FIITJEE RET – 1

(2017 – 2019)(2ND YEAR_CHAMPIONS)

IIT-2014 (P1)

DATE: 11.06.2018

Time: 3 hours **Maximum Marks: 180**

INSTRUCTIONS:

A. General

1. This booklet is your Question Paper containing 60 questions.
2. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
3. Fill in the boxes provided for Name and Enrolment No.
4. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
5. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

B. Filling in the OMR:

6. The instructions for the OMR sheet are given on the OMR itself.

C. Question paper format:

7. The question paper consists of **3 parts (Physics, Chemistry and Mathematics)**. Each part consists of **two sections**.
8. **Section I** contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.
9. **Section II** contains **10 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

D. Marking Scheme

10. For each question in **Section I**, you will be awarded **3 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answers in this section.
11. For each question in **Section II**, you will be awarded **3 marks** if you darken the bubble corresponding to the correct answer **ONLY.** In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answers in this section.

Don't write / mark your answers in this question booklet.
If you mark the answers in question booklet, you will not be allowed to continue the exam.

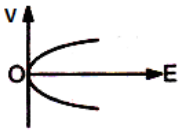
NAME: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

ENROLLMENT NO.: ☐☐☐☐☐☐☐☐☐☐

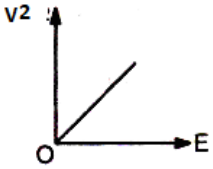
PAPER–I
PART I: PHYSICS
SECTION – I: (One or more than one options are correct)

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

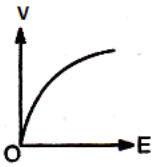
1 . If at distance r from a positively charged particle, electric field strength and potential are E and V respectively, which of the following graph is / are correct ?



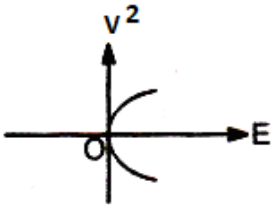
(A)



(B)

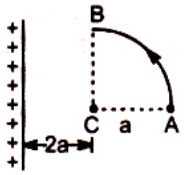


(C)



(D)

2. An arc AB with the centre C and an infinitely long wire having linear charge density λ are lying in the same plane. The minimum amount of work to be done to move a point charge q_0 from point A to B through a circular path AB of radius a is equal to :

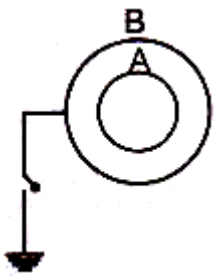


(A) $\frac{q_0^2}{2\pi\varepsilon_0}\log\left(\frac{2}{3}\right)$ (B) $\frac{q_0\lambda}{2\pi\varepsilon_0}\log\left(\frac{3}{2}\right)$

(C) $\frac{q_0\lambda}{2\pi\varepsilon_0}\log\left(\frac{2}{3}\right)$ (D) $\frac{q_0\lambda}{\sqrt{2}\pi\varepsilon_0}$

Space for rough work

3. Two concentric shells have radii R and 2R, charges q_A and q_B and potential 2V and $\left(\frac{3}{2}\right)V$ respectively. Now shell B is earthed and let charges on them become q_A' & q_B'. Then.



(A) $\frac{q_A}{q_B}=\frac{1}{2}$ (B) $\frac{q_A'}{q_B'}=1$

(C) Potential of A after earthing becomes $\left(\frac{3}{2}\right)V$

(D) Potential difference between A and B after earthing becomes $\frac{V}{2}$

4. A ring of radius R is made out of a thin metallic wire of area of cross section A. The ring has a uniform charge Q distributed on it. A charge q_0 is placed at the centre of the ring. If Y is the Young's modulus for the material of the ring and ΔR is the change in the radius of the ring then :

(A) $\Delta R=\frac{q_0Q}{4\pi\varepsilon_0RAY}$ (B) $\Delta R=\frac{q_0Q}{4\pi^2\varepsilon_0RAY}$

(C) $\Delta R=\frac{q_0Q}{8\pi^2\varepsilon_0^2RAY}$ (D) $\Delta R=\frac{q_0Q}{8\pi\varepsilon_0RAY}$

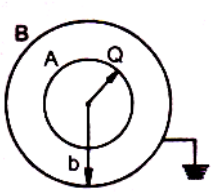
5. A charge Q is uniformly distributed over a circular annulus of inner radius 'a' and outer radius 'b'. Taking potential at infinity to be zero, the potential at the centre of the annulus will be given by.

(A) $\frac{Q}{4\pi\varepsilon_0b}$ (B) $\frac{Q}{4\pi\varepsilon_0a}$ (C) $\frac{Q}{2\pi\varepsilon_0(b-a)}$ (D) $\frac{Q}{2\pi\varepsilon_0(b+a)}$

6. If the flux of the electric field through a closed surface is zero.
(A) the electric field must be zero every where on the surface
(B) the electric field may be zero every where on the surface
(C) the charge inside the surface must be zero
(D) the charge in the vicinity of the surface must be zero.

Space for rough work

7. A conducting sphere A of radius a, with charge Q is placed concentrically inside a conducting shell B of radius b .B is earthed C is the common centre of the A and B.



(A) The field is a distance r from C, Where $a \le r \le b$ is $\frac{1}{4\pi\varepsilon_0 r^2}\frac{Q}{r^2}$

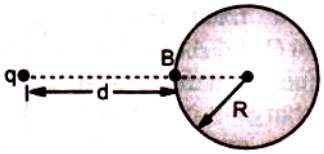
(B) The potential at a distance r from C, where $a \le r \le b$ is $\frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$

(C) The potential difference between A and B is $\frac{1}{4\pi\varepsilon_0}Q\left(\frac{1}{a}-\frac{1}{b}\right)$

(D) The potential at a distance r from C, where $a \le r \le b$, $\frac{1}{4\pi\varepsilon_0}Q\left(\frac{1}{r}-\frac{1}{b}\right)$

8. Select the correct statements w.r.t electric field intensity due to various charge configuration.
(A) $\vec{E}$ due to discrete point charge in not defined at the location of discrete point charge.
(B) $\vec{E}$ due to volume charge distribution can be defined at any point.
(C) $\vec{E}$ due to surface charge distribution is discontinuous at surface.
(D) $\vec{E}$ due to line charge distribution is not defined at any point on line charge itself.

9. For the situation shown in the figure, select the correct statement(s):



(A) Potential of the conductor is $\frac{q}{4\pi\varepsilon_0(d+R)}$

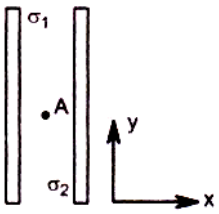
(B) Potential of the conductor is $\frac{q}{4\pi\varepsilon_0 d}$

(C) Potential of the conductor can't be determined as nature of distribution of induced charges is not known.

(D) Potential at point B due to induced charges is $\frac{-qR}{4\pi\varepsilon_0(d+R)d}$

Space for rough work

10. Two large conducting sheets are kept parallel to each other as shown in fig. In equilibrium, the charge density on facing surfaces is σ_1 and σ_2. What is the value of electric field at A:



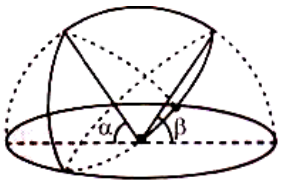
(A) $\frac{\sigma_1 \hat{i}}{\varepsilon_0}$ (B) $-\frac{\sigma_2}{\varepsilon_0} i$

(C) $\frac{\sigma_1 + \sigma_2}{2\varepsilon_0} i$ (D) $\frac{\sigma_1 - \sigma_2}{2\varepsilon_0} i$

SECTION – II: (Integer value type)

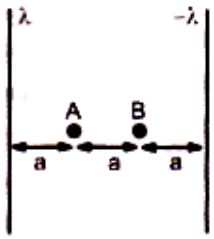
This section contains **10 questions.** The answer to each of the questions is a **single digit integer**, ranging from 0 to 9 (both inclusive).

11. The electric field intensity at the centre of uniformly charged hemispherical shell is E_0. Now two portions of the hemispherical are cut from either side and remaining portion is shown in figure. IF $\alpha = \beta = \frac{\pi}{3}$, if field intensity due to remaining portion at centre is $\frac{E_0}{n}$ then n is



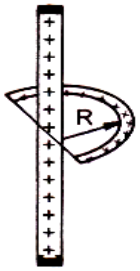
12. A very long uniformly charged circular cylinder (radius R) has a surface charge density σ. A very long uniformly charged line charge (linear charge density λ) is placed along the cylinder axis. If electric field intensity vector outside the cylinder is zero, for $\lambda = -n\pi R\sigma$, then n =

13. Between two infinitely long wires having linear charge densities λ and $-\lambda$ there are two points A and B as shown in the figure. If the amount of work done by the electric field in moving a point charge q_0 from A to B is equal to $\frac{\lambda q_0}{\pi \in_0} \log[k]$, then k is

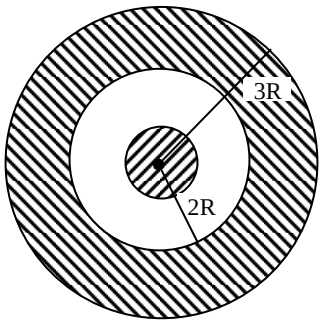


Space for rough work

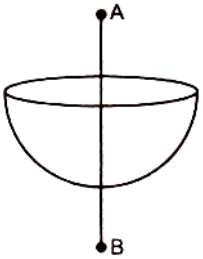
14. The force experienced by the semicircular rod charged with a charge q, placed as shown in figure is $\frac{\lambda q}{n\pi^2\varepsilon_0 R}$. Radius of the wire is R and the line of charge with linear charge density λ is passing through its centre and perpendicular to the plane of wire. Value of n is



15. A metal ball of radius R is placed concentrically inside a hollow metal sphere of inner radius 2R and outer radius 3R. The ball is given a charge +2Q and the hollow sphere a total charge –Q. The electrostatic potential energy of this system is $\frac{5Q^2}{6n\pi\varepsilon_0 R}$. The value of 'n' is



16. The diagram shows a uniformly charged hemisphere of radius r. It has volume charge density ρ. If the electric field at a point 2 R distance above its centre is E then the electric field at the point which is 2R below its centre is $\frac{\rho R}{2n\varepsilon_0} - E$. Then 'n' is

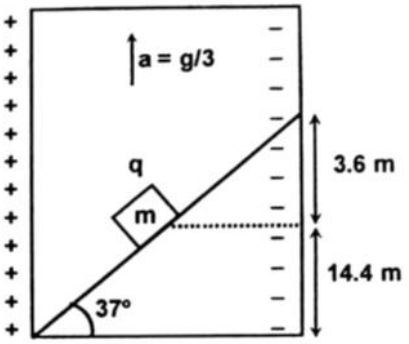


17. A charged particle having some mass is resting in equilibrium at a height H above the centre of a uniformly charged non – conducting horizontal ring of radius R. The force of gravity acts downwards. The equilibrium of the particle will be stable, for only if $H > \frac{R}{\sqrt{n}}$. Then value of 'n' is

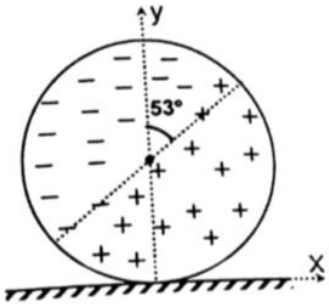
18. There are four concentric shells, A,B,C and D of radii a , 2a and 4a respectively. shells A and B are given charges +q and –q respectively. Shell C is now earthed. The potential difference $V_A - V_C$ is $\frac{kq}{na}$. Then value of 'n' is

Space for rough work

19. A small block of mass ' m' is kept on the smooth inclined plane of angle 37^0, placed in an elevator going upward with acceleration $a = \frac{g}{3}$, as shown in the figure. A horizontal electric field E perpendicular to the left and right vertical wall of the elevator exists. The charge on the block is +q. Find the time (in sec) when the block collide with the vertical wall. $\left(\text{take } g = 10 m/s^2 \text{ and } \frac{qE}{m} = 25 m/s^2\right)$



20. A non conducting solid sphere of mass m and radius R having uniform charge density $+\rho$ and $-\rho$ as shown in figure. It is then placed on a rough non conducting horizontal plane . At t =0 a uniform electric field $\vec{E} = E_0\hat{i}\ N/C$ is switched on and the solid sphere starts rolling without sliding. The magnitude of frictional force at t= 0 is $\frac{2\rho\pi R^3 E_0}{K}$. Find the value of K

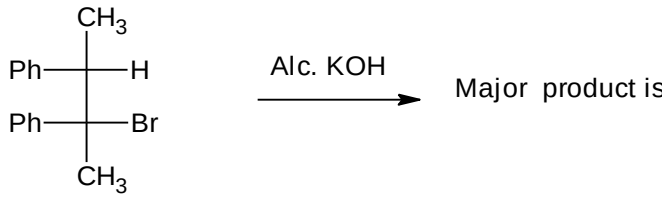


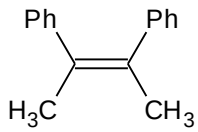
PART II: CHEMISTRY

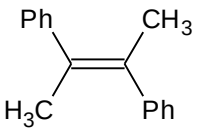
SECTION – I: (One or more than one options are correct)

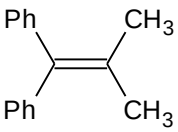
This section contains **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE THAN ONE** are correct.

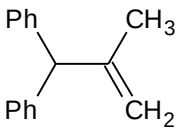
21.



(A) 

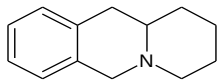
(B) 

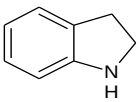
(C) 

(D) 

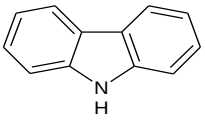
Space for rough work

22. Which of the following compounds, cannot undergo complete Hoffman exhaustive methylation (formation of alkene and removal of N – atom as trimethyl amine)


(A)


(B)

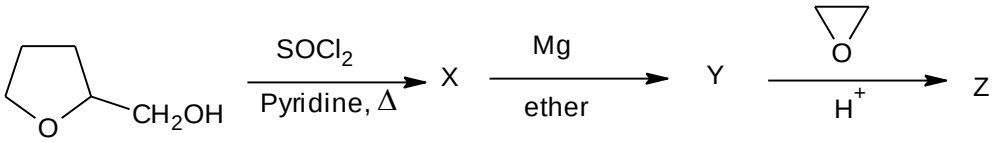

(C)


(D)

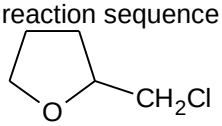
23. Epoxides react with Grignard reagent to form
(A) 1^o alcohols (B) 2^o alcohols (C) 3^o alcohols (D) Any of these

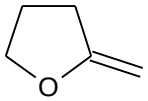
24. $CH_3–C\equiv N \xrightarrow[2)\ H_2O/H^+]{1)\ CH_3MgBr} X \xrightarrow{CHCl_3} Y$. Regarding 'Y' incorrect statement is
(A) It is used as hypnotic drug
(B) Its IUPAC name is 1, 1, 1–trichloro 2–methyl propan–2–ol
(C) It is optical active (D) X is an alcohol

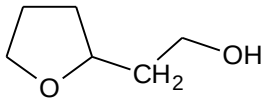
25.

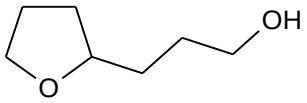


In above reaction sequence what are X and Z

(A) 

(B) 

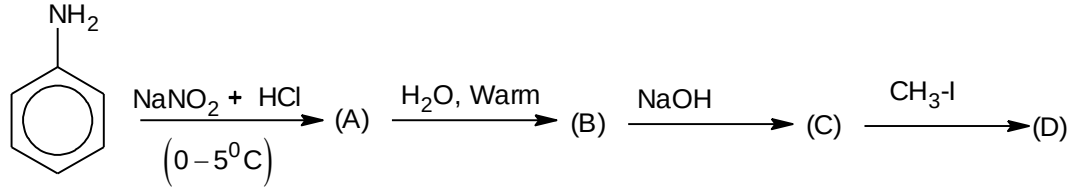
(C) 

(D) 

26. 2–Phenylbutanol–2–can be prepared by which of the following combinations ?
(A) $C_6H_5COCH_3 + C_2H_5MgBr$ (B) $C_2H_5COCH_3 + C_6H_5MgBr$
(C) $C_6H_5COC_2H_5 + CH_3MgBr$ (D) $C_6H_5COC_6H_5 + C_2H_5MgBr$

Space for rough work

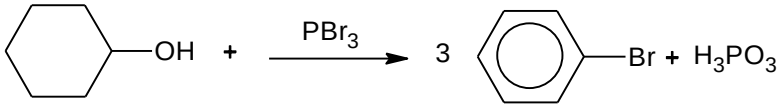
27. Identify the incorrect statement.

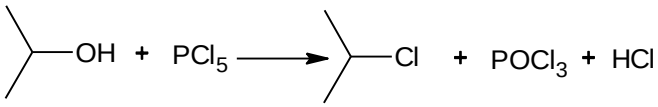


(A) The product (D) is an ether
(B) The product (D) gives CO_2 gas on treatment with $NaHCO_3$
(C) The product (B) is more acidic than H_2CO_3
(D) The product(D) is an aryl halide

28. Identify the **CORRECT** statement among the following
(A) The rate of hydrolysis of tert–butyl chloride does not change by increasing the concentration of OH^-
(B) 1–phenylethanol reacts with thionyl chloride to give a chloro compound with almost complete retention of configuration.
(C) Polar solvents generally increase the rate of S_N1 reactions
(D) S_N2 reaction of optically active substrate leads to racemisation if the leaving group is attached to the chiral carbon.

29. Identify incorrect reaction from the following

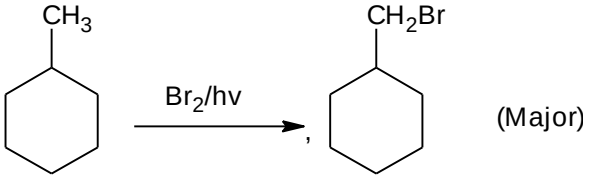
(A) 

(B) 

(C) $R-OH+\xrightarrow{SOCl_2} R-Cl+SO_2+HCl$

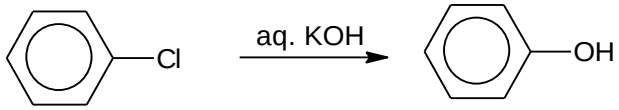
(D) $R-F+\xrightarrow{AgCl} R-Cl+AgF$

30. Which of the following reactions are not feasible ?

(A) 

(B) $CH_3-CH_2-Br\xrightarrow[DMSO]{OH^{(-)}}CH_3-CH_2-OH$

(C) $CH_2=CH-Cl\xrightarrow{aq.KOH}CH_2=CH-OH$

(D) 

Space for rough work

SECTION – II: (Integer value type)

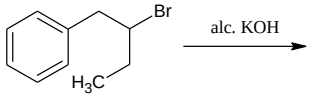
This section contains **10 questions.** The answer to each of the questions is a **single digit integer**, ranging from 0 to 9 (both inclusive).

31. $C_2H_5Br + CH_3Br \xrightarrow[\text{ether}]{Na} \text{products}$

Maximum number of hydrocarbons formed in the above reaction.

32. The number of possible enantiomeric pairs that can be produced during monochlorination of 2–methylbutane is :

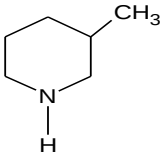
33. The compound on E_2 elimination gives 'x' number of all possible alkenes. The value of x is



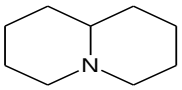
34. The maximum number of carbon atoms in the expected products of the following reaction

$CH_3CH_2Br + CH_3 - CH(CH_3) - CH_2Br \xrightarrow{Na/Ether} Product$

35. If for the two compounds given below, the number of moles of CH_3I required for complete Hoffman exhaustive methylation is x & y. What is the value of x + y?



(I)



(II)

36. $Cl-\overset{\overset{O}{\|}}{C}-O-Et \xrightarrow[(2)NH_4Cl]{(1)xRMgX} 3^0$ alcohol. Value of x is

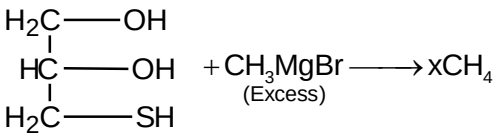
37. No. of Chiral centres in DDT

Space for rough work

38. Ethyl alcohol is treated with bleaching powder to form chloroform. The number of moles of bleaching powder consumed during the conversion of 1 mole of ethyl alcohol to chloroform is

39. Give the number of methyl ($-CH_3$) groups in the final product, C in the following reaction sequence.

$$\underset{\text{1–butanol}}{H_3CCH_2CH_2CH_2OH} \xrightarrow{H^+/\Delta} (A) \xrightarrow{HI} (B) \xrightarrow{Na/Ether} (C)$$

40. 

What is the value of 'x' in the above reaction?

PART III: MATHEMATICS

SECTION – I: (One or more than one options are correct)

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

41. The range of values of a such that angle θ between the pair of tangents drawn from (a, 0) to the circle $x^2 + y^2 = 1$ satisfies $\frac{\pi}{2} < \theta < \pi$ is

(A) (1, 2) (B) $\left(1, \sqrt{2}\right)$ (C) $\left(-\sqrt{2}, -1\right)$ (D) (–2, –1)

42. Tangents drawn from the point (α, 3) to the circle $2x^2 + 2y^2 = 25$ will be perpendicular to each other if α equals

(A) 5 (B) –4 (C) 4 (D) –5

43. $A\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ is a point on the circle $x^2 + y^2 = 1$ and B is another point on the circle such that are length AB $= \frac{\pi}{2}$ units. Then the coordinates of B can be

(A) $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ (B) $\left(-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ (C) $\left(-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right)$ (D) none of these

Space for rough work

44. Let x and y be real variables satisfying $x^2 + y^2 + 8x - 10y - 40 = 0$. 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) a . b = 73

45. Three sides of a triangle have equations $L_1 \equiv y - m_i x = 0$; i = 1, 2, and 3. Then $L_1L_2 + \lambda L_2L_3 + \mu L_3L_1 = 0$, where $\lambda \neq 0$, $\mu \neq 0$, is the equation of the circumcircle of the triangle if

(A) $1 + \lambda + \mu = m_1m_2 + \lambda m_2m_3 + \lambda m_3m_1$ (B) $m_1(1 + \mu) + m_2(1 + \lambda) + m_3(\mu + \lambda) = 0$

(C) $\frac{1}{m_3} + \frac{1}{m_1} + \frac{1}{m_2} = 1 + \lambda + \mu$ (D) none of these

46. If the equation $x^2 + y^2 + 2hxy + 2gx + 2fy + c = 0$ represents a circle, then the condition for that circle to pass through three quadrants only but not passing through the origin is

(A) $f^2 > c$ (B) $g^2 > c$ (C) $c > 0$ (D) $h = 0$

47. The coordinates of the centre of a circle, whose radius is 2 unit and which touches the line pair $x^2 - y^2 - 2x + 1 = 0$, are

(A) (4, 0) (B) $\left(1+2\sqrt{2},0\right)$ (C) (4, 1) (D) $\left(1,2\sqrt{2}\right)$

48. The equation of the chord of the circle $x^2 + y^2 - 3x - 4y - 4 = 0$, which passes through the origin such that the origin divides it in the ratio 4 : 1, is

(A) x = 0 (B) 24x + 7y = 0 (C) 7x + 24y = 0 (D) 7x – 24y = 0

49. The line 2x – y + 1 = 0 is tangent to the circle at the point (2, 5) and the centre of the circle lies on x – 2y = 4. The radius of the circle is

(A) $3\sqrt{5}$ (B) $5\sqrt{3}$ (C) $2\sqrt{5}$ (D) $5\sqrt{2}$

50. The locus of the centre of the circles such that point (2, 3) is the midpoint of the chord 5x + 2y = 16 is

(A) 2x – 5y + 11 = 0 (B) 2x + 5y – 11 = 0 (C) 2x + 5y + 11 = 0 (D) none of these

Space for rough work

SECTION – II: (Integer value type)

This section contains **10 questions.** The answer to each of the questions is a **single digit integer**, ranging from 0 to 9 (both inclusive).

51. The circle which is touched by y = x has its centre on positive direction of the x-axis and cuts off a chord of length 2 units along the line $\sqrt{3}\,y - x = 0$. The distance of the centre from the origin is

52. The number of integral values of α for which the point $(\alpha - 1, \alpha + 1)$ lies in the larger segment of the circles $x^2 + y^2 - x - y - 6 = 0$ made by the chord whose equation is $x + y - 2 = 0$ is

53. The number of integral values of k for which the circle $x^2 + y^2 - 6x - 10y + k = 0$ does not touch or intersect the coordinate axes and the point (1, 4) inside the circle is

54. Let the lines $(y - 2) = m_1(x - 5)$ and $(y + 4) = m_2(x - 3)$ intersect at right angles at P (where m_1 and m_2 are parameters). If the locus of P is $x^2 + y^2 + gx + fy + 7 = 0$, then the value of $|f + g|$ is

55. The number of points P(x, y) lying inside or on the circle $x^2 + y^2 = 9$ and satisfying the equation $\tan^4 x + \cot^4 x + 2 = 4 \sin^2 y$ is

56. If real numbers x and y satisfy $(x + 5)^2 + (y - 12)^2 = (14)^2$, then the minimum value of $\sqrt{x^2 + y^2}$ is

57. The sum of the slopes of the lines tangent to both the circles $x^2 + y^2 = 1$ and $(x - 6)^2 + y^2 = 4$ is

58. Line segments AC and BD are diameters of the circle of radius one. If $\angle BDC = 60°$, the length of line segment AB is

59. Let $A \equiv (-4, 0)$ and $B \equiv (4, 0)$. If the number of points on the circle $x^2 + y^2 = 16$ such that the area of the triangle whose vertices are A, B and C is a positive integer N, then the value of $\left[\frac{N}{7}\right]$, where [ ] represents greatest integer function, is

60. If the length of the tangents from any point on the circle $15x^2 + 15y^2 - 48x + 64y = 0$ to the two circles $5x^2 + 5y^2 - 24x + 32y + 75 = 0$ and $5x^2 + 5y^2 - 48x + 64y + 300 = 0$ is PT_1 and PT_2, then the value of $\frac{PT_2}{PT_1}$ is

Space for rough work

FIITJEE RET – 1

(2017 – 2019)(2ND YEAR_CHAMPIONS)

IIT-2014 (P1)

DATE: 11.06.2018

ANSWERS

PHYSICS

1.	**B,C**	2.	**B**	3.	**A,D**	4.	**Bonus**
5.	**D**	6.	**B,C**	7.	**C,D**	8.	**A,B,C,D**
9.	**A,D**	10.	**A,B,D**	11.	**2**	12.	**2**
13.	**2**	14.	**1**	15.	**4**	16.	**6**
17.	**2**	18.	**Bonus**	19.	**1**	20.	**7**

CHEMISTRY

21.	**B**	22.	**A, B, D**	23.	**A, B, C, D**	24.	**C, D**
25.	**A, D**	26.	**A, B, C**	27.	**B, C, D**	28.	**A, B, C**
29.	**A, D**	30.	A, **C, D**	31.	**5**	32.	**2**
33.	**4**	34.	**8**	35.	**6**	36.	**3**
37.	**0**	28.	**4**	39.	**4**	40.	**3**

MATHEMATICS

41.	**BC**	42.	**BC**	**43.**	**Bonus**	44.	**ACD**
45.	**B**	46.	**ABCD**	47.	**BD**	48.	**B**
49.	**A**	50.	**A**	51.	**2**	52.	**1**
53.	**3**	54.	**6**	55.	**8**	56.	**1**
57.	**0**	58.	**1**	59.	**8**	60.	**2**