FIITJEE RET – 7

(2017 – 2019)(2ND YEAR_REGULAR)

IIT-2015 (P1)_SET–A

DATE: 13.08.2018

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

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 **8 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).
9. **Section II** contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.
10. **Section III** contains **2 Match the following** type questions and you will have to match entries in Column I with the entries in Column II

D. Marking Scheme

11. For each question in **Section I**, you will be awarded **4 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.
12. For each question in **Section II**, you will be awarded **4 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. **–2 marks** will be awarded for incorrect answers in this section.
13. For each question in **Section III**, you will be awarded **2 marks** for each entry in Column I; if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **–1 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: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

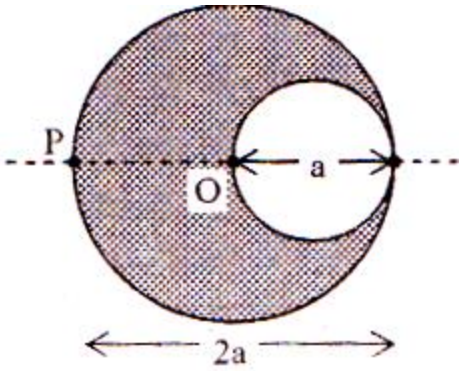
ENROLLMENT NO.: ☐☐☐☐☐☐☐☐☐☐

PAPER–I
PART I: PHYSICS
SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

1. Two parallel wires in the plane of the paper are distance X_0 apart. A point charge is moving with speed u between the wires in the same plane at a distance X_1 from one of the wires. When the wires carry current of magnitude I in the same direction, the radius of curvature of the path of the point charges is R_1. In contrast, if the currents I in the two wires have direction opposite to each other, the radius of curvature of the path is R_2. If $\frac{X_0}{X_1} = 3$, the value of $\frac{R_1}{R_2}$ is.

2. A cylindrical cavity of diameter a exists inside a cylinder of diameter 2a as shown in the figure. Both the cylinder and the cavity are infinitely long. A uniform current density J flows along the length. If the magnitude of the magnitude field at the point P is given by $\frac{N}{12}\mu_0 aJ$, then the value of N is

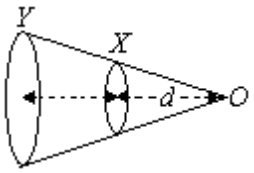


3. A steady current I goes through a wire loop PQR having shape of right angle triangle with PQ = 3x, PR = 4x and QR = 5x, IF the magnitude of the magnetic field at P due to this loop is $k\left(\frac{\mu_0 I}{48\pi x}\right)$, find the value of k.

4. A beam of protons with a velocity $4\times10^5\,m/s$ enters a uniform magnetic field of 0.3 tesla at an angle 60^0 to the magnetic field. If the radius of the helical path taken by the proton beam is given by $\left(3n\times10^{-3}\right)m$, then n is

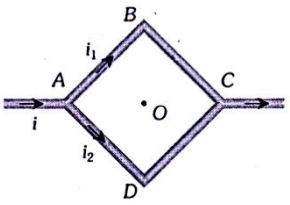
space for rough work

5. Two circular coils X and Y have equal number of turns and carry equal currents in the same sense and subtend same solid angle at point O. If the smaller coil X is midway between O and Y, then if we represent the magnetic induction due to bigger coil Y at O as B_Y and that due to smaller coil X at O as B_X, if $\frac{B_Y}{B_X}=\frac{4}{n}$ then n is ….



6. Two very long, straight, parallel wires carry steady currents I each in opposite directions . The distance between the wires is d. At a certain instant of time, a point charge q is at a point equidistant from the two wires, in the plane of the wires. Its instantaneous velocity $\vec{\upsilon}$ is perpendicular to this plane. The magnitude of the force due to the magnetic filed acting on the charge at this instant is N times $\frac{\mu_0 Iq\upsilon}{2\pi d}$, then find N?

7. Figure shows a square loop ABCD with edge length a. The resistance of the wire ABC is r and that of ADC is 3r. The value of magnetic field at the centre of the loop assuming uniform wire is found to be k times $\frac{\sqrt{2}\mu_0 i}{6\pi a}\otimes$. Find K .



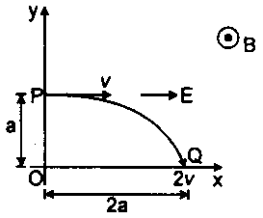
8. The magnetic field due to a current carrying circular loop of radius 3 cm at a point on the axis at a distance of 4 cm from the centre is 54 μ T. Its value at the centre of the loop is k times 50 μT, then find k?

SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

space for rough work

9. A particle of charge +q and mass m moving under the influence of a uniform electric field E $\hat{i}$ and uniform magnetic field B $\hat{k}$ follows a trajectory from P to Q as shown in figure. The velocities at P and Q are v $\hat{i}$ and – 2v $\hat{j}$. Which of the following statements is/are correct?



(A) $E = \frac{3}{4}\left(\frac{mv^2}{qa}\right)$

(B) Rate of work done by the electric field at P is $\frac{3}{4}\left(\frac{mv^3}{a}\right)$

(C) Rate of work done by electric field at P is zero

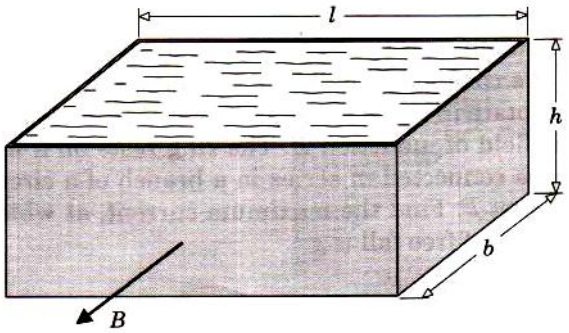
(D) Rate of work done by both the fields at Q is zero

10. A thin flexible wire of length L is connected to two adjacent fixed points and carries a current I in the clockwise direction, as shown in the figure. When the system is put in a uniform magnetic field of strength B going into the plane of the paper, the wire takes the shape of circle. The tension in the wire is

(A) IBL (B) $\frac{IBL}{\pi}$

(C) $\frac{IBL}{2\pi}$ (D) $\frac{IBL}{4\pi}$

11. A conducting fluid of mass density ρ_m and electrical resistivity ρ_e is kept in an insulating vessels of dimensions $\ell \times b \times h$. The vessel is placed on a horizontal floor where a uniform horizontal magnetic field of induction B is established perpendicular to the face $\ell \times h$ as shown in the figure. How much potential difference V must be applied on the liquid between the side faces designated by dimensions $b \times h$ so that the fluid pressure at the bottom of the vessel vanishes ? The acceleration of free fall is g.



(A) $V = \frac{\rho_m \rho_e g \ell}{B}$ (B) $V > \frac{\rho_m \rho_e g \ell}{B}$

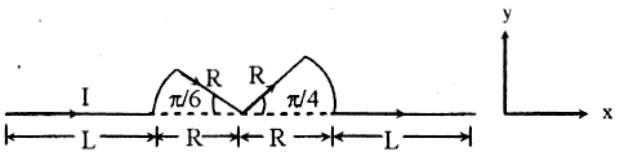
(C) $V < \frac{\rho_m \rho_e g \ell}{B}$ (D) can not be determined

space for rough work

12. As shown in the figure, four identical loops are placed in a uniform magnetic field B. The loops carry equal current i. $\hat{n}$ denotes the normal to the plane of each loop. Potential energies in descending order are

(A) I, II, III, IV (B) IV, II, III, I (C) I, III, II, IV (D) IV, III, II, I

13. A conductor (shown in the figure) carrying constant current I is kept in the x – y plane in a uniform magnetic field $\vec{B}$. If F is the magnitude of the total magnetic force acting on the conductor, then the correct statement(s) is (are)



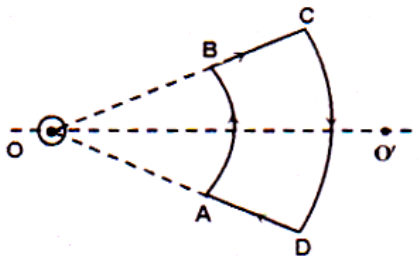
(A) If $\vec{B}$ is along $\hat{z}, F \propto (L+R)$

(B) If $\vec{B}$ is along $\hat{x}, F = 0$

(C) If $\vec{B}$ is along $\hat{y}, F \propto (L+R)$

(D) If is along $\hat{z}, F = 0$

14. An infinite current carrying wire passes through point O and in perpendicular to the plane containing a current carrying loop ABCD as shown in the figure. Choose the correct option(s).
(A) Net force on the loop is zero
(B) Net torque on the loop is zero
(C)As seen from O, the loop rotates clockwise
(D) As seen from O, the loop rotates anticlockwise



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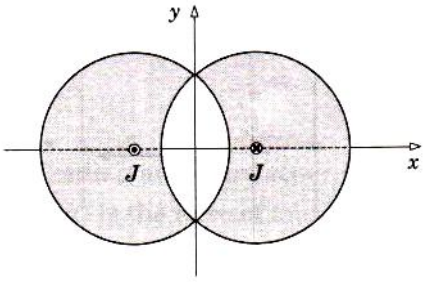
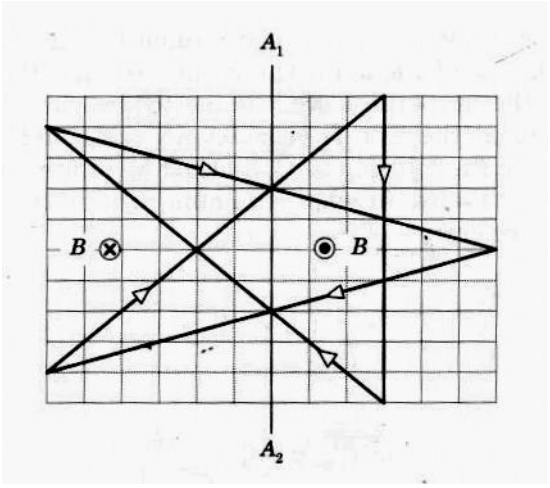
15. A long straight conductor has uniform cross –section having shape of two identical overlapped circles with their center – to – center spacing a. The material from overlapped section has been removed from entire length of the conductor as shown in the figure. Now the portions on either sides of the y–z plane are split and restacked after coating their surfaces by a very thin layer of insulating paint.
The portions of composite conductor to the left and the right side of the y–z plane carry uniform currents of current density J in the positive z and the negative z–directions respectively. The permeability of both the conductors is the same as that of vacuum.
Which one of the following statements best describes the magnetic field in the empty space inside the composite conductor.



(A) It is nonuniform and points in the positive y –direction everywhere on the y –axis
(B) It is nonuniform and points in the positive y –direction everywhere on the x and y –axis
(C) It is uniform , points every where in the positive y –direction and has magnitude $\frac{1}{2}\mu_0 Ja$
(D) It has different directions at different points but the same magnitude $\frac{1}{2}\mu_0 Ja$

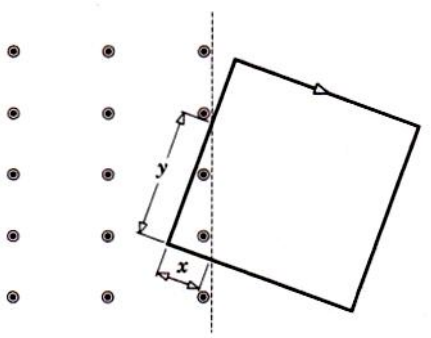
16. A hard insulated conducting wire is bent into shape of a five – pointed star like planar structure and carries current I. On the left and on the right side of the line A_1A_2, uniform magnetic fields each of induction B exists in direction perpendicularly into and perpendicularly out of the plane of the star respectively. If length of a side of a unit cell of the grid shown is ℓ, find force of interaction between the current and the magnetic field.



(A) 16IB ℓ towards the right
(B)16IB ℓ towards the left
(C) 8IB ℓ towards the left
(D) 8IB ℓ towards the right

space for rough work

17. On a frictionless horizontal tabletop is held at rest a rigid square loop of side length ℓ carrying an electric current. A uniform magnetic field pointing upwards to the left of the dashed line as shown in the figure is switched on and then the loop is released.
Considering different length of the side segments x and y (x<y) shown in the figure, which of the following conclusion can you make ?



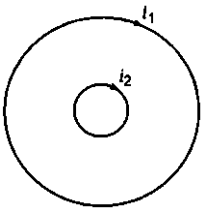
(A) If $x < \frac{\ell}{2}$ and $y = \frac{\ell}{2}$, the loop starts rotating anticlockwise

(B) If $x < \frac{\ell}{2}$ and $y = \frac{\ell}{2}$, the loop starts rotating anticlockwise

(C) If $x < \frac{\ell}{2}$ and $y > \frac{\ell}{2}$, the loop starts rotating anticlockwise

(D) If $x < \frac{\ell}{2}$ and $y > \frac{\ell}{2}$, more information is required to decide which way the loop stats rotating.

18. Two concentric circular coils of radii R and r (<<R) carry currents of i_1 and i_2 respectively. If the smaller coil is rotated slightly about one of its diameter, it starts oscillating. Then which of the following statement(s) is/are correct:
(A) The oscillations are simple harmonic in nature
(B) The frequency of oscillation is proportional to product $i_1 i_2$
(C) The frequency of oscillation is inversely proportional to square root of R
(D) The frequency of oscillation is proportional to square root of R



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SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4×5 matrix whose layout will be similar to the one shown below:

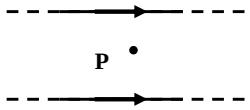
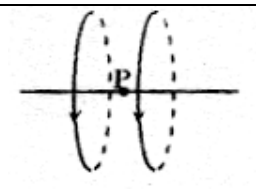
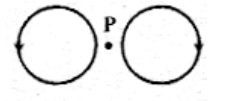
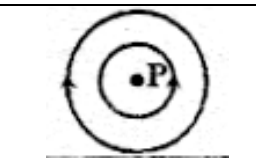
(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.

+2	If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
0	If none of the bubbles is darkened.
–1	In all other cases.

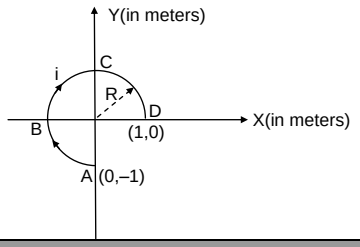
space for rough work

19. Two wires each carrying a steady current I are shown in four configurations in column I. Some of the resulting effects are described in column II. Match the statements in column I with the statements in column II and indicate your answer by darkening appropriate bubbles in the 4 x 4 matrix given ORS

Column – I			Column – II	
(A)	Point P is situated midway between the wires		(p)	The magnetic fields (B) at P due to the currents in the wires are in the same direction.
(B)	Point P is situated at the mid-point of the line joining the centers of the circular wires, which have same radii		(q)	The magnetic field (B) at P due to the currents in the wires are in opposite directions
(C)	Point P is situated at the mid – point of the line joining the centres of the circular wires, which have same radii		(r)	There is no magnetic field at P
(D)	Point P is situated at the common center of the wires		(s)	The wires repel each other.
			(t)	None

space for rough work

20. The wire ABCD is bent as shown in the figure and placed in xy-plane. It carries current i. A uniform magnetic field $\vec{B}$ of magnitude B_0 is applied in the region.



Column I		Column II	
(A)	If $\vec{B} = B_0\hat{j}$ the total force (in Newton) on the wire is	(p)	$iB_0\hat{k}$
(B)	If $\vec{B} = B\hat{i}$ the total force on the wire is	(q)	$-iB_0\hat{k}$
(C)	The magnetic field intensity due to current in wire ABCD at the origin is $\left(\frac{3\mu_0 i}{8}\right)(-\hat{k})$	(r)	$iB_0(\hat{i}-\hat{j})$
(D)	If $\vec{B} = B_0\hat{k}$ the total force (in Newton) on the wire is	(s)	$\frac{3\mu_0 I}{8}(-\hat{k})$
		(t)	$\frac{3\mu_0 i}{8}(\hat{k})$

PART II: CHEMISTRY

SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

21. For a first order reaction, the ratio of time to complete 99.9% and 75%of the reaction is

22. A hydrogenation reaction is carried only at 500K. If the same reaction is carried out in presence of a catalyst at the same rate, the temperature required is 400K. If the catalyst lowers the activation barrier by 20 kJ mol^{-1} then the activation energy of the uncatalysed reaction is E_a kJ mole^{-1}. Find $\frac{E_a}{20}$ value.

space for rough work

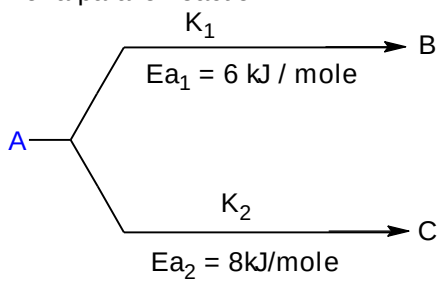
23. Consider the following two first order reactions :

$A \rightarrow P$ ....(i)

$B \rightarrow Q$ ....(ii)

Reaction (i) is 75% complete in 4 hrs while reaction (ii) takes 16hrs for same 75% completion of reaction under identical conditions. By how many hours, half- life of (ii) is greater than the half- life of (i)?

24. For a parallel reaction



The mole % of B & C after 1 hr was found to be same . Then the overall activation energy for the reaction is

25. In the following reaction

$$xA \longrightarrow yB$$

$$\log -\frac{d[A]}{dt} = \log\left[\frac{d[B]}{dt}\right] + 0.6$$

where –ve sign indicates rate of disappearance of the reactant, thus x / y is

26. For the first order reaction, A(g) $\longrightarrow$ 2B(g) + C(s); $t_{1/2}$ = 24 min. The reaction is carried out taking certain mass of A enclosed in a vessel in which it exerts a pressure of 400mm Hg. The pressure of the reaction mixture after the expiry of 48min will be P x10^2 mm of Hg then P is

27. If the fermentation of sugar in an enzymatic solution that is 0.12 M, the concentration of the sugar is reduced to 0.06 M in 10 h and to 0.03 M in 20 h. What is the order of the reaction?

28. In the upper atmosphere H_2O and O react bimolecularly to form two OH radicals. ΔH for this reaction is 72 kJ at 500 K and E_a is 77 kJ mol^{-1}, then E_a for the bimolecular recombination of two OH radicals to form H_2O and O is (in kJ/ mole)

space for rough work

SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

29. Consider $P \xrightarrow{k_1} Q \quad 2P \xrightarrow{k_2} R \quad 3P \xrightarrow{k_3} S$
Which is the differential rate equation for rate of disappearance of P

(A) $\frac{-d(P)}{dt} = k_1[P] + k_2[P]^2 + k_3[P]^3$

(B) $-\frac{d[P]}{dt} = [k_1 + k_2 + k_3][P]^6$

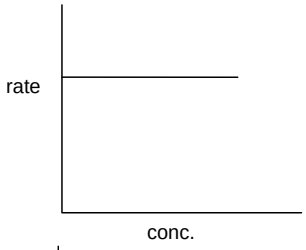
(C) $-\frac{d[P]}{dt} = k_1[P] + 2k_2[P]^2 + 3k_3[P]^3$

(D) $-\frac{d[P]}{dt} = k_1[P] + \frac{k_2}{2}[P]^2 + \frac{k_3}{3}[P]^3$

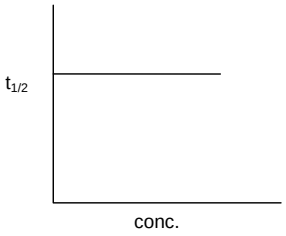
30. A catalyst
(A) increases the average kinetic energy of reacting molecules
(B) decreases the activation energy
(C) alters the reaction mechanism
(D) increases the frequency of collisions of reacting species.

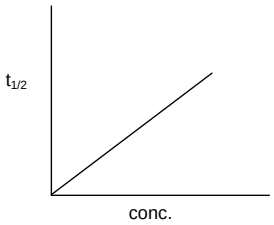
space for rough work

31. Choose the correct option(s) for a zero order reaction (a= initial concentration, K = rate constant, $t_{1/2}$ = half life)

(A) 

(B) $t_{1/2} = \frac{a}{2K}$

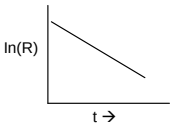
(C) 

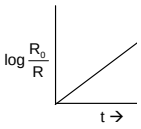
(D) 

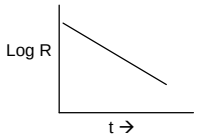
32. Which of the following is/are true for the first order reaction?

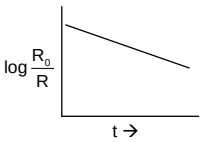
(A) $t_{3/4} = 2t_{1/2}$ (B) $t_{15/16} = 4t_{1/2}$ (C) $t_{15/16} = 3t_{3/4}$ (D) $t_{7/8} = 2t_{3/4}$

33. Which of the following is a correct representation of first order reactions? (R_0 is initial rate and R is rate at anytime)

(A) 

(B) 

(C) 

(D) 

34. Which of the following statement is incorrect ?

(A) Unit of rate of disappearance is s^{-1} (B) Unit of rate of reaction is Ms^{-1}

(C) Unit of rate constant k is depend on order (D) Unit of k for first order reaction is Ms^{-1}

35. Which of the following statements is correct ?

(A) A second order reaction must be a bimolecular elementary reaction

(B) A bimolecular elementary reaction must be a second order reaction

(C) Zero order reaction must be a complex reaction

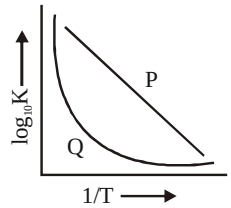
(D) First order reaction may be complex or elementary reaction

space for rough work

36. Rate constant k varies with temperature by equation, $\log k(\min^{-1}) = 5 - \frac{2000}{T(K)}$. We can conclude

(A) Pre-exponential factor A is 5
(B) E_a is 2000 kcal
(C) Pre-exponential factor A is 10^5
(D) E_a is 9.212 kcal

37. Which of the following statement are true regarding the log K vs. 1/T plot shown in the given diagram?



(a) Plot P shows that the energy of activation is independent of temperature
(b) Plot Q describes the behavior of temperature dependence of energy of activation
(c) Arrhenius behavior is described by P
(d) The slope of curve P gives the value $-\frac{E_a}{R}$

38. If the rate of reaction, $2SO_2(g) + O_2(g) \xrightarrow{Pt} 2SO_3(g)$ is given by :

$$\text{Rate} = K\frac{[SO_2]}{[SO_3]^{1/2}}$$

Which statements are correct
(a) The overall order of reaction is –1/2
(b) The overall order of reaction is +1/2
(c) The reaction slows down as the product SO_3 is build up
(d) The rate of reaction does not depend upon concentration of SO_3 formed

space for rough work

SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4 × 5 matrix whose layout will be similar to the one shown below:

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.
  - **+2** If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–1** In all other cases.

39.

Column – I (order)		Column – II (rate constant)	
(A)	Zero	(p)	$k=\frac{1}{2t}\left[\frac{1}{(a-x)^2}-\frac{1}{a^2}\right]$
(B)	First	(q)	$k=\frac{1}{t}\left[\frac{1}{(a-x)}-\frac{1}{a}\right]$
(C)	Second	(r)	$k=\frac{x}{t}$
(D)	Third	(s)	$k=\frac{1}{t}\log_e\left(\frac{a}{(a-x)}\right)$

40. For a first order reaction at 300 K the $t_{1/2}$ is 90 min. At 310 K $t_{1/2}$ is 22.5 min. for this reaction

Column – I (order)		Column – II (rate constant)	
(A)	$2t_{1/2}$ (300K)	(p)	Activation energy
(B)	107 kJ	(q)	$K_{(310\ K)}$
(C)	$t_{3/4}$ (300 k)	(r)	4 x K_{300K}
(D)	3.1 x 10^{-2}	(s)	8 $t_{1/2}$ (310k)

space for rough work

PART III: MATHEMATICS

SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

41. The number of points on the ellipse $\frac{x^2}{50}+\frac{y^2}{20}=1$ from which a pair of perpendicular tangents is drawn to the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$ is

42. P is the point on the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$ and Q is the corresponding point on the auxiliary circle of the ellipse. If the line joining the center C to Q meets the normal at P with respect to the given ellipse at K, then find the value of CK.

43. The length of the sides of the square which can be made by four perpendicular tangents to the ellipse $\frac{x^2}{7}+\frac{2y^2}{11}=1$ is

44. If x, y $\in$ R, satisfies the equation $\frac{(x-4)^2}{4}+\frac{y^2}{9}=1$, then the difference between the largest and the smallest value of the expression $\frac{x^2}{4}+\frac{y^2}{9}$ is

45. Tangents drawn from the point P(2, 3) to the circle $x^2 + y^2 – 8x + 6y + 1 = 0$ touch circle at points A and B. The circumcircle of ΔPAB cuts the director circle of ellipse $\frac{(x+5)^2}{9}+\frac{(y-3)^2}{b^2}=1$ orthogonally. Then the value of $\frac{b^2}{6}$ is

46. Suppose x and y are real numbers and that $x^2 + 9y^2 – 4x + 6y + 4 = 0$, then the maximum value of $\frac{(4x-9y)}{2}$ is

space for rough work

47. Consider an ellipse E, $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, centered at point O and having AB and CD as its major and minor axes, respectively. If S_1 is one of the focus of the ellipse, the radius of the incircle of triangle OCS_1 is 1 unit, and $OS_1 = 6$ units, then the value of $\frac{(a-b)}{2}$ is

48. Rectangle ABCD has area 200. An ellipse with area 200π passes through A and C and has foci at B and D. If the perimeter of the rectangle is P, then the value of $\frac{P}{20}$ is

SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

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49. If the tangent at the point $P(\theta)$ to the ellipse $16x^2 + 11y^2 = 256$ is also a tangent to the circle $x^2 + y^2 – 2x = 15$, then θ =

(A) $\frac{2\pi}{3}$ (B) $\frac{4\pi}{3}$ (C) $\frac{5\pi}{3}$ (D) $\frac{\pi}{3}$

50. The coordinates (2, 3) and (1, 5) are the foci of an ellipse which passes through the origin. Then the equation of the

(A) tangent at the origin is $\left(3\sqrt{2}-5\right)x+\left(1-2\sqrt{2}\right)y=0$

(B) tangent at the origin is $\left(3\sqrt{2}+5\right)x+\left(1+2\sqrt{2}\right)y=0$

(C) normal at the origin is $\left(3\sqrt{2}+5\right)x-\left(2\sqrt{2}+1\right)y=0$

(D) normal at the origin is $x\left(3\sqrt{2}-5\right)-y\left(1-2\sqrt{2}\right)y=0$

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space for rough work

51. Which of the following is/are true ?

(A) There are infinite positive integral values of a for which $(13x - 1)^2 + (13y - 2)^2 = \left(\frac{5x + 12y - 1}{a}\right)^2$ represents an ellipse

(B) the minimum distance of a point (1, 2) from the ellipse $4x^2 + 9y^2 + 8x - 36y + 4 = 0$ is 1

(C) If from a point P(0, α) two normals other than the axes are drawn to the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$, then $|\alpha| < \frac{9}{4}$

(D) If the length of the latus rectum of an ellipse is one-third of its major axis, then its eccentricity is equal to $\frac{1}{\sqrt{3}}$

52. An ellipse passes through the point (4, –1) and touches the line $x + 4y - 10 = 0$. Find its equation if its axes coincide with the coordinate axes.

(A) $\frac{x^2}{80} + \frac{4y^2}{5} = 1$ (B) $\frac{x^2}{40} + \frac{y^2}{5} = 1$ (C) $\frac{x^2}{20} + \frac{y^2}{5} = 1$ (D) $\frac{4x^2}{5} + \frac{y^2}{40} = 1$

53. Find the point on the ellipse $16x^2 + 11y^2 = 256$ where the common tangent to it and the circle $x^2 + y^2 - 2x = 15$ touch

(A) $2 + \frac{8\sqrt{3}}{\sqrt{11}}$ (B) $2 - \frac{8\sqrt{3}}{\sqrt{11}}$ (C) $4 + \frac{5\sqrt{3}}{11}$ (D) $4 - \frac{5\sqrt{3}}{11}$

54. The locus of the image of the focus of the ellipse $\frac{x^2}{25} + \frac{y^2}{9} = 1$, (a > b), with respect to any of the tangents to the ellipse is

(A) $(x + 4)^2 + y^2 = 100$ (B) $(x + 2)^2 + y^2 = 50$ (C) $(x - 4)^2 + y^2 = 100$ (D) $(x - 2)^2 + y^2 = 50$

55. Consider the ellipse $\frac{x^2}{f(k^2 + 2k + 5)} + \frac{y^2}{f(k + 11)} = 1$. If f(x) is a positive decreasing function, then

(A) the set of values of k for which the major axis is the x-axis is (–3, 2)

(B) the set of values of k for which the major axis is the y-axis is $(-\infty, 2)$

(C) the set of values of k for which the major axis is the y-axis is $(-\infty, -3) \cup (2, \infty)$

(D) the set of values of k for which the major axis is the y-axis is $(-3, \infty)$

space for rough work

56. If the tangent drawn at point $(t^2, 2t)$ on the parabola $y^2 = 4x$ is the same as the normal drawn at point $\left(\sqrt{5}\cos\theta, 2\sin\theta\right)$ on the ellipse $4x^2 + 5y^2 = 20$, then

(A) $\theta = \cos^{-1}\left(-\frac{1}{\sqrt{5}}\right)$ (B) $\theta = \cos^{-1}\left(\frac{1}{\sqrt{5}}\right)$ (C) $t = -\frac{2}{\sqrt{5}}$ (D) $t = -\frac{1}{\sqrt{5}}$

57. If the ellipse $\frac{x^2}{a^2-7} + \frac{y^2}{13-5a} = 1$ is inscribed in a square of side length $\sqrt{2}a$, then a is equal to

(A) $\frac{6}{5}$ (B) $\left(-\infty, -\sqrt{7}\right) \cup \left(\sqrt{7}, \frac{13}{5}\right)$

(C) $\left(-\infty, -\sqrt{7}\right) \cup \left(\frac{13}{5}, \sqrt{7}\right)$ (D) no such a exists

58. In a triangle ABC with fixed base BC, the vertex A moves such that $\cos B + \cos C = 4\sin^2\frac{A}{2}$. If a, b and c denote the lengths of the sides of the triangle opposite to the angles A, B and C respectively, then

(A) b + c = 4a (B) b + c = 2a

(C) the locus of point A is an ellipse (D) the locus of point A is a pair of straight lines

SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4×5 matrix whose layout will be similar to the one shown below:

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.

+2 If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.

0 If none of the bubbles is darkened.

–1 In all other cases.

space for rough work

59.

Column I		Column II	
(A)	A stick of length 10m slides on the co-ordinate axes. Then locus of the point dividing this stick from the x-axis in the ratio 6 : 4 is a curve whose eccentricity is e. Then 3e is equal to	p.	$\sqrt{6}$
(B)	AA′ is the major axis of the ellipse $3x^2 + 2y^2 + 6x - 4y - 1 = 0$ and P is a variable point on it. Then the greatest area of triangle APA′ is	q.	$2\sqrt{7}$
(C)	The distance between the foci of the curve represented by the equation $x = 1 + 4\cos\theta$, $y = 2 + 3\sin\theta$ is	r.	$\frac{128}{3}$
(D)	Tangents are drawn to the ellipse $\frac{x^2}{16} + \frac{y^2}{7} = 1$ at the endpoints of the latus rectum. The area of the quadrilateral so formed is	s.	$\sqrt{5}$

60. Match the following

Column I		Column II	
(A)	An ellipse passing through the origin has its foci (3, 4) and (6, 8). Then the length of its minor axis is	p.	8
(B)	If PQ is a focal chord of the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$ which passes through $S \equiv (3, 0)$ and PS = 2, then the length of chord PQ is	q.	$10\sqrt{2}$
(C)	If the line $y = x + K$ touches the ellipse $9x^2 + 16y^2 = 144$, then the difference of values of K is	r.	10
(D)	The sum of distances of a point on the ellipse $\frac{x^2}{9} + \frac{y^2}{16} =$ 1 from the foci is	s.	12

space for rough work

FIITJEE RET – 7

(2017 – 2019)(2ND YEAR_REGULAR)

IIT-2015 (P1)_SET–A

DATE: 13.08.2018

ANSWERS

PHYSICS

1.	**3**	2.	**5**	3.	**7**	4.	**4**
5.	**8**	6.	**0**	7.	**3**	8.	**5**
9.	**A,B,D**	10.	**C**	11.	**A,B**	12.	**C**
13.	**A,B,C**	14.	**A,C**	15.	**C**	16.	**B**
17.	**A,B,D**	18.	**A,C**	19.	**A → q,r; B → p; C → q, r; D → q**		
20.	**A → p, B → q, C → s, D → r**						

CHEMISTRY

21.	**5**	22.	**5**	23.	**6**	24.	**7**
25.	**4**	26.	**7**	27.	**1**	28.	**5**
29.	**C**	30.	**B, C**	31.	**A, B, D**	32.	**A, B**
33.	**A, B, C**	34.	**A, D**	35.	**C, D**	36.	**C, D**
37.	**A, B, C**	38.	**B, C**	39.	**A → r; B → s; C → q; D → p**		
40.	**A → s; B → p; C → s; D → q, r**						

MATHEMATICS

41.	**4**	42.	**7**	43.	**5**	44.	**8**
45.	**9**	46.	**8**	47.	**4**	48.	**4**
49.	**CD**	50.	**AC**	51.	**ABC**	52.	**AC**
53.	**AB**	54.	**AC**	55.	**AC**	56.	**AD**
57.	**D**	58.	**BC**	59.	**A → s; B → p; C → q; D → r**		
60.	**A → q; B → r; C → r; D → p**						

FIITJEE RET – 7

(2017 – 2019)(2ND YEAR_REGULAR)

IIT-2015 (P1)_SET–B

DATE: 13.08.2018

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

INSTRUCTIONS:

A. General

1. This booklet is your Question Paper containing 60 questions.
6. 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.
7. Fill in the boxes provided for Name and Enrolment No.
8. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
9. 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:

14. The question paper consists of **3 parts (Physics, Chemistry and Mathematics)**. Each part consists of **two sections**.
15. **Section I** contains **8 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).
16. **Section II** contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.
17. **Section III** contains **2 Match the following** type questions and you will have to match entries in Column I with the entries in Column II

D. Marking Scheme

18. For each question in **Section I**, you will be awarded **4 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.
19. For each question in **Section II**, you will be awarded **4 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. **–2 marks** will be awarded for incorrect answers in this section.
20. For each question in **Section III**, you will be awarded **2 marks** for each entry in Column I; if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **–1 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 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

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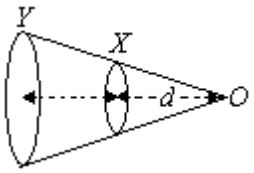
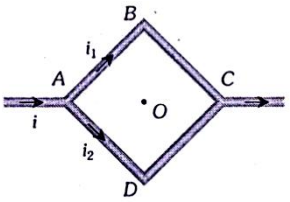
1. Two circular coils X and Y have equal number of turns and carry equal currents in the same sense and subtend same solid angle at point O. If the smaller coil X is midway between O and Y, then if we represent the magnetic induction due to bigger coil Y at O as B_Y and that due to smaller coil X at O as B_X, if $\frac{B_Y}{B_X}=\frac{4}{n}$ then n is ….



2. Two very long, straight, parallel wires carry steady currents I each in opposite directions . The distance between the wires is d. At a certain instant of time, a point charge q is at a point equidistant from the two wires, in the plane of the wires. Its instantaneous velocity $\vec{\upsilon}$ is perpendicular to this plane. The magnitude of the force due to the magnetic filed acting on the charge at this instant is N times $\frac{\mu_0 Iq\upsilon}{2\pi d}$, then find N?

3. Figure shows a square loop ABCD with edge length a. The resistance of the wire ABC is r and that of ADC is 3r. The value of magnetic field at the centre of the loop assuming uniform wire is found to be k times $\frac{\sqrt{2}\mu_0 i}{6\pi a}\otimes$. Find K .



4. The magnetic field due to a current carrying circular loop of radius 3 cm at a point on the axis at a distance of 4 cm from the centre is 54 μ T. Its value at the centre of the loop is k times 50 μT, then find k?

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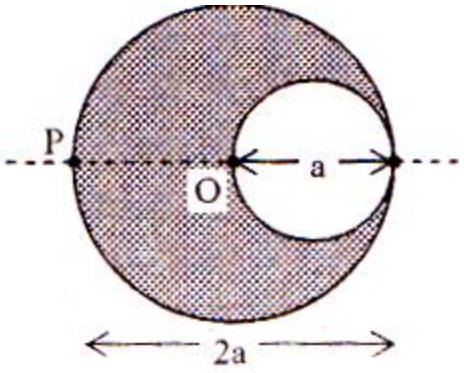
space for rough work

5. Two parallel wires in the plane of the paper are distance X_0 apart. A point charge is moving with speed u between the wires in the same plane at a distance X_1 from one of the wires. When the wires carry current of magnitude I in the same direction, the radius of curvature of the path of the point charges is R_1. In contrast, if the currents I in the two wires have direction opposite to each other, the radius of curvature of the path is R_2. If $\frac{X_0}{X_1} = 3$, the value of $\frac{R_1}{R_2}$ is.

6. A cylindrical cavity of diameter a exists inside a cylinder of diameter 2a as shown in the figure. Both the cylinder and the cavity are infinitely long. A uniform current density J flows along the length. If the magnitude of the magnitude field at the point P is given by $\frac{N}{12}\mu_0 aJ$, then the value of N is



7. A steady current I goes through a wire loop PQR having shape of right angle triangle with PQ = 3x, PR = 4x and QR = 5x, IF the magnitude of the magnetic field at P due to this loop is $k\left(\frac{\mu_0 I}{48\pi x}\right)$, find the value of k.

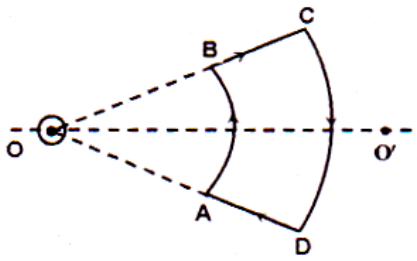
8. A beam of protons with a velocity $4\times10^5\,m/s$ enters a uniform magnetic field of 0.3 tesla at an angle 60^0 to the magnetic field. If the radius of the helical path taken by the proton beam is given by $\left(3n\times10^{-3}\right)m$, then n is

space for rough work

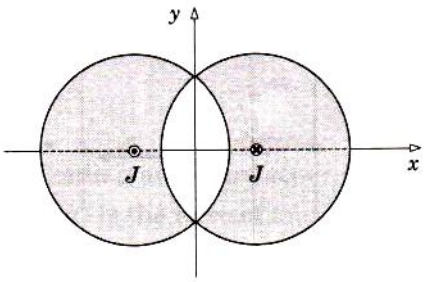
SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

9. An infinite current carrying wire passes through point O and in perpendicular to the plane containing a current carrying loop ABCD as shown in the figure. Choose the correct option(s).
(A) Net force on the loop is zero
(B) Net torque on the loop is zero
(C)As seen from O, the loop rotates clockwise
(D) As seen from O, the loop rotates anticlockwise



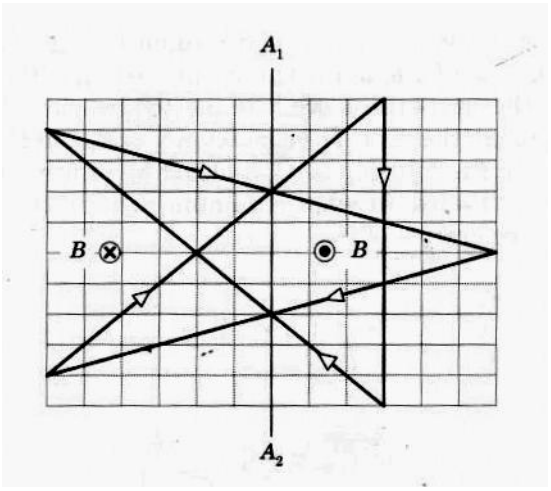
10. A long straight conductor has uniform cross –section having shape of two identical overlapped circles with their center – to – center spacing a. The material from overlapped section has been removed from entire length of the conductor as shown in the figure. Now the portions on either sides of the y–z plane are split and restacked after coating their surfaces by a very thin layer of insulating paint.
The portions of composite conductor to the left and the right side of the y–z plane carry uniform currents of current density J in the positive z and the negative z–directions respectively. The permeability of both the conductors is the same as that of vacuum.
Which one of the following statements best describes the magnetic field in the empty space inside the composite conductor.



(A) It is nonuniform and points in the positive y –direction everywhere on the y –axis
(B) It is nonuniform and points in the positive y –direction everywhere on the x and y –axis
(C) It is uniform , points every where in the positive y –direction and has magnitude $\frac{1}{2}\mu_0 Ja$
(D) It has different directions at different points but the same magnitude $\frac{1}{2}\mu_0 Ja$

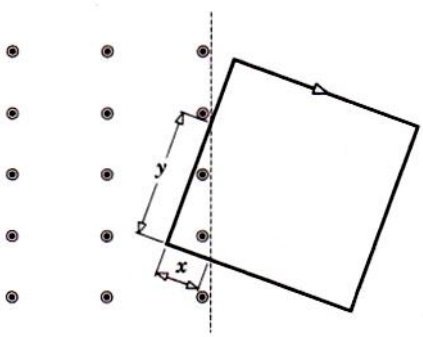
space for rough work

11. A hard insulated conducting wire is bent into shape of a five – pointed star like planar structure and carries current I. On the left and on the right side of the line A_1A_2, uniform magnetic fields each of induction B exists in direction perpendicularly into and perpendicularly out of the plane of the star respectively. If length of a side of a unit cell of the grid shown is ℓ, find force of interaction between the current and the magnetic field.



(A) $16IB\ell$ towards the right
(B) $16IB\ell$ towards the left
(C) $8IB\ell$ towards the left
(D) $8IB\ell$ towards the right

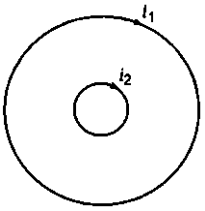
12. On a frictionless horizontal tabletop is held at rest a rigid square loop of side length ℓ carrying an electric current. A uniform magnetic field pointing upwards to the left of the dashed line as shown in the figure is switched on and then the loop is released.
Considering different length of the side segments x and y (x<y) shown in the figure, which of the following conclusion can you make ?



(A) If $x < \frac{\ell}{2}$ and $y = \frac{\ell}{2}$, the loop starts rotating anticlockwise
(B) If $x < \frac{\ell}{2}$ and $y = \frac{\ell}{2}$, the loop starts rotating anticlockwise
(C) If $x < \frac{\ell}{2}$ and $y > \frac{\ell}{2}$, the loop starts rotating anticlockwise
(D) If $x < \frac{\ell}{2}$ and $y > \frac{\ell}{2}$, more information is required to decide which way the loop stats rotating.

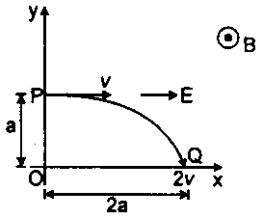
space for rough work

13. Two concentric circular coils of radii R and r (<<R) carry currents of i_1 and i_2 respectively. If the smaller coil is rotated slightly about one of its diameter, it starts oscillating. Then which of the following statement(s) is/are correct:



(A) The oscillations are simple harmonic in nature
(B) The frequency of oscillation is proportional to product $i_1 i_2$
(C) The frequency of oscillation is inversely proportional to square root of R
(D) The frequency of oscillation is proportional to square root of R

14. A particle of charge +q and mass m moving under the influence of a uniform electric field E $\hat{i}$ and uniform magnetic field B $\hat{k}$ follows a trajectory from P to Q as shown in figure. The velocities at P and Q are v $\hat{i}$ and – 2v $\hat{j}$. Which of the following statements is/are correct?



(A) $E = \frac{3}{4}\left(\frac{mv^2}{qa}\right)$

(B) Rate of work done by the electric field at P is $\frac{3}{4}\left(\frac{mv^3}{a}\right)$

(C) Rate of work done by electric field at P is zero
(D) Rate of work done by both the fields at Q is zero

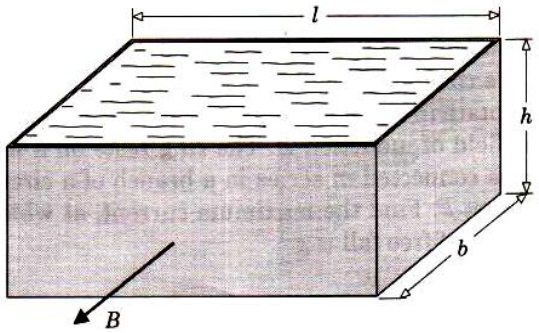
15. A thin flexible wire of length L is connected to two adjacent fixed points and carries a current I in the clockwise direction, as shown in the figure. When the system is put in a uniform magnetic field of strength B going into the plane of the paper, the wire takes the shape of circle. The tension in the wire is

(A) IBL (B) $\frac{IBL}{\pi}$

(C) $\frac{IBL}{2\pi}$ (D) $\frac{IBL}{4\pi}$

space for rough work

16. A conducting fluid of mass density ρ_m and electrical resistivity ρ_e is kept in an insulating vessels of dimensions $\ell \times b \times h$. The vessel is placed on a horizontal floor where a uniform horizontal magnetic field of induction B is established perpendicular to the face $\ell \times h$ as shown in the figure. How much potential difference V must be applied on the liquid between the side faces designated by dimensions $b \times h$ so that the fluid pressure at the bottom of the vessel vanishes ? The acceleration of free fall is g.



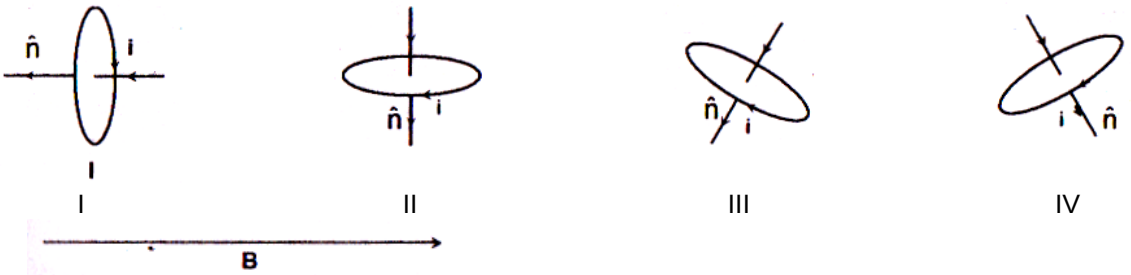
(A) $V = \frac{\rho_m \rho_e g \ell}{B}$

(B) $V > \frac{\rho_m \rho_e g \ell}{B}$

(C) $V < \frac{\rho_m \rho_e g \ell}{B}$

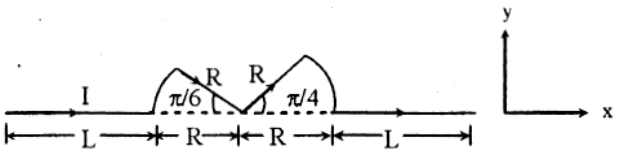
(D) can not be determined

17. As shown in the figure, four identical loops are placed in a uniform magnetic field B. The loops carry equal current i. $\hat{n}$ denotes the normal to the plane of each loop. Potential energies in descending order are



(A) I, II, III, IV (B) IV, II, III, I (C) I, III, II, IV (D) IV, III, II, I

18. A conductor (shown in the figure) carrying constant current I is kept in the x – y plane in a uniform magnetic field $\vec{B}$. If F is the magnitude of the total magnetic force acting on the conductor, then the correct statement(s) is (are)



(A) If $\vec{B}$ is along $\hat{z}, F \propto (L + R)$

(B) If $\vec{B}$ is along $\hat{x}, F = 0$

(C) If $\vec{B}$ is along $\hat{y}, F \propto (L + R)$

(D) If is along $\hat{z}, F = 0$

space for rough work

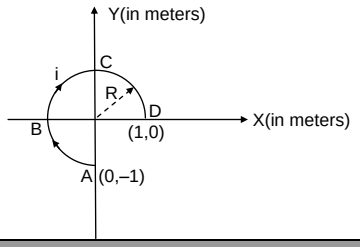
SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4×5 matrix whose layout will be similar to the one shown below:

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.
  - **+2** If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–1** In all other cases.

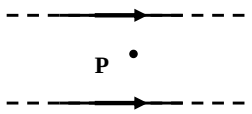
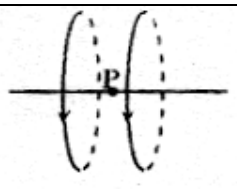
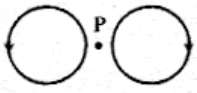
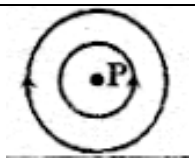
19. The wire ABCD is bent as shown in the figure and placed in xy-plane. It carries current i. A uniform magnetic field $\vec{B}$ of magnitude B_0 is applied in the region.



Column I		Column II	
(A)	If $\vec{B} = B_0\hat{j}$ the total force (in Newton) on the wire is	(p)	$iB_0\hat{k}$
(B)	If $\vec{B} = B\hat{i}$ the total force on the wire is	(q)	$-iB_0\hat{k}$
(C)	The magnetic field intensity due to current in wire ABCD at the origin is $\left(\frac{3\mu_0 i}{8}\right)(-\hat{k})$	(r)	$iB_0(\hat{i}-\hat{j})$
(D)	If $\vec{B} = B_0\hat{k}$ the total force (in Newton) on the wire is	(s)	$\frac{3\mu_0 I}{8}(-\hat{k})$
		(t)	$\frac{3\mu_0 i}{8}(\hat{k})$

space for rough work

20. Two wires each carrying a steady current I are shown in four configurations in column I. Some of the resulting effects are described in column II. Match the statements in column I with the statements in column II and indicate your answer by darkening appropriate bubbles in the 4 x 4 matrix given ORS

Column – I			Column – II	
(A)	Point P is situated midway between the wires		(p)	The magnetic fields (B) at P due to the currents in the wires are in the same direction.
(B)	Point P is situated at the mid-point of the line joining the centers of the circular wires, which have same radii		(q)	The magnetic field (B) at P due to the currents in the wires are in opposite directions
(C)	Point P is situated at the mid – point of the line joining the centres of the circular wires, which have same radii		(r)	There is no magnetic field at P
(D)	Point P is situated at the common center of the wires		(s)	The wires repel each other.
			(t)	None

space for rough work

PART II: CHEMISTRY

SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

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21. In the following reaction

$$xA \longrightarrow yB$$

$$\log -\frac{d[A]}{dt} = \log\left[\frac{d[B]}{dt}\right] + 0.6$$

where –ve sign indicates rate of disappearance of the reactant, thus x / y is

22. For the first order reaction, A(g) $\longrightarrow$ 2B(g) + C(s); $t_{1/2}$ = 24 min. The reaction is carried out taking certain mass of A enclosed in a vessel in which it exerts a pressure of 400mm Hg. The pressure of the reaction mixture after the expiry of 48min will be P x10^2 mm of Hg then P is

23. If the fermentation of sugar in an enzymatic solution that is 0.12 M, the concentration of the sugar is reduced to 0.06 M in 10 h and to 0.03 M in 20 h. What is the order of the reaction?

24. In the upper atmosphere H_2O and O react bimolecularly to form two OH radicals. ΔH for this reaction is 72 kJ at 500 K and E_a is 77 kJ mol^{-1}, then E_a for the bimolecular recombination of two OH radicals to form H_2O and O is (in kJ/ mole)

25. For a first order reaction, the ratio of time to complete 99.9% and 75%of the reaction is

26. A hydrogenation reaction is carried only at 500K. If the same reaction is carried out in presence of a catalyst at the same rate, the temperature required is 400K. If the catalyst lowers the activation barrier by 20 kJ mol^{-1} then the activation energy of the uncatalysed reaction is E_a kJ mole^{-1}. Find $\frac{E_a}{20}$ value.

27. Consider the following two first order reactions :

$A \to P$ ....(i)

$B \to Q$ ....(ii)

Reaction (i) is 75% complete in 4 hrs while reaction (ii) takes 16hrs for same 75% completion of reaction under identical conditions. By how many hours, half- life of (ii) is greater than the half- life of (i)?

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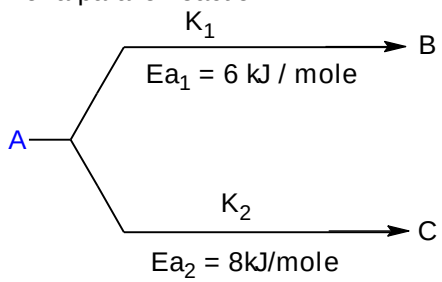
space for rough work

28. For a parallel reaction



The mole % of B & C after 1 hr was found to be same . Then the overall activation energy for the reaction is

SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

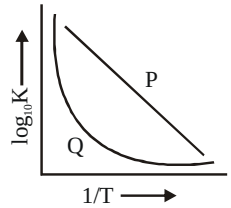
29. Which of the following statement is incorrect ?
(A) Unit of rate of disappearance is s^{-1} (B) Unit of rate of reaction is Ms^{-1}
(C) Unit of rate constant k is depend on order (D) Unit of k for first order reaction is Ms^{-1}

30. Which of the following statements is correct ?
(A) A second order reaction must be a bimolecular elementary reaction
(B) A bimolecular elementary reaction must be a second order reaction
(C) Zero order reaction must be a complex reaction
(D) First order reaction may be complex or elementary reaction

31. Rate constant k varies with temperature by equation, $\log k(\min^{-1}) = 5 - \frac{2000}{T(K)}$. We can conclude
(A) Pre-exponential factor A is 5 (B) E_a is 2000 kcal
(C) Pre-exponential factor A is 10^5 (D) E_a is 9.212 kcal

space for rough work

32. Which of the following statement are true regarding the log K vs. 1/T plot shown in the given diagram?



(a) Plot P shows that the energy of activation is independent of temperature
(b) Plot Q describes the behavior of temperature dependence of energy of activation
(c) Arrhenius behavior is described by P
(d) The slope of curve P gives the value $-\frac{E_a}{R}$

33. If the rate of reaction, $2SO_2(g) + O_2(g) \xrightarrow{Pt} 2SO_3(g)$ is given by :

$$\text{Rate} = K\frac{[SO_2]}{[SO_3]^{1/2}}$$

Which statements are correct
(a) The overall order of reaction is –1/2
(b) The overall order of reaction is +1/2
(c) The reaction slows down as the product SO_3 is build up
(d) The rate of reaction does not depend upon concentration of SO_3 formed

34. Consider $P \xrightarrow{k_1} Q$ $2P \xrightarrow{k_2} R$ $3P \xrightarrow{k_3} S$
Which is the differential rate equation for rate of disappearance of P

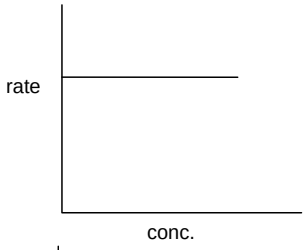
(A) $\frac{-d(P)}{dt} = k_1[P] + k_2[P]^2 + k_3[P]^3$ (B) $-\frac{d[P]}{dt} = [k_1 + k_2 + k_3][P]^6$

(C) $-\frac{d[P]}{dt} = k_1[P] + 2k_2[P]^2 + 3k_3[P]^3$ (D) $-\frac{d[P]}{dt} = k_1[P] + \frac{k_2}{2}[P]^2 + \frac{k_3}{3}[P]^3$

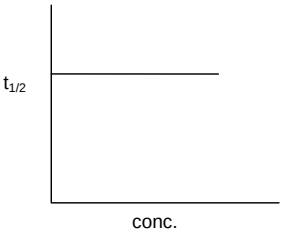
35. A catalyst
(A) increases the average kinetic energy of reacting molecules
(B) decreases the activation energy
(C) alters the reaction mechanism
(D) increases the frequency of collisions of reacting species.

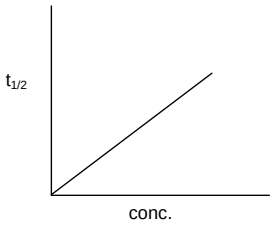
space for rough work

36. Choose the correct option(s) for a zero order reaction (a= initial concentration, K = rate constant, $t_{1/2}$ = half life)

(A) 

(B) $t_{1/2} = \frac{a}{2K}$

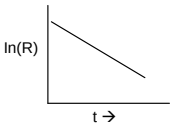
(C) 

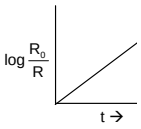
(D) 

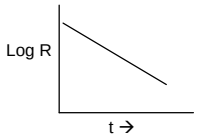
37. Which of the following is/are true for the first order reaction?

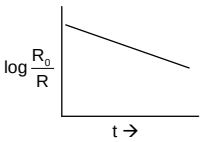
(A) $t_{3/4} = 2t_{1/2}$ (B) $t_{15/16} = 4t_{1/2}$ (C) $t_{15/16} = 3t_{3/4}$ (D) $t_{7/8} = 2t_{3/4}$

38. Which of the following is a correct representation of first order reactions? (R_0 is initial rate and R is rate at anytime)

(A) 

(B) 

(C) 

(D) 

space for rough work

SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4 × 5 matrix whose layout will be similar to the one shown below:

(A) (P) (Q) (R) (S) (T)
(B) (P) (Q) (R) (S) (T)
(C) (P) (Q) (R) (S) (T)
(D) (P) (Q) (R) (S) (T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.
  - **+2** If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–1** In all other cases.

39. For a first order reaction at 300 K the $t_{1/2}$ is 90 min. At 310 K $t_{1/2}$ is 22.5 min. for this reaction

Column – I (order)		Column – II (rate constant)	
(A)	$2t_{1/2}$ (300K)	(p)	Activation energy
(B)	107 kJ	(q)	$K_{(310\ K)}$
(C)	$t_{3/4}$ (300 k)	(r)	$4 \times K_{300K}$
(D)	3.1×10^{-2}	(s)	$8\ t_{1/2}$ (310k)

space for rough work

40.

Column – I (order)		Column – II (rate constant)	
(A)	Zero	(p)	$k=\frac{1}{2t}\left[\frac{1}{(a-x)^2}-\frac{1}{a^2}\right]$
(B)	First	(q)	$k=\frac{1}{t}\left[\frac{1}{(a-x)}-\frac{1}{a}\right]$
(C)	Second	(r)	$k=\frac{x}{t}$
(D)	Third	(s)	$k=\frac{1}{t}\log_e\left(\frac{a}{(a-x)}\right)$

PART III: MATHEMATICS

SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

41. Tangents drawn from the point P(2, 3) to the circle $x^2 + y^2 – 8x + 6y + 1 = 0$ touch circle at points A and B. The circumcircle of ΔPAB cuts the director circle of ellipse $\frac{(x+5)^2}{9}+\frac{(y-3)^2}{b^2}=1$ orthogonally. Then the value of $\frac{b^2}{6}$ is

42. Suppose x and y are real numbers and that $x^2 + 9y^2 – 4x + 6y + 4 = 0$, then the maximum value of $\frac{(4x-9y)}{2}$ is

space for rough work

43. Consider an ellipse E, $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, centered at point O and having AB and CD as its major and minor axes, respectively. If S_1 is one of the focus of the ellipse, the radius of the incircle of triangle OCS_1 is 1 unit, and $OS_1 = 6$ units, then the value of $\frac{(a-b)}{2}$ is

44. Rectangle ABCD has area 200. An ellipse with area 200π passes through A and C and has foci at B and D. If the perimeter of the rectangle is P, then the value of $\frac{P}{20}$ is

45. The number of points on the ellipse $\frac{x^2}{50}+\frac{y^2}{20}=1$ from which a pair of perpendicular tangents is drawn to the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$ is

46. P is the point on the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$ and Q is the corresponding point on the auxiliary circle of the ellipse. If the line joining the center C to Q meets the normal at P with respect to the given ellipse at K, then find the value of CK.

47. The length of the sides of the square which can be made by four perpendicular tangents to the ellipse $\frac{x^2}{7}+\frac{2y^2}{11}=1$ is

48. If $x, y \in R$, satisfies the equation $\frac{(x-4)^2}{4}+\frac{y^2}{9}=1$, then the difference between the largest and the smallest value of the expression $\frac{x^2}{4}+\frac{y^2}{9}$ is

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SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

49. The locus of the image of the focus of the ellipse $\frac{x^2}{25}+\frac{y^2}{9}=1$, (a > b), with respect to any of the tangents to the ellipse is
(A) $(x+4)^2+y^2=100$ (B) $(x+2)^2+y^2=50$ (C) $(x-4)^2+y^2=100$ (D) $(x-2)^2+y^2=50$

50. Consider the ellipse $\frac{x^2}{f\left(k^2+2k+5\right)}+\frac{y^2}{f\left(k+11\right)}=1$. If f(x) is a positive decreasing function, then
(A) the set of values of k for which the major axis is the x-axis is (–3, 2)
(B) the set of values of k for which the major axis is the y-axis is $(-\infty, 2)$
(C) the set of values of k for which the major axis is the y-axis is $(-\infty, -3) \cup (2, \infty)$
(D) the set of values of k for which the major axis is the y-axis is $(-3, \infty)$

51. If the tangent drawn at point $(t^2, 2t)$ on the parabola $y^2 = 4x$ is the same as the normal drawn at point $\left(\sqrt{5}\cos\theta, 2\sin\theta\right)$ on the ellipse $4x^2 + 5y^2 = 20$, then
(A) $\theta = \cos^{-1}\left(-\frac{1}{\sqrt{5}}\right)$ (B) $\theta = \cos^{-1}\left(\frac{1}{\sqrt{5}}\right)$ (C) $t = -\frac{2}{\sqrt{5}}$ (D) $t = -\frac{1}{\sqrt{5}}$

52. If the ellipse $\frac{x^2}{a^2-7}+\frac{y^2}{13-5a}=1$ is inscribed in a square of side length $\sqrt{2}a$, then a is equal to
(A) $\frac{6}{5}$ (B) $\left(-\infty,-\sqrt{7}\right)\cup\left(\sqrt{7},\frac{13}{5}\right)$
(C) $\left(-\infty,-\sqrt{7}\right)\cup\left(\frac{13}{5},\sqrt{7}\right)$ (D) no such a exists

space for rough work

53. In a triangle ABC with fixed base BC, the vertex A moves such that cos B + cos C = $4\sin^2\frac{A}{2}$. If a, b and c denote the lengths of the sides of the triangle opposite to the angles A, B and C respectively, then
(A) b + c = 4a (B) b + c = 2a
(C) the locus of point A is an ellipse (D) the locus of point A is a pair of straight lines

54. If the tangent at the point P(θ) to the ellipse $16x^2 + 11y^2 = 256$ is also a tangent to the circle $x^2 + y^2 - 2x = 15$, then θ =
(A) $\frac{2\pi}{3}$ (B) $\frac{4\pi}{3}$ (C) $\frac{5\pi}{3}$ (D) $\frac{\pi}{3}$

55. The coordinates (2, 3) and (1, 5) are the foci of an ellipse which passes through the origin. Then the equation of the
(A) tangent at the origin is $\left(3\sqrt{2}-5\right)x+\left(1-2\sqrt{2}\right)y=0$
(B) tangent at the origin is $\left(3\sqrt{2}+5\right)x+\left(1+2\sqrt{2}\right)y=0$
(C) normal at the origin is $\left(3\sqrt{2}+5\right)x-\left(2\sqrt{2}+1\right)y=0$
(D) normal at the origin is $x\left(3\sqrt{2}-5\right)-y\left(1-2\sqrt{2}\right)y=0$

56. Which of the following is/are true ?
(A) There are infinite positive integral values of a for which $(13x - 1)^2 + (13y - 2)^2 = \left(\frac{5x+12y-1}{a}\right)^2$ represents an ellipse
(B) the minimum distance of a point (1, 2) from the ellipse $4x^2 + 9y^2 + 8x - 36y + 4 = 0$ is 1
(C) If from a point P(0, α) two normals other than the axes are drawn to the ellipse $\frac{x^2}{25}+\frac{y^2}{16}=1$, then $|\alpha| < \frac{9}{4}$
(D) If the length of the latus rectum of an ellipse is one-third of its major axis, then its eccentricity is equal to $\frac{1}{\sqrt{3}}$

space for rough work

57. An ellipse passes through the point (4, –1) and touches the line x + 4y – 10 = 0. Find its equation if its axes coincide with the coordinate axes.

(A) $\frac{x^2}{80}+\frac{4y^2}{5}=1$ (B) $\frac{x^2}{40}+\frac{y^2}{5}=1$ (C) $\frac{x^2}{20}+\frac{y^2}{5}=1$ (D) $\frac{4x^2}{5}+\frac{y^2}{40}=1$

58. Find the point on the ellipse $16x^2 + 11y^2 = 256$ where the common tangent to it and the circle $x^2 + y^2 – 2x = 15$ touch

(A) $2+\frac{8\sqrt{3}}{\sqrt{11}}$ (B) $2-\frac{8\sqrt{3}}{\sqrt{11}}$ (C) $4+\frac{5\sqrt{3}}{11}$ (D) $4-\frac{5\sqrt{3}}{11}$

SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4×5 matrix whose layout will be similar to the one shown below:

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.

+2 If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
0 If none of the bubbles is darkened.
–1 In all other cases.

space for rough work

59. Match the following

Column I		Column II	
(A)	An ellipse passing through the origin has its foci (3, 4) and (6, 8). Then the length of its minor axis is	p.	8
(B)	If PQ is a focal chord of the ellipse $\frac{x^2}{25}+\frac{y^2}{16}=1$ which passes through $S \equiv (3, 0)$ and PS = 2, then the length of chord PQ is	q.	$10\sqrt{2}$
(C)	If the line $y = x + K$ touches the ellipse $9x^2 + 16y^2 = 144$, then the difference of values of K is	r.	10
(D)	The sum of distances of a point on the ellipse $\frac{x^2}{9}+\frac{y^2}{16}=$ 1 from the foci is	s.	12

60.

Column I		Column II	
(A)	A stick of length 10m slides on the co-ordinate axes. Then locus of the point dividing this stick from the x-axis in the ratio 6 : 4 is a curve whose eccentricity is e. Then 3e is equal to	p.	$\sqrt{6}$
(B)	AA′ is the major axis of the ellipse $3x^2 + 2y^2 + 6x – 4y – 1 = 0$ and P is a variable point on it. Then the greatest area of triangle APA′ is	q.	$2\sqrt{7}$
(C)	The distance between the foci of the curve represented by the equation $x = 1 + 4 \cos \theta$, $y = 2 + 3 \sin \theta$ is	r.	$\frac{128}{3}$
(D)	Tangents are drawn to the ellipse $\frac{x^2}{16}+\frac{y^2}{7}=1$ at the endpoints of the latus rectum. The area of the quadrilateral so formed is	s.	$\sqrt{5}$

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FIITJEE RET – 7

(2017 – 2019)(2ND YEAR_REGULAR)

IIT-2015 (P1)_SET–B

DATE: 13.08.2018

ANSWERS

PHYSICS

1.	**8**	2.	**0**	3.	**3**	4.	**5**
5.	**3**	6.	**5**	7.	**7**	8.	**4**
9.	**A,C**	10.	**C**	11.	**B**	12.	**A,B,D**
13.	**A,C**	14.	**A,B,D**	15.	**C**	16.	**A,B**
17.	**C**	18.	**A,B,C**	19.	**A → p, B → q, C → s, D → r**		
20.	**A → q, r; B → p; C → q, r; D → q**						

CHEMISTRY

21.	**4**	22.	**7**	23.	**1**	24.	**5**
25.	**5**	26.	**5**	27.	**6**	28.	**7**
29.	**A, D**	30.	**C, D**	31.	**C, D**	32.	**A, B, C**
33.	**B, C**	34.	**C**	35.	**B, C**	36.	**A, B, D**
37.	**A, B**	38.	**A, B, C**	39.	**A → s; B → p; C → s; D → q, r**		
40.	**A → r; B → s; C → q; D → p**						

MATHEMATICS

41.	**9**	42.	**8**	43.	**4**	44.	**4**
45.	**4**	46.	**7**	47.	**5**	48.	**8**
49.	**AC**	50.	**AC**	51.	**AD**	52.	**D**
53.	**BC**	54.	**CD**	55.	**AC**	56.	**ABC**
57.	**AC**	58.	**AB**	59.	**A → q; B → r; C → r; D → p**		
60.	**A → s; B → p; C → q; D → r**						