JEE EXPERT

STAYHOME#STAYSAFE

CORONA KO STOP KARO NA
AT LOCKDOWN, UNLOCK YOUR POTENTIAL
PRACTICE TEST – 03

Time: 3 Hours **Maximum Marks: 240**

INSTRUCTIONS

A. General Instructions

1. This booklet is your question paper. Answers have to be marked on the provided OMR sheets.
2. This question paper contains 20 questions. All questions are compulsory.
3. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
4. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.
5. Write in your Name and the Enrolment No. in the space provided at the bottom of this page.

B. Filling of OMR Sheet

6. On the OMR sheet, write in ink your Name, Enrolment No., and Name of the centre and put your signature in the appropriate boxes.
7. Every question has four choices for its answers (A), (B), (C), (D)

C. Marking Scheme

8. **(i)** Questions **1 to 8** have only one correct answer and carries **+3 marks** each for correct answer and **– 1 mark** for each wrong answer.

   (ii) Questions **9 to 12** have one or more than one correct answer and carries **+4 marks** each for correct answer and **0 mark** for each wrong answer.

   (iii) Questions **1 to 2** Matrix-Match Type (4 × 5 Matrix) Col – I & II to be matched for 4 rows per question and carries **+8 marks** each for correct answer and **0 mark** for each wrong answer.

   (iv) Questions **1 to 6** are numerical based which has numerical value as answer and carries **+4 marks** each for correct answer and **0 mark** for each wrong answer.

PART - I: PHYSICS

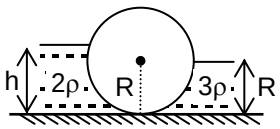
SECTION – A
Single Correct Answer Type

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

1. In a 10 metre deep lake, the bottom is at a constant temperature of 4°C. The air temperature is constant at −4°C. The thermal conductivity of ice is 3 times that water. Neglecting the expansion of water on freezing, the maximum thickness of ice will be
(A) 7.5 m (B) 6 m
(C) 5 m (D) 2.5 m

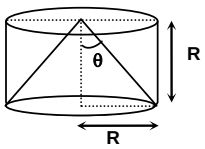
2. A rod of length L with sides fully insulated is made of a material whose thermal conductivity varies with temperature as $K=\frac{\alpha}{T}$ where α is a constant. The ends of the rod are kept at temperatures T_1 and T_2. The temperature T at x, where x is the distance from the end whose temperature is T_1 is
(A) $T_1\left(\frac{T_2}{T_1}\right)^{\frac{x}{L}}$ (B) $\frac{x}{L}\ln\frac{T_2}{T_1}$
(C) $T_1 e^{\frac{T_2 x}{T_1 L}}$ (D) $T_1+\frac{T_2-T_1}{L}x$

3. In the figure shown. The heavy cylinder (radius R) resting on a smooth surface separates two liquids of densities 2ρ and 3ρ. The height h for the equilibrium of cylinder must be



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

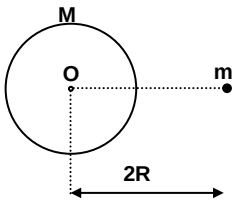
4. A vertical cylinder of radius R and height R has a right circular cone at its base of height R and base radius R. The liquid of density ρ is filled upto the brim. The force due to liquid on the curved surface of cone is (neglect the atmospheric pressure)



(A) $\pi R^3\rho g$ (B) $2/3\ \pi R^3\rho g$
(C) $\pi R^3\rho g/2$ (D) none of the above

Space for rough work

5. A particle of mass m is at a distance 2R from the centre of a thin shell of mass M and having radius R as shown in figure. The gravitational field at the centre of shell is



(A) zero (B) $\frac{GM}{R^2}$

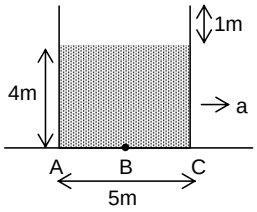
(C) $\frac{G(M+m)}{4R^2}$ (D) $\frac{Gm}{4R^2}$

6. A block of mass m is suspended by a light thread from an elevator. The elevator initially at rest, starts moving upward with uniform acceleration 'a'. Work done on the block during first t sec by the tension in the thread with respect to ground frame is

(A) $\frac{m}{2}(g+a)at^2$ (B) $\frac{m}{2}(g-a)at^2$

(C) $\frac{m}{2}gat^2$ (D) zero

7. A cubical open vessel of side 5m filled with liquid upto a height of 4m is accelerated with an acceleration a. The minimum value of a so that pressure at mid point of AC is equal to atmospheric pressure is



(A) g (B) 2g

(C) g/2 (D) 2g/5

8. The work done to take a particle of mass m from surface of the earth to a height equal to 2R is (R is radius of earth)

(A) 2mg/R (B) $\frac{mgR}{2}$

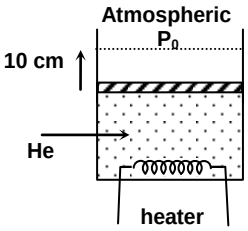
(C) 3mgR (D) $\frac{2mgR}{3}$

Space for rough work

Multiple Correct Answers Type

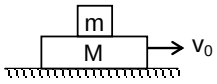
This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

9. A vertical cylinder enclosed the gas through a piston of mass M and area of cross section A = 10 cm^2 (At pressure) $P_0 = 10^5$ N/m^2. Heat is supplied to the gas slowly and piston slowly moves up distance of 10 cm. Which of the following is true
($M = 10$ kg, $A = 10$ cm^2, $g = 10$ m/s^2)



(A) Expansion of gas is isobaric process
(B) Work done by the gas is 20 J of the gas
(C) Internal energy of the gas increased by 30 J
(D) Heat absorbed to the gas is 50 J

10. A block of mass m is placed gently onto a long plank of mass M moving with a velocity v_0 on a smooth horizontal floor. If friction is present between M and m



(A) velocity of centre of mass of the system (block + plank) $v_c = \frac{mv_0}{M+m}$
(B) work done by the friction force on block till slipping between block and plank stops, is positive
(C) work done by the friction force on the plank till slipping between block and plank stops, is negative
(D) work done by the friction force on the system (block + plank) till slipping between block and plank stops, $= -\frac{Mmv_0^2}{4(M+m)}$

11. A point moves with deceleration along the circle of radius R so that at any moment of time its tangential and normal accelerations are equal in magnitude. At the initial moment t = 0, the velocity of the point is V_0. The velocity of point will be: (S is the distance travelled)

(A) $V = \frac{V_0}{1+\frac{V_0 t}{R}}$ at t second
(B) $V = V_0 e^{-S/R}$ after s meter
(C) $V = V_0 e^{-R/S}$
(D) None of these

12. A particle moves with an initial velocity v_0 and retardation αv, where v is its velocity at any time t.
(A) The particle will cover a total distance v_0/α.
(B) The particle will come to rest after a time $1/\alpha$.
(C) The particle will continue to move for a very long time.
(D) The velocity of the particle will become $v_0/2$ after a time $1/\alpha$.

Space for rough work

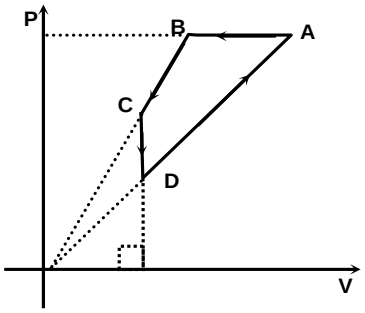
SECTION – B
Matrix-Match Type

This section contains **2 questions**. Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II.** Any given statement in **Column I** can have correct matching with one or more statement(s) in **Column II.** For example, if for a given question, statement B matches with the statements given in q and r, then for that particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.

13. Match the standing waves formed in column – II due to plane progressive SHM waves in column - I.

Column – I		**Column – II**	
(A)	Incident wave is $y = A \sin(kx - \omega t)$	(p)	$y = 2A \cos kx \sin \omega t$
(B)	Incident wave is $y = A \cos(kx - \omega t)$	(q)	$y = 2A \sin kx \sin \omega t$
(C)	x = 0 is rigid support.	(r)	$y = 2A \sin kx \cos \omega t$
(D)	x = 0 is flexible support.	(s)	$y = 2A \cos kx \cos \omega t$
		(t)	None

14. A thermodynamic cyclic process of an ideal gas is shown in the given indicator diagram. For the cyclic process match the column I (containing process) with Column II (containing physical quantities)



Column-I		**Column-II**	
(A)	In the process, $A \rightarrow B$	(p)	$\Delta W = 0$
(B)	In the process, $B \rightarrow C$	(q)	$\Delta U > 0$
(C)	In the process, $C \rightarrow D$	(r)	$\Delta Q > 0$
(D)	In the process, $D \rightarrow A$	(s)	$\Delta Q < 0$
		(t)	$\Delta W > 0$

Space for rough work

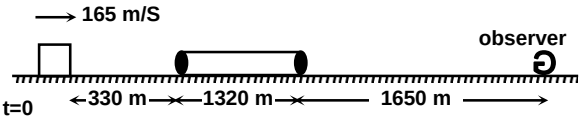
SECTION –C
Integer Answer Type

This section contains **6 questions**. The answer to each of the questions is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

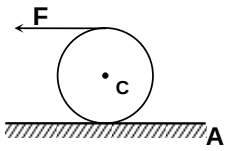
15. Two particles A and B are located at points (0, $-10\sqrt{3}$) and (0, 0) in xy plane. They start moving simultaneously at time t = 0 with constant velocities $\vec{v}_A = 5\hat{i}$ m/s and $\vec{v}_B = -5\sqrt{3}\hat{j}$ m/s, respectively. Time when they are closest to each other is found to be $\frac{\sqrt{3}}{K}$ second. Find K. All distances are given in meter.

16. A horizontal telephone cord is 4 m long and has a mass of 0.2 kg. A transverse wave pulse is produced by plucking one end of the taut cord. The pulse makes four trips back and forth along the cord in 0.8 sec. The tension in the cord is 80K. Find the value of K.

17. A small block of mass 1 kg is moving on a frictionless horizontal table. It collides with a solid rod of equal mass, elastically as shown in the figure. At t = 0 block is at 330 m from left end of the rod. Rod has cross-sectional area 0.001 m^2 and Young's modulus 3.3×10^5 N/m^2. Find the minimum time t at which observer hears sound produced by collision (Velocity of sound is 330 m/s).

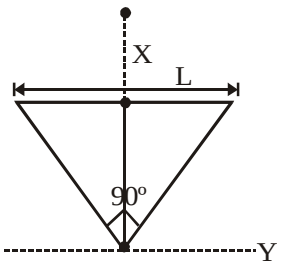


18. A massless string is wrapped around a hollow cylinder having mass m and radius r. The cylinder is kept on a rough horizontal surface (coefficient of friction is μ). A constant force F is applied as shown in the figure. In case of pure rolling, the friction force acting on the bottom most point of the cylinder is K (μmg). Find the value of K.



19. An organ pipe P_1 closed at one end vibrating in its first overtone and another pipe P_2 open at the both ends vibrating in its third overtone are in resonance with a given tuning fork. The ratio of the length of P_1 to that of P_2 is x / 8. Find x

20. The figure shows an isosceles triangular plate of mass M and base L lying in the x-y plane. The angle at the apex in 90º. The apex lies at the origin and the base is parallel to y-axis. The moment of the inertia about the z-axis is ML^2/k. Find k.



Space for rough work

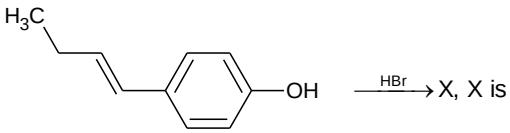
PART - II: CHEMISTRY

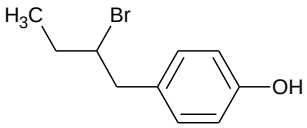
SECTION – A
Single Correct Answer Type

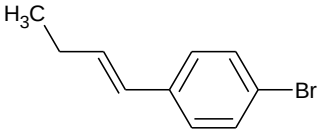
This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct**.**

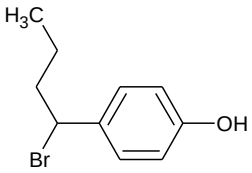
1. $2SO_2 + O_2 \rightleftharpoons 2SO_3$. Starting with 2 moles of SO_2 and 1 mol of O_2 in 1 L flask, mixture required 0.4 moles of MnO_4^- in acidic medium. Hence, K_c is
   (A) 2 (B) 0.4
   (C) 1.6 (D) 2.6

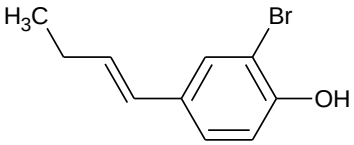
2. Ammonia is introduced in a closed vessel (initially evacuated). Now ammonia is heated and it dissociates completely into N_2 and H_2. The vapour density of the mixture is?
   (A) 4.25 (B) 8.75
   (C) 6.5 (D) 23.5

3. 

   (A) 

   (B) 

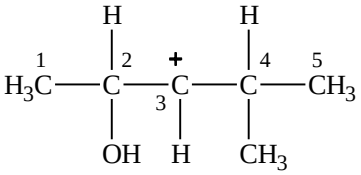
   (C) 

   (D) 

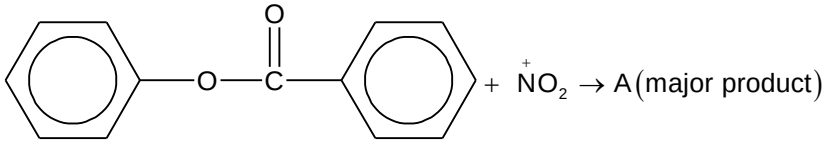
4. The correct order of stability of following dihalides:
   CCl_2, $SiCl_2$, $GeCl_2$, $SnCl_2$, $PbCl_2$
   (A) $CCl_2 > SiCl_2 > GeCl_2 > SnCl_2 > PbCl_2$ (B) $CCl_2 < SiCl_2 < GeCl_2 < SnCl_2 < PbCl_2$
   (C) $CCl_2 < SiCl_2 < GeCl_2 < PbCl_2 < SnCl_2$ (D) None

Space for rough work

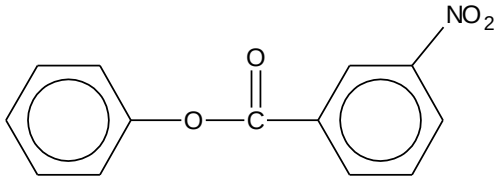
5. In the following carbocation H or CH_3 that is most likely to migrate to the positively charged carbon is

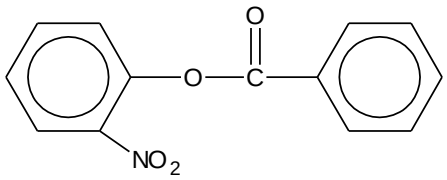


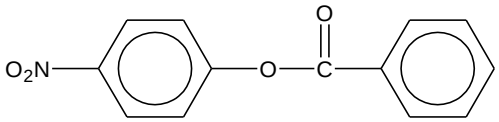
(A) CH_3 at C-4
(B) H at C-4
(C) CH_3 at C-2
(D) H at C-2

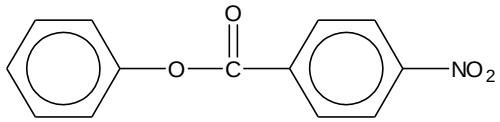
6. 

The product A of this reaction is

(A) 

(B) 

(C) 

(D) 

7. Which of these will not react with acetylene?
(A) NaOH
(B) ammonical $AgNO_3$
(C) $NaNH_2$
(D) HCl

8. At 27^oC for reaction

$$C_6H_6\ \ell + \frac{15}{2}O_2\ g \rightarrow 6CO_2\ g + 3H_2O\ \ell$$

proceeds spontaneously because the magnitude of
(A) $\Delta H = T\Delta S$
(B) $\Delta H > T\Delta S$
(C) $\Delta H < T\Delta S$
(D) $\Delta H > 0$ and $T\Delta S < 0$

Space for rough work

Multiple Correct Answer(s) Type

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

9. A flask contains 100.00 mL of 0.10 M CH_3COOH. To prepare a buffer of pH = p^{ka} which of the following samples of barium acetate solution should be added to the flask?
(A) 50.00 ml of 0.40 M $Ba(OAc)_2$ (B) 25 ml of 0.200 M $Ba(OAc)_2$
(C) 50.00 ml of 0.10 M $Ba(OAc)_2$ (D) 100.00 ml of 0.100 M $Ba(OAc)_2$

10. Which of the following statements is/are true ?
(A) The bond angle in H_2O is greater than F_2O
(B) ClF_2^- is linear but the ion ClF_2^+ is bent
(C) $BF_3 < H_2S < H_2O$ is the increasing order of dipole moment
(D) o-hydroxy benzaldehyde is liquid at room-temperature, while p-hydroxy benzaldehyde is high melting solid

11. Which is correct for a typical real gas?
(A) greater the value of a, more will be liquefiability
(B) at very high temperature and very low pressure the van der Waal's equation is reduced to PV = RT
(C) for a gas following van der Waal's equation, $P_{real} < P_{ideal}$
(D) at low pressure, for one mole of gas, the van der Waal's equation reduces to $PV = RT - a/V$

12. Which of the following statements are not correct?
(A) NaCl(s) being an ionic compound, is a good conductor of electricity
(B) In canonical structures, these is a difference in arrangement of atoms
(C) Hybrid orbitals form stronger bonds than p-orbitals
(D) VSEPR theory cannot explain the square planar geometry of XeF_4

Space for rough work

SECTION – B
(Matrix-Match Type)

This section contains **2 questions**. Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II.** Any given statement in **Column I** can have correct matching with one or more statement(s) in **Column II.** For example, if for a given question, statement B matches with the statements given in q and r, then for that particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.

13. Match the following:

Columns – I		Column - II	
(A)	ClO_2^+	(p)	sp^3d^2
(B)	ClO_3^-	(q)	sp^3d
(C)	$TeCl_4$	(r)	sp^2
(D)	IO_6^{5-}	(s)	sp^3 with a lone pair
		(t)	distorted geometry

14. Match the following:

Columns – I		Column - II	
(A)	Isothermal process (reversible)	(p)	$W = -2.303\ nRT\ \log(P_1/P_2)$
(B)	Adiabatic process	(q)	PV^γ = constant
(C)	Isochoric process	(r)	$W = -2.303nRT\log\left(\frac{V_2}{V_1}\right)$
(D)	Irreversible isothermal process	(s)	W = 0
		(t)	$W = +Pext\ (V_2 - V_1)$

Space for rough work

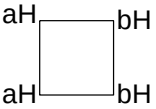
SECTION – C
Integer Answer Type

This section contains **6 questions**. The answer to each question is a **single digit integer,** ranging from 0 to 9 (both inclusive).

15. The velocity of electron in a certain Bohr's orbit of H – atom bears the ratio 1 : 275 to the velocity of light. What is the number of orbit? (Speed of light = 3×10^8 m/sec)

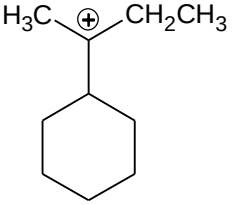
16. At identical temperature and pressure, the rate of diffusion of hydrogen gas is $3\sqrt{3}$ times that of hydrocarbon having molecular formula C_nH_{2n-2}. What is the value of n?

17. Number of geometrical isomers of the molecule.



18. Among XeO_4, SO_3, $\ddot{N}Me_3$, NH_2OH, NH_4Cl, SO_2 and PCl_4^+, number of compound is/are in which central atom is sp^3 hybridized?

19. The total number of contributing structure showing hyperconjugation (involving C – H bonds) for the following carbocation is



20. How many of the following are o, p –directing and activating groups towards EAS reaction?
$-Cl$, $-NO_2$, $-SO_3H$, $-NH_2$, $-OH$, $-NR_2$, $-OR$

Space for rough work

PART - III: MATHEMATICS

SECTION – A
Straight Objective Type

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

1. A tangent to the parabola $x^2 = 4ay$ meets the hyperbola $x^2 - y^2 = a^2$ in two points P and Q, then mid-point of P and Q lies on the curve
(A) $y^3 = x(y - a)$ (B) $y^3 = x^2(y - a)$
(C) $y^2 = x^2(y - a)$ (D) none of these

2. If bisector of the angle APB where PA and PB are the tangents to the parabola $y^2 = 4ax$ is equally inclined to the coordinate axes, then the point P lies on
(A) tangent at vertex of the parabola (B) directrix of the parabola
(C) circle with centre at origin and radius a (D) the line of latus rectum

3. If $4n\alpha = \pi$ then the value of $\tan\alpha \tan 2\alpha \tan 3\alpha \ldots \tan(2n-1)\alpha$ is equal to
(A) 1 (B) 0
(C) – 1 (D) none of these

4. If $\alpha \in \left(-\frac{\pi}{2}, 0\right)$, then the value of $\tan^{-1}(\cot\alpha) - \cot^{-1}(\tan\alpha)$ is equal to
(A) zero (B) π
(C) $-\pi$ (D) $\frac{\pi}{2}$

Space for rough work

5. If the sides of a triangle ABC are $k\left(\sqrt{\cot\frac{B}{2}\cot\frac{C}{2}-1}\right)\cos\frac{A}{2}$, $k\left(\sqrt{\cot\frac{C}{2}\cot\frac{A}{2}-1}\right)\cos\frac{B}{2}$, $k\left(\sqrt{\cot\frac{A}{2}\cot\frac{B}{2}-1}\right)\cos\frac{C}{2}$, then k is equal to

(A) $2\sqrt{Rr}$ (B) $2(R + r)$

(C) $2(R – r)$ (D) $\sqrt{\frac{R}{r}}$

6. If exactly one of the roots of the equation $x^2 + (a + 3)x + a = 0$ lies in [1, 3] then the minimum value of $\frac{1-a^2}{a}$ is

(A) $\frac{3}{2}$ (B) $\frac{77}{18}$

(C) $-\frac{9}{2}$ (D) $– 2$

7. Let T_r and S_r be the r^{th} term and sum upto r^{th} term of a series respectively. If for odd number n, $S_n = n$ and $T_n = \frac{T_{n-1}}{n^2}$, then T_m (m being even) is

(A) $\frac{2}{1+m^2}$ (B) $\frac{2m^2}{1+m^2}$

(C) $\frac{(m+1)^2}{2+(m+1)^2}$ (D) $\frac{2(m+1)^2}{1+(m+1)^2}$

8. If $x_1x_2x_3 = 2\cdot 5\cdot 7^2$, then the number of solution set for (x_1, x_2, x_3) where $x_i \in N$, $x_i > 1$, is

(A) 24 (B) 81

(C) 36 (D) 21

Space for rough work

Multiple Correct Answers Type

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

9. The value of $169e^{i\left(\pi+\sin^{-1}\frac{12}{13}+\cos^{-1}\frac{5}{13}\right)}$ is
(A) 119 –120i
(B) –i(120 +119i)
(C) 119 + 120i
(D) none of these

10. Suppose that the complex number z lies on the curve such that $\frac{z-4}{z-2i}$ is purely imaginary. If the complex number z_1 represents the mid-point of chord OA of this curve, O being the origin, then z_1 necessarily satisfy
(A) $\frac{z_1-2}{z_1-i}=ik$, $k \in R-\{0\}$
(B) $\frac{z_1}{z_1-2-i}=ik$, $k \in R-\{0\}$
(C) $\frac{z_1-2}{2z_1-i}=k$, $k \in R-\{0\}$
(D) $|z_1| = \frac{\sqrt{5}}{2}$

11. Each of the circles $|z-1-i|=1$ and $|z-1+i|=1$ touches internally a circle of radius 2. The complex equation of the circle touching all the three circles can be
(A) $3z\bar{z}+z+\bar{z}-1=0$
(B) $3z\bar{z}-7(z+\bar{z})+15=0$
(C) $z\bar{z}-z-\bar{z}-3=0$
(D) $3z\bar{z}+i(z+\bar{z})-1=0$

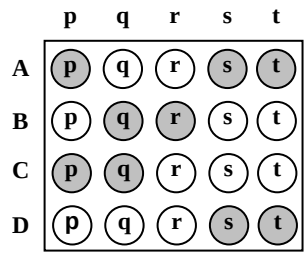
12. A square is inscribed in the circle $x^2 + y^2 – 10x – 6y +30 = 0$. One side of the square is parallel to $y = x + 3$. Then one vertex of the square is
(A) (3, 3)
(B) (7, 3)
(C) (5, 5)
(D) None of these

Space for rough work

SECTION – B

Matrix-Match Type

*This section contains **2 questions**. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statement(s) in **Column II.** The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example:*



If the correct matches are A – p, s and t; B – q and r; C – p and q; and D – s and t; then the correct darkening of bubbles will look like the following:

13. Match the following:

Column – I		Column – II	
(A)	The product of length of perpendicular from any point of the hyperbola $x^2 - y^2 = 10$ to its asymptotes is	(p)	0
(B)	The number of points on the ellipse $\frac{x^2}{4}+\frac{y^2}{3}=1$ from which mutually perpendicular tangents can be drawn to the hyperbola $\frac{x^2}{4}-\frac{y^2}{1}=1$ is/are	(q)	5
(C)	The distance between the directrices of the ellipse $(4x-8)^2 + 16y^2 = \left(x+\sqrt{3}y+10\right)^2$ is	(r)	16
(D)	Tangents are drawn from any point on the line $y = x - 2$ to the parabola $y^2 = 4x$ such that chords of contact pass through fixed point the sum of whose abscissa and ordinate is	(s)	2
		(t)	1

14. Match the following:

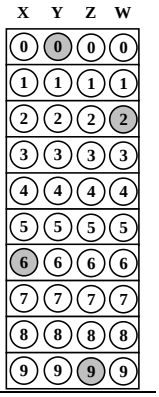
Column – I		Column – II	
(A)	The real values of a for which the quadratic equation $2x^2 - (a^3 + 8a - 1)x + a^2 - 4a = 0$, possesses roots of opposite signs are given by	(p)	$a \geq 6$
(B)	If the equation $x^2 + 2(a + 1)x + 9a - 5 = 0$ has only negative roots, then	(q)	$0 < a < 1$
(C)	The values of a for which the inequality $x^2 - 2(4a - 1)x + 15a^2 - 2a - 7 > 0$ is valid for all $x \in R$, is	(r)	$0 < a < 4$
(D)	If $x \in R$, then $\frac{x^2+2x+a}{x^2+4x+3a}$ can take all real values if	(s)	$2 < a < 4$
		(t)	$a \in \phi$

Space for rough work

SECTION – C

Integer Answer Type

*This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened. For example, if the correct answers to question numbers X, Y, Z and W (say) are 6, 0, 9 and 2, respectively, then the correct darkening of bubbles will look like the following:*



15. All chords of the curve $3x^2 - y^2 - 2x + 4y = 0$ that subtends a right angle at the origin, pass through a fixed point whose co–ordinates are (h, k), then the value of |h + k| is _____

16. If two circles $x^2 + y^2 - 6x - 6y + 13 = 0$ and $x^2 + y^2 - 8y + 9 = 0$ intersect at A and B. The coordinates of focus of the parabola whose directrix is line AB and vertex at (0, 0) are (h, k), then the value of 5(k – h) is _____

17. If a tangent of slope 2 of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is normal to the circle $x^2 + y^2 + 4x + 1 = 0$, then the maximum value of ab is _____

18. Total number of divisors of $n = 3^5 \cdot 5^7 \cdot 7^9$ that are of the form $4\lambda + 1$, $\lambda \geq 0$, are equal to k, then the value of k/30 is equal to _____

19. If in any triangle ABC, cos A cos C = $\frac{ac}{b^2}$, then distance between the circumcentre and orthocentre of the triangle is _____ (given b = 8, c = 5).

20. If $\tan^{-1}x = 1$, then greatest integer less than x is equal to _____

Space for rough work