FIITJEE Phase Test (JEE-Advanced)

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - CPT-1 | **QP Code: 100177** | **PAPER - 1**

Time Allotted: 3 Hours **Maximum Marks: 183**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections**.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Two Parts**: **Part-A & B** in the OMR.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. 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 HB pencil 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.

C. Marking Scheme For All Two Parts.

(i) **Part-A (01-07) –** Contains seven (07) multiple choice questions which have **One or More** correct answer.
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.

(i) **Part-A (08-13) –** Contains six (06) multiple choice questions which have ONLY ONE CORRECT answer Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.

(ii) **Part-B (01-05)** contains five (05) Numerical based questions, the answer of which maybe positive or negative numbers or decimals to **Two decimal Places** (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+3 marks** for correct answer and **there will be no negative marking.**

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

BATCH – NWCM2125O1S_PT-1

SECTION-1 : PHYSICS

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. A man who can swim at a speed v relative to the water wants to cross a river of width d, flowing with a speed u. The point opposite him across the river is P.

   (A) The minimum time in which he can cross the river is $\frac{d}{v}$.

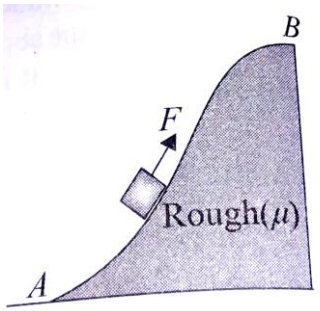
   (B) He can reach the point P in time $\frac{d}{v}$.

   (C) He can reach the point P in time $\frac{d}{\sqrt{v^2 - u^2}}$

   (D) He cannot reach P if u > v.

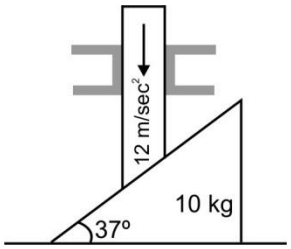
2. A body of mass M was slowly hauled up the rough hill by a force F which at each point was directed along a tangent to the hill. Work done by the force

   (A) is independent of shape of trajectory.
   (B) depends upon vertical component of displacement but independent of horizontal component.
   (C) depends upon both the horizontal and vertical components of total displacement.
   (D) does not depend upon coefficient of friction.



3. In the system as shown in figure, all the surfaces are smooth. Rod of mass 5 kg is moved by external agent with acceleration 12 m/sec^2 vertically downwards then

   (A) Acceleration of 10 kg wedge is 10 m/sec^2
   (B) Acceleration of 10 kg wedge 16 m/sec^2
   (C) The force exerted by rod on the wedge is 100 N
   (D) The force exerted by rod on the wedge is $\frac{800}{3}$ N



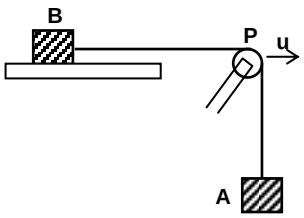
4. There are three vectors $\vec{P}, \vec{Q}$ and $\vec{R}$. The angle between $\vec{P}$ and $\vec{Q}$ is 60º and $\vec{R}$ is perpendicular to the plane containing the vectors $\vec{P}$ and $\vec{Q}$. Which of the following relation is possibly correct ?

   (A) $\vec{P}+\vec{Q}+\vec{R}=0$ (B) $\vec{P}\times\vec{Q}=\vec{R}$

   (C) $\vec{P}\times\vec{R}=\vec{Q}$ (D) All of these

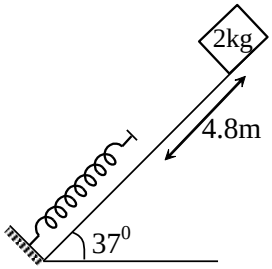
Space For Rough Work

5. In the figure, the pulley P moves to the right with a constant speed u. The downward speed of A is v_A, and the speed of B to the right is v_B.



(A) $v_B = v_A$
(B) $v_B = u + v_A$
(C) $v_B + u = v_A$
(D) The two block have acceleration of the same magnitude.

6. Figure shows a massless spring fixed at the bottom end of an inclined of inclination 37^0 ($\tan 37^0 = 3/4$). A small block of mass 2 kg start slipping down the incline from a point 4.8 m away from free end of spring. The block compresses the spring by 20 cm, stops momentarity and then rebounds through a distance 1 m up the inclined, then ($g = 10\ m/s^2$)



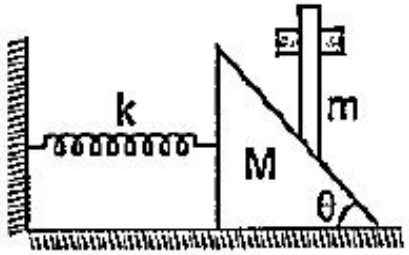
(A) coefficient of friction between block and inclined is 0.5.

(B) coefficient of friction between block and inclined is 0.75.

(C) value of spring constant is 1000 N/m.

(D) value of spring constant is 2000 N/m.

7. A wedge of mass M fitted with a spring of stiffness 'k' is kept on a smooth horizontal surface. A rod of mass m is kept on the wedge as shown in figure. System is in equilibrium. Assuming that all surfaces are smooth the potential energy stored in the spring is

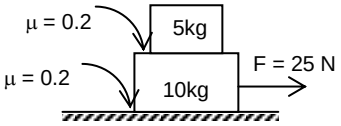


(A) $\frac{mg^2\tan^2\theta}{2K}$ (B) $\frac{m^2g\tan^2\theta}{2K}$ (C) $\frac{m^2g^2\tan^2\theta}{2K}$ (D) $\frac{m^2g^2\tan^2\theta}{K}$

(Single Correct Choice Type)

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

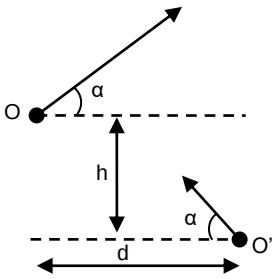
8. Two blocks of masses 10 kg and 5 kg are placed one over the other on a horizontal plane as shown in the figure. If co-efficient of friction is $\mu = 0.2$, and an external force F = 25 N is applied horizontally on the lower blocks, then, the force of friction between the two blocks is



(A) 30 N (B) 25 N
(C) zero (D) 20 N

Space For Rough Work

9. Two particles are projected simultaneously from two points, O and O' such that d is the horizontal distance and h is the vertical distance between them. They are projected at the same inclination α to the horizontal with the same speed v. The time after which their separation becomes minimum is

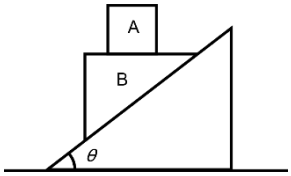


(A) d/(v cos α) (B) 2d/(v cos α)
(C) d/(2v cos α) (D) d/v

10. The work done on a particle of mass m by a force $k\left[\frac{-y}{\left(x^2+y^2\right)^{3/2}}\hat{i}+\frac{x}{\left(x^2+y^2\right)^{3/2}}\hat{j}\right]$. k being a constant of appropriate dimensions, when the particle is taken from the point (a, 0) to (0, a) along a circular path of radius a (1st quadrant) about the origin in the x – y plane is

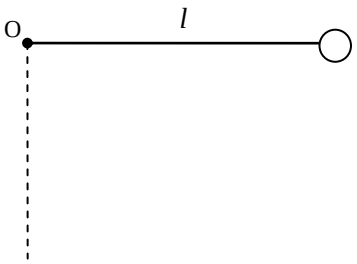
(A) $\frac{2k\pi}{a}$ (B) $\frac{k\pi}{a}$ (C) $\frac{k\pi}{2a}$ (D) 0

11. The coefficient of friction between the block A of mass m and block B of mass $2m$ is $\mu=\frac{1}{\sqrt{3}}$. The inclined plane is smooth. If the system of blocks A and B is released from rest and there is no slipping between A and B, then $\theta \le \frac{\pi}{\alpha}$. Find the value of α.



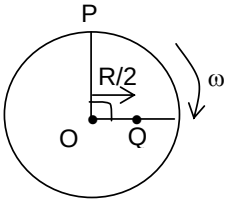
(A) 2 (B) 4
(C) 6 (D) 7

12. A particle is attached to one end of a string whose other end is fixed at point 'O' in the vertical plane. The particle is released from rest when the string is horizontal. Then, the angle made by the string with the vertical when the net acceleration of particle is horizontal



(A) $\tan^{-1}\left(\sqrt{2}\right)$ (B) $\tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$
(C) $\tan^{-1}\left(2\right)$ (D) $\tan^{-1}\left(\frac{1}{2}\right)$

13. A circular disc of radius R is rotating about its axis through O with a uniform angular velocity ω rad/s as shown in the figure. P and Q are two points on the disc. At any instant of time the magnitude of the relative velocity of P with respect to Q is

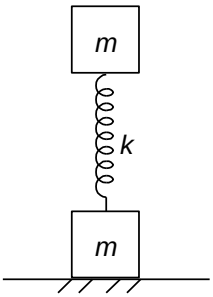


(A) 0 (B) $\frac{R\omega}{2}$
(C) $\sqrt{3}\frac{R\omega}{2}$ (D) $\frac{\sqrt{5}R\omega}{2}$

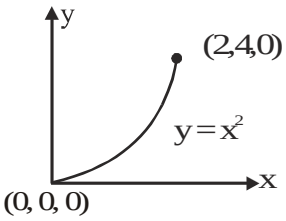
Space For Rough Work

PART – B
(Numerical based)

1. A system consists of two identical slabs each of mass *m* linked by compressed weightless spring of stiffness *k* as shown in Figure. The slabs are also connected by a thread, which is burnt at a certain moment. If the value of $\Delta\ell$ the initial compression of spring, the lower slab will bounce up after the thread is burned through is $\frac{x\,mg}{k}$, then find the value of 'x'.

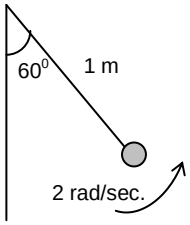


2. A force $\vec{F}=(3xy-5z)\hat{j}+4z\hat{k}$ is applied on a particle. The work done by the force when the particle moves from the point (0,0,0) to the point (2,4,0) as shown in the figure is _____ units.

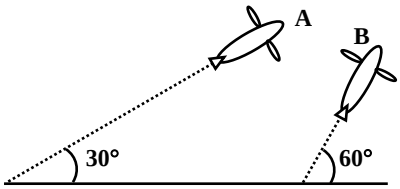


3. The potential energy of a particle is determined by the expression U = α ($x^2 + y^2$), where α is a positive constant. The particle begins to move from a point with the coordinates (3, 3) (m), only under the action of potential field force. The kinetic energy of the particle at the point (1, 1) (m) is n α, then 'n' is

4. A simple pendulum of mass 0.5 kg, during its swing in the vertical plane, is observed to have an angular velocity of 2 rad/s in the position shown. The instantaneous tension in the string is given by _____ (take g = 10 m/s^2)



5. Airplanes A and B are flying with constant velocity in the same vertical plane at angles 30° and 60° with respect to the horizontal respectively as shown in the figure. The speed of A is $100\sqrt{3}$ ms^{-1}. At time t = 0 s, an observer in A finds B at a distance of 500 m. This observer sees B moving with a constant velocity perpendicular to the line of motion of A. If at t = t_0, A just escapes being hit by B, t_0 in seconds is



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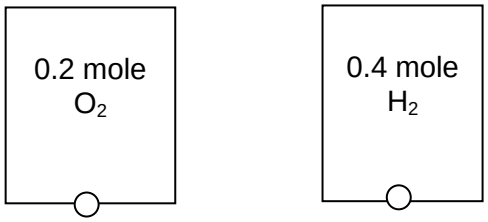
SECTION-2 : CHEMISTRY

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. 

V = 2 L T = 300 K V = 2 L T = 300 K

Choose correct statement(s)
(A) the ratio of the relative rate of effusion of O_2 : H_2 is 1 : 8.
(B) if 20 mL of O_2 effuses in 10 sec, then 30 mL of H_2 will effuse in 7.5 sec.
(C) the ratio of pressures of the gases in the two closed containers is 1 : 2.
(D) the rms velocity of H_2 will be higher than that of O_2.

2. One litre solution contains x g of NaOH and y g of Na_2CO_3. 100 mL of the solution requires 10 mL of 2 M HCl for titration in presence of phenolphthalein indicator. In another container, 100 mL of the original solution requires 10 mL of 3 M HCl solution for titration in presence of methyl orange indicator.
Choose correct statement(s)
(A) the value of x is 4
(B) the value of y is 10.6
(C) CO_2 gas is formed during titration in presence of phenolphthalein indicator
(D) this type of titration is called back titration

3. The most probable velocity of ideal gases depends on
(A) temperature (B) molecular mass
(C) intermolecular force of attraction (D) collision

4. In which option(s), the dipole moment of the left side molecule is higher than that of right side molecule according to VBT?
(A) NH_3, NF_3 (B) PF_3Cl_2 and PF_2Cl_3
(C) CO_2, CO (D) SO_2, SO_3

Space For Rough Work

5. The value of the successive ionization energies of a second period element(X) are 2.8, 4.2, 7.9, 142.2, 218.4 eV respectively. Choose correct statement(s) from the following.
(A) the principal quantum number of it's highest energetic electron is 2.
(B) it contains three valence electrons.
(C) it's atomic number is 5.
(D) it is a non-metal

6. Which is/are thermally less stable and decomposes easily than $CaCO_3$?
(A) $BeCO_3$ (B) $MgCO_3$
(C) $SrCO_3$ (D) $BaCO_3$

7. $Mg + 2H_2O \xrightarrow{\text{Heating}} (X) + H_2$

$(X) \xrightarrow{\text{Heat}} (Y) + (Z)$

The unknown compound(s) of above reaction is/are
(A) MgO (B) $Mg(OH)_2$
(C) H_2O (D) MgH_2

(Single Correct Choice Type)

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

8. One mole of CO_2 gas exerts one bar pressure if it is enclosed in a container of 22.4 L volume at 273 K. What is the compressibility factor(Z) of the gas?
(A) Z > 1 (B) Z < 1
(C) Z = 1 (D) Z >>1

9. The electronegativity order of N, O, F and C is
(A) C > N > O > F (B) F > O > N > C
(C) F > O > C > N (D) F > N > O > C

10. Which statement is not correct for PCl_5?
(A) The axial bonds are longer than equatorial bonds.
(B) The bond angles observed in the molecule are 120°, 180° and 90°.
(C) Two molecules of PCl_5 can split into PCl_4^+ and PCl_6^- ions
(D) It has octahedral geometry.

Space For Rough Work

11. Which statement(s) is/are correct for a sub-shell which quantum numbers are n = 4, ℓ =1?
(I) It contains three orbitals having dumb-bell shape.
(II) It can hold a maximum of six electrons.
(III) The value of one of it's magnetic quantum number if -2.
(IV) The orbitals orient in between the Cartesian axes X, Y & Z
(A) I, II (B) II, III
(C) I, II, III (D) II, IV

12. What is the wavelength of the second line of Balmer series in hydrogen spectrum? [R = Rydberg constant]
(A) $\frac{48}{R}$ (B) $\frac{R}{48}$
(C) $\frac{16}{3R}$ (D) $\frac{3R}{16}$

13. $MnO_4^- + Fe_2\left(C_2O_4\right)_3 + H^+ \longrightarrow Mn^{2+} + Fe^{3+} + CO_2 + H_2O$
What is the n-factor of $Fe_2(C_2O_4)_3$ in above reaction?
(A) 3 (B) 6
(C) 9 (D) 12

PART – B
(Numerical based)

1. What is the wavelength of a sub-atomic particle in $\overset{o}{A}$ unit, when it moves with a velocity of 2.2×10^7 ms^{-1}. The mass of the particle is 2×10^{-31} Kg.
[h = 6.6×10^{-34} js]

2. For a real gas, the difference between PV and RT, i.e. PV – RT = 120 at extremely high pressure of 100 atm. What is the value of 'b'(van der Waal's constant) in L mol^{-1} unit?

3. How many moles of HCl is required for reaction with 0.5 mole of Na_2CO_3 and 0.5 mole NaOH in presence of methyl orange indicator?

4. 14 g of a metal oxide of formula MO is added to a container containing 500 mL of 1.25 M HCl solution. After complete reaction, the reaction mixture is treated with 250 mL of 0.5 M NaOH to neutralize the excess acid. If the atomic mass of M is expressed as (2x + 15). What is x?

5. The successive ionization energies of a s-block element are
8.6, 12.9, 1630.2, 2406.2 eV, etc
If atomic mass of the elements is 39.8 g mol^{-1}, what will be the molar mass of it's normal oxide?

Space For Rough Work

SECTION-3 : MATHEMATICS

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Point M moves on the circle $(x-4)^2+(y-8)^2=20$. Then it broke away from it and moving along a tangent to the circle, cuts the x – axis at the point (–2, 0). The coordinates of a point on the circle at which the moving point broke away is:

   (A) $\left(-\frac{3}{5}, \frac{46}{5}\right)$ (B) $\left(-\frac{2}{5}, \frac{44}{5}\right)$

   (C) $(6, 4)$ (D) $(3, 5)$

2. $\int \frac{\cos 2x}{\cos^2 x \sin^2 x}dx =$

   (A) $-\tan x-\cot x+c$ (B) $\tan x+\cot x+c$

   (C) $-2\operatorname{cosec} 2x+c$ (D) $2\sec 2x+c$

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 $9x^2+72x-2011=0$. Then the points $A(x_1,y_2)B(x_2,y_2)$ 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. If $27\sin^3 9^o+9\sin^3 27^o+3\sin^3 81^o+\sin^3 243^o=\alpha\sin\beta^o$ where β is an acute angle then

   (A) $\alpha+\beta=29$ (B) $\alpha+2\beta=38$

   (C) $2\alpha+\beta=49$ (D) $2\alpha+\beta=29$

5. If $x^2-2a|x-a|-3a^2=0;\ a<0$ then $\frac{x}{a}=$

   (A) $1+\sqrt{2}$ (B) $\sqrt{6}-1$

   (C) $1-\sqrt{2}$ (D) $1+\sqrt{6}$

Space For Rough Work

6. Tangents PA and PB are drawn to the circle $S = x^2 + y^2 - 2y - 3 = 0$ from the point P(3, 4). Which of the following alternative(s) is/are correct?
(A) The power of point P (3, 4) with respect to circle S = 10 is 14.
(B) The angle between tangents from P (3, 4) to the circle S = 0 is $\frac{\pi}{3}$
(C) The equation of circum circle of ΔPAB is $x^2 + y^2 - 3x - 5y + 4 = 0$
(D) The area of quadrilateral PACB is $3\sqrt{7}$ square units where C is the centre of circle S = 0.

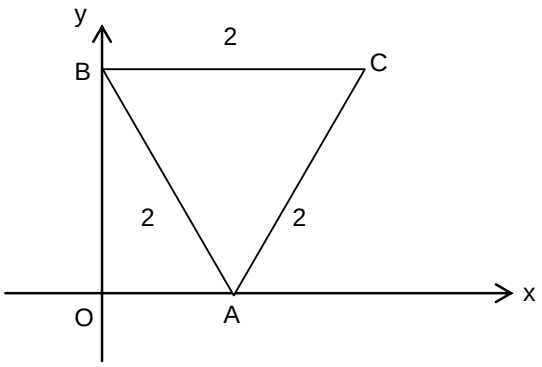
7. If $\alpha = \frac{\pi}{7}$ which of the following hold(s) good?
(A) $\tan\alpha.\tan2\alpha.\tan3\alpha = \tan3\alpha - \tan2\alpha - \tan\alpha$
(B) $\operatorname{cosec}\alpha = \operatorname{cosec}2\alpha + \operatorname{cosec}4\alpha$
(C) $\cos\alpha - \cos2\alpha + \cos3\alpha$ has the value equal to $\frac{1}{2}$
(D) $8\cos\alpha.\cos2\alpha.\cos4\alpha$ has the value of equal to 1.

(Single Correct Choice Type)

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

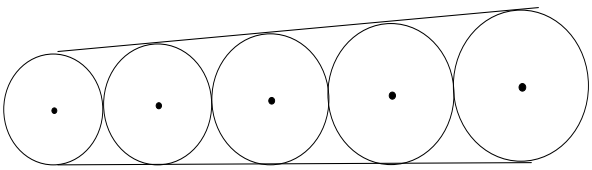
8. Let (x_0, y_0) be the solution of the following equations:
$(2x)^{\ln 2} = (3y)^{\ln 3}$
$3^{\ln x} = 2^{\ln y}$
Then x_0 equals
(A) $\frac{1}{6}$ (B) $\frac{1}{3}$ (C) $\frac{1}{2}$ (D) 0

9. Adjacent figure represents a equilateral triangle ABC, of side length 2 units. Locus of vertex C as the side AB slides along the coordinate axes is:
(A) $x^2 + y^2 - xy + 1 = 0$
(B) $x^2 + y^2 + xy\sqrt{3} = 1$
(C) $x^2 + y^2 = 1 + xy\sqrt{3}$
(D) $x^2 + y^2 - xy\sqrt{3} + 1 = 0$



Space For Rough Work

10. As shown in the figure, the five circles are tangent to one another consecutively and to the lines L_1 and L_2. If the radius of the largest circle is 18 and that of the smaller one is 8, then find the radius of the middle circle is



(A)10
(B) 12
(C) 14
(D) 16

11. If $4a^2 - 5b^2 + 6a + 1 = 0$ and the line $ax + by + 1 = 0$ touches a fixed circle, then:

(A) centre of circle is at (5, 0)
(B) the radius of cir circle is $\sqrt{5}$
(C) the radius of circle is $\sqrt{3}$
(D) the circle passes through (0, 1)

12. Tangents are drawn from any point on the circle $x^2 + y^2 = R^2$ to the circle $x^2 + y^2 = r^2$ .if the line joining the points of intersection of these tangents with the first circle also touch the second, Then R equals

(A) $\sqrt{2r}$
(B) $2r$
(C) $\frac{2r}{2-\sqrt{3}}$
(D) $\frac{4r}{3-\sqrt{5}}$

13. The maximum value of f(x), where $f(x) = (\sin x + 1)(\cos x + 1)$ is given by

(A) $\frac{\left(\sqrt{3}+1\right)^2}{2}$
(B) $\frac{\left(\sqrt{2}-1\right)^2}{2}$
(C) $\frac{\left(\sqrt{3}-1\right)^2}{2}$
(D) $\frac{\left(\sqrt{2}+1\right)^2}{2}$

Space For Rough Work

PART – B
(Numerical based)

1. The value of $\frac{\sin 1^\circ + \sin 3^\circ + \sin 5^\circ + \sin 7^\circ}{16 \cos 1^\circ . \cos 2^\circ . \sin 4^\circ}$ is_____.

2. A triangle has two of its sides along the axes, its third side touches the circle $x^2 + y^2 - 2ax - 2ay + a^2 = 0$ where a > 0. If the locus of the circumcentre of the triangle passes through the point (38, – 37) then $a^2 - 2a$ gives remainder when divided by 11 is __

3. If $y = \frac{3 + 2x}{3 - 2x}$ then $\frac{dy}{dx}$ at x = 3 is _____

4. Exact value of $\sec 10^o - \tan 10^o - \tan 40^o + 1$ is equal to _____

5. If $\log_{10} \sin x + \log_{10} \cos x = -1$ and $\log_{10} (\sin x + \cos x) = \frac{\log_{10} n - 1}{2}$, then the value of $\frac{n}{15}$ is equal to

Space For Rough Work

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QP Code: 100177

ANSWERS

SECTION-1 : PHYSICS

PART – A

1.	ACD	2.	AC	3.	BD	4.	B
5.	BD	6.	AC	7.	C	8.	C
9.	C	10.	C	11.	C	12.	A
13.	D						

PART – B

1.	3	2.	38.4	3.	16	4	4.50
5.	5						

SECTION – 2 : CHEMISTRY

PART – A

1.	ABCD	2.	AB	3.	AB	4.	ABD
5.	ABCD	6.	AB	7.	ABC	8.	C
9.	B	10.	D	11.	A	12.	C
13.	B						

PART – B

1.	1.5	2.	1.2	3.	1.5	4.	12.5
5.	55.8						

SECTION – 3 : MATHEMATICS

PART – A

1.	BC	2	AC	3.	AD	4.	ABC
5.	BC	6.	AC	7.	ABC	8.	C
9.	C	10.	B	11.	B	12.	B
13.	D						

PART – B

1.	0.25	2.	7	3.	1.33	4.	1.00
5.	0.80						