VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Main - 6 | JEE 2024

Date: 27/1/2023 **Maximum Marks: 300**

Timing: 04:00 PM to 07:00 PM

General Instructions

1. The test is of **3 hours** duration and the maximum marks is **300.**
2. The question paper consists of **3 Parts** (Part I: **Physics**, Part II: **Chemistry**, Part III: **Mathematics**). Each Part has **two** sections (Section 1 & Section 2).
3. **Section 1** contains **20 Multiple Choice Questions**. Each question has 4 choices **(A)**, **(B)**, **(C)** and **(D)**, out of which **ONLY ONE CHOICE** is correct.
4. **Section 2** contains **5 Numerical Value Type Questions**. The answer to each question is an **integer** ranging from 0 to 999.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
6. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
7. On completion of the test, the candidate must hand over the Answer Sheet to the **Invigilator** on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them**.
8. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

Marking Scheme

1. **Section – 1:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.
2. **Section – 2:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ **Invigilator's Signature** _____

Syllabus

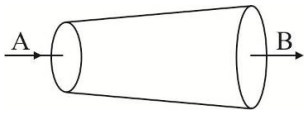
Physics: Rotational Motion, Gravitation, Liquids
Chemistry: Thermochemistry, Thermodynamics, Chemical Equilibrium
Mathematics: Straight Line, Circles, Parabola

PART - I : PHYSICS 100 MARKS

SECTION-1

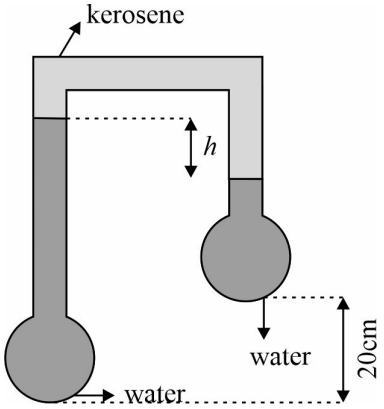
This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. An ideal fluid flows through a pipe of circular cross section with diameters 5 cm and 10 cm as shown. The ratio of velocities of fluid at *A* and *B* is:



(A) 4 : 1 **(B)** 1 : 4 **(C)** 2 : 1 **(D)** 1 : 2

2. For the arrangement shown in the figure the value of h if the pressure difference between the vessel A and *B* is $3000\ \text{N/m}^2$ is: $(\rho_{\text{kerosene}} = 800kg/m^3, \rho_{\text{water}} = 1000kg/m^3)$



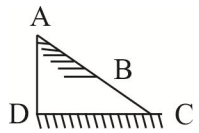
(A) 50 cm **(B)** 20 cm **(C)** 30 cm **(D)** 40 cm

SPACE FOR ROUGH WORK

3. The mass of a hypothetical planet is 1/1000 that of Earth and its radius is 1/8 that of Earth. If a person weighs 500 N on Earth, what would he weigh on this planet?

(A) 24 N **(B)** 48 N **(C)** 32 N **(D)** 192 N

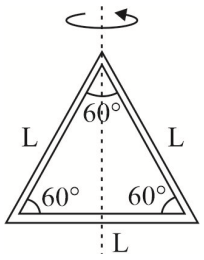
4. Portion *AB* of the wedge shown in figure is rough and *BC* is smooth. A solid cylinder rolls without slipping from *A* to *B*. If *AB* = *BC*, then ratio of translational kinetic energy to rotational kinetic energy at point *C* is:



(A) 3/5 **(B)** 5

(C) 7/5 **(D)** 8/3

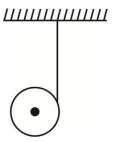
5. Three identical thin rods, each of mass m and length L are joined to form an equilateral triangle. Find the moment of inertia of the triangle about an axis in its plane perpendicular on one of its sides as shown in the figure.



(A) $\frac{5mL^2}{6}$ **(B)** $\frac{mL^2}{4}$

(C) $\frac{3mL^2}{4}$ **(D)** $\frac{5mL^2}{12}$

6. A massless rope is wrapped around a ring (with a groove along its circumference) having a radius R and mass *m*. The ring is allowed to move downward without slipping on the rope. The linear acceleration of the ring is:



(A) $2g/3$ **(B)** $g/2$ **(C)** $g/3$ **(D)** g

SPACE FOR ROUGH WORK

7. When a solid sphere rolls without slipping down an inclined plane making an angle θ with the horizontal, the acceleration of its centre of mass is *a*. If the same sphere slides without friction its acceleration is:

(A) (7/2) *a* **(B)** (5/7) *a* **(C)** (7/5) *a* **(D)** (5/2) *a*

8. The distance between the centres of the Moon and the earth is *D*. The mass of the earth is 100 times the mass of the Moon. At what distance from the centre of the earth, the gravitational force on a particle will be zero?

(A) $\frac{D}{2}$ **(B)** $\frac{10D}{11}$ **(C)** $\frac{11D}{10}$ **(D)** $\frac{9D}{10}$

9. Water from a tap emerges vertically downwards with an initial velocity V_0. Assuming pressure is constant throughout the stream of water and the flow is steady, find the distance from the tap at which cross-sectional area of stream is one-fourth of the cross sectional area at the tap.

(A) $V_0^2 / 2g$ **(B)** $15V_0^2 / 2g$ **(C)** $2V_0^2 / g$ **(D)** $5V_0^2 / 2g$

10. The angle of contact between glass and water is 0° and water (surface tension 70 dyne/*cm*) rises in a glass capillary up to 6 *cm*. Another liquid of surface tension 210 dyne/*cm*, angle of contact 30° and relative density 2 will rise in the same capillary up to :

(A) 3 *cm* **(B)** $9\sqrt{3}/2$ cm **(C)** 9 *cm* **(D)** 6 *cm*

SPACE FOR ROUGH WORK

11. A planet is moving in an elliptical orbit around the sun. The ratio of minimum distance between planet and sun to maximum distance between planet & sun is $\sqrt{3}:2$, if the speed of planet at the minimum distance is v_0, then its speed at the maximum distance is:

(A) $\frac{v_0}{\sqrt{3}}$ **(B)** $\sqrt{3}v_0$ **(C)** v_0 **(D)** $\frac{v_0\sqrt{3}}{2}$

12. Two satellites, *A* and *B*, have masses m and 2m respectively. *A* is in a circular orbit of radius *R*, and *B* is in a circular orbit of radius 2*R* around the earth. The ratio of their kinetic energies, T_A / T_B, is:

(A) $\frac{1}{2}$ **(B)** 1 **(C)** $\sqrt{\frac{1}{2}}$ **(D)** 2

13. A wheel, of radius 1m, is rolling purely on a flat, horizontal surface. It's centre is moving with a constant horizontal acceleration = 3m/s^2. At a moment when the centre of the wheel has a velocity 3m/s, then the acceleration of a point 1/3m vertically above the centre of the wheel will be:

(A) 10m/s^2 **(B)** 4m/s^2 **(C)** 6m/s^2 **(D)** 5m/s^2

14. A uniform ring of radius *R* is given a back spin of angular velocity $V_0 / 2R$ and thrown on a horizontal rough surface with velocity of centre equal to V_0. The velocity of the centre of the ring when it starts pure rolling will be :

(A) $\frac{V_0}{2}$ **(B)** $\frac{V_0}{4}$ **(C)** $\frac{3V_0}{4}$ **(D)** 0

15. A small sphere of volume *V* falling in a viscous fluid acquires a terminal velocity v_t. The terminal velocity of a sphere of volume 64*V* of the same material and falling in the same fluid will be :

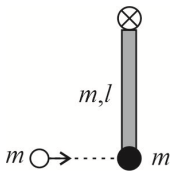
(A) $\frac{v_t}{16}$ **(B)** $\frac{v_t}{4}$ **(C)** $16v_t$ **(D)** $4v_t$

SPACE FOR ROUGH WORK

16. A solid sphere of mass 1kg, radius 10 cm rolls down an inclined plane of height 7m. The velocity of its centre as it reaches the ground level is: (Take $g = 10\text{m/s}^2$)

(A) 7 m/s **(B)** 10 m/s **(C)** 15 m/s **(D)** 20 m/s

17. A particle is attached to the lower end of a uniform rod which is hinged at its other end as shown in the figure. Another identical particle moving horizontally collides inelastically and sticks to it. The minimum speed of moving particle so that the rod with particles performs circular motion in a vertical plane will be: [length of the rod is *l*, consider masses of both particle and rod to be same]



(A) $\sqrt{20gl}$ **(B)** $\sqrt{10gl}$ **(C)** $\sqrt{\frac{70gl}{3}}$ **(D)** $\sqrt{\frac{175gl}{3}}$

18. A body is projected with a velocity of $2 \times 11.2 \text{ km s}^{-1}$ from the surface of earth. The velocity of the body when it escaped the gravitational pull of earth is:

(A) $\sqrt{3} \times 11.2 \text{ km s}^{-1}$ **(B)** 11.2 km s^{-1}

(C) $\sqrt{2} \times 11.2 \text{ km s}^{-1}$ **(D)** $0.5 \times 11.2 \text{ km s}^{-1}$

19. A child is standing with folded hands at the centre of a platform rotating about its central axis. The kinetic energy of the system is *K*. The child now stretches his arms so that the moment of inertia of the system triples. The kinetic energy of the system now is :

(A) $2K$ **(B)** $\frac{K}{2}$ **(C)** $\frac{K}{3}$ **(D)** $3K$

20. A large tank is filled with water (density $=10^3\text{kg/m}^3$). A small hole is made at depth 10m below water surface. The range of water coming out of the hole is *R*, on ground. What extra pressure must be applied on the water surface so the range becomes 2*R*. (Take 1 atm = 10^5 Pa and g = $10\,\text{m/s}^2$)

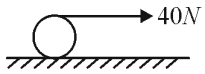
(A) 9 atm **(B)** 4 atm **(C)** 5 atm **(D)** 3 atm

SPACE FOR ROUGH WORK

SECTION-2

This section contains Five (05) Numerical Value Type Questions. The answer to each question is an integer ranging from 0 to 999 (both inclusive).

1. A string is wound around a hollow cylinder of mass 5 kg and radius 0.5 m. If the string is now pulled with a horizontal force of 40N, and the cylinder is rolling without slipping on a horizontal surface (see figure), then the angular acceleration of the cylinder will be _____ rad/s^2. (Neglect the mass and thickness of the string)



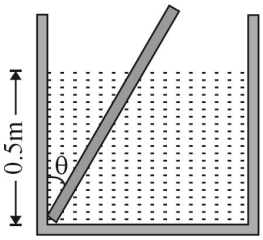
2. Two solids *P* and *Q* float in water. It is observed that *P* floats with half of its volume immersed and *Q* floats with $\frac{2^{rd}}{3}$ of its volume immersed. If the ratio of densities of *P* and *Q* is *x*/4, then *x* is _____.

SPACE FOR ROUGH WORK

3. The surface energy of a liquid drop is E. It is sprayed into 729 equal droplets. The work done in spraying is nE. Find n.

4. Three particles each of mass m are placed at the corners of an equilateral triangle of side l. The work done required to change the side of the triangle from l to $3l$ is $\frac{nGm^2}{2l}$. Find value of n.

5. A wooden plank of length 1m and uniform cross section is hinged at one end to the bottom of a tank as shown in the figure. The tank is filled with water upto a height of 0.5m. The specific gravity of the plank is 0.5.
Find the angle θ (in degrees) that the plank makes with the vertical in equilibrium position. (Excluding the case $\theta = 0°$)



SPACE FOR ROUGH WORK

PART - II : CHEMISTRY 100 MARKS

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. A mixture of SO_3, SO_2 and O_2 gases are maintained at equilibrium in 10 litre flask at a temperature at which K_C for the reaction $2SO_2(g)+O_2(g) \rightleftharpoons 2SO_3(g)$ is 100. If number of moles of SO_2 and SO_3 are same at equilibrium, the number of moles of O_2 present is:

(A) 0.01 **(B)** 0.1 **(C)** 1 **(D)** 10

2. A sample of Argon gas at 1 atm pressure and 27°C expands reversibly and adiabatically from $1.25\,dm^3$ to $2.5\,dm^3$. Calculate the enthalpy change in this process. $C_{V,m}$ for Argon is $12.48\,JK^{-1}\,mol^{-1}$.

[Given: $(0.5)^{0.66} = 0.633$]

(A) – 114.47 J **(B)** – 110.32 J **(C)** –100.42 J **(D)** –126.42 J

3. For the reaction:

$3Fe_2O_3(s) \rightleftharpoons 2Fe_3O_4(s)+\frac{1}{2}O_2(g)$, $\Delta H^0_{298\,K} = 55.5\,kcal$ and $\Delta G^0_{298\,K} = 46.5\,kcal$.

What is the partial pressure of O_2 at equilibrium at 298 K for this reaction. [Given: $e^{-78} = 1.3\times10^{-34}$]

(A) 1.3×10^{-34} **(B)** 2.6×10^{-34} **(C)** 4×10^{-35} **(D)** 1.69×10^{-68}

SPACE FOR ROUGH WORK

4. For the following equilibrium in a close container.

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

At a constant temperature, the volume of the container is halved suddenly. Which of the following is correct for K_p and α?

(A) Both K_p and α changes

(B) None of the K_p and α change

(C) K_p changes but α does not

(D) α- changes but K_p does not

5. Which of the following statement is incorrect?

(A) Free energy (G) is a path function

(B) In the expression G = H – TS, TS is the part of the system's energy that is disordered

(C) ΔG for a system is equal to $T\Delta S_{Total}$ in magnitude

(D) ΔG is positive for non-spontaneous reaction

6. Quick lime; (CaO) is produced by heating limestone $CaCO_3$ to drive off CO_2 gas.

$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$

$\Delta H = 180\,kJ\,mol^{-1}$

$\Delta S = 150\,JK^{-1}$

Assuming that variation of enthalpy change and entropy change with temperature to be negligible, which of the following is correct?

(A) Decomposition of $CaCO_3(s)$ is always non-spontaneous at room temperature

(B) Decomposition of $CaCO_3(s)$ becomes spontaneous when temperature is less than 927°C

(C) Decomposition of $CaCO_3(s)$ becomes non-spontaneous when temperature is greater than 1200°C

(D) All of the above

SPACE FOR ROUGH WORK

7. 1 mole of a gas AB_3 present in 10 L container at pressure 2.5 atm and 273 K temperature. On increasing the temperature to 540 K, AB_3 dissociates into $AB_2(g)$ and $B_2(g)$. If the degree of dissociation of AB_3 is 80%, then final pressure at 540 K is:

(A) 5 atm **(B)** 1.25 atm **(C)** 10 atm **(D)** 6.2 atm

8. When 20 g of $CaCO_3$ were put into 10 litre flask and heated to 794°C, 40% of $CaCO_3$ decomposed at equilibrium. K_P for the decomposition of $CaCO_3$ is:

(A) 0.7 atm **(B)** 0.3 atm **(C)** 1.05 atm **(D)** 2.5 atm

9. The normal boiling point of a liquid X is 400 K. ΔH_{vap} at normal boiling point is 40 kJ/mol. Select the correct statement.

(A) $\Delta S_{vap} < 100\ J/mol\,K$ at 400 K and 2 atm

(B) $\Delta S_{vap} < 10\ J/mol\,K$ at 400 K and 1 atm

(C) $\Delta G_{vap} > 0$ at 410 K and 1 atm

(D) $\Delta U = 43.22\ kJ/mol\,K$ at 400 K and 1 atm

10. Select the incorrect statement:

(A) An adiabatic system can exchange energy with its surroundings

(B) A thermodynamic property which is intensive is additive

(C) For cyclic process, ΔH is zero

(D) For an isolated system, the entropy can never decrease

SPACE FOR ROUGH WORK

11. What will be the effect on the equilibrium constant on increasing temperature, if the reaction neither absorbs heat nor releases heat?

(A) Equilibrium constant will remain constant
(B) Equilibrium constant will decrease
(C) Equilibrium constant will increase
(D) Can not be predicted

12. The conversion of ozone into oxygen is exothermic, under what condition ozone is more stable?

$2O_3(g) \rightleftharpoons 3O_2(g)$

(A) At low pressure and low temperature
(B) At high pressure and high temperature
(C) At high pressure and low temperature
(D) At low pressure and high temperature

13. Consider the partial decomposition of A as $2A(g) \rightleftharpoons 2B(g) + C(g)$.

At equilibrium, 700 ml gaseous mixture contains 100 ml of gas C at 10 atm and 300 K. What is the value of K_P for the reaction?

(A) $\frac{40}{7}$ **(B)** $\frac{1}{28}$ **(C)** $\frac{10}{28}$ **(D)** $\frac{28}{10}$

14. The equilibrium constant K_P for the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ is 4.5.

What would be the average molar mass (in g/mol) of an equilibrium mixture of N_2O_4 and NO_2 at a total pressure of 2 atm formed by the dissociation of pure N_2O_4?

(A) 69 **(B)** 57.5 **(C)** 80.5 **(D)** 85.5

SPACE FOR ROUGH WORK

15. Find ΔH at 358K for the reaction $Fe_2O_3(s) + 3H_2(g) \longrightarrow 2Fe(s) + 3H_2O(\ell)$.

Given that, $\Delta H = -33.29\,kJ/mol$ at 298 K and C_p for $Fe_2O_3(s)$, Fe(s), $H_2O(\ell)$ and $H_2(g)$ are 103.8, 25.1, 75.3 and 28.8 J/K mol.

(A) 85.9 kJ/mol **(B)** –28.136 kJ/mol

(C) + 28.136 kJ/mol **(D)** 85.9 J/mol

16. For a reversible adiabatic ideal gas expansion $\frac{dP}{P}$ is equal to:

(A) $\gamma\frac{dV}{V}$ **(B)** $-\gamma\frac{dV}{V}$ **(C)** $\left(\frac{\gamma}{\gamma-1}\right)\frac{dV}{V}$ **(D)** $\frac{dV}{V}$

17. Consider the following reaction:

$H_2O(\ell) \longrightarrow H_2O(g)$ $\Delta H_1 = 44\,kJ$

$2CH_3OH(\ell) + 3O_2(g) \longrightarrow 4H_2O(\ell) + 2CO_2(g)$ $\Delta H_2 = -1453\,kJ$

What is the value of ΔH for second reaction if water vapour instead of liquid water is formed as product?

(A) $-1409\,kJ$ **(B)** $-1629\,kJ$ **(C)** $-1277\,kJ$ **(D)** $-1490\,kJ$

SPACE FOR ROUGH WORK

18. 36 mL of pure water takes 100 sec to evaporate from a vessel when a heater of 806 watt is used. The $\Delta H_{vaporisation}$ of H_2O is: [Density of water = 1g/cc]

(A) $40.3\,kJ/mol$ **(B)** $43.2\,kJ/mol$ **(C)** $4.03\,kJ/mol$ **(D)** $3.22\,kJ/mol$

19. Two samples A and B of an ideal gas, initially at same temperature and pressure, are compressed from volume V to V/2, isothermally for A and adiabatically for B. The final pressure of A will be:

(A) Greater than that of B **(B)** Less than that of B

(C) Twice that of B **(D)** Equal to that of B

20. Consider the following reversible reaction $NO + NO_3 \rightleftharpoons 2NO_2$.

If 1.0 mol of NO is mixed with 3.0 mol of NO_3, 'x' mol of NO_2 is produced at equilibrium. If 2.0 mol of NO is added further. 'x' mole of NO_2 is further produced. What is the value of equilibrium constant?

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

SPACE FOR ROUGH WORK

SECTION-2

This section contains Five (05) Numerical Value Type Questions. The answer to each question is an integer ranging from 0 to 999 (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 to unity, if the 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. For a equilibrium $A \rightleftharpoons B$, $\Delta H = +ve$, graph between $\log K_{eq}$ and $\frac{1}{T}$ is a straight line with slope $= -\frac{1}{4.606}$. Find ΔH in calories.

SPACE FOR ROUGH WORK

3. Calculate the magnitude of resonance energy of N_2O from the following data.

$[\Delta_f H^0$ of $N_2O = 82.4\,kJ/mol]$

$BE_{N \equiv N} = 946.2\,kJ/mol$

$BE_{N=N} = 418\,kJ/mol$

$BE_{O=O} = 497\,kJ/mol$

$BE_{N=O} = 605.3\,kJ/mol$

4. At 298 K, if $\Delta_f G^0$ of $HCl(g)$ is 1.72 kJ mol^{-1}, then calculate K_p for the following reversible reaction: $2HCl(g) \rightleftharpoons H_2(g) + Cl_2(g)$

[Use: at 298 K : 2.303 RT = 5700 J mol^{-1} and $\text{antilog}(0.6) = 4$]

5. The following equilibrium exists in a closed vessel in 1L capacity.

$A(g) + 3B(g) \rightleftharpoons 4C(g)$

Initial concentration of A(g) is equal to that of B(g). The equilibrium concentration of A(g) and C(g) are equal. K_c for the reaction is _____.

SPACE FOR ROUGH WORK

PART - III: MATHEMATICS 100 MARKS

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. Given the points $A(3, 4)$ and $B(4, 3)$ and the line $ax + by + c = 0$, $\left(a, b, c \in R^+\right)$ and let P_1 and P_2 be lengths of perpendicular from A and B to the line such that $2P_1 + 3P_2 = 10$ then the line $ax + by + c = 0$ touches the circle.

(A) $(x-18)^2 + (y-17)^2 = 4$ **(B)** $\left(x+\frac{18}{5}\right)^2 + \left(y-\frac{17}{5}\right)^2 = 4$

(C) $\left(x-\frac{18}{5}\right)^2 + \left(y-\frac{17}{5}\right)^2 = 4$ **(D)** $(x-3)^2 + (y-6)^2 = 4$

2. If the distance between the pair of parallel lines $x^2 + 2xy + y^2 - 8ax - 8ay - 9a^2 = 0$ is $25\sqrt{2}$, then a is:

(A) ± 4 **(B)** ± 2 **(C)** ± 3 **(D)** ± 5

3. Consider straight line $ax + by = c$ where $a, b, c \in R^+$ and a, b, c are distinct. This line meets the coordinate axes at P and Q respectively. If area of $\Delta OPQ = \frac{1}{2}$, 'O' being origin, then:

(A) a, b, c are in GP **(B)** a, c, b are in GP

(C) a, b, c are in AP **(D)** a, c, b are in AP

SPACE FOR ROUGH WORK

4. Consider the circle $C: x^2 + y^2 = 1$ and the line $L: y = m(x+2)$. If L intersects C at P and Q, then locus of middle point of PQ is:

(A) $(x+1)^2 + y^2 = 1$ **(B)** $x^2 + (y-1)^2 = 1$

(C) $(x-1)^2 + y^2 = 1$ **(D)** $x^2 + (y+1)^2 = 1$

5. If the equation $ax^2 - 6xy + y^2 + 2gx + 2fy + c = 0$ represents a pair of lines whose slopes are m and m^2, then sum of all possible values of a is:

(A) –27 **(B)** 8 **(C)** –19 **(D)** + 19

6. A light ray gets reflected from the line x = – 2. If the reflected ray touches the circle $x^2 + y^2 = 4$ and point of incidence is (–2, –4), the equation of incident ray is:

(A) $4y + 3x + 22 = 0$ **(B)** $3y + 4x + 20 = 0$

(C) $4y + 2x + 20 = 0$ **(D)** $y + x + 6 = 0$

7. A parabola $y = ax^2 + bx + c$ crosses the x-axis at $(\alpha, 0)$ and $(\beta, 0)$ both to the right of the origin. A circle also passes through these two points. The length of a tangent from the origin to the circle is:

(A) $\sqrt{\frac{c}{a}}$ **(B)** $\frac{ac}{b^3}$ **(C)** $\frac{b}{a}$ **(D)** $\frac{c}{b}$

8. Consider a circle, $x^2 + y^2 = 1$ and point $(1, \sqrt{3})$. PAB is a secant drawn from P intersecting circle in A and B (distinct) then range of $|PA| + |PB|$ is:

(A) $[2, 2\sqrt{3}]$ **(B)** $(2\sqrt{3}, 4]$ **(C)** $(0, 4]$ **(D)** $[2, 4]$

SPACE FOR ROUGH WORK

9. If the tangents are drawn from any point on the line $x + y = 3$ to the circle $x^2 + y^2 = 9$, then the chord of contact passes through the point:

(A) $(3, 5)$ **(B)** $(3, 3)$ **(C)** $(5, 3)$ **(D)** (5, 5)

10. The equation of a straight line joining 2 points equidistant 3 units from a point (1, 2) lying on the circle $x^2 + y^2 = 5$ is given by:

(A) $4x + 2y - 1 = 0$ **(B)** $2x + 4y - 1 = 0$

(C) $2x + 3y - 1 = 0$ **(D)** $3x + 2y - 1 = 0$

11. Line $L_1 = 3x - 4y + 1 = 0$ touches the circles C_1 and C_2 whose centers are $A_1(1, 2)$ and $A_2(3, 1)$ respectively, then identify the INCORRECT statement from the following statements.

(A) L_1 is direct common tangent of these circles

(B) L_1 is transverse common tangent to the circles

(C) Radius of circle C_1 is $\frac{4}{5}$ units

(D) Radius of circle C_2 is $\frac{6}{5}$ units

12. The angle between the chords of the circle $x^2 + y^2 = 100$, which pass through the point (7, 1) and also divide the circumference of the circle into two arcs whose lengths are in the ratio 2 : 1, is equal to:

(A) $\frac{\pi}{6}$ **(B)** $\frac{\pi}{3}$ **(C)** $\frac{\pi}{2}$ **(D)** $\frac{2\pi}{3}$

SPACE FOR ROUGH WORK

13. If G is the centroid of triangle with vertices $A(a, 0)$, $B(-a, 0)$ and $C(b, c)$, then $\frac{AB^2 + BC^2 + CA^2}{GA^2 + GB^2 + GC^2} =$

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

14. The line parallel to the x-axis and passing through the intersection of the lines $ax + 2by + 3b = 0$ and $bx - 2ay - 3a = 0$, where $(a, b) \neq (0, 0)$ is:

(A) Below the x-axis at a distance of $\frac{3}{2}$ from it **(B)** Below the x-axis at a distance of $\frac{2}{3}$ from it

(C) Above the x-axis at a distance of $\frac{3}{2}$ from it **(D)** Above the x-axis of distance of $\frac{2}{3}$ from it

15. If the equation $2x^2 + 2hxy + 6y^2 - 4x + 5y - 6 = 0$ represents a pair of straight lines, then the length of intercept on the x-axis cut by the lines is equal to:

(A) 2 **(B)** 4 **(C)** $\sqrt{7}$ **(D)** 0

16. If θ is the angle between tangents to $x^2 + y^2 = 9$ which are normal to the circle $x^2 + y^2 - 6x - 10y + 33 = 0$ then $\tan\theta =$

(A) $\frac{3}{5}$ **(B)** $\frac{5}{3}$ **(C)** $\frac{8}{15}$ **(D)** $\frac{15}{8}$

17. If $25a^2 + 16b^2 - 40ab - c^2 = 0$, then the line $2ax + by + c = 0$ passes through a fixed-point P. Then the coordinates of P can be:

(A) $\left(\frac{5}{2}, 4\right)$ **(B)** $\left(\frac{5}{2}, -4\right)$ **(C)** $(5, 4)$ **(D)** $(5, -4)$

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18. Let P and Q be any two points on the lines represented by $2x-3y=0$ and $2x+3y=0$ respectively. If the area of triangle OPQ (where O is origin) is 5, then which of the following is the possible equation of the locus of mid-point of PQ ?

(A) $4x^2-9y^2+15=0$ **(B)** $4x^2-9y^2-30=0$

(C) $9x^2-4y^2-30=0$ **(D)** $4x^2+9y^2-30=0$

19. The range of values of 'a' such that the angle θ between the pair of tangents drawn from (a, 0) to the circle $x^2+y^2=1$ lies in the interval $\left(\frac{\pi}{3},\pi\right)$ is:

(A) $(-2,-1)\cup(1,2)$ **(B)** $\left(-\sqrt{2},-1\right)\cup\left(1,\sqrt{2}\right)$

(C) $\left(-2,-\sqrt{3}\right)\cup\left(\sqrt{3},2\right)$ **(D)** $\left(-\sqrt{3},-\sqrt{2}\right)\cup\left(\sqrt{2},\sqrt{3}\right)$

20. A focal chord of parabola $y^2=4x$ is inclined at an angle of $\frac{\pi}{4}$ with positive x-direction, then the slope of normal drawn at the ends of chord will satisfy the equation.

(A) $m^2-2m-1=0$ **(B)** $m^2+2m-1=0$

(C) $m^2+m-1=0$ **(D)** $m^2+2m-2=0$

SPACE FOR ROUGH WORK

SECTION-2

This section contains Five (05) Numerical Value Type Questions. The answer to each question is an integer ranging from 0 to 999 (both inclusive).

1. If $(\lambda, 2)$ is an interior point of ΔABC formed by $x+y=4, 3x-7y=8$ and $4x-y=31$ and range of $\lambda=(a, b)$, the value of $\frac{3a+4b}{4^3-3^2}$ must be _____.

2. Find the number of triangles formed by the lines represented by $x^3-x^2-x-2=0$ and $xy^2+2xy+4x-2y^2-4y-8=0$.

3. Slope of a common tangent drawn to 2 curves $x^2=4y$ and $xy=-2$ is equal to _____.

4. Consider circles C_1 & C_2 touching both the axes and passing through (4, 4), then the product of radii of these circles is _____.

5. If *S* be the focus of a parabola and *PQ* be the focal chord, such that *SP* = 3 and *SQ* = 6, then the length of latus rectum of the parabola is _____.

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