FIITJEE INTERNAL TEST

RANK IMPROVEMENT TEST – III

Batches:

IIT- JEE 2021

QP CODE:

Time: ***3 hours*** **Maximum Marks: 264**

- ***Please read the instructions carefully. You are allotted 5 minutes specially for this purpose.***
- ***You are not allowed to leave the examination hall before end of the test.***
- ***Use Blue/Black Ball Point Pen only*** *for writing particulars on* ***Side–1 and Side–2*** *of the Answer Sheet.* ***Use to Pencil is strictly prohibited.***

Instructions

Note:

1. The question paper contains 3 sections (Sec-1, Chemistry, Sec-II, Physics & Sec-III, Mathematics.)

2. Each section is divided into two parts, **Part-A & B**.

3. **Part – A** contains 16 questions which are further divided as follows:

❖ **PART – A** (**01 – 10)** contains 10 Multiple Choice Questions which have **One or More Correct** answer.

For each question in the group **Q. 1 – 10** of **PART – A** you will be awarded
Full Marks: **+4** If only the bubble(s) corresponding to all the correct options(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: **–1** In all other cases.

For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **–1** marks, as a wrong option is also darkened.

❖ **PART – A** (**11 – 16)** contains 2 Paragraphs. Based upon each paragraph, 3 Multiple Choice Questions. Each question has four choices (A), (B), (C) and (D), out of which **only one is correct**. Each question carries **+4 marks** for correct answer and zero marks if no bubble is darkened. In all other cases, **minus one(–1) mark will be awarded.**

4. **PART-B (1 – 6)** contains 6 Numerical Based questions the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) answer and each question carries **+4 marks** for correct answer and zero marks if no bubble is darkened. In all other cases, **minus one (–1) mark will be awarded.**

Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with ***Blue/Black Ball Point Pen*** for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.
4. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
5. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

Name of the Candidate ***:*** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Enrolment Number ***:*** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Section – I (Chemistry)

PART – A

(Multiple Correct Choice Type)

This section contains 10 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. The concentration of the saturated solution of a salt AX_2 is 0.01 mol L^{-1}. Choose correct statement(s) regarding the solution?
   (A) The solubility product of the salt is 4×10^{-6}
   (B) The concentration of X^- ions is twice that of A^{2+} ion
   (C) More solute can be dissolved in the solution by heating
   (D) The pH of the solution must be seven

2. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$, $K_p = 2$ atm at 300 K
   20 gram $CaCO_3$(solid) is heated in a closed container of volume 1 litre at 300 K. Which is/are the correct option(s)?
   (A) on addition of small amount of $CaCO_3$, pressure of CO_2 will increase
   (B) on increasing temperature, the decomposition of $CaCO_3$ becomes faster
   (C) amount of CaO should decrease on addition of $CaCO_3$.
   (D) equilibrium constant depends on temperature .

3. At 400°C, a 1:3 mixture of N_2 and H_2 reacts to form an equilibrium mixture of N_2, H_2 and NH_3. The total pressure at equilibrium was found to be 8 atm and mole fraction of NH_3 = 0.5. Calculate partial pressure of N_2 at equilibrium
   $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
   (A) 1 atm (B) 2 atm
   (C) 3 atm (D) 4 atm

4. Which of the following ion(s) undergo(es) hydrolysis in water?
   (A) NH_4^+ (B) CN^-
   (C) S^{2-} (D) Fe^{2+}

5. At 25°C, a saturated solution of $BaSO_4$ is 3.9×10^{-5} M. What is its solubility in 0.1 M Na_2SO_4 solution?
   (A) 1.5×10^{-9} M (B) 1.5×10^{-8} M
   (C) 2.4×10^{-7} M (D) 2.5×10^{-9} M

6. Which of the following option is true? If $\Delta^{\circ}_{ioniz}(HCN) = 45.2$ kJ mol^{-1} and $\Delta H^{\circ}_{ioniz}(CH_3COOH) = 2.1$ kJ mol^{-1}
   (A) pKa(HCN) =pKa(CH_3COOH) (B) pKa(HCN) > pKa(CH_3COOH)
   (C) Ka(HCN) < Ka(CH_3COOH) (D) Ka(HCN) > Ka(CH_3COOH)

7. The following two equilibria exist simultaneously in a closed container of volume 2 L
   $A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$
   $A_2(g) + C(g) \rightleftharpoons A_2C(g)$
   Which of the following change affect the concentration of AB(g)
   (A) Increase in pressure (B) Addition of C
   (C) Addition of He gas at constant volume (D) All of these

8. In the reaction A + 2B $\rightleftharpoons$ 2C+D, the initial concentration of B was 1.5 times that of A, but equilibrium concentrations of A & B are found to be equal. The equilibrium constant for the reaction is
(A) 4 (B) 16
(C) 2 (D) 32

9. P(s) and S(g) establish two equilibria in a closed vessel at 300 K.
$P(s) \rightleftharpoons Q(g) + R(g);\quad K_{c_1} = ?$
$R(g) + S(g) \rightleftharpoons T(g);\quad K_{c_2} = 10^8\,(mol/L)^{-1}$
Now if [Q(g)] and [S(g)] at equilibrium are 2×10^{-2} M and 10^{-5} M, and concentration of Q is equal to concentration of T, then K_{c_1} will be
(A) 4×10^{-4} M^2 (B) 4×10^{-7} M^2
(C) 4×10^{-8} M^2 (D) 4×10^{-10} M^2

10. pH of 0.01 M $(NH_4)_2SO_4$ and 0.02 M NH_4OH buffer (pKa of NH_4^+ = 9.26) is:
(A) 4.74 + log 2 (B) 4.74 – log 2
(C) 4.74 + log 1 (D) 9.26 + log 1

PART – A
(Single Correct Choice Type Q. No. 11 - 16)
Comprehension Type
Paragraph for question nos. 11 – 13

Variation of equilibrium constant K with temperature is given by Van't Hoff equation

$$\ell nK = \frac{\Delta S^o}{R} - \frac{\Delta H^o}{RT}$$

From this equation, ΔH^o can be evaluated if equilibrium constant K_1 and K_2 at two temperature T_1 and T_2 are know

$$\log\left(\frac{K_2}{K_1}\right) = \frac{\Delta H^o}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

11. For an isomerisation $X(g) \rightleftharpoons Y(g)$, the temperature dependency of equilibrium constant is given by

$$\ell nK = 2 - \frac{1000}{T}$$

The value of ΔS^o at 300 K is
(A) 2R (B) $\frac{2}{R}$
(C) 1000 R (D) none of these

12. Select the correct statement
(A) value of K_{eq} always increases with increasing temperature
(B) for exothermic reaction value of K_{eq} increases with decreasing temperature
(C) for endothermic reaction value of K_{eq} increases with decrease in temperature
(D) for exothermic reaction slope of log K vs $\frac{1}{T}$ is negative

13. The equilibrium constant K_P for the following reaction is 1 at 27°C and 4 at 47°C.
$A(g) \rightleftharpoons B(g) + C(g)$
Calculate the enthalpy change for the reaction $B(g) + C(g) \rightleftharpoons A(g)$
(Given R = 2 cal/mol-K)
(A) -13.31 Kcal mol^{-1} (B) 13.31 Kcal mol^{-1} (C) -19.2 Kcal mol^{-1} (D) 55.63 Kcal mol^{-1}

Paragraph for question nos. 14 – 16

Equilibrium constants are given (in atm) for the following reactions at 0°C

$SrCl_2.6H_2O(s) \rightleftharpoons SrCl_2.2H_2O(s) + 4H_2O(g); K_p = 5 \times 10^{-12}$

$Na_2HPO_4.12H_2O(s) \rightleftharpoons Na_2HPO_4.7H_2O(s) + 5H_2O(g); K_p = 2.43 \times 10^{-13}$

$Na_2.SO_4.10H_2O(s) \rightleftharpoons Na_2SO_4(s) + 10H_2O(g); K_p = 1.024 \times 10^{-27}$

The vapour pressure of water at 0°C is 4.56 torr

14. Which is most effective drying agent at 0°C?
(A) $SrCl_2.2H_2O$ (B) $NaH_2PO_4.7H_2O$
(C) Na_2SO_4 (D) All equally

15. At what relative humidities will $Na_2SO_4.10H_2O$ be efflorescent (release moisture) when exposed to air at 0°C?
(A) above 33.33% (B) below 33.33%
(C) above 66.66% (D) below 66.66%

16. At what relative humidities will Na_2SO_4 be deliquescent(i.e. absorb moisture) when exposed to air at 0°C?
(A) above 33.33% (B) below 33.33%
(C) above 66.66% (D) below 66.66%

PART – B

This section contains 06 **multiple choice questions**. The answer to each question is a single digit integer, ranging from 0 to 9 (both inclusive)

1. Compound X dissociates according to the reaction $2X(g) \rightleftharpoons 2Y(g) + Z(g)$, with degree of dissociation α which is small compared with unity, if expression for α in terms of equilibrium constant K_p and total pressure P is given as $\alpha = \left(\frac{2K_p}{P}\right)^{1/n}$. The value of n is

2. The pH of the mixture
50 ml of 0.05 M NH_4OH + 50 mL of 0.05 M CH_3COOH
taking $pK_a = pK_b = 4.74$ is

3. How much water (in lit) should be added to 10.0 g of acetic acid to give a hydrogen-ion concentration equal to 1.0×10^{-3} M (given Ka=1.8×10^{-5}, $\alpha << 1$)

4. For the reaction at 25°C
$A(g) + 2B(g) \rightleftharpoons 2C(g) + D(g)$
The initial concentration of B is 1.5 times the initial concentration of A. If at equilibrium, the equilibrium concentration of A and D are equal. The equilibrium constant at 25°C is

5. $M(OH)_x$ has $K_{sp} = 4 \times 10^{-12}$ and solubility = 10^{-4} M. The value of x is

6. A sample of HI(g) is placed in a flask at a pressure 0f 0.2 atm. At equilibrium, the partial pressure of HI(g) is 0.04 atm. What is the value of K_p for the given equilibrium?
$2HI \rightleftharpoons H_2 + I_2$

space for rough work

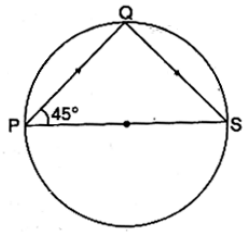
Section – II (Physics)

PART – A

(Multiple Correct Choice Type)

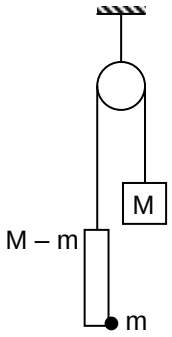
This section contains 10 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. A body is fired from point P and strikes at Q inside a smooth circular wall as shown in the figure. It rebounds to point S (diametrically opposite to P), then choose from following the correct option(s).



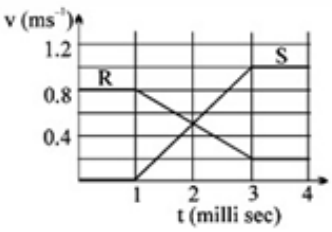
(A) kinetic energy is not conserved in this collision
(B) the coefficient of restitution is 1
(C) kinetic energy is conserved in this collision
(D) the coefficient of restitution is $1/\sqrt{3}$

2. A rod of mass 'M − m' carries an insect of mass 'm' at its bottom end and its top end is connected with a string which passes over a smooth pulley and the other end of the string is connected to a counter mass M. Initially the insect is at rest. Choose the correct option(s).



(A) As insect starts moving up relative to rod, the acceleration of centre of mass of the system (insect + rod + counter mass) becomes non-zero
(B) As insect starts moving up relative to rod, tension in the string remains constant and is equal to Mg.
(C) As insect starts moving up relative to rod, the tension in the string becomes more than Mg.
(D) Acceleration of centre of mass of the system (insect + rod +counter mass) is zero when insect moves with constant velocity.

3. The diagram to the right shows the velocity-time graph for two masses R and S that collided elastically. Which of the following statements is true?



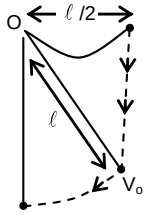
(A) R and S moved n the same direction after the collision.
(B) Kinetic energy of the system (R & S) is minimum at t = 2 milli sec.
(C) The mass of R was greater than mass of S.
(D) The mass of R was lesser than mass of S.

4. A Completely filled closed aquarium is kept on a weighing machine. It can be assumed that the density of the fish is greater than the density of the water. The total mass of the aquarium and its contents put together is M. If now all the fish start accelerating upwards with a acceleration A, then the incorrect option(s) are
(A) The weight recorded will be equal to Mg.
(B) The weight recorded will be less than Mg.
(C) The weight reading will be more than Mg.
(D) No conclusion can be drawn from the given information.

5. In a one dimensional collision between two identical particles. A and B, B is stationary and A has momentum p before impact. During impact, B gives impulse J to A. Choose from the following the correct option(s).
   (A) The total momentum of the 'A plus B ' system is p before and after the impact, and (p-J) during the impact
   (B) During the impact, A gives impulse J to B
   (C) The coefficient of restitution is $\frac{2J}{p}-1$
   (D) The coefficient of restitution is $\frac{J}{p}+1$

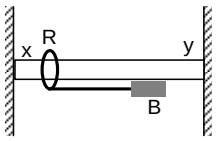
6. A man of mass 60 kg can throw a stone of mass 1 kg upto a height 5 m. Now the same stone is being thrown in the horizontal direction when he is standing on frictionless ground. Choose the correct option(s): ($g = 10\ m/s^2$)
   (A) He throws the stone with the same total work done as before then speed of stone is $v = 10\sqrt{\frac{60}{61}}\ m/s$
   (B) He throws the stone with the same impulse with respect to ground as before then speed of stone is v = 10 m/s.
   (C) If he throws the stone with the same relative velocity as before, then speed of stone is $v = \frac{600}{61} m/s$
   (D) If he throws the stone with the same momentum as before, then speed of stone is $v = \frac{600}{61} m/s$

7. A bob of mass "m" is tied to a string of length "ℓ" which is hinged to a point "O". The bob is pulled up to the same level as that of point of suspension "O" (see figure).
   The bob is now released, it is found that as soon as string becomes tight, bob starts traversing a circular path. Answer the following



   (A) The impulse of tension in string will be $\frac{m\sqrt{3\sqrt{3}g\ell}}{2}$
   (B) The impulse of tension in string will be $\frac{m\sqrt{\sqrt{3}g\ell}}{2}$
   (C) The work done by impulsive tension on the bob will be $-\frac{3\sqrt{3}\,mg\ell}{8}$
   (D) The work done by impulsive tension on the bob will be $-\frac{3\sqrt{3}\,mg\ell}{4}$

8. The ring *R* in the arrangement shown can slide along a smooth fixed, horizontal rod XY. It is attached to the block *B* by a light string. The block is released from rest, with the string horizontal. Then choose from following the correct option(s).



(A) One point in the string will have only vertical motion
(B) R and B will always have momenta of the same magnitude
(C) When the string becomes vertical, the speeds of *R* and *B* will be inversely proportional to their masses
(D) R will lose contact with the rod at some point

9. A raft of mass M with a man of mass m aboard stays motionless on the surface of a lake. The man moves a distance ℓ relative to raft with velocity v and then stops. Assuming the water resistance to be negligible and length of the raft to be ℓ, choose from the following the correct option(s).

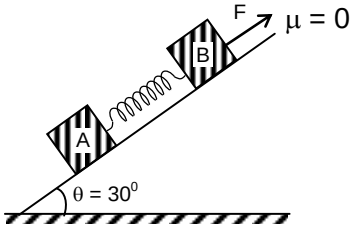
(A) The displacement of the raft relative to the man is $\left(\frac{m\ell}{M+m}\right)$

(B) The displacement of the raft relative to the shore is $\left(\frac{m\ell}{M+m}\right)$

(C) The acceleration of raft during the motion is $\frac{m}{M+m}\left(\frac{dv}{dt}\right)$

(D) Acceleration of raft will be zero.

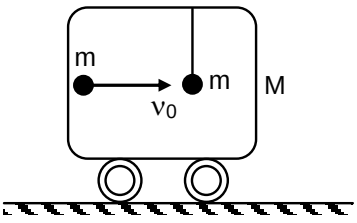
10. In the situation shown in the figure, blocks A and B each of mass m are placed on a large, fixed and smooth inclined plane of inclination θ = 30°. The blocks are initially at rest and connected to spring of stiffness k at its natural length when a force F = mg is applied on the block parallel to the plane. What is the difference between maximum and minimum separation between the blocks in cm? (take $\frac{mg}{k} = 8\,cm$)



(A) 2 (B) 4 (C) 6 (D) 8

PART – A
(Single Correct Choice Type Q. No. 11 - 16)
Comprehension Type
Paragraph for question nos. 11 – 13

A ball of mass m = 1 kg is hung vertically by a thread of length ℓ = 1.50 m. Upper end of the thread is attached to the ceiling of a trolley of mass M = 4 kg. Initially, the trolley is stationary and it is free to move along horizontal rails without friction. A shell of mass m = 1 kg, moving horizontally with velocity v_0 = 6 m/s, collides with the ball and gets stuck with it. As a result, the thread starts to defect towards right.



11. The velocity of the combined body (ball + shell) just after collision is
(A) 2 m/s (B) 3 m/s
(C) 1 m/s (D) 4 m/s

12. At the time of maximum deflection of the thread with vertical, the trolley will move with velocity

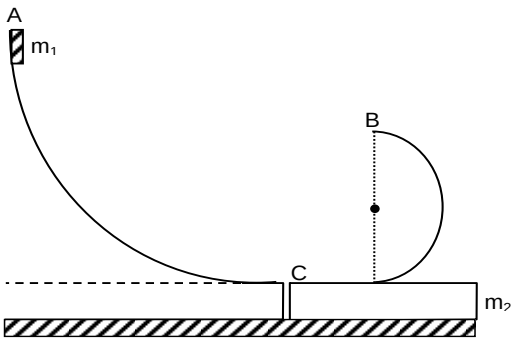
(A) 2 m/s
(B) 3 m/s
(C) 1 m/s
(D) 4 m/s

13. The maximum deflection of the thread with the vertical is

(A) $\cos^{-1}\left(\frac{4}{5}\right)$
(B) $\cos^{-1}\left(\frac{3}{5}\right)$
(C) $\cos^{-1}\left(\frac{2}{3}\right)$
(D) $\cos^{-1}\left(\frac{3}{4}\right)$

Paragraph for question nos. 14 – 16

On a smooth curved track a particle of mass m_1 = 1kg is released from rest as shown in the figure. The track leads to a plank of mass m_2 on which a quarter cylindrical track of radius 2.5 m is attached at its midpoint. The block reaches point 'B' the top of the cylindrical track, comes to rest, falls freely and lands up at an end of the plank. Assume all surfaces to be smooth.



14. The mass m_2 of the plank is
(A) 3 kg
(B) 1.8 kg
(C) 2.56 kg
(D) 4.2 kg

15. The length of the plank
(A) 5 m
(B) 10 m
(C) 15 m
(D) 20 m

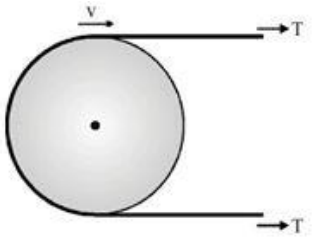
16. The velocity of the plank when the ball reaches highest point of the track is
(A) 5 m/s
(B) 2.5 m/s
(C) 25 m/s
(D) none of these

PART – B

This section contains 06 **multiple choice questions**. The answer to each question is a single digit integer, ranging from 0 to 9 (both inclusive)

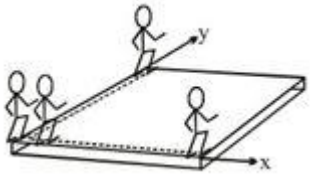
1. A ball is dropped on a horizontal surface. The sound of 1st collision is heard after 2 sec. The second collision is heard again 2 sec after the 1st collision. After what time (from 2nd collision) will we hear the 3rd collision?

2. A flexible drive belt runs over a frictionless flywheel (see figure). The mass per unit length of the drive belt is 1 kg/m, and he tension in the drive belt is 10 N. The sped of the drive belt is 2 m/s. The whole system is located on a horizontal plane. If the normal force (in N) exerted by the belt on the flywheel is K, then $\frac{K}{2} = ?$



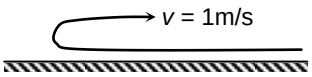
3. At a time when mining asteroids has become feasible, astronauts have connected a line between their 600 kg space ship and a 1200 kg asteroid. Using their ship's engine, they pull on the asteroid with a constant force of 450 N. Initially the space ship and the asteroid are at rest, 225 m apart. If time (in second) taken for the ship and the asteroid to meet is T, then $\frac{T}{4}$ = ? (Neglect gravitational interaction).

4. A square plank of mass m_1 = 100 kg and edge length L = $20\sqrt{2}$ m is placed on a smooth surface. Two person each of mass $m_2 = m_3$ = 50 kg are at corner of a plank as shown in figure. Two person begin to walk on the plank along two different paths as shown in figure and reach nearest corners. If magnitude of displacement of plank (in m) in the process is K, then (K – I) = ?



5. A sphere of mass m is moving with a velocity $4\hat{i}+3\hat{j}-5\hat{k}$ when it hits a smooth wall and rebounds with velocity $2\hat{i}+2\hat{j}+3\hat{k}$. If coefficient of restitution between the sphere and the wall is e. Then find the value of 17e.

6. A long, thin carpet is laid on a floor. One end of the carpet is bent back and then pulled backwards with constant unit velocity. The speed of centre of mass of the moving part, just above the part of the carpet which is still at rest on the floor, is $\frac{u}{4}$ m/s, then find the value of 'u' is



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Section – III (Mathematics)

PART – A

(Multiple Correct Choice Type)

This section contains 10 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Equations of four circles are $(x \pm a)^2 + (y \pm a)^2 = a^2$, then:

   (A) The radius of the greatest circle touching all the four circles is $(\sqrt{2}+1)a$

   (B) The radius of the smallest circle touching all the four circles is $(\sqrt{2}-1)a$

   (C) Area of region enclosed by four given circles is $(4-\pi)a^2$ sq. units

   (D) The centres of four circles are the vertices of a square

2. Two sides of a triangle have the joint equation $(x-3y+2)(x+y-2)=0$, then third side which is variable always passes through the point (–5, –1), then possible values of slope of third side such that origin is an interior point of triangle is/are:

   (A) $\frac{-4}{3}$ (B) $\frac{-2}{3}$

   (C) $\frac{-1}{3}$ (D) $\frac{1}{6}$

3. Let x_1 and y_1 be the roots of $x^2+8x-2009=0$; x_2 and y_2 be the roots of $3x^2+24x-2010=0$ and x_3 and y_3 be the roots of $9x^2+72x-2011=0$. The points $A(x_1,y_1)B(x_2,y_2)$ and $C(x_3,y_3)$:

   (A) cannot lie on a circle (B) form a triangle of area 2 sq. units

   (C) form a right – angled triangle (D) are collinear

4. Let x, y be real variable satisfying the $x^2+y^2+8x-10y-40=0$. Let a = max $\left(\sqrt{(x+2)^2+(y-3)^2}\right)$ and $b=\min\left(\sqrt{(x+2)^2+(y-3)^2}\right)$, then :

   (A) $a+b=18$ (B) $a+b=4\sqrt{2}$

   (C) $a-b=4\sqrt{2}$ (D) $ab=73$

5. Equation of line that touches the curves $|y|=x^2$ and $x^2+(y-2)^2=4$ where $x\neq 0$ is:

   (A) $y=4\sqrt{5}x+20$ (B) $y=4\sqrt{3}x-12$

   (C) $y=-4\sqrt{5}x+20$ (D) $y=-4\sqrt{5}x-20$

6. A variable line 'L' is drawn through O (0, 0) to meet the lines $L_1: y-x-10=0$ and $L_2: y-x-20=0$ at point A and B respectively. A point P is taken on line 'L' .If $OP^2=(OA)(OB)$, and locus of P is $(x-y)^2=k$, then k-4 is divisible by

   (A) 8 (B) 5

   (C) 7 (D) 4

7. A straight line through the vertex P of a triangle PQR intersects the side QR at the point S and the circumcircle of the triangle PQR at the point. If S is not the centre of the circumcircle, then

   (A) $\frac{1}{PS}+\frac{1}{ST}<\frac{2}{\sqrt{QS\times SR}}$ (B) $\frac{1}{PS}+\frac{1}{ST}>\frac{2}{\sqrt{QS\times SR}}$

   (C) $\frac{1}{PS}+\frac{1}{ST}<\frac{4}{QR}$ (D) $\frac{1}{PS}+\frac{1}{ST}>\frac{4}{QR}$

8 Consider a family of circles passing through two fixed points A (3, 7) and $B(6, 5)$. Let that the chord in which the circle $x^2 + y^2 - 4x - 6y - 3 = 0$ cuts the members of the family are concurrent at a point (a,b) , then

(A) $a + b = \frac{33}{5}$ (B) $a + b = \frac{23}{5}$

(C) a > b (D) a < b

9. A circle S = 0 passes through the common point of family of circle $x^2 + y^2 + \lambda x - 4y + 3 = 0\ (\lambda \in R)$ and have minimum area then

(A) area of S = 0 is π sq. unit

(B) radius of director circle of S = 0 is $\sqrt{2}$

(C) length of intercept made by S = 0 from x-axis is 1 unit

(D) $S \equiv 0$ never cuts $|2x| = 1$

10. Let S_1 and S_2 be circle passing through (2, 3) and touching the coordinate axis and S be the circle having common points of S_1 and S_2 as the centre and radius equal to G.M of radius of S_1 and S_2 then

(A) S = 0 cuts y-axis is but not the x-axis

(B) S = 0 cuts y = x

(C) radius of director circle of S = 0 is $\sqrt{2}$

(D) A.M of radius of S_1 is 5

PART – A
(Single Correct Choice Type Q. No. 11 - 16)
Comprehension Type
Paragraph for question nos. 11 – 13

A circle C of radius 1 is inscribed in an equilateral triangle PQR. The points of contact of C with the sides PQ, QR RP are D, E, F, respectively. The line PQ is given by the equation $\sqrt{3}x + y - 6 = 0$ and the point D is $\left(\frac{3\sqrt{3}}{2}, \frac{3}{2}\right)$. Further, it is given that the origin and the centre of C are on the same side of the line PQ.

11. The equation of circle C is

(A) $\left(x - 2\sqrt{3}\right)^2 + (y-1)^2 = 1$ (B) $\left(x - 2\sqrt{3}\right)^2 + \left(y + \frac{1}{2}\right)^2 = 1$

(C) $\left(x + \sqrt{3}\right)^2 + (y+1)^2 = 1$ (D) $\left(x + \sqrt{3}\right)^2 + (y-1)^2 = 1$

12. Points E and F are given by

(A) $\left(\frac{\sqrt{3}}{2}, \frac{3}{2}\right), \left(\sqrt{3}, 0\right)$ (B) $\left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right), \left(\sqrt{3}, 0\right)$

(C) $\left(\frac{\sqrt{3}}{2}, \frac{3}{2}\right), \left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$ (D) $\left(\frac{3}{2}, \frac{\sqrt{3}}{2}\right), \left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$

13. Equation of the sides QR, RP are

(A) $y = \frac{2}{\sqrt{3}}x + 1,\ y = -\frac{2}{\sqrt{3}}x - 1$ (B) $y = \frac{1}{\sqrt{3}}x,\ y = 0$

(C) $y = \frac{\sqrt{3}}{2}x + 1,\ y = -\frac{\sqrt{3}}{2}x - 1$ (D) $y = \sqrt{3}x,\ y = 0$

Paragraph for question nos. 14 – 16

A circle C whose radius is 1 unit, touches the x-axis at piont A. The centre Q of C lies in first quadrant. The tangent from origin O to the circle touches it at T and a point P lies on it such that ΔOAP is a right angled triangle at A and its periemter is 8 units

14. The length of PQ is

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

(C) $\frac{5}{3}$ (D) none of these

15. Equation of circle C is

(A) $\left\{x-\left(2+\sqrt{3}\right)\right\}^2+(y-1)^2=1$ (B) $\left\{x-\left(\sqrt{3}+\sqrt{2}\right)\right\}^2+(y-1)^2=1$

(C) $\left(x-\sqrt{3}\right)^2+(y-2)^2=1$ (D) none of these

16. Equation of tangent OT is

(A) $x-\sqrt{3}y=0$ (B) $x-\sqrt{2}y=0$

(C) $y-\sqrt{3}x=0$ (D) none of these

PART – B

This section contains 06 **multiple choice questions**. The answer to each question is a single digit integer, ranging from 0 to 9 (both inclusive)

1 . If p is the length of the perpendicular from the origin on the line $\frac{x}{a}+\frac{y}{b}=1$ and a^2, p^2, b^2 are in A.P., then $a^4-2p^2a^2+2p^4=$

2. If the line lx + my = 4 intersects the lines y = x – 2 and y = x + 2 at A and B respectively such that $\angle AOB$ is right angle (where 'O' is origin) is $l^2 + m^2 = n^2$, then the value of n^2 is equal to

3. Let total number of lines of the form $ax+by=1\ \{a,b\neq 0\}$ which intersect the circle $x^2+y^2=50$ at two integral points are equals to K then k/10 is

4. If the lengths of external and internal common tangent to two circles $x^2+y^2+14x-4y+28=0$ and $x^2+y^2-14x+4y-28=0$ are λ and μ the value of $\frac{\lambda+\mu}{3}$ must be

5. Two parallel chords of a circle of radius 2 are at a distance $\sqrt{3}+1$ apart. If the chords subtend at the centre, angles of $\frac{\pi}{k}$ and $\frac{2\pi}{k}$, where $k>0$, then the value of $[k]$ is , [.] represents G.I.F.

6. Let ABCD be a quadrilateral with area 18, with side AB parallel to the side CD and AB + CD=2. Let AD be perpendicular to AB and CD. If a circle is drawn inside the quadrilateral ABCD touching all the sides, then its radius is

space for rough work

FIITJEE INTERNAL TEST

RANK IMPROVEMENT TEST – III

Batches:

IIT- JEE 2021

ANSWERS

QP CODE:

SECTION – I (Chemistry)

Part – A

1.	ABC	2.	BD	3.	A	4.	ABCD
5.	B	6.	BC	7.	AB	8.	A
9.	B	10.	D	11.	A	12.	B
13.	A	14.	A	15.	B	16.	A

Part – C

1.	3	2.	7	3.	3	4.	4
5.	2	6.	4				

SECTION – II (Physics)

Part – A

1.	**BC**	2.	**ACD**	3.	**ABC**	4.	**ABD**
5.	**BC**	6.	**ABC**	7.	**AC**	8.	**AC**
9.	**BC**	10.	**D**	11.	**B**	12.	**C**
13.	**A**	14.	**C**	15.	**B**	16.	**A**

Part – C

1.	**1**	2.	**6**	3.	**5**	4.	**9**
5.	**0.35** Range: 0.34 to 0.36			6.	**0.75** Range: 0.70 to 0.80		

SECTION – III (Mathematics)

Part – A

1.	ABCD	2.	BCD	3.	AD	4.	ACD
5.	ABC	6.	CD	7.	BD	8.	AD
9.	ABD	10.	BCD	11.	D	12.	A
13.	D	14.	C	15.	A	16.	A

Part – C

1.	0	2.	8	3.	6	4.	6
5.	2	6.	2				