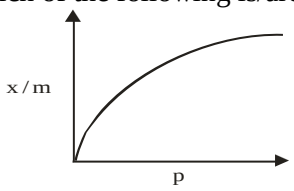
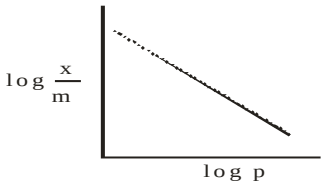
26. Back bonding is possible in which of the following compounds?

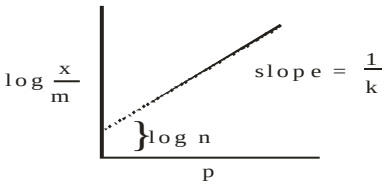
(A) $R_3SiOH$ (B) $PF_3$ (C) $BF_3$ (D) $[B_3O_6]^{3-}$

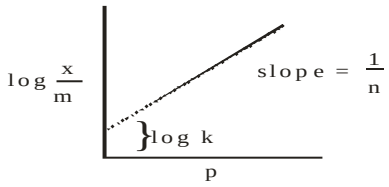
***Space for Rough Work***

27. Which of the following is/are true for freundlich adsorption isotherm?

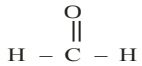
(A) 

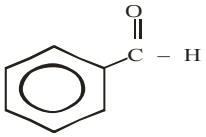

(B) 

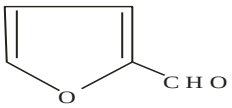

(C) 

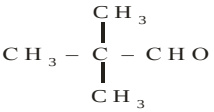

(D) 


28. Which of the following compound(s) give(s) cannizaro reaction?

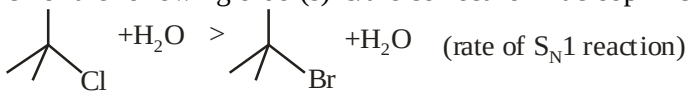
(A) 

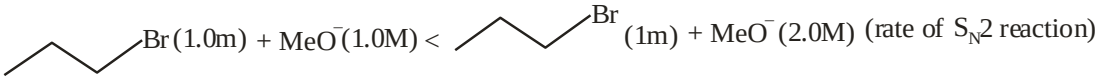
(B) 

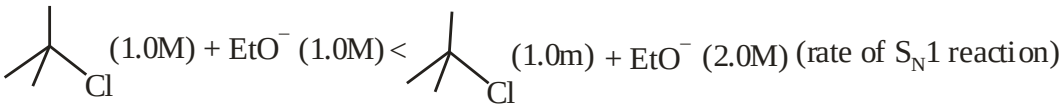
(C) 

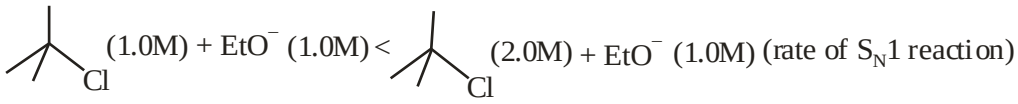
(D) 

29. Which of the following order(s) is/are correct for Nucleophilic substitution reaction?

(A) 


(B) 


(C) 


(D) 


30. For a complex reaction
(A) Order of overall reaction is same as molecularity of the slowest step.
(B) Order of overall reaction is less than the molecularity of slowest step.
(C) Order of overall reaction is greater than molecularity of slowest step.
(D) Molecularity of the slowest step is never zero or non-integer.

31. Which of the following inner orbital octahedral complex ions are diamagnetic?
(A) $\left[CO(NH_3)_6\right]^{+3}$ (B) $\left[Mn(CN)_6\right]^{-3}$ (C) $\left[Fe(CN)_6\right]^{-4}$ (D) $\left[Fe(CN)_6\right]^{-3}$

32. Which of the following is/are elastomers?
(A) Buna-S (B) Neoprene (C) Bakelite (D) Nylon 6, 6

***Space for Rough Work***

## SECTION-3 (MAXIMUM MARKS : 12)

- *This section contains **TWO** paragraphs*
- *Based on each paragraph, there are **TWO** 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 OMR*
- *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***

### PARAGRAPH-01

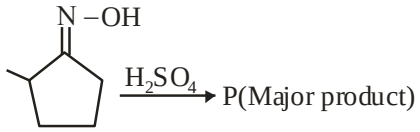
Enthalpy of hydrogenation is the enthalpy change when one mole of unsaturated compound is converted to saturated compound. $\Delta H_{hydrogenation}$ helps to calculate resonance energy.

33. The standard enthalpy of combustion at 25°C of hydrogen, cyclohexene and cyclohexane are –300, –3600 and –3770 KJ/mole respectively. Calculate the heat of hydrogenation of cyclohexene.
(A) + 130 kJ/mole (B) – 78 kJ/mole (C) –130 kJ/mole (D) –137kJ/mole

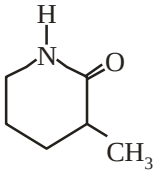
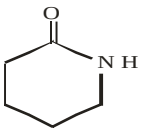
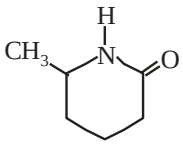
34. The heat of neutralization of $CH_3COOH$, HCOOH, HCN and $H_2S$ are –12.8, –13.2, –3.2 and –3.9 Kcal per equivalent. Arrange these acids in increasing order of strength.
(A) $H_2S < HCN < HCOOH < CH_3COOH$ (B) $HCN < H_2S < CH_3COOH < HCOOH$
(C) $HCOOH < CH_3COOH < H_2S < HCN$ (D) $CH_3COOH < HCOOH < HCN < H_2S$

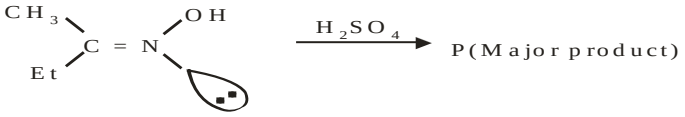
### PARAGRAPH-02

Conversion of Ketoximes to N- substituted amides is known as Beckmann rearrangement. In this rearrangement migration takes place from carbon to nitrogen. The reaction is catalyzed by acidic reagents. The main function of the acidic catalyst is to convert –OH of the oxime into a better leaving group by protonation.

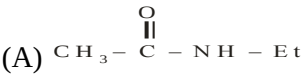
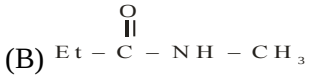
35. 

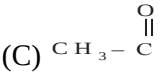
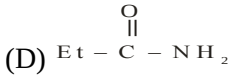
P is

(A)  (B)  (C)  (D) None of the above

36. 

P is

(A)  (B) 

(C)  (D) 

***Space for Rough Work***

# PART-III : MATHEMATICS

## SECTION-1 (MAXIMUM MARKS : 21)

- *This section contains **SEVEN** 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 all the correct option in the OMR*
- *For each question, marks will be awarded in one of the following categories:*

| | | | |
|---|---|---|---|
| ***Full Marks*** | ***:*** | ***+3*** | ***If only the bubble corresponding to all the correct option is darkened*** |
| ***Zero Marks*** | ***:*** | ***0*** | ***If none of the bubbles is darkened*** |
| ***Negative Marks*** | ***:*** | ***–1*** | ***In all other cases*** |

37. If $a \sin x + b \cos(x + \theta) + b \cos(x - \theta) = d$, then the minimum value of $|\cos \theta|$ is equal to

(A) $\frac{1}{2|b|}\sqrt{d^2 - a^2}$ (B) $\frac{1}{2|a|}\sqrt{d^2 - a^2}$ (C) $\frac{1}{2|d|}\sqrt{d^2 - a^2}$ (D) None of these

38. If $f(x) = \begin{vmatrix} 5+\sin^2 x & \cos^2 x & 4\sin 2x \\ \sin^2 x & 5+\cos^2 x & 4\sin 2x \\ \sin^2 x & \cos^2 x & 5+4\sin 2x \end{vmatrix}$ then

(A) domain of $f(x) \in (0, \infty)$ (B) range of $f(x) \in (0, \infty)$

(C) period of $f(x) = 2\pi$ (D) $\lim_{x \to 0} \frac{f(x) - 150}{x} = 200$

39. One of the diameter of the circle circumscribing the rectangle ABCD is $4y = x + 7$. If A and B are the points (–3, 4) and (5, 4) respectively, then the area of the rectangle is (in square units)

(A) 16 (B) 32 (C) 8 (D) None of these

40. If $1 < x < \sqrt{2}$, then number of solutions of the equation $\tan^{-1}(x - 1) + \tan^{-1} x + \tan^{-1}(x + 1) = \tan^{-1} 3x$, is

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

41. The pair of straight lines joining the origin to the points of intersection of the line $y = 2\sqrt{2}x + c$ and the circle $x^2 + y^2 = 2$ are at right angles, if

(A) $c^2 - 4 = 0$ (B) $c^2 - 8 = 0$ (C) $c^2 - 9 = 0$ (D) $c^2 - 10 = 0$

42. The value of $\sum_{r=1}^{n} (-1)^{r-1} \left(1 + \frac{1}{2} + \frac{1}{3} + .... + \frac{1}{r}\right) {}^nC_r$ is equal to

(A) –1 (B) $\frac{1}{r}$ (C) $\frac{1}{n}$ (D) $-\frac{1}{n^3}$

43. If the function $f(x) = |x^2 + a|x| + b|$ has exactly three points of non-differentiability, then which of the following may hold?

(A) $b = 0, a < 0$ (B) $b < 0, a \in R$ (C) $b > 0, a \in R$ (D) $b < 0, a \in R^-$

***Space for Rough Work***

## SECTION-2 (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 options is correct*
- *For each question, darken the bubble(s) corresponding to the correct option(s) in the OMR.*
- *For each question, marks will be awarded in <u>one of the following categories</u>:*

| | | | |
|---|---|---|---|
| ***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*

44. If A and B are two invertible matrices of the same order, then adj (AB) is equal to
(A) adj (B) adj (A) (B) $|B|\,|A|\;B^{-1}A^{-1}$ (C) $|B|\,|A|\;A^{-1}B^{-1}$ (D) $|A|\,|B|\;(AB)^{-1}$

45. If two distinct chords of a parabola $y^2 = 4ax$, passing through (a, 2a) are bisected on the line x + y = 1, then length of the latus-rectum can be
(A) 2 (B) 1 (C) 4 (D) 3

46. The equation of curve passing through (1, 1) in which the sub-tangent is always bisected at the origin cannot be
(A) $y^2 = x$ (B) $2x^2 - y^2 = 1$ (C) $x^2 + y^2 = 2$ (D) $x + y = 2$

47. A class has 30 students. The following prizes are to be awarded to the students of this class: first and second in Mathematics; first and second in Physics first in Chemistry and first in Biology. If N denote the number of ways in which this can be done, then
(A) N is divisible by 400
(B) N is divisible by 600
(C) N is divisible by 8100
(D) N is divisible by four distinct prime numbers

48. If $\lim\limits_{x\to 0} \dfrac{a\sin x - bx + cx^2 + x^3}{2x^2\log(1+x) - 2x^3 + x^4}$ exists and is finite, then
(A) a = b (B) c = 0 (C) a = 6 (D) c = 2

49. For the series $S = 1 + \dfrac{1}{(1+3)}(1+2)^2 + \dfrac{1}{(1+3+5)}(1+2+3)^2 + \dfrac{1}{(1+3+5+7)}(1+2+3+4)^2 + \ldots\ldots$
(A) $9^{th}$ term is 25
(B) $7^{th}$ term is 16
(C) sum of first ten terms is 505/4
(D) sum of first ten terms is 505

50. If $A = \int_0^{\pi} \dfrac{\sin x}{\sin x + \cos x}\,dx$

$B = \int_0^{\pi} \dfrac{\sin x}{\sin x - \cos x}\,dx$

(A) value of A is equal to B
(B) A and B both are rational number
(C) A and B both are irrational number
(D) A is period of |sin x|

***Space for Rough Work***

## SECTION-3 (MAXIMUM MARKS : 12)

- *This section contains **TWO** paragraphs*
- *Based on each paragraph, there are **TWO** questions*
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***Zero Marks : 0 If none of the bubbles is darkened***

### PARAGRAPH-01

There are four boxes $A_1$, $A_2$, $A_3$ and $A_4$. Box $A_i$ has i cards and on each card a number is printed, the numbers are from 1 to i. A box is selected randomly, the probability of selection of box $A_i$ is $\frac{i}{10}$ and then a card is drawn. Let $E_i$ represents the event that a card with number 'i' is drawn.

51. $P(E_1)$ is equal to

(A) $\frac{1}{5}$ (B) $\frac{1}{10}$ (C) $\frac{2}{5}$ (D) $\frac{1}{4}$

52. $P(A_3/E_2)$ is equal to

(A) $\frac{1}{4}$ (B) $\frac{1}{3}$ (C) $\frac{1}{2}$ (D) $\frac{2}{3}$

### PARAGRAPH-02

Consider lines

$L_1 : \frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{-k}$

$L_2 : \frac{x-1}{2} = \frac{y-4}{2} = \frac{z-5}{1}$

53. Value of 'k' so that lines $L_1$ and $L_2$ are coplanar, is

(A) –1 (B) $-\frac{1}{2}$ (C) –2 (D) 2

54. Equation of plane containing these lines is

(A) x – y – 2 = 0 (B) 2x – y + 2 = 0 (C) x – y + 7 = 0 (D) None of these

***Space for Rough Work***