FIITJEE RET – 5

(2017 – 2019)(2ND YEAR_CHAMPIONS)

IIT-2017 (P1)

DATE: 23.07.2018

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. Current I flowing along edges of one face of a cube as shown in the figure – I, produces magnetic field $\vec{B} = B_0\hat{j}$ at the center of the cube. Consider another identical cube, where the current I flows along the path shown in the figure II. magnetic field exists at the centre of the second cube is $(B_0\left(\alpha\hat{i}+\beta\hat{j}+\gamma\hat{k}\right))$ then $\alpha+\beta+\gamma$ is

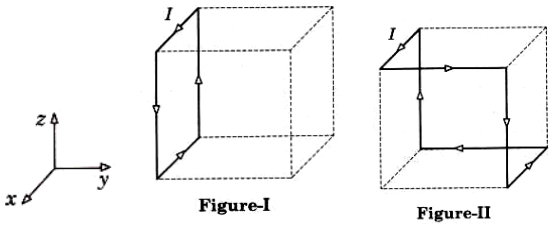
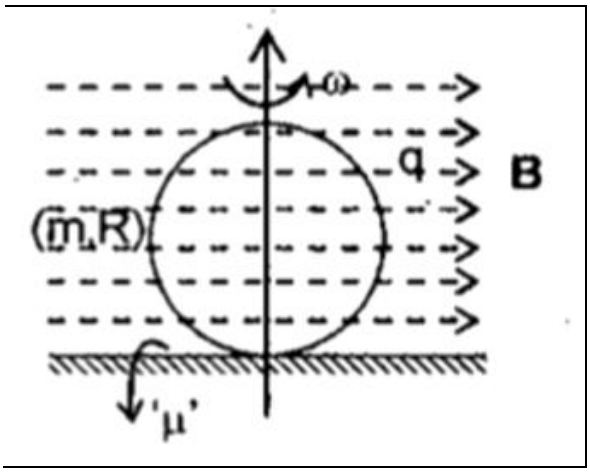


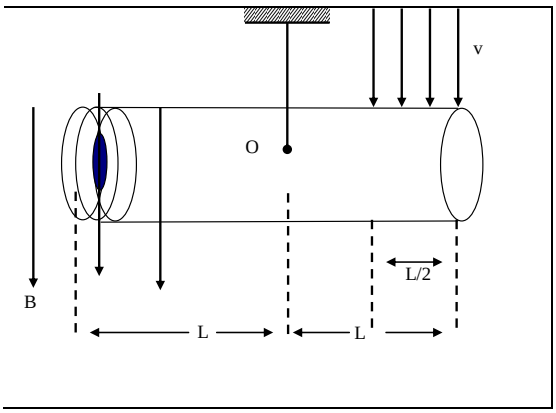
Figure-I Figure-II

2. A non conducting hollow sphere of mass m and radius R, having total charge 'q' is rotating with constant angular velocity ω about a vertical axis as shown in the figure. The sphere is then gently placed on the horizontal direction as shown having a magnetic field applied in the horizontal direction as shown. If there is sufficient friction to prevent any slipping, then the friction force acting on the sphere at t= 0 is $\frac{q\omega RB}{n}$. Find the value of n.

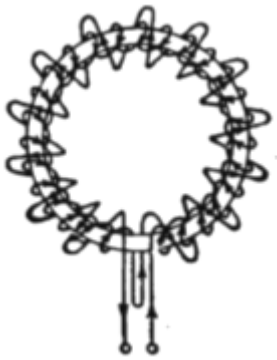


Space for rough work

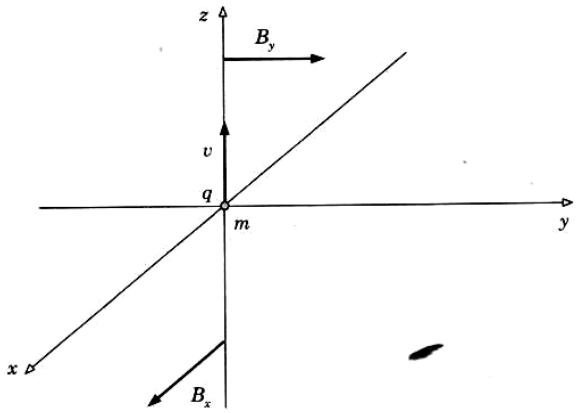
3. A non – conducting non magnetic rod having circular cross section of radius R is suspended from a rigid support as shown in the figure. A light and small coil of 300 turns is wrapped tightly at the left end of the rod where magnetic field B exists in vertically downward direction.
Air of density ρ this the half of the right part of the rod with velocity v (see the fig). What should be the current in ampere in clockwise direction (as seen O) in the coil so that the rod remains horizontal ?
Given V= $\frac{2}{L}\sqrt{\frac{\pi RB}{\rho}}$ m/s



4. Two winding connected as shown in fig are wound around a thin in iron ring with a radius R = 10 cm. The first winding has 2,000 turns and the second 1,000 turns . The intensity of the magnetic field the ring if a current of I = 10 A flows through the winding is $\alpha \times 10^{-2}$ Tesla then α is

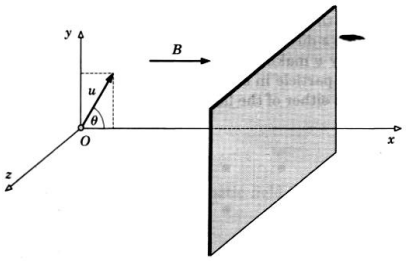


5. A particle of mass m and charge q is given velocity v in the positive z–direction at the origin of a coordinate frame. Above the plane z = 0 is a uniform and constant magnetic field of induction B_y in the positive y–direction and below the plane z = 0 is a uniform and constant magnetic field of induction B_x in the positive x–direction. Determine the coordinates of the point where the particle crosses the plane z=0 third time is $\left(-\frac{\alpha mv}{qB_y}, -\frac{\beta mv}{qB_x}\right)$. Then $\alpha + \beta$

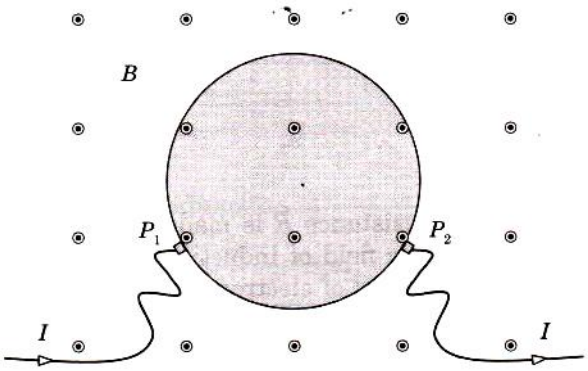


Space for rough work

6. In a region of free space, a uniform magnetic field of induction B is established everywhere pointing in the positive x–direction. A rigid plane is fixed perpendicular to the x–axis at a certain distance from the origin. A particle of mass m and charge q is projected from the origin with its velocity vector $\vec{u}$ in the x–y plane making angle θ with the x–axis as shown in the figure. After an elastic collision with the plane, the particle loses half of its charge and then returns to the point of projection passing n times through the x–axis. Find distance of the plane from the origin is $\frac{\alpha\pi nmu\cos\theta}{qB}$. Then α is



7. On a rough horizontal tabletop rests a thin uniform conducting disk of radius r and mass m. The coefficient of friction between the disk and the tabletop is μ. From two points P_1 and P_2 on the rim of the disk. The contact points P_1 and P_2 subtend an angle θ at the center of the disk. On the tabletop is established a uniform magnetic field of induction B pointing vertically upward. minimum current through the disk will the disk start sliding ? The acceleration of free fall is g is $\frac{\mu mg}{\alpha Br\sin\left(\frac{\theta}{\beta}\right)}$. Then $2\alpha+\beta$ is



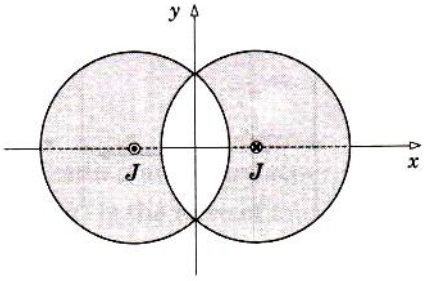
8. Single layer conducting coil is wound with no gap between adjacent turns on a cylindrical frame of radius R. Diameter of cross – section of the wire used is d (d<< R). If breaking stress of the material of the wire is σ_b, magnitude of current will the coil burst is $\frac{1}{\sqrt{\beta}}\sqrt{\frac{\sigma_b\pi d^3}{\mu_0 R}}$ then β 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. 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

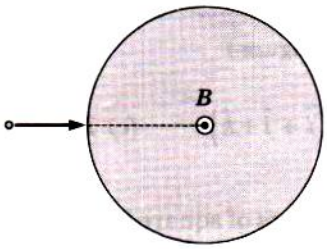
(B) It is nonuniform and points in the positive y –direction everywhere on the x and y –axis

(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

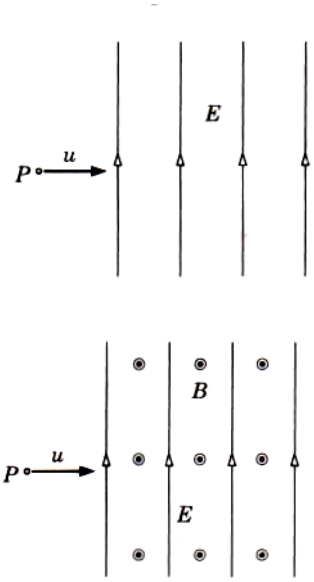
10. Several α – particles of different speeds enter a uniform magnetic field confined into a cylindrical region. If all the α – particles enter the field radially and perpendicular to the axis of the cylindrical region, what can you say about the time interval that these particles spend in the magnetic field ?
(A) Faster is the particle, lesser is the time
(B) Slower is the particle, lesser is the time
(C) Slower is the particle, greater is the time
(D) The time is same for all the particle.



11. A particle P having positive charge q enters a region with velocity u perpendicular to the uniform electric field of intensity E present in that region and exists the opposite side of the region with speed v_1. Now the experiment is repeated with a uniform magnetic field of induction B superimposed on the electric field keeping all other parameters unchanged as shown in the second figure. in this experiment, the particle exits the opposite side of the region with velocity v_2
What can you conclude regarding speeds v_1 and v_2 ?

(A) If $u < \frac{E}{B}$ then $v_2 < v_1$ (B) If $u = \frac{E}{B}$ then $v_2 < v_1$

(C) If $u = \frac{E}{B}$ then $v_2 = v_1$ (D) If $u > \frac{E}{B}$ then $v_2 < v_1$



Space for rough work

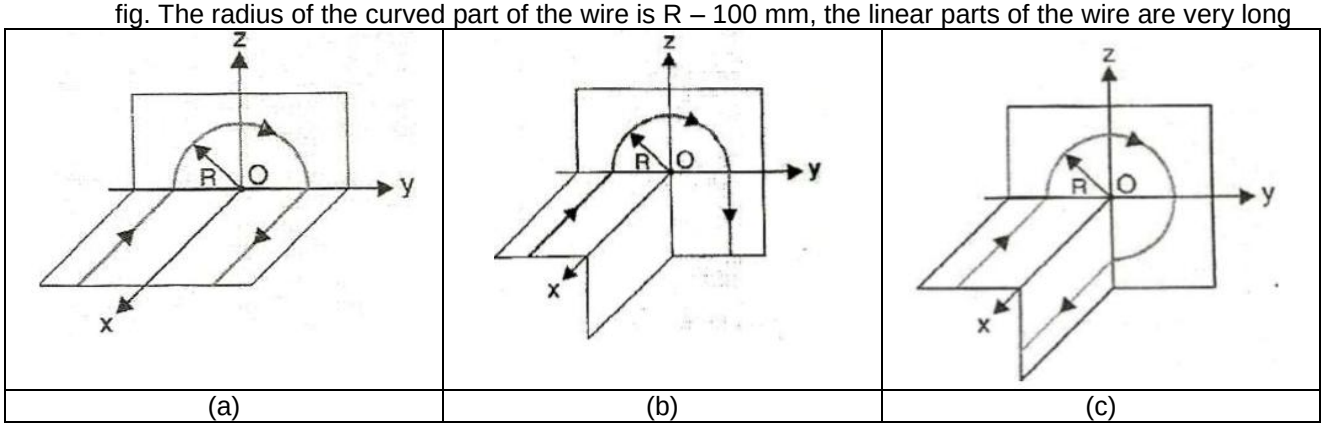
12. In a homogeneous, non – magnetic, highly insulating and viscous medium, a moving particle experiences a viscous drag given by the law $\vec{f} = -b\vec{v}$. Here b is a positive constant. A particle having charge q projected with an unknown velocity from a point in the medium almost stops (its speed becomes partially negligible) after traveling a distance of 10 m in a straight line.
Now a uniform magnetic field is established in the region and the same particle again launched with the same projection velocity directed perpendicular to the magnetic field.

(A) The path followed by the particle in presence of the magnetic field is spiral path of decreasing radius of curvature
(B) In the presence of above magnetic field, if the particle almost stops at a point 6 m away from the point of projection, the magnetic field is equal to 4b / 3q

(C) The strength of the magnetic field is now doubled in magnitude. Distance of the the point of projection where the particle come to an almost rest is $\frac{30}{\sqrt{73}}$
(D) The path followed by the particle in presence of the magnetic field is spiral path of increasing radius of curvature

13. A very long wire carrying a current I = 5.0 A is bent at right angles. the magnetic induction at a point lying on a perpendicular to the wire, drawn through the point of bending, at a distance I = 35 cm from it is
(A) $2\mu T$ (B) $0.3\,\mu T$ (C) $4\mu T$ (D) $0.8\mu T$

14. Find the magnetic induction at the point Q if the wire carrying a current I = 8.0 A lies the shape shown in fig. The radius of the curved part of the wire is R – 100 mm, the linear parts of the wire are very long

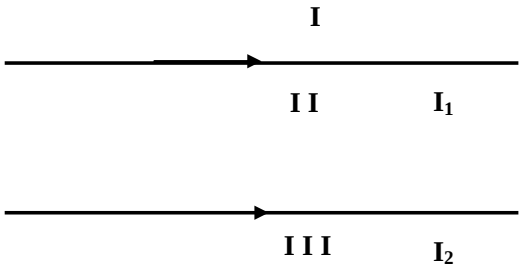


(a) (b) (c)

(A) Magnetic field is case (a) is 0.3 μT
(B) Magnetic field is case (b) is 0.3 μT
(C) Magnetic field is case (b) is 0.8 μT
(D) Magnetic field is case (c) is 0.5 μT

Space for rough work

15. Current I_1 and I_2 flow in the same direction along two parallel conductors, with $I_1 > I_2$. In which of the three regions. I, II or III and at what distance from the conductor is the magnetic induction equal to zero ?



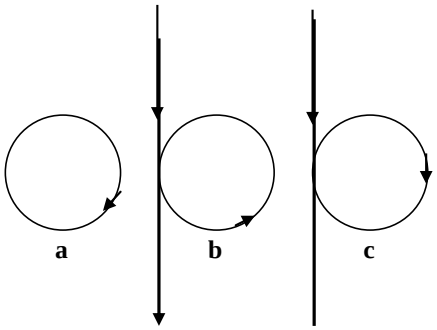
(A) $\frac{I_1 a}{I_1 + I_2}$ from wire carrying I_1 current

(B) $\frac{I_2 a}{I_1 + I_2}$ from wire carrying I_2 current

(C) a/2 from both wire if $I_1 = I_2$

(D) There is no point possible in the plane containing the wires

16. Equal current are flowing along the three conductors a ring radius R (fig a), an infinitely long straight conductor that forms a loop of the same radius R (fig b), and an infinitely long straight conductor that also forms a loop of radius R but is broken at the point where the loop touches the conductor (fig c). The relationships that link the magnetic induction at the center of the each circle.



(A) $B_b = 1.32 B_a$

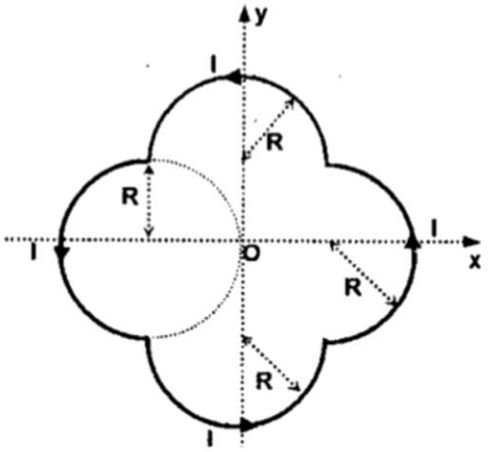
(B) $B_c = \frac{\pi - 1}{\pi} B_a$

(C) $B_a = \frac{\pi - 1}{\pi} B_c$

(D) $B_c = 0.68 B_a$

Space for rough work

17. A system of four semi – circular wires of radius a carrying current I as shown in the figure.



(A) The magnetic field at 'O' due to current carrying loop is $\frac{\mu_0 I}{2\pi R}\ell n\left(\sqrt{2}+1\right)\left(\hat{k}\right)$

(B) The magnetic field at 'O' due to current carrying loop is $\frac{\mu_0 I}{\pi R}\ell n\left(\sqrt{2}+1\right)\left(\hat{k}\right)$

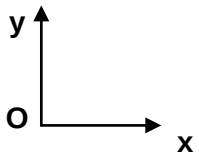
(C) The magnetic moment of the system is $4R^2 I(2+\pi)\left(+\hat{k}\right)$

(D) The magnetic moment of the system is $2R^2(2+\pi)\left(+\hat{k}\right)$

18. The space has electromagnetic field which varies with time whose variation is given as

$$\vec{B}=\begin{cases}-B_0\hat{k} & \text{if} \quad 0\le t\le\frac{\pi m}{qB_0}\\ -B_0\hat{j} & \text{if} \quad \frac{\pi m}{qB_0}\le t\le\frac{2\pi m}{qB_0}\\ 0 & \text{if} \quad \frac{2\pi m}{qB_0}\le t\le\infty\end{cases} \text{ and } \vec{E}=\begin{cases}0 & \text{if} \quad 0\le t\le\frac{2\pi m}{qB_0}\\ -E_0\hat{k} & \text{if} \quad \frac{2\pi m}{qB_0}\le t\le\infty\end{cases}$$

A charge particle having mass m and positive charge q is given velocity $v_0\hat{i}$ at origin at t =0 sec. The coordinates of point x – y plan when it is passing through x – y plane again is $(x_0,y_0,0)$ [Ignore the effect of any induced electromagnetic field due to sudden change in magnetic or electric fields]. Choose the correct answers.



(A) $X_0=\frac{2mV_0}{q}\sqrt{\frac{V_0}{E_0B_0}}$ (B) $X_0=\frac{mV_0}{q}\sqrt{\frac{V_0}{E_0B_0}}$

(C) $y_0=\frac{mV_0}{qB_0}$ (D) $y_0=\frac{2mV_0}{qB_0}$

Space for rough work

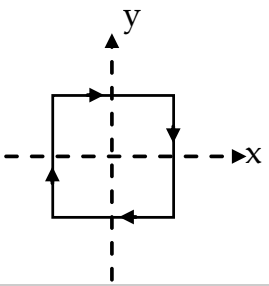
SECTION 3 (Maximum Marks: 16)

- 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.

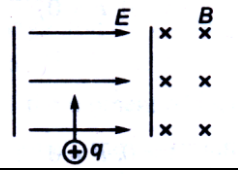
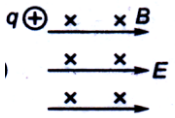
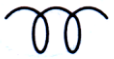
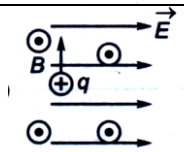
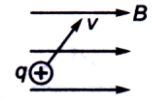
19. Assume the loop is of square shape with each side a.



Column – I		Column -II	
(A)	$\vec{\tau} = \vec{\mu} \times \vec{B}$	(p)	$\vec{B} = B_0\hat{i}; B_0 \rightarrow +$ve constant
(B)	$\vec{\tau} \neq \vec{\mu} \times \vec{B}$	(q)	$\vec{B} = B_0(k-y)\hat{i}; B_0, k \rightarrow +$ve constant; k>a
(C)	Torque about any point will be same	(r)	$\vec{B} = B_0(k-x)\hat{i}; B_0, k \rightarrow +$ve constant; k>a
(D)	Torque about any point will not be same	(s)	$\vec{B} = B_0(k^2-y^2)\hat{i}; B_0, k \rightarrow +$ve constant; k>a

Space for rough work

20. Match the following

	Systems			Path of charge particles
(A)	The charge q is projected perpendicular to the electric field. Then it moves through the magnetic field.		(p)	
(B)	The charge is released from rest in a crossed $\vec{B}$ and $\vec{E}$		(q)	
(C)	The charge is projected perpendicular to E in a crossed $\vec{B}$ and $\vec{E}$		(r)	
(D)	The charge is projected at a non-zero angle θ (< 90°) with the magnetic induction.		(s)	

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. Choose the no. of INCORRECT statement(s)
(i) Molecularity can never be negative
(ii) In general molecularity and order are same for an elementary reaction
(iii) For zero order reaction rate is independent of initial concentration
(iv) In Arrhenius equation the units of A depend on the order of reaction

22. The first order decomposition of di–tert–butylperoxide (DTBP) to acetone is given by the equation:
$C_8H_{18}O_{2(g)} \rightarrow 2CH_3COCH_{3(g)} + C_2H_{6(g)}$
The reaction has a half life of 80 min at 147°C. Starting with pure DTBP in a flask of constant volume at a pressure of 800 torr. At what time (in hour) the partial pressure of DTBP be 100 torr

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Space for rough work

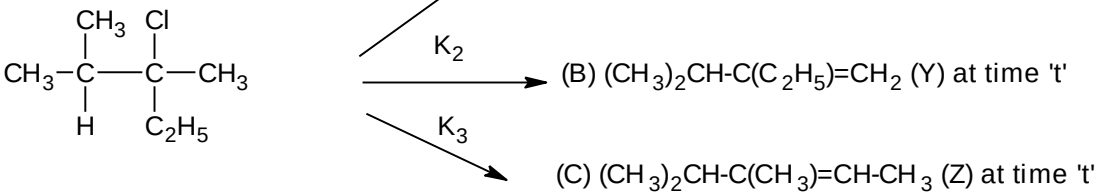
23. What is the pH of a solution when 0.2 mole of 'HCl' is added to one litre solution containing 0.1 M each of acetic acid and acetate ion ?

24. Two buffers (X) and (Y) of pH = 4.0 and 6.0 respectively are prepared from acid HA and the salt NaA. Both the buffers are 0.5M in HA. What would be the pH of the solution obtained by mixing equal volumes of two buffers? K(HA) = 1×10^{-5}. (Answer in nearest whole integer)

25. How many of the following statement(s) is/are incorrect ?
1) the pH of 1.0×10^{-8} M solution of HCl is 8
2) the conjugate base of $H_2PO_4^-$ is HPO_4^{2-}
3) autoprotolysis constant of water increases with temperature
4) When a solution of a weak monoprotic acid is titrated against a strong base at half neutralization point, pH = (1/2) pKa.

26. Number of neutrons in a parent nucleus 'X' which gives N_7^{14} after two successive $\beta-$ emission would be

27. For a given parallel reaction taking place in presence of $EtO^{(-)}\ Na^{(+)}$/ EtOH



If x : y : z is 4 : 2 : 1 and $K_2 = 2 \times 10^{-2}$ L $mol^{-1}s^{-1}$ and the value of the overall rate constant (K) is [A x 10^{-2}] L $mol^{-1}s^{-1}$ then the value if 'A' is

28. The number of neutrons emitted when $^{235}_{92}U$ undergoes controlled nuclear fission to $^{142}_{54}Xe$ and $^{90}_{38}Sr$ is

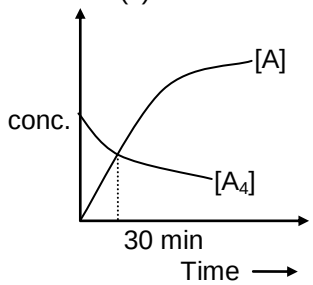
Space for rough work

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

29. Which of the following 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) $t_{7/8} = 2t_{3/4}$

30. Consider the following first order decomposition reaction: $A_4(g) \rightarrow 4A(g)$. Which of the following statement(s) is/are correct regarding the reaction? (Take ln2=0.69 & ln1.25=0.23)



(A) At 30 min. only 20% reaction is complete. (B) $t_{1/2}$ of reaction is approximately 90 min.
(C) Rate of reaction decreases linearly with time.
(D) The time for intersection of two curves is independent of initial concentration of A_4.

31. Select the correct statement(s):
(A) When $T \rightarrow \infty$ or $E_a \rightarrow 0$ then k = A
(B) A positive catalyst can change ΔH of the reaction
(C) A zero order reaction is completed in $2t_{1/2}$
(D) $t_{1/2}$ of first order reaction is independent of initial concentration of reactant

32. A 1 litre solution of PH = 2 is diluted 10 times, what volume of the solution pH = 3 is to be added to the above diluted solution so that the pH does not change
(A) 1 Litre (B) 11 litre (C) 25 litre (D) 20 litre

Space for rough work

33. If Ka_1 Ka_2 Ka_3 be the first, second and third ionization constant of H_3PO_4 and $Ka_1 > Ka_2 > Ka_3$ which is/are incorrect

(A) $H^+ \simeq \sqrt{Ka_1[H_3PO_4]}$ (B) $(H^+) \simeq [HPO_4^{-2}]$ (C) $Ka_2 \simeq [HPO_4^{-2}]$ (D) $[HPO_4^{-2}] = [PO_4^{-3}]$

34. Which of the following mixture of solutions will act as buffer solutions ?
(A) 10 ml 0.1 M HCl + 20 ml 0.1 M CH_3COONa
(B) 50 ml 1 M NH_4OH + 25 ml 1M HCl
(C) Aqueous solution of Borax (D) 20 ml 1M CH_3COOH + 40 ml 0.4 M NaOH

35. In the decay process, Which of the following results in the formation of isobar
(A)beta emission (B)positron emission (C) alpha emission (D)K-capture

36. A radioactive isotope A_z^p decays to give B_{z-6}^{p-12} stable nucleus by emitting the α - particles. If 2P gm of A are taken and kept in a sealed tube, how much He will accumulate in 20 days at 127^0C and 8.2 atmosphere
(A) 134.4 lit. (B) 6 lit (C) 24 lit (D) 12 lit

37. If concentrations of two acids are same, their relative strengths can be compared by
(A) α_1/α_2 (B) K_1/K_2 (C) $[H^+]_1/[H^+]_2$ (D) $\sqrt{K_1/K_2}$

38. In the following reaction,

$$\underset{(A)}{[Cu(H_2O)_3(OH)]^+} + \underset{(B)}{[Al(H_2O)_6]^{3+}} \rightarrow \underset{(C)}{[Cu(H_2O)_4]^{2+}} + \underset{(D)}{[Al(H_2O)_5(OH)]^{2+}}$$

(A) (A) is an acid and (B) is a base (B) (A) is a base and (B) is an acid
(C) (C) is the conjugate acid of (A) and (D) is the conjugate base of (B)
(D) (C) is the conjugate base of (A) and (D) is the conjugate acid of (B)

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		Column – II	
(A)	${}_7N^{14} + {}_2He^4 \longrightarrow {}_8O^{17} + ...$	(p)	${}_0n^1$
(B)	$2_1H^3 \longrightarrow {}_2He^4 + 2.....$	(q)	${}_1H^1$
(C)	${}_{94}Pu^{239} + {}_2He^4 \longrightarrow {}_{96}Cm^{242} + ...$	(r)	${}_2He^4$
(D)	${}_{29}Cu^{53} \longrightarrow {}_{28}Ni^{53} + ...$	(s)	${}_1e^0$

40. Match the following

List–I (Series)		List–II (Particles emitted)	
(A)	Thorium	(p)	8α, 5β
(B)	Neptunium	(q)	8α, 6β
(C)	Actinium	(r)	6α, 4β
(D)	Uranium	(s)	7α, 4β

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. If the line $\ell x + my + n = 0$ cuts the ellipse $\left(\frac{x^2}{a^2}\right)+\left(\frac{y^2}{b^2}\right) = 1$ at points whose eccentric angles differ by $\frac{\pi}{2}$, then find the value of $\frac{\left(a^2\ell^2 + b^2m^2\right)}{2n^2}$.

42. 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

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. 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

45. 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

Space for rough work

46. For the ellipse $\frac{x^2}{9}+\frac{y^2}{4}=1$ with vertices A and A′, tangent drawn at the point P in the first quadrant meets the y-axis at Q and the chord A′P meets the y-axis at M. If O is the origin, then $OQ^2 - MQ^2$ is equal to

47. Tangents are drawn from the point (α, β) to the hyperbola $3x^2 - 2y^2 = 6$ and are inclined at angles θ and ϕ to the x-axis. If $\tan\theta \cdot \tan\phi = 2$, then the value of $2\alpha^2 - \beta^2$ is

48. The area of triangle formed by the tangents from the point (3, 2) to the hyperbola $x^2 - 9y^2 = 9$ and the chord of contact w.r.t the point (3, 2) 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:
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  - **–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. 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 $P(0, \alpha)$ 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

51. 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 (–∞, 2)
(C) the set of values of k for which the major axis is the y-axis is (–∞, –3) ∪ (2, ∞)
(D) the set of values of k for which the major axis is the y-axis is (–3, ∞)

52. If the chord through the points whose eccentric angles are θ and ϕ on the ellipse $\frac{x^2}{25}+\frac{y^2}{9}=1$ passes through a focus, then the value of $\tan\left(\frac{\theta}{2}\right)\tan\left(\frac{\phi}{2}\right)$ is

(A) $\frac{1}{9}$ (B) –9 (C) $-\frac{1}{9}$ (D) 9

53. If the curves $\frac{x^2}{4}+y^2=1$ and $\frac{x^2}{a^2}+y^2=1$ for a suitable value of a cut on four concyclic points, the equation of the circle passing through these four points is

(A) $x^2+y^2=2$ (B) $x^2+y^2=1$ (C) $x^2+y^2=4$ (D) none of these

54. 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

55. The locus of the point of intersection of the lines $\sqrt{3}x-y-4\sqrt{3}t=0$ and $\sqrt{3}tx+ty-4\sqrt{3}=0$ (where t is a parameter) is a hyperbola whose eccentricity is

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

Space for rough work

56. With one focus of the hyperbola $\frac{x^2}{9}-\frac{y^2}{16}=1$ as the centre, a circle is drawn which is tangent to the hyperbola with no part of the circle being outside the hyperbola. The radius of the circle is

(A) less than 2 (B) 2 (C) $\frac{1}{3}$ (D) none of these

57. From the point (2, 2), tangents are drawn to the hyperbola $\frac{x^2}{16}-\frac{y^2}{19}=1$. Then the point of contact lies in the

(A) first quadrant (B) second quadrant (C) third quadrant (D) fourth quadrant

58. For the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$, let n be the number of points on the plane through which perpendicular tangents are drawn.

(A) If n = 1, then e = $\sqrt{2}$ (B) If n > 1, then 0 < e < $\sqrt{2}$

(C) If n = 0, then e > $\sqrt{2}$ (D) none of these

SECTION 3 (Maximum Marks: 16)

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(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.

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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)	If the vertices of a rectangle of maximum area inscribed in the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ are extremities of latus rectum, then the eccentricity of the ellipse is	p.	$\frac{2}{\sqrt{5}}$
(B)	If the extremities of the diameter of the circle $x^2 + y^2 = 16$ are the foci of the ellipse, then the eccentricity of the ellipse, if its size is just sufficient to contain the circle, is	q.	$\frac{1}{\sqrt{2}}$
(C)	If the normal at point (6, 2) to the ellipse passes through its nearest focus (5, 2), having centre at (4, 2), then its eccentricity is	r.	$\frac{1}{3}$
(D)	If the extremities of the latus rectum of the parabola $y^2 = 24x$ are the foci of ellipse, and if the ellipse passes through the vertex of the parabola, then its eccentricity is	s.	$\frac{1}{2}$

60. Match the following

Column I		Column II	
(A)	The points common to the hyperbola $x^2 – y^2 = 9$ and the circle $x^2 + y^2 = 41$ are	p.	(–5, –4)
(B)	Tangents are drawn from the point $\left(0,-\frac{9}{4}\right)$ to the hyperbola $x^2 – y^2 = 9$. Then the point of tangency may have coordinates	q.	(5, 4)
(C)	The point which is diametrically opposite to point (5, 4) with respect to the hyperbola $x^2 – y^2 = 9$ is	r.	(–5, 4)
(D)	If P and Q lie on the hyperbola $x^2 – y^2 = 9$ such that the area of the isosceles triangle PQR, where PR = QR = 10 sq. units and R ≡ (0, –6), then P can have the coordinates	s.	(5, –4)

Space for rough work

FIITJEE RET – 5

(2017 – 2019)(2ND YEAR_CHAMPIONS)

IIT-2017 (P1)

DATE: 23.07.2018

ANSWERS

PHYSICS

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

CHEMISTRY

21.	**0**	22.	**4**	23.	**1**	24.	**6**
25.	**2**	26.	**9**	27.	**7**	28.	**3**
29.	**AB**	30.	**ABD**	31.	**ACD**	32.	**Bonus**
33.	**B, D**	34.	**A, B, C**	35.	**A, B, D**	36.	**Bonus**
37.	**C**	38.	**B, C**				
39.	**A → q ; B → p ; C → p ; D → s**						
40.	**A → r ; B → p ; C → s ; D → q**						

MATHEMATICS

41.	**1**	42.	**9**	43.	**2**	44.	**8**
45.	**4**	46.	**4**	47.	**7**	48.	**8**
49.	**CD**	50.	**ABC**	51.	**AC**	52.	**B,C**
53.	**D**	54.	**D**	55.	**B**	56.	**B**
57.	**CD**	58.	A,C or **ABC**	59.	**A → q; B → q; C → s; D → p**		
60.	**A → p, q, r, s; B → q, r; C → p; D → p, s**						