LAKSHYA ADVANCED UNIT TEST (LAUT)

Test No.	Physics : Horizontal circular motion (kinematics and dynamics) - uniform and non uniform , banking of tracks Chemistry : KTG, Real Gases, Thermodynamics (excluding Thermochemistry) Mathematics : Circles (60% weightage), St lines (40% weightage)	Question Booklet Serial No.
1051371		091016

Date : 09/10/2016 **Maximum Marks : 264** **Time Allottted : 3 Hours**

Please read the instructions carefully.

1. Immediately fill the particulars on this page of the Test Booklet with Blue/Black ball point pen. Use of pencil is strictly prohibited.
2. The answer sheet is kept inside this test booklet. When you are directed to open the test booklet, take out the answer sheet and fill in the particulars carefully.
3. The test booklet consists of 60 questions. The maximum marks are 264.
4. **PCM Paper** is divided into 3 Sections.
   (a) **Section I (01 – 10)** consists of 10 multiple choice questions which have **ONE OR MORE THAN ONE** correct answer. Each question carries +4 marks for correct answer and -1 marks for incorrect response.
   (b) **Section II (01 - 02)** contains 2 Matrix Match type questions. Statements in the first column have to be matched with statements in the second column. 2 marks if you darken the bubble corresponding to only the correct answer and 0 mark in all other cases.
   (c) **Section III (01 – 08)** contains 8 Integer Type questions with single digit integer as answer, ranging from 0 to 9 and each question carries +4 marks for correct answer and 0 mark for incorrect response.
5. Use Black Ball Pen only for writing/marking responses on side-1 and side-2 of the Answer sheet. Use of pencil is strictly prohibited.
6. No candidate is allowed to carry any textual material, printed or written, bits of papers, paper, mobile phone, any electronic device, etc. except the admit card inside the examination hall/room.
7. Rough work is to be done on the space provided for this purpose in the test booklet only. This space is given at the bottom of each page.
8. 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.
9. Do not fold or make any stray marks on the answer sheet.

Advice :

1. It is recommended to select easy questions and optimize your score.
2. Students are advised not to spend too much time on a particular question.

Do not open this booklet unless instruction is given

PART A - PHYSICS

SECTION I (Multiple Answer Correct)

Section I consists of 10 multiple choice questions which have one or more than one correct answer. Each question carries +4 marks for correct answer and -1 mark otherwise.

1. An amusement park ride called "The Spinning Terror" is a large vertical drum which spins so fast that everyone inside stays pinned against the wall when the floor drops away

a) The minimum linear velocity is $\omega_{min} = \sqrt{\frac{g}{\mu R}}$ for everyone to stay inside.

b) The minimum linear velocity is $\upsilon_{min} = \sqrt{\frac{g}{\mu R}}$ for everyone to stay inside.

c) The mínimum angular velocity is $\omega_{min} = \sqrt{\frac{gR}{\mu}}$ for everyone to stay inside.

d) The minimum linear velocity is $\upsilon_{min} = \sqrt{\frac{gR}{\mu}}$ for everyone to stay inside.

2. A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane. If follows that

a) its velocity is constant
b) its acceleration is constant
c) its kinetic energy is constant
d) it moves in a circular path

3. A particle is moving on a circular path of radius 2 m with constant angular velocity ω. In time $t = \frac{\pi}{3\omega}$,

a) the magnitude of displacement is 2 m
b) the magnitude of displacement is $\frac{4\pi}{3}$ m
c) distance travelled by particle is $\frac{2\pi}{3}$ m
d) distance travelled by particle is 2 m

4. A ceiling fan is turning at $\frac{1}{\pi}$ rpm. A bug is moving on the blade with velocity v_0 = 1 cm/s towards the axis of the fan with respect to blade. Then,

a) the speed of the bug at distance 30 cm from the axis of fan is $\sqrt{2}$ cm/s
b) the acceleration of the bug at distance 30 cm from axis of fan is $\frac{1}{30}$ cm/s^2
c) the acceleration of the bug at distance 30 cm from axis of fan is 1 cm/s^2
d) None of the above

5. If a particle is moving on a circular path with increasing speed, then which of the following options are correct?

a) Acceleration and velocity never be perpendicular to each other
b) Acceleration is always directed towards centre
c) Angular acceleration and angular velocity are along the axis of rotation in the same direction
d) Tangential acceleration and angular acceleration are always perpendicular to each other

6. A cyclist is moving on a circular path of radius R with increasing speed. The rate of increase of speed is a_0 which is uniform. The coefficient of friction between tyre and horizontal ground is μ.

a) Friction is directed towards centre

b) Maximum angle of inclination with vertical is $\tan^{-1}\mu$

c) Friction is not directed towards centre

d) Friction provides tangential as well as centripetal acceleration

7. A cyclist is moving on a circular path of radius $\sqrt{3}$ m. The coefficient of friction between tyre and ground is $\mu_s = \frac{1}{\sqrt{3}}$.

a) The maximum speed of cyclist to safe riding is $\sqrt{10}$ m/s

b) The maximum inclination with vertical is 30^0

c) Friction provides required centripetal acceleration

d) The line of action of net contact force is passing through the centre of gravity of cyclist system

8. A car is moving with a speed of 10m/s on a circular path of radius 25m. Driver of car applies the brakes producing a uniform deceleration of $3m/s^2$. Then,

a) the centripetal acceleration of car just after applying the brake is $4m/s^2$

b) the acceleration just after applying the brake is $5\ m/s^2$

c) the acceleration is directed towards the centre just after applying the brake

d) The angle between acceleration and velocity just after applying the brake is 127^0

9. A particle is moving along a circular path. The angular velocity, linear velocity, angular acceleration and centripetal acceleration of the particle at any instant are $\vec{\omega}, \vec{\upsilon}, \vec{a}, \vec{a}_c$ respectively. Which of the following relations are correct?

a) $\vec{\omega} \perp \vec{v}$ b) $\vec{\omega} \perp \vec{a}$

c) $\vec{\omega} \perp \vec{a}_c$ d) $\vec{v} \perp \vec{a}_c$

10. A smooth circular road of radius *r* is banked for a speed υ = 40km/hr. A car of mass m attempts to go on the Circular road. The friction coefficient between the tyre and the road is negligible. The correct statements are :

a) The car can not make a turn without skidding.

b) If the car turns at a speed less than 40 km/hr, it slips down.

c) If the car turns at the correct speed of 40 km/hr, the forcé by the road on the car is equal to $m\upsilon^2/r$.

d) If the car turns at the correct speed of 40 km/hr, the force by the road on the car is greater than mg as well as greater than $m\upsilon^2/r$.

SECTION II (Matrix Match Type)

Section II consists of 2 matrix match type questions in which each row have one or more than one match. Each question carries 2 marks for each correct row and 0 marks for incorrect response. No negative marking.

1. Match the Column I with Column II and select the correct option from the given codes.

	Column -I		Column-II
A)	Motion of a particle on circular path with increasing speed ($v \neq 0$)	P)	Acceleration is directed towards centre
B)	Motion of a car on circular path with constant speed	Q)	Acceleration is not directed towards centre
C)	Motion of cyclist on circular path with decreasing speed ($v \neq 0$)	R)	Centripetal acceleration is non-zero
D)	Motion of a particle on a circular path with constant angular acceleration	S)	Friction is not directed towards centre

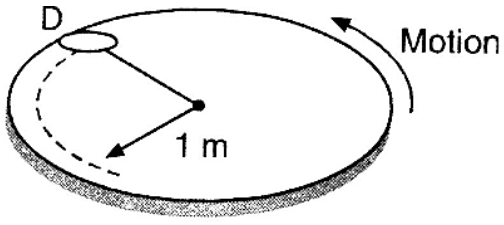
2. A particle moves on a circular path of radius 7m with constant speed 7m/s. Match the Column I with Column II and mark the correct option given below.

	Column –I		Column-II
A)	The magnitude of displacement in metre of the particle during travelling the quarter of circle.	P)	6.3
B)	The magnitude of average velocity in m/s during travelling quarter of circle.	Q)	7
C)	The magnitude of acceleration in m/s^2 of the particle.	R)	$\frac{\pi}{2}$
D)	The magnitude of average acceleration in m/s^2 during travelling a quarter of circle.	S)	$7\sqrt{2}$

SECTION III (Integer Type)

Section III consists of 8 Integer type questions. Each is allotted +4 marks for correct response and 0 marks for incorrect response.

1. The 4 kg disk D is attached to the end of a cord as shown in figure. The other end of the cord is tied at the centre of a platform. If the platform is rotating rapidly and the disk is placed on it and released from rest as shown, determine the time, in seconds, it takes for the disk to reach a speed great enough to break the cord. The maximum tension the cord can sustain is 100 N and the coefficient of kinetic friction between the disk and the platform is $\mu_k = 0.1$. Take $g = 10ms^{-2}$



2. A stone of mass 16 kg is attached to a string 144 m long and is whirled in a horizontal circle. The maximum tension the string can stand is 16N. The maximum velocity of revolution that can be given to the stone without breaking the string is twice the value of n, find n.

3. A wheel rotates with constant acceleration of 2 rad s^{-2} . If the wheel starts from rest, the number of revolution it makes in the first ten second will be approximately square of n, find n.

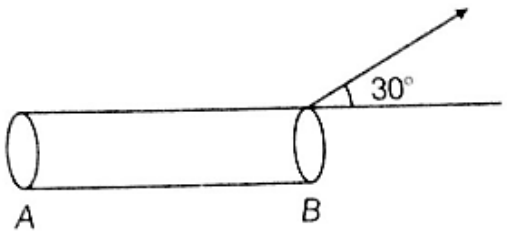
4. On a dry road, the maximum permissible speed of a car in a circular path is $10ms^{-1}$. If the road becomes wet, the maximum speed is $5\sqrt{2}$. If the coefficient of friction for dry road is μ, then that for the wet road is $\frac{\mu}{p}$, find p.

5. In amusement parks there is a device called rotor where people stand on a platform inside a large cylinder that rotates about a vertical axis. When the rotor reaches a certain angular velocity, the platform drops away. If the minimum coefficient of friction for the people not to slide down is $\frac{n}{10}$, find n. Take the radius to be 2m and time period of revolution to be 2 s.

6. A car is moving in a circular path of radius 50m, on a flat rough horizontal ground. The mass of the car is 1000 kg. At a certain moment, when the speed of the car 5m/s, the driver is increasing speed at the rate of $1m/s^2$. If the value of static friction on tyres at this moment, in newtons is $100 \times n^{3/2}$. Find n.

7. An object is moving in a circle at constant speed v. The magnitude of the rate of change of momentum of the object is proportional to v^n. find value of n.

8. The instantaneous velocity of point B of the given rod of length 0.5 m is 3 m/s in the represented direction. The angular velocity of the rod for minimum velocity of end A is ω rad/s. Find the value of ω



PART B - CHEMISTRY

SECTION I (Multiple Answer Correct)

Section I consists of 10 multiple choice questions which have one or more than one correct answer. Each question carries +4 marks for correct answer and -1 mark otherwise.

1. The Critical temperature and critical pressure of a gas are 300 K and 70 atmospheres. Which one of the following is true regarding liquefaction of the gas.

a) below 300 K the gas can be liquefied by applying high pressure
b) At 300 K, If pressure applied is 70 atm liquefaction of gas is possible
c) below 300 K. If the pressure applied is less than 70 atm the gas may become liquid.
d) Above 300 K. If the pressured applied is greater than 70 atm the gas cannot be liquefied..

2. Choose correct statement/s

a) From a mixture of two Vander waal's gases with same value of b and different values of 'a' the gas with larger value of 'a' can occupy lesser volume.
b) From a mixture of two Vander waal's gases with same value of 'a' and different values of 'b' the gas with smaller value of 'b' can occupy larger volume
c) From a mixture of two Vander waal's gases with same value of 'b' and different values of 'a', the gas with larger value of 'a' can occupy larger volume.
d) From a mixture of two Vander waal's gases with same value of 'a' and different values of 'b', the gas with smaller value of 'b' can occupy lesser volume.

3. A gas obeys P(V- b) = RT. Which of the following are correct about this gas ?

a) Isochoric curves of P vs T have slope $= \frac{R}{V-b}$
b) Isobaric curves of V vs T have slope R/P and intercept b
c) For the gas the compressibility factor $= 1 + \frac{Pb}{RT}$
d) The attractive forces are overcome by repulsive forces

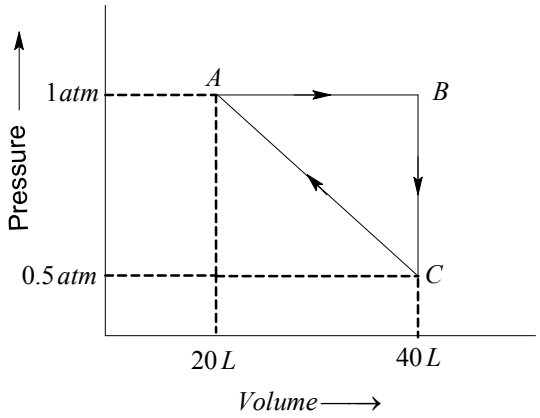
4. Which of the following equation represent or related with Charle's law for gaseous behaviour–

a) $V \propto \frac{1}{T}$
b) $\left(\frac{dV}{dT}\right)_p = K$
c) $\left(\frac{dT}{dV}\right)_p = K$
d) $\left(\frac{1}{T} - \frac{V}{T^3}\right)_p = 0$

5. The reaction between gaseous NH_3 and HBr produces a white solid NH_4Br. Suppose gaseous NH_3 and gaseous HBr are introduced simultaneously into opposite ends of an open tube under identical condition which is one metre long. Then.

a) NH_4Br solid is formed at 68.5cm from NH_3 end
b) NH_4Br solid is formed at 31.5cm from NH_3 end
c) NH_4Br solid is formed at 31.5cm from HCl end
d) NH_4Br solid is formed at 68.5 cm from HCl end

6. On the basis of following graph $(P-V \text{ graph})$, choose the correct statement.



a) Total work done W = q
b) The entropy change for the overall process is zero
c) For the overall process $\Delta H > \Delta U$
d) Total work = 620.77J.

7. In an adiabatic process, the work involved during expansion or compression of an ideal gas is given by

a) $nC_p\Delta T$
b) $\frac{nR}{\gamma-1}(T_2-T_1)$
c) $-nRP_{ext}\left[\frac{T_2P_1-T_1P_2}{P_1P_2}\right]$
d) $-2.303R\ell n\frac{V_2}{V_1}$

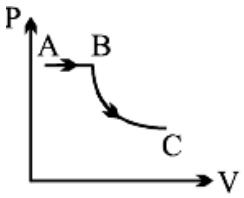
8. Identify the intensive quantities from the following

a) Refractive index
b) Temperature
c) Density
d) Enthalpy

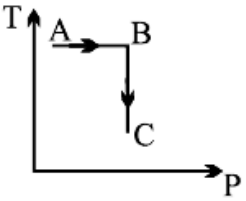
9. Which of the following is(are) state function(s)?

a) Enthalpy
b) Heat
c) Entropy
d) Internal Energy

10. A process is shown in the diagram.



Which of the following is/are correct

a)


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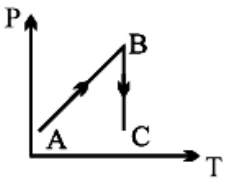
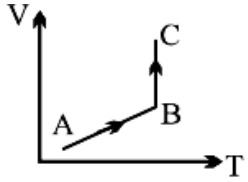
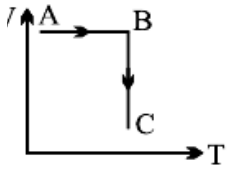


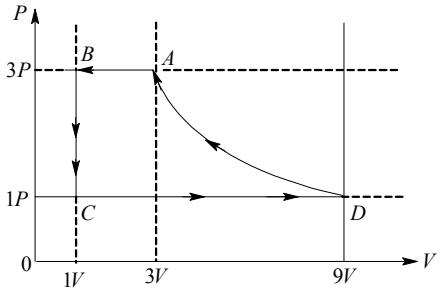
c) 

d) 

SECTION II (Matrix Match Type)

Section II consists of 2 matrix match type questions in which each row have one or more than one match. Each question carries 2 marks for each correct row and 0 marks for incorrect response. No negative marking.

1. One mole of a monoatomic ideal gas is taken through a cycle ABCDA as shown in the P-V diagram. Column-II gives the characteristics involved in the cycle. Match the with each of the processes given in Column-I.



	Column I		Column II
A)	Process A $\rightarrow$ B	P)	Internal energy decreases
B)	Process B $\rightarrow$ C	Q)	Internal energy increases
C)	Process C $\rightarrow$ D	R)	Heat is lost
D)	Process D $\rightarrow$ A	S)	Heat is gained
		t)	Work is done on the gas

2.

	Column I		Column II
A)	If force of attraction among the gas molecules be negligible	P)	$\left(P+\frac{a}{V^2}\right)(V-b)=RT$
B)	At Very low pressure and at high temperature	Q)	$PV=RT-\frac{a}{V}$
C)	At STP	R)	$PV=RT+Pb$
D)	If the volume of the gas molecules be negligible	S)	$PV=RT$

SECTION III (Integer Type)

Section III consists of 8 Integer type questions. Each is allotted +4 marks for correct response and 0 marks for incorrect response.

1. A graph is plotted between log V(lit) on y-axis and logT(K) on x-axis at a constant pressure of 0.0821 atm, for 2 moles of gas. Find the ratio between V and T?

2. For 2 different gases at different temperatures, the relation for rms velocity is $\frac{C_1}{C_2}=\sqrt{\frac{T_1}{T_2}\times\frac{M_2}{M_1}}$. Then if rms velocity of 32 grams of O_2 at 270^0C and 3 atm pressure is 10 mt/s and kinetic energy is 900 cal. At 27^0 and 6 atm pressure kinetic energy of 2 grams of H_2 is $x\times 100$ cal. Value of x is

3. Two gases A and B having same volume diffuse through a porous partition in 20 and 10 seconds respectively. The molecular weight of A is 36. The molecular weight of gas B will be

4. A half litre container at 27^0C is filled with C_2H_4 at 1 atm and oxygen at 5 atm and the mixture is exploded. Then, the final pressure would be nearly _____ atm, when final temperature is 127^0 C.

5. The stop cock connecting two bulbs of volume 5 litre and 10 litre containing an ideal gas at 9atm and 6atm respectively, is opened. What is the final (in atm) pressure in the two bulbs if the temperature remains the same?

6. 1.736mol of ideal gas was allowed to expand isothermally reversibly from $6\,dm^3$ to $24\,dm^3$ at 300K. The maximum work done was reported as $-x\,kJ$. If $R = 8.314\,JK^{-1}mol^{-1}$ & $\log 4 = 0.6020$. What is the value of x ?

7. 4.48 L of an ideal gas at STP requires 12 cal to raise the temperature by 15^0C at constant volume. The C_p of the gas is _____ cal.

8. How many of the following are extensive properties? heat capacity, entropy, enthalpy of phase change per mole, volume, resistance, specific heat capacity

PART C - MATHS

SECTION I (Multiple Answer Correct)

Section I consists of 10 multiple choice questions which have one or more than one correct answer. Each question carries +4 marks for correct answer and -1 mark otherwise.

1. Let x, y be variables satisfying the equation $x^2 + y^2 + 8x - 10y - 40 = 0$. 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) $a + b = \sqrt{2}$

c) $a - b = 4\sqrt{2}$ d) $ab = 73$

2. Common tangents are drawn to two circles $x^2 + y^2 = 1$ and $(x-4)^2 + (y-4)^2 = 4$. If the intersection points of transverse common tangents with the direct common tangents are A, B, C and D, then

a) ABCD is a cyclic quadrilateral

b) Equation of circumcircle of Δ ABC is $x^2 + y^2 - 4x - 4y = 0$

c) Equation of circumcircle of Δ ABC is $x^2 + y^2 - 5x - 5y = 0$

d) ABCD is a square

3. If α, β, χ are the parameters of points A, B, C on circle $x^2 + y^2 = a^2$ and if the triangle ABC be equilateral, then

a) $\sum\cos\alpha = 0$ b) $\sum\sin\alpha = 0$

c) $\sum\tan\alpha = 0$ d) $\sum\cot\alpha = 0$

4. Let S_1 and S_2 be two circles passing through (2, 3) and touching the coordinate axes and S be the circle passing through common points of S_1 and S_2 and radius equal to G.M. of radius of S_1 and S_2, then

a) $S \equiv 0$ cuts y-axis is but not the x-axis b) $S \equiv 0$ cuts $y = x$

c) Radius of director circle of $S \equiv 0$ is $\sqrt{26}$ d) A.M. of radius of S_1 and S_2 is 5

5. If the line $|y| = x - \alpha$; where $\alpha > 0$ does not meet the circle $x^2 + y^2 - 10x + 21 = 0$, then

a) $\alpha < 5 - 2\sqrt{2}$ b) $\alpha > 5 + 2\sqrt{2}$

c) $\alpha \in (5-2\sqrt{2},\ 5+2\sqrt{2})$ d) $\alpha \in (-1, 1)$

6. If the lines $3x - 4y + 4 = 0$ and $6x - 8y - 7 = 0$ are tangents to the same circle, then

a) Radius of the circle = 3/4 b) Radius of the circle = 3/2

c) Centre of the circle lies on $12x - 16y + 1 = 0$ d) Centre of the circle lies on $12x - 16y + 31 = 0$

7. The lines $(m-2)x + (2m-5)y = 0$; $(m-1)x + (m^2-7)y - 5 = 0$ and $x + y - 1 = 0$ are

a) Concurrent for three values of 'm' b) Concurrent for one value of 'm'

c) Concurrent for no value of 'm' d) are parallel for $m = 3$

8. If $x^2 + 2hxy + y^2 = 0$ ($h \neq 1$) represents the equations of the straight lines through the origin which make an angles α with the straight line $y + x = 0$, then

a) $\sec 2\alpha = h$ b) $\cos\alpha = \sqrt{\frac{1+h}{2h}}$

c) $m_1 + m_2 = -2\sec 2\alpha$ d) $\cot\alpha = \sqrt{\frac{h+1}{h-1}}$

9. The equation of the line passing through (2, 3) and making an intercept of 2 units between the lines $y + 2x = 5$ And $y + 2x = 3$ is

a) $5x - 4y + 2 = 0$ b) $3x + 4y = 18$

c) $x = 2$ d) $y = 3$

10. The equation of the diagonal of the square formed by the pairs of lines $xy + 4x - 3y - 12 = 0$ and $xy - 3x + 4y - 12 = 0$ is

a) $x - y = 0$ b) $x + y + 1 = 0$

c) $x + y = 0$ d) $x - y + 1 = 0$

SECTION II (Matrix Match Type)

Section II consists of 2 matrix match type questions in which each row have one or more than one match. Each question carries 2 marks for each correct row and 0 marks for incorrect response. No negative marking.

1. Match the following Column I with Column II

	Column -I		Column-II
A)	The distance between the lines $(x + 7y)^2 + 4\sqrt{2}(x + 7y) - 42 = 0$ is	P)	2
B)	If the sum of the distance of a point from two perpendicular lines in plane is 1, then its locus is $\|x\| + \|y\| = k$, where k is equal to	Q)	7
C)	If $6x + 6y + m = 0$ is acute angle bisector of lines $x + 2y + 4 = 0$ and $4x + 2y - 1 = 0$, then m is equal to	R)	3
D)	Area of the triangle formed by the lines $y^2 - 9xy + 18x^2 = 0$ and $y = 6$ is	S)	1

2. Match the following:

	Column -I		Column-II
A)	The value of k for which $4x^2 + 8xy + ky^2 = 9$ is the equation of pair of straight lines, is	P)	3
B)	If the sum of the slopes of the lines given by $x^2 - 2Cxy - 7y^2 = 0$ is four times their product, then the value of C is	Q)	–3
C)	If the gradient of one of the lines $x^2 + hxy + 2y^2 = 0$ is twice that of the other, then h =	R)	2
D)	If the lines $ax^2 + 2hxy + by^2 = 0$ are equally inclined to the lines $ax^2 + 2hxy + by^2 + \lambda(x^2 + y^2) = 0$, then the value of λ can be	S)	4

SECTION III (Integer Type)

Section III consists of 8 Integer type questions. Each is allotted +4 marks for correct response and 0 marks for incorrect response.

1. If the line $3x - 4y - 8 = 0$ divides the circumference of the circle with centre (2, -3) in the ratio 1 : 2, then the radius of the circle is

2. If two circles each of unit radius intersect orthogonally. The common area of the circles is $\frac{\pi}{\lambda}-1$. Then the value of λ =

3. For the circle $x^2 + y^2 = r^2$, the value of r for which the area enclosed by the tangents drawn from the point P(6, 8) to the circle and the chord of contact is maximum, is

4. Tangents are drawn to the circle $x^2 + y^2 = 1$ at the points where it is met by the circles $x^2 + y^2 - (\lambda + 6)x + (8 - 2\lambda)y - 3 = 0$, λ being parameter. The locus of point intersection of these tangents is $px + qx + 10 = 0$, then $p + q$ =

5. If the radius of circumcircle of the ΔTPQ where PQ is chord of contact corresponding to point T with respect to circle $x^2 + y^2 - 2x + 4y - 11 = 0$ is 6 units. Then the minimum distance of T from the director circle of the given circle is $12 - 4\sqrt{K} \Rightarrow K =$

6. In a ΔABC, AB is parallel to y-axis, BC is parallel to x-axis, centroid is at(2, 1). If median through C is $x - y = 1$, then the slope of median through A is

7. If the orthocenter of the triangle formed by $2x + 3y - 1 = 0$, $x + 2y - 1 = 0$, $ax + by - 1 = 0$ is at the origin then $\frac{b-a}{4} =$

8. The area of the rhombus ABCD is 24. The equation of the diagonal BD is $4x + 3y + 2 = 0$ and A = (3, 2). The length of the side of the rhombus is