FIITJEE RET – 3

(2018 – 2020)(1ST YEAR_REGULAR)

IIT-2015 (P1)_SET–A

DATE: 25.06.2018

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.

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1. If $y = (\sin x)^2$ then $\frac{dy}{dx} = k \sin 2x$, find the value of k?

2. You are given vectors $\vec{A} = 5\hat{i} - 6.5\hat{j}$ and $\vec{B} = 10\hat{i} - 7\hat{j}$. A third vector C lies in the x-y plane. Vector $\vec{C}$ is perpendicular to vector $\vec{A}$ and the scalar product of $\vec{C}$ with $\vec{B}$ is 15. From this information, if the X-component of $\vec{C}$ is (39/2x), then x is?

3. On a horizontal flat ground, a person is standing at a point A. At this point, he installs a 5 m long pole vertically. Now, he moves 5 m towards east and then 2 m towards north and reaches at a point B. There he installs another 3 m long vertical pole. A bird flies from the top of the first pole to the top of the second pole. If the magnitude of the displacement of the bird is $\sqrt{25+n}$ then n?

4. The components of a vector along the x- and y-directions are (n + 1) and 1, respectively. If the coordinate system is rotated by an angle θ = 60°, then the components change to $\frac{n}{2}$ and 3. Then value of n is?

5. Angle between the vectors $(\hat{i}+\hat{j})$ and $(\hat{j}+\hat{k})$ is $\frac{2\pi}{n}$, then n is?

6. If $\vec{a}$ and $\vec{b}$ are two units vectors such that $\vec{a}+2\vec{b}$ and $5\vec{a}-4\vec{b}$ are perpendicular to each other, then the angle between $\vec{a}$ and $\vec{b}$ is $\frac{2\pi}{n}$, then n is?

Space for rough work

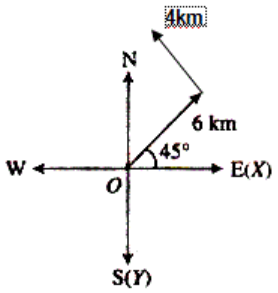
7. The components of a vector along x and y-directions are A cos θ and A sin θ respectively. If the co-ordinate system is rotated by 60^0 then the components are found to be equal to 3 and 4. Then the value of A is?

8. The projection of a vector $\vec{r} = 3\hat{i} + \hat{j} + 2\hat{k}$ on the Y–Z plane has magnitude given by $\sqrt{\frac{20}{n}}$. The value of n 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

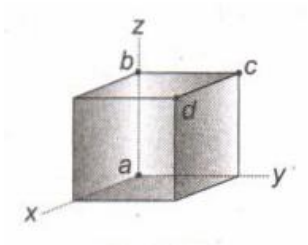
9. A car travels 6 km towards north at an angle of 45^0 to the east and then travels distance of 4 km towards north at angle of 135^0 to the east as shown in fig. Shortest distance between initial and final points is.



(A) $\sqrt{32}$km (B) $1\sqrt{32}$m

(C) $\sqrt{52}$m (D) $\sqrt{52}$km

10. A cube is placed so that one corner is at the origin and three edges are along the x–,y–, and z–axes of a coordinate system fig.



The angle between the edge along the z–axis (line ab) and the diagonal from the origin to the opposite corner (line ad) is

(A) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (B) $\cos^{-1}\left(\frac{1}{\sqrt{5}}\right)$

(C) $\cos^{-1}\left(\frac{1}{3}\right)$ (D) None

Space for rough work

11. If $y = \sin^2 x^2$ then $\frac{dy}{dx}$ =

(A) $4x \sin^2 x \cos x^2$ (B) $4x \sin x^2 \cos x^2$ (C) $2x \sin (2x^2)$ (D) All of the above

12. If $\vec{A} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{B} = \hat{i} + \hat{j} + \hat{k}$ are two vectors, then the unit vector

(A) Perpendicular to $\vec{A}$ is $\frac{-\hat{j} + \hat{k}}{\sqrt{2}}$

(B) Parallel to $\vec{A}$ is $\frac{2\hat{i} + \hat{j} + \hat{k}}{\sqrt{6}}$

(C) Perpendicular to $\vec{B}$ is $\left(\frac{-\hat{j} + \hat{k}}{\sqrt{2}}\right)$

(D) Parallel to $\vec{A}$ is $\frac{\hat{i} + \hat{j} + \hat{k}}{\sqrt{3}}$

13. Given $\vec{a} = 2\hat{i} + 3\hat{j} + 10\hat{k}$ and $\vec{b} = 5\hat{i} + 2\hat{j} + 7\hat{k}$,the unit vector which is perpendicular to both $\vec{a}$ and $\vec{b}$ is

(A) $\frac{\hat{i} + 36\hat{j} - 11\hat{k}}{\sqrt{1418}}$ (B) $\frac{\hat{i} + 36\hat{j} - 11\hat{k}}{\sqrt{1218}}$ (C) $\frac{\hat{i} + 36\hat{j} + 11\hat{k}}{\sqrt{1418}}$ (D) none of the above

14. If P and Q are two non-collinear vectors, then choose correct option(s):

(A) $\vec{P} + \vec{Q}$ vector is parallel to the direction of the cross product $\vec{P} \times \vec{Q}$

(B) $\vec{P} + \vec{Q}$ vector is perpendicular to the direction of the cross product $\vec{P} \times \vec{Q}$

(C) If P can be expressed as $a\hat{i} + b\hat{j}$ and Q as $c\hat{i} + d\hat{j}$, where a,b,c and d are non-zero integers, and $\vec{P} \times \vec{Q} = c\hat{j}$ is possible (c is a non-zero integer)

(D) If P can be expressed as $a\hat{i} + b\hat{j}$ and Q as $c\hat{i} + d\hat{j}$, where a,b,c and d are non-zero integers, and $\vec{P} \times \vec{Q} = c\hat{j}$ is not possible (c is a non-zero integer)

15. Four forces acting on a particle keep it at rest. Then:

(A) the forces must be coplanar.

(B) The forces cannot be coplanar.

(C) The forces may or may not be coplanar.

(D) If three of these forces are coplanar, so must be the fourth.

Space for rough work

16. If $\vec{P}\times\vec{Q}=\vec{R},\ \vec{Q}\times\vec{R},=\vec{P}$ and $\vec{R}\times\vec{P}=\vec{Q},$ then

(A) $\vec{P},\vec{Q}$ and $\vec{R},$ are coplanar

(B)angle between $\vec{P},$ and $\vec{Q}$ may be less than 90º

(C) $(\vec{P}+\vec{Q}+\vec{R})$ cannot be equal to zero

(D) $\vec{P},\vec{Q}$ and $\vec{R},$ are mutually perpendicular

17. The velocity, acceleration and force in two systems of units are related to each other as under

(i) $\upsilon' = \frac{\alpha^2}{\beta}\upsilon$ (ii) $a' = (\alpha\beta)a$ (iii) $F' = \left(\frac{1}{\alpha\beta}\right)F$

Where, all the primed symbols belong to one system of units and the unprimed symbols belong to the other system of units. Here α and β are dimensionless constants. Which of the following is/are correct?

(A) The standard of length in each of these two systems are related to each other as $l' = \frac{\alpha^3}{\beta^3}l$

(B) The standard of mass in each of these two systems are related to each other as $m' = \left(\frac{1}{\alpha^2\beta^2}\right)m$

(C) The standard of time in each of these two systems are related to each other as $t' = \left(\frac{\alpha}{\beta^2}\right)t$

(D) The standard of momentum in each of these two systems are related to each other as $p' = \left(\frac{1}{\beta^3}\right)p$

18. If $y = 2x^2 - x$, then

(A) $\frac{dy}{dx} = 4x$

(B) $\frac{dy}{dx} = 4x - 1$

(C) y will be maximum at $x = \frac{1}{4}$

(D) y will be minimum at $x = \frac{1}{4}$

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. Position of particle is given by $x = t^3 - t^2 - t + 4$

Column – I		Column – II	
(A)	Velocity of particle at t= 2 seconds(in m/s)	(p)	1
(B)	Acceleration of particle at t= 2 seconds (in m/s^2)	(q)	7
(C)	Local maximum of position of particle occurs at (in sec)	(r)	10
(D)	Local maximum for velocity of particle (in m/s)	(s)	O
		(t)	None of these

20. A cylinder whose dimensions are changing has a radius of 2 cm and height of 1 cm at an instant. Its radius is increasing at a rate of 0.01 cm/s

Column – I		Column – II	
(A)	Rate of change of volume of cylinder in CGS units (If height of cylinder is constant)	(p)	0.01
(B)	Rate of change of curved surface area of cylinder in CGS units (If height of cylinder is constant)	(q)	0.02
(C)	If height of cylinder is decreasing at a rate of x cm/s, then cylinder volume is constant. Find x	(r)	0.08π
(D)	If height of cylinder is decreasing at a rate of x cm/s, then cylinder curved surface area is constant. Find x	(s)	0.04π
		(t)	None of these

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.

21. The transition of electron occurs in H–atom from 6^{th} to 3^{rd} orbit. The number of spectral lines in visible region are

22. The total values of m for each orbital in M–shell are

23. How many sets of four quantum numbers are possible for electrons present in He^{2-}.

24. $E_n = \frac{-z^2B}{n^2}$ where Z is the atomic number of species and B = 2.179 x 10^{-18} J. If energy level of Li^{+2} ion in a particular shell is –2.179 x 10^{-18} J, the principal quantum number of shell is …

25. A dust particle having mass of 10^{-11}g and velocity 10^{-4} cms^{-1}. The error in measurement of velocity in 0.1%. the uncertainity in position is x x 10^{-10} cm. Find x.

26. The momentum of radiation emitted when an electron de–excited from 3^{rd} excited state to first excited state is a x 10^{-40}kg.m.s^{-1}. Find a

27. The maximum number of electrons that can have principal quantum number, n = 3 and $m_s = -\frac{1}{2}$ is ..

28. The wavelength of certain line in Balmer series is observed to be 4341 $\overset{0}{A}$. To what value of n_2 does this corresponds

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. Select the correct statements if $\hbar = \frac{h}{2\pi}$

U_y – velocity along y – axis
U_x – velocity along x – axis

(A) $\Delta P.\Delta x = \frac{\hbar}{2}$ (B) $\Delta P.\Delta x = \frac{\hbar}{2}$

(C) $\Delta U_y.\Delta x = \frac{\hbar}{2m}$ (D) $\Delta U_x.\Delta x = \frac{\hbar}{2m}$

30. Which of the following electronic configuration(s) is/are possible
(A) n = 4 , l = 1, m = 0, s = 1/2 (B) n = 3, l = 3, m = 0, s = –1/2
(C) n = 4, l = 3, m = –3 , s = 1/2 (D) n = 3, l = 2, m = 0, s = 0

31. Which of the following is correct regarding a radiation emitted due to $2 \rightarrow 1$ transition in H–atom.
(A) 1216 $\overset{0}{A}$ (B) $24.6 \times 10^{14}\ s^{-1}$ (C) 10 eV (D) 1.6×10^{-15}J

32. Which of the following wavelengths of radiations belong to Paschan series of H–atom ?
(A) 6566. 4 $\overset{0}{A}$ (B) 18761 $\overset{0}{A}$ (C) 12825 $\overset{0}{A}$ (D) 4864 $\overset{0}{A}$

33. Which of the following are correct ?
(A) The angular momentum of 3p is $1.5\frac{h}{\pi}$
(B) The orbital angular momentum of 3d is 2.4 $\hbar$.
(C) The total spin of Cr is 3.
(D) The angular momentum of 3p is $0.7\frac{h}{\pi}$

Space for rough work

34. Which of the following statement(s) is/are incorrect ?
(A) The number of spectral lines of Balmer series are 2 when electron returns from 4^{th} excited state to 1^{st} shell
(B) The 1^{st} line of Balmer series of H atom appear in IR – region
(C) 2p < 3s < 4p < 3d is the increasing order of energy of subshells.
(D) For ground state H–atom, the energy of 2s=2p subshells.

35. If the wave number of 1^{st} line of Balmer series of H-atom is 'x' then:
(A) wave number of1st line of lyman series of the He^+ ion will be $\frac{108\,x}{5}$
(B) wave number of 1^{st} line of lyman series of the He^+ ion will be $\frac{36\,x}{5}$
(C) the wave length of 2^{nd} line of lyman series of H-atom is $\frac{5}{32\,x}$
(D) the wave length of 2^{nd} line of lyman series of H-atom is $\frac{32\,x}{5}$

36. Which of the following statement(s) is/are correct?
(A) The ratio of the radii of the first three Bohr orbits of hydrogen atom is 1:8:27.
(B) The ratio of magnitude of total energy : kinetic energy : potential energy for electron in any orbit of hydrogen atom is 1:1:2.
(C) The frequency of a green light is 6×10^{14} Hz , then its wavelength is 500 nm.
(D) The ratio of de-Broglie wavelength of a H–atom, He – atom moving with equal kinetic energy is 2 : 1.

37. An electron in an H–like species is in excited state (n_2). The wavelength corresponding to a transition to second orbit is 54 nm. From the same orbit, wavelength corresponding to a transition to third orbit is 208.4 nm. Find n_2 and z.
(A) The excited sate, n_2 is 5
(B) The excited state, n_2 is 4
(C) The atomic number, z is 4
(D) The atomic number, z is 3.

38. The ratio of the de–Broglie wavelengths of an α–particle and a proton can be 2 : 1 when
(A) their velocities are in 4 : 1 ratio
(B) their velocities are in 8 : 1 ratio
(C) their kinetic energies are in 128 : 1 ratio
(D) their kinetic energies are in 256 : 1 ratio

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)	Orbital angular momentum of 4f – subshell	(p)	Zero
(B)	Total spin of 6electrons in p–subshell	(q)	$\frac{3h}{\pi}$
(C)	Angular momentum of electron in 6^{th} shell	(r)	$\frac{\sqrt{3}}{4}\frac{h}{\pi}$
(D)	Spin angular momentum of $3d^8$ subshell	(s)	$\sqrt{3}\frac{h}{\pi}$

40.

Column – I		Column – II	
(A)	Maximum no. of spectral lines for $5 \rightarrow 1$ transition	(p)	3
(B)	Maximum no. of spectral lines for $5 \rightarrow 1$ transition by one atom	(q)	6
(C)	Maximum no. of spectral lines for $5 \rightarrow 1$ transition by Two atoms	(r)	4
(D)	Minimum No. of atoms required to get maximum spectral lines for $5 \rightarrow 1$ transition.	(s)	10

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 real solutions of the equation $\sin(e^x) = 2^x + 2^{-x}$.

42. The value of $3\left(\frac{\sin^4 t + \cos^4 t - 1}{\sin^6 t + \cos^6 t - 1}\right) =$

43. If $\sin\theta + \sin^2\theta = 1$, then the value of $\cos^{12}\theta + 3\cos^{10}\theta + 3\cos^8\theta + \cos^6\theta - 1$ is

44. If $\operatorname{cosec}\theta - \sin\theta = a^3$ and $\sec\theta - \cos\theta = b^3$, then the value of $a^2b^2(a^2 + b^2)$ is

45. The value of $3\left[\sin^4\left(\frac{7\pi}{2} - \alpha\right) + \sin^4(5\pi + \alpha)\right] - 2\left[\sin^6\left(\frac{3\pi}{2} + \alpha\right) + \sin^6(7\pi - \alpha)\right]$ is

46. The value of $\log\tan 1° + \log\tan 2° + \log\tan 3° + \ldots\ldots + \log\tan 89°$ is

47. $\sec^4\theta(1 - \sin^4\theta) - 2\tan^2\theta =$

48. If $\sin(-870°) + \operatorname{cosec}(-660°) + \tan(-855°) + 2\cot(840°) + \cos(480°) + \sec(900°) = -\frac{k}{7}$, then the value of k 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

49. The angles of a triangle are in AP. The ratio of the number of degrees in the least angle to the number of radians in the greatest angle is given as 60 : π. The angles of the triangle are
(A) 30° (B) 90° (C) 45° (D) 60°

50. $\sqrt{\frac{1-\sin\theta}{1+\sin\theta}}$ =

(A) sec θ – tan θ, $-\frac{\pi}{2} < \theta < \frac{\pi}{2}$ (B) cosec θ + cot θ, $0 < \theta < \pi$

(C) –sec θ + tan θ, $\frac{\pi}{2} < \theta < \frac{3\pi}{2}$ (D) –cosec θ – cot θ, $\pi < \theta < 2\pi$

51. If $e^{\left\{\log_e 3\left(\sin^2 x+\sin^4 x+\sin^6 x+\cdots\cdots+\infty\right)\right\}}$, satisfies the equation $x^2 - 28x + 27 = 0$, find the value of $\frac{\cos x}{\cos x+\sin x}, 0 < x < \frac{\pi}{2}$

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

52. Let $0 \le \theta \le \frac{\pi}{2}$ and $x = X\cos\theta + Y\sin\theta$, $y = X\sin\theta - Y\cos\theta$, such that $x^2 + 4xy + y^2 = aX^2 + bY^2$, where a, b are constants, then

(A) a = –1, b = 3 (B) $\theta = \frac{\pi}{4}$ (C) a = 3, b = –1 (D) $\theta = \frac{\pi}{3}$

Space for rough work

53. If $2\tan\beta + \cot\beta = \tan\alpha$, then
(A) $\cot\beta = 2\tan(\alpha - \beta)$ (B) $\cot\alpha = 2\tan(\alpha - \beta)$
(C) $\cot(\alpha - \beta) = 2\tan\alpha$ (D) $\cot(\alpha - \beta) = 2\tan\beta$

54. If $2\sec^2A - \sec^4A - 2\,\text{cosec}^2A + \text{cosec}^4A = \frac{15}{4}$, then tan A is equal to
(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{2}$ (C) $\frac{1}{2\sqrt{2}}$ (D) $-\frac{1}{\sqrt{2}}$

55. If $\sin(\pi\cos\theta) = \cos(\pi\sin\theta)$, then the value of $\sin 2\theta$ is
(A) $\frac{4}{3}$ (B) $\frac{3}{4}$ (C) $-\frac{3}{4}$ (D) $-\frac{4}{3}$

56. The expression $\frac{\sec^4\alpha}{\tan^2\beta} + \frac{\sec^4\beta}{\tan^2\alpha}$ is defined, then it can take value
(A) 9 (B) 6 (C) 8 (D) 10

57. In ΔABC, if $\tan A < 0$, then
(A) $\tan B \tan C > 1$ (B) $\tan B \tan C = 1$ (C) $\tan B \tan C < 1$ (D) none of these

58. For $0 < \phi \le \frac{\pi}{2}$, if $x = \sum_{n=0}^{\infty}\cos^{2n}\phi$, $y = \sum_{n=0}^{\infty}\sin^{2n}\phi$, $z = \sum_{n=0}^{\infty}\cos^{2n}\phi\sin^{2n}\phi$, then
(A) $xyz = xz + y$ (B) $xyz = xy + z$ (C) $xyz = x + y + z$ (D) $xyz = yz + x$

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.

59. Match the following

Column I (Number of positive integers for which)		**Column II**	
(A)	If $x = \sin\theta\,\lvert\sin\theta\rvert$ and $y = \cos\theta\,\lvert\cos\theta\rvert$ and $\frac{99\pi}{2} < \theta < 50\pi$, then $(y - x)$ is equal to	p.	–1
(B)	$\frac{\sin(270°+x)\cos^3(720°-x) - \sin(270°-x)\sin^3(540°+x)}{\sin(90°+x)\sin(-x) - \cos^2(180°-x)} + \frac{\cot(270°-x)}{\operatorname{cosec}^2(450°+x)}$	q.	0
(C)	$\frac{\sec(270°-\theta)\cdot\sec(90°-\theta) - \tan(270°-\theta)\cdot\tan(90°+\theta)}{\cot\theta + \tan(180°+\theta) + \tan(90°+\theta) + \tan(360°-\theta) + \cos 180°}$	r.	–2
(D)	$2\frac{\cos^3\left(\frac{\pi}{2}+x\right)\cot(3\pi+3)\sec(x-3\pi)\operatorname{cosec}\left(\frac{3\pi}{2}-x\right)}{\cot x\tan^2(x-\pi)\sin(x-2\pi)}$ is equal to	s.	1

Space for rough work

60. Match the following

Column I		Column II	
(A)	Suppose ABC is a triangle with three acute angles A, B and C. The point whose coordinates are (cos B – sin A, sin B – cos A) can be in the	p.	1^{st} quadrant
(B)	If $2^{\sin\theta} > 1$ and $3^{\cos\theta} < 1$, then $\theta \in$	q.	2^{nd} quadrant
(C)	$\lvert\cos x + \sin x\rvert = \lvert\sin x\rvert + \lvert\cos x\rvert$	r.	3^{rd} quadrant
(D)	If $\sqrt{\frac{1-\sin A}{1+\sin A}} + \frac{\sin A}{\cos A} = \frac{1}{\cos A}$, for all permissible values of A, then A can belong to	s.	4^{th} quadrant

Space for rough work

FIITJEE RET – 3

(2018 – 2020)(1ST YEAR_REGULAR)

IIT-2015 (P1)_SET–A

DATE: 25.06.2018

ANSWERS

PHYSICS

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

CHEMISTRY

21.	**0**	22.	**9**	23.	**4**	24.	**3**
25.	**5**	26.	**Bonus**	27.	**9**	28.	**5**
29.	**Bonus**	30.	**A, C**	31.	**A, B, C**	32.	**B, C**
33.	**A, B, C**	34.	**A, B, C**	35.	**A, C**	36.	**B, C, D**
37.	**B, D**	38.	**Bonus**				
39.	**A → s ; B → p ; C → q ; D → r**						
40.	**A → s ; B → r ; C → q ; D → q**						

MATHEMATICS

41.	**0**	42.	**2**	43.	**0**	44.	**1**
45.	**1**	46.	**0**	47.	**1**	48.	**7**
49.	**ABD**	50.	**AC**	51.	**AC (Bonus)**	52.	**BC**
53.	**AD**	54.	**AD**	55.	**BC**	56.	**ACD**
57.	**C**	58.	**BC**	59.	**A → s; B → s; C → s; D → r**		
60.	**A → q; B → q; C → p, r; D → p, s**						

FIITJEE RET – 3

(2018 – 2020)(1ST YEAR_REGULAR)

IIT-2015 (P1)_SET–B

DATE: 25.06.2018

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.

1. Angle between the vectors $(\hat{i}+\hat{j})$ and $(\hat{j}+\hat{k})$ is $\frac{2\pi}{n}$, then n is?

2. If $\vec{a}$ and $\vec{b}$ are two units vectors such that $\vec{a}+2\vec{b}$ and $5\vec{a}-4\vec{b}$ are perpendicular to each other, then the angle between $\vec{a}$ and $\vec{b}$ is $\frac{2\pi}{n}$, then n is?

3. The components of a vector along x and y-directions are A cos θ and A sin θ respectively. If the co-ordinate system is rotated by 60^0 then the components are found to be equal to 3 and 4. Then the value of A is?

4. The projection of a vector $\vec{r}=3\hat{i}+\hat{j}+2\hat{k}$ on the Y–Z plane has magnitude given by $\sqrt{\frac{20}{n}}$. The value of n is

5. If $y=(\sin x)^2$ then $\frac{dy}{dx}=k\sin 2x$, find the value of k?

6. You are given vectors $\vec{A}=5\hat{i}-6.5\hat{j}$ and $\vec{B}=10\hat{i}-7\hat{j}$. A third vector C lies in the x-y plane. Vector $\vec{C}$ is perpendicular to vector $\vec{A}$ and the scalar product of $\vec{C}$ with $\vec{B}$ is 15. From this information, if the X-component of $\vec{C}$ is (39/2x), then x is?

7. On a horizontal flat ground, a person is standing at a point A. At this point, he installs a 5 m long pole vertically. Now, he moves 5 m towards east and then 2 m towards north and reaches at a point B. There he installs another 3 m long vertical pole. A bird flies from the top of the first pole to the top of the second pole. If the magnitude of the displacement of the bird is $\sqrt{25+n}$ then n?

Space for rough work

8. The components of a vector along the x- and y-directions are (n + 1) and 1, respectively. If the coordinate system is rotated by an angle $\theta = 60°$, then the components change to $\frac{n}{2}$ and 3. Then value of n 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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9. If P and Q are two non-collinear vectors, then choose correct option(s):
   (A) $\vec{P}+\vec{Q}$ vector is parallel to the direction of the cross product $\vec{P}\times\vec{Q}$
   (B) $\vec{P}+\vec{Q}$ vector is perpendicular to the direction of the cross product $\vec{P}\times\vec{Q}$
   (C) If P can be expressed as $a\hat{i}+b\hat{j}$ and Q as $c\hat{i}+d\hat{j}$, where a,b,c and d are non-zero integers, and $\vec{P}\times\vec{Q}=c\hat{j}$ is possible (c is a non-zero integer)
   (D) If P can be expressed as $a\hat{i}+b\hat{j}$ and Q as $c\hat{i}+d\hat{j}$, where a,b,c and d are non-zero integers, and $\vec{P}\times\vec{Q}=c\hat{j}$ is not possible (c is a non-zero integer)

10. Four forces acting on a particle keep it at rest. Then:
    (A) the forces must be coplanar.
    (B) The forces cannot be coplanar.
    (C) The forces may or may not be coplanar.
    (D) If three of these forces are coplanar, so must be the fourth.

11. If $\vec{P}\times\vec{Q}=\vec{R},\ \vec{Q}\times\vec{R},=\vec{P}$ and $\vec{R}\times\vec{P}=\vec{Q},$ then
    (A) $\vec{P},\vec{Q}$ and $\vec{R},$ are coplanar
    (B) angle between $\vec{P},$ and $\vec{Q}$ may be less than 90º
    (C) $(\vec{P}+\vec{Q}+\vec{R})$ cannot be equal to zero
    (D) $\vec{P},\vec{Q}$ and $\vec{R},$ are mutually perpendicular

---

Space for rough work

12. The velocity, acceleration and force in two systems of units are related to each other as under

(i) $\upsilon' = \frac{\alpha^2}{\beta}\upsilon$ (ii) $a' = (\alpha\beta)a$ (iii) $F' = \left(\frac{1}{\alpha\beta}\right)F$

Where, all the primed symbols belong to one system of units and the unprimed symbols belong to the other system of units. Here α and β are dimensionless constants. Which of the following is/are correct?

(A) The standard of length in each of these two systems are related to each other as $l' = \frac{\alpha^3}{\beta^3}l$

(B) The standard of mass in each of these two systems are related to each other as $m' = \left(\frac{1}{\alpha^2\beta^2}\right)m$

(C) The standard of time in each of these two systems are related to each other as $t' = \left(\frac{\alpha}{\beta^2}\right)t$

(D) The standard of momentum in each of these two systems are related to each other as $p' = \left(\frac{1}{\beta^3}\right)p$

13. If $y = 2x^2 - x$, then

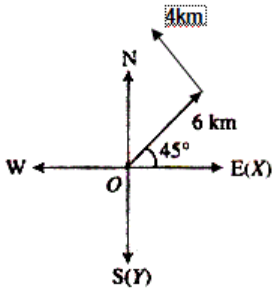
(A) $\frac{dy}{dx} = 4x$ (B) $\frac{dy}{dx} = 4x - 1$

(C) y will be maximum at $x = \frac{1}{4}$ (D) y will be minimum at $x = \frac{1}{4}$

14. A car travels 6 km towards north at an angle of 45^0 to the east and then travels distance of 4 km towards north at angle of 135^0 to the east as shown in fig. Shortest distance between initial and final points is.

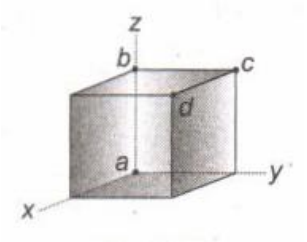
(A) $\sqrt{32}$km (B) $1\sqrt{32}$m

(C) $\sqrt{52}$m (D) $\sqrt{52}$km



Space for rough work

15. A cube is placed so that one corner is at the origin and three edges are along the x–,y–, and z–axes of a coordinate system fig.
The angle between the edge along the z–axis (line ab) and the diagonal from the origin to the opposite corner (line ad) is



(A) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (B) $\cos^{-1}\left(\frac{1}{\sqrt{5}}\right)$

(C) $\cos^{-1}\left(\frac{1}{3}\right)$ (D) None

16. If $y = \sin^2 x^2$ then $\frac{dy}{dx}$ =

(A) $4x \sin^2 x \cos x^2$ (B) $4x \sin x^2 \cos x^2$ (C) $2x \sin (2x^2)$ (D) All of the above

17. If $\vec{A} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{B} = \hat{i} + \hat{j} + \hat{k}$ are two vectors, then the unit vector

(A) Perpendicular to $\vec{A}$ is $\frac{-\hat{j} + \hat{k}}{\sqrt{2}}$

(B) Parallel to $\vec{A}$ is $\frac{2\hat{i} + \hat{j} + \hat{k}}{\sqrt{6}}$

(C) Perpendicular to $\vec{B}$ is $\left(\frac{-\hat{j} + \hat{k}}{\sqrt{2}}\right)$

(D) Parallel to $\vec{A}$ is $\frac{\hat{i} + \hat{j} + \hat{k}}{\sqrt{3}}$

18. Given $\vec{a} = 2\hat{i} + 3\hat{j} + 10\hat{k}$ and $\vec{b} = 5\hat{i} + 2\hat{j} + 7\hat{k}$,the unit vector which is perpendicular to both $\vec{a}$ and $\vec{b}$ is

(A) $\frac{\hat{i} + 36\hat{j} - 11\hat{k}}{\sqrt{1418}}$ (B) $\frac{\hat{i} + 36\hat{j} - 11\hat{k}}{\sqrt{1218}}$ (C) $\frac{\hat{i} + 36\hat{j} + 11\hat{k}}{\sqrt{1418}}$ (D) none of the above

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. A cylinder whose dimensions are changing has a radius of 2 cm and height of 1 cm at an instant. Its radius is increasing at a rate of 0.01 cm/s

Column – I		Column – II	
(A)	Rate of change of volume of cylinder in CGS units (If height of cylinder is constant)	(p)	0.01
(B)	Rate of change of curved surface area of cylinder in CGS units (If height of cylinder is constant)	(q)	0.02
(C)	If height of cylinder is decreasing at a rate of x cm/s, then cylinder volume is constant. Find x	(r)	0.08π
(D)	If height of cylinder is decreasing at a rate of x cm/s, then cylinder curved surface area is constant. Find x	(s)	0.04π
		(t)	None of these

Space for rough work

20. Position of particle is given by $x = t^3 - t^2 - t + 4$

Column – I		Column – II	
(A)	Velocity of particle at t= 2 seconds(in m/s)	(p)	1
(B)	Acceleration of particle at t= 2 seconds (in m/s^2)	(q)	7
(C)	Local maximum of position of particle occurs at (in sec)	(r)	10
(D)	Local maximum for velocity of particle (in m/s)	(s)	O
		(t)	None of these

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. A dust particle having mass of 10^{-11}g and velocity 10^{-4} cms^{-1}. The error in measurement of velocity in 0.1%. the uncertainity in position is x x 10^{-10} cm. Find x.

22. The momentum of radiation emitted when an electron de–excited from 3rd excited state to first excited state is a x 10^{-40}kg.m.s^{-1}. Find a

23. The maximum number of electrons that can have principal quantum number, n = 3 and $m_s = -\frac{1}{2}$ is ..

Space for rough work

24. The wavelength of certain line in Balmer series is observed to be 4341 $\overset{0}{A}$. To what value of n_2 does this corresponds

25. The transition of electron occurs in H–atom from 6^{th} to 3^{rd} orbit. The number of spectral lines in visible region are

26. The total values of m for each orbital in M–shell are

27. How many sets of four quantum numbers are possible for electrons present in He^{2-}.

28. $E_n = \frac{-z^2B}{n^2}$ where Z is the atomic number of species and B = 2.179 x 10^{-18} J. If energy level of Li^{+2} ion in a particular shell is –2.179 x 10^{-18} J, the principal quantum number of shell 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(s) is/are incorrect ?
(A) The number of spectral lines of Balmer series are 2 when electron returns from 4^{th} excited state to 1^{st} shell
(B) The 1^{st} line of Balmer series of H atom appear in IR – region
(C) 2p < 3s < 4p < 3d is the increasing order of energy of subshells.
(D) For ground state H–atom, the energy of 2s=2p subshells.

Space for rough work

30. If the wave number of 1st line of Balmer series of H-atom is 'x' then:
(A) wave number of1st line of lyman series of the He^+ ion will be $\frac{108\,x}{5}$
(B) wave number of 1st line of lyman series of the He^+ ion will be $\frac{36\,x}{5}$
(C) the wave length of 2nd line of lyman series of H-atom is $\frac{5}{32\,x}$
(D) the wave length of 2nd line of lyman series of H-atom is $\frac{32\,x}{5}$

31. Which of the following statement(s) is/are correct?
(A) The ratio of the radii of the first three Bohr orbits of hydrogen atom is 1:8:27.
(B) The ratio of magnitude of total energy : kinetic energy : potential energy for electron in any orbit of hydrogen atom is 1:1:2.
(C) The frequency of a green light is 6×10^{14} Hz , then its wavelength is 500 nm.
(D) The ratio of de-Broglie wavelength of a H–atom, He – atom moving with equal kinetic energy is 2 : 1.

32. An electron in an H–like species is in excited state (n_2). The wavelength corresponding to a transition to second orbit is 54 nm. From the same orbit, wavelength corresponding to a transition to third orbit is 208.4 nm. Find n_2 and z.
(A) The excited sate, n_2 is 5
(B) The excited state, n_2 is 4
(C) The atomic number, z is 4
(D) The atomic number, z is 3.

33. The ratio of the de–Broglie wavelengths of an α–particle and a proton can be 2 : 1 when
(A) their velocities are in 4 : 1 ratio
(B) their velocities are in 8 : 1 ratio
(C) their kinetic energies are in 128 : 1 ratio
(D) their kinetic energies are in 256 : 1 ratio

Space for rough work

34. Select the correct statements if $\hbar = \frac{h}{2\pi}$

U_y – velocity along y – axis
U_x – velocity along x – axis

(A) $\Delta P.\Delta x = \frac{\hbar}{2}$ (B) $\Delta P.\Delta x = \frac{\hbar}{2}$

(C) $\Delta U_y.\Delta x = \frac{\hbar}{2m}$ (D) $\Delta U_x.\Delta x = \frac{\hbar}{2m}$

35. Which of the following electronic configuration(s) is/are possible
(A) n = 4 , l = 1, m = 0, s = 1/2 (B) n = 3, l = 3, m = 0, s = –1/2
(C) n = 4, l = 3, m = –3 , s = 1/2 (D) n = 3, l = 2, m = 0, s = 0

36. Which of the following is correct regarding a radiation emitted due to $2 \rightarrow 1$ transition in H–atom.
(A) 1216 $\overset{0}{A}$ (B) 24.6 x 10^{14} s^{-1} (C) 10 eV (D) 1.6 x 10^{-15}J

37. Which of the following wavelengths of radiations belong to Paschan series of H–atom ?
(A) 6566. 4 $\overset{0}{A}$ (B) 18761 $\overset{0}{A}$ (C) 12825 $\overset{0}{A}$ (D) 4864 $\overset{0}{A}$

38. Which of the following are correct ?
(A) The angular momentum of 3p is $1.5\frac{h}{\pi}$
(B) The orbital angular momentum of 3d is 2.4 $\hbar$.
(C) The total spin of Cr is 3.
(D) The angular momentum of 3p is $0.7\frac{h}{\pi}$

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

39.

Column – I		Column – II	
(A)	Maximum no. of spectral lines for $5 \rightarrow 1$ transition	(p)	3
(B)	Maximum no. of spectral lines for $5 \rightarrow 1$ transition by one atom	(q)	6
(C)	Maximum no. of spectral lines for $5 \rightarrow 1$ transition by Two atoms	(r)	4
(D)	Minimum No. of atoms required to get maximum spectral lines for $5 \rightarrow 1$ transition.	(s)	10

40.

Column – I		Column – II	
(A)	Orbital angular momentum of 4f – subshell	(p)	Zero
(B)	Total spin of 6electrons in p–subshell	(q)	$\frac{3h}{\pi}$
(C)	Angular momentum of electron in 6^{th} shell	(r)	$\frac{\sqrt{3}}{4}\frac{h}{\pi}$
(D)	Spin angular momentum of $3d^8$ subshell	(s)	$\sqrt{3}\frac{h}{\pi}$

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 value of $3\left[\sin^4\left(\frac{7\pi}{2}-\alpha\right)+\sin^4(5\pi+\alpha)\right]-2\left[\sin^6\left(\frac{3\pi}{2}+\alpha\right)+\sin^6(7\pi-\alpha)\right]$ is

42. The value of log tan 1° + log tan 2° + log tan 3° + ... + log tan 89° is

43. $\sec^4\theta\,(1-\sin^4\theta)-2\tan^2\theta =$

44. If sin (–870°) + cosec (–660°) + tan (–855°) + 2 cot (840°) + cos (480°) + sec (900°) = $-\frac{k}{7}$, then the value of k is

45. The number of real solutions of the equation $\sin(e^x) = 2^x + 2^{-x}$.

46. The value of $3\left(\frac{\sin^4 t+\cos^4 t-1}{\sin^6 t+\cos^6 t-1}\right)=$

47. If $\sin\theta + \sin^2\theta = 1$, then the value of $\cos^{12}\theta + 3\cos^{10}\theta + 3\cos^8\theta + \cos^6\theta - 1$ is

48. If $\operatorname{cosec}\theta - \sin\theta = a^3$ and $\sec\theta - \cos\theta = b^3$, then the value of $a^2b^2(a^2+b^2)$ 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

49. If $2\sec^2A - \sec^4A - 2\,\text{cosec}^2A + \text{cosec}^4A = \frac{15}{4}$, then tan A is equal to

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{2}$ (C) $\frac{1}{2\sqrt{2}}$ (D) $-\frac{1}{\sqrt{2}}$

50. If $\sin(\pi\cos\theta) = \cos(\pi\sin\theta)$, then the value of $\sin 2\theta$ is

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

51. The expression $\frac{\sec^4\alpha}{\tan^2\beta} + \frac{\sec^4\beta}{\tan^2\alpha}$ is defined, then it can take value

(A) 9 (B) 6 (C) 8 (D) 10

52. In ΔABC, if tan A < 0, then

(A) tan B tan C > 1 (B) tan B tan C = 1 (C) tan B tan C < 1 (D) none of these

53. For $0 < \phi \le \frac{\pi}{2}$, if $x = \sum_{n=0}^{\infty}\cos^{2n}\phi$, $y = \sum_{n=0}^{\infty}\sin^{2n}\phi$, $z = \sum_{n=0}^{\infty}\cos^{2n}\phi\sin^{2n}\phi$, then

(A) xyz = xz + y (B) xyz = xy + z (C) xyz = x + y + z (D) xyz = yz + x

54. The angles of a triangle are in AP. The ratio of the number of degrees in the least angle to the number of radians in the greatest angle is given as 60 : π. The angles of the triangle are

(A) 30° (B) 90° (C) 45° (D) 60°

Space for rough work

55. $\sqrt{\frac{1-\sin\theta}{1+\sin\theta}}$ =

(A) sec θ – tan θ, $-\frac{\pi}{2} < \theta < \frac{\pi}{2}$ (B) cosec θ + cot θ, $0 < \theta < \pi$

(C) –sec θ + tan θ, $\frac{\pi}{2} < \theta < \frac{3\pi}{2}$ (D) –cosec θ – cot θ, $\pi < \theta < 2\pi$

56. If $e^{\left\{\log_e 3\left(\sin^2 x+\sin^4 x+\sin^6 x+\cdots+\infty\right)\right\}}$, satisfies the equation $x^2 - 28x + 27 = 0$, find the value of $\frac{\cos x}{\cos x+\sin x}, 0 < x < \frac{\pi}{2}$

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

57. Let $0 \le \theta \le \frac{\pi}{2}$ and x = X cos θ + Y sin θ, y = X sin θ – Y cos θ, such that $x^2 + 4xy + y^2 = aX^2 + bY^2$, where a, b are constants, then

(A) a = –1, b = 3 (B) $\theta = \frac{\pi}{4}$ (C) a = 3, b = –1 (D) $\theta = \frac{\pi}{3}$

58. If 2 tan β + cot β = tan α, then

(A) cot β = 2 tan (α – β) (B) cot α = 2 tan (α – β)

(C) cot (α – β) = 2 tan α (D) cot (α – β) = 2 tan β

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)	Suppose ABC is a triangle with three acute angles A, B and C. The point whose coordinates are (cos B – sin A, sin B – cos A) can be in the	p.	1^{st} quadrant
(B)	If $2^{\sin\theta} > 1$ and $3^{\cos\theta} < 1$, then $\theta \in$	q.	2^{nd} quadrant
(C)	$\lvert\cos x + \sin x\rvert = \lvert\sin x\rvert + \lvert\cos x\rvert$	r.	3^{rd} quadrant
(D)	If $\sqrt{\frac{1-\sin A}{1+\sin A}} + \frac{\sin A}{\cos A} = \frac{1}{\cos A}$, for all permissible values of A, then A can belong to	s.	4^{th} quadrant

60. Match the following

Column I (Number of positive integers for which)		Column II	
(A)	If $x = \sin\theta \lvert\sin\theta\rvert$ and $y = \cos\theta \lvert\cos\theta\rvert$ and $\frac{99\pi}{2} < \theta < 50\pi$, then (y – x) is equal to	p.	–1
(B)	$\frac{\sin(270°+x)\cos^3(720°-x) - \sin(270°-x)\sin^3(540°+x)}{\sin(90°+x)\sin(-x) - \cos^2(180°-x)} + \frac{\cot(270°-x)}{\text{cosec}^2(450°+x)}$	q.	0
(C)	$\frac{\sec(270°-\theta)\cdot\sec(90°-\theta) - \tan(270°-\theta)\cdot\tan(90°+\theta)}{\cot\theta + \tan(180°+\theta) + \tan(90°+\theta) + \tan(360°-\theta) + \cos 180°}$	r.	–2
(D)	$2\frac{\cos^3\left(\frac{\pi}{2}+x\right)\cot(3\pi+3)\sec(x-3\pi)\text{cosec}\left(\frac{3\pi}{2}-x\right)}{\cot x\tan^2(x-\pi)\sin(x-2\pi)}$ is equal to	s.	1

Space for rough work

FIITJEE RET – 3

(2018 – 2020)(1ST YEAR_REGULAR)

IIT-2015 (P1)_SET–B

DATE: 25.06.2018

ANSWERS

PHYSICS

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

CHEMISTRY

21.	**5**	22.	**Bonus**	23.	**9**	24.	**5**
25.	**0**	26.	**9**	27.	**4**	28.	**3**
29.	**A, B, C**	30.	**A, C**	31.	**B, C, D**	32.	**B, D**
33.	**Bonus**	34.	**Bonus**	35.	**A, C**	36.	**A, B, C**
37.	**B, C**	38.	**A, B, C**	39.	**A → s ; B → r ; C → q ; D → q**		
40.	**A → s ; B → p ; C → q ; D → r**						

MATHEMATICS

41.	**1**	42.	**0**	43.	**1**	44.	**7**
45.	**0**	46.	**2**	47.	**0**	48.	**1**
49.	**AD**	50.	**BC**	51.	**ACD**	52.	**C**
53.	**BC**	54.	**ABD**	55.	**AC**	56.	**AC (Bonus)**
57.	**BC**	58.	**AD**	59.	**A → q; B → q; C → p, r; D → p, s**		
60.	**A → s; B → s; C → s; D → r**						