

# FIITJEE RET – 1

(2018 – 2020)(1<sup>ST</sup> YEAR\_REGULAR)

IIT-2014 (P1)\_SET-A

DATE: 11.06.2018

Time: 3 hours

Maximum Marks: 180

## INSTRUCTIONS:

### A. General

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

### B. Filling in the OMR:

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

### C. Question paper format:

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

### D. Marking Scheme

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

Don't write / mark your answers in this question booklet.

If you mark the answers in question booklet, you will not be allowed to continue the exam.

NAME:

ENROLLMENT NO.:

<b>PHYSICS USEFUL DATA</b>
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$$1. \quad F = qE, F = qvB, B = \frac{\mu_0 I}{2\pi a}, \frac{1}{\sqrt{\mu_0 \epsilon_0}} = c$$

Where F is force, q is charge, v is speed, I is current, a is distance, E is electric field, B is magnetic field,  $\mu_0$  is magnetic permeability, c is speed of light,  $\epsilon_0$  is permittivity of free space.

$$2. \quad E = \frac{q^2}{2C}, P = I^2 R, Y = \frac{FL}{A \cdot \Delta L}, E = h\nu, V_G = \frac{-Gm}{r}, F = -\eta A \cdot \frac{dv}{dh}$$

Where

- q is charge
- E is Energy
- C is capacitance
- P is power
- I is electric current
- R is resistance
- L is Length
- F is force
- A is Area
- h is planck's constant
- $\nu$  is frequency
- G is gravitational constant
- r is distance
- m is mass
- $\eta$  = coefficient of viscosity
- dv = small change in velocity
- dh = small change in height

$$3. \quad \text{Energy density} = \frac{\text{Energy}}{\text{Volume}}$$

Curie = number of disintegrations per second

$$\text{surface Tension} = \frac{\text{Force}}{\text{Length}}$$

PAPER-I  
PART I: PHYSICS

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

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

1. Which of the following pairs has the same dimensions?  
 (A) torque and work (B) angular momentum and Planck's constant  
 (C) energy and Young's modulus (D) Light year and wavelength
2. Which of the following pairs have different dimensions?  
 (A) Frequency and angular velocity. (B) Tension and surface tension.  
 (C) Density and energy density. (D) Linear momentum and angular momentum.
3. Pressure is dimensionally  
 (A) Force per unit area (B) Energy per unit volume  
 (C) Momentum per unit area per second (D) Momentum per unit volume
4. Choose the correct statement(s).  
 (A) A dimensionally correct equation must be correct.  
 (B) A dimensionally correct equation may be correct.  
 (C) A dimensionally incorrect equation must be incorrect.  
 (D) A dimensionally incorrect equation may be correct.
5. Consider three quantities :  $x = \frac{E}{b}$ ,  $y = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$  and  $z = \frac{\ell}{CR}$ . Here,  $\ell$  is the length of a wire, C is the capacitance, and R is a resistance, E is electric field, b is distance between two point. All other symbols have usual meanings. Then  
 (A) x and y have the same dimensions.  
 (B) x and z have the same dimensions.  
 (C) y and z have the same dimensions.  
 (D) None of the above three pairs have the same dimensions.
6. Let  $[\epsilon_0]$  denote the dimensional formula of the permittivity of vacuum and  $[\mu_0]$  that of the permeability of vacuum. If M mass, L = length, T= time, and I = electric current, then  
 (A)  $[\epsilon_0] = M^{-1}L^{-3}T^2I$  (B)  $[\epsilon_0] = M^{-1}L^{-3}T^4I^{-2}$  (C)  $[\mu_0] = MLT^{-2}I^{-2}$  (D)  $[\mu_0] = ML^2T^{-1}I$
7. Which of the following pairs has/have the same dimensions?  
 (A) Reynold number and coefficient of friction (B) Curie and frequency of light wave  
 (C) Latent heat and gravitational potential (D) Planck's constant and torque

***Space for rough work***

8. Suppose a quantity P can be represented in terms of M, L and T, i.e.  $[P] = M^a L^b T^c$ . The quantity mass  
 (A) can always be dimensionally represented in terms of L, T and P  
 (B) can never be dimensionally represented in terms of L, T and P  
 (C) may be represented in terms of L, T and P if  $a = 0$   
 (D) may be represented in terms of L, T and P if  $a \neq 0$
9. If the speed  $v$  of a particle of mass  $m$  as function of time  $t$  is given by  $v = \omega A \sin \left[ \left( \sqrt{\frac{k}{m}} \right) t \right]$ . Where A has dimension of length.  
 (A) The argument of trigonometric function must be a dimensionless quantity  
 (B) Dimensional formula of  $\omega$  is  $[LT^{-1}]$   
 (C) Dimensional formula of  $k$  is  $[MT^{-2}]$   
 (D) Dimensional formula of  $\sqrt{\frac{k}{m}}$  is  $[T^{-1}]$
10. If instead of mass, length and time as fundamental quantities, we choose velocity, acceleration and force as fundamental quantities express their dimensions by  $v, a$  and  $F$  respectively, then the dimensions of Young's modulus will be expressed as.  
 (A)  $[Fa^2v^{-4}]$  (B)  $[F^2v^{-1}a]$  (C)  $[Fa^2v^{-1}]$  (D)  $[Fa v^{-2}]$

### SECTION – II: (Integer value type)

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

11. P represents radiation pressure, C represents the speed of light, and Q represents radiation energy striking a unit area per second. If non – zero integers  $x, y$  and  $z$  are such that  $P^x Q^y C^z$  is dimensionless, find the value of  $x + 2y + 4z$  is \_\_\_\_
12. The value of Stefan's constant is  $\sigma = 5.67 \times 10^{-8} \text{ J s}^{-1} \text{ m}^{-2} \text{ K}^{-4}$ . Its value in c.g.s. system is approximately  $34/N \times 10^{-5} \text{ erg s}^{-1} \text{ cm}^{-2} \text{ K}^{-4}$ . Find the value of N.
13. Derive an expression for the rate of flow of a liquid through a capillary tube using dimensional approach. Assume that the rate of flow depends on (1) the pressure gradient  $\left(\frac{P}{\ell}\right)$  (ii) the radius  $r$ , and (iii) the coefficient of viscosity  $\eta$ . The exponent of  $r$  in the derived expression will be equal to

**Space for rough work**

14. If the unit of length is doubled, mass is tripled and time is halved, by what factor is the unit of pressure effected?
15. The unit of viscosity in the CGS system is poise (P) that in SI is poiseuille (PI). If  $2 \times P = PI$ , then the value of x will be?
16. The speed of light ( $c$ ), gravitational constant ( $G$ ) and Planck's constant ( $h$ ) are taken as the fundamental units in a system. Then if sum of mod of exponents of dimensions of time in this new system is  $x/2$ , then the value of x is?
17. The sum of exponents of dimensions of  $e^2 / 4\pi\epsilon_0 hc$ , where  $e, \epsilon_0, h$  and  $c$  are electronic charge, electric permittivity, Planck's constant and velocity of light in vacuum respectively is?
18. If frequency  $F$ , velocity  $V$ , and density  $D$  are considered fundamental units and the dimensional formula for momentum is found to be  $D^a V^b F^c$  then  $(a + b + c)$  is \_\_\_\_
19. The frequency  $f$  of vibrations of a mass  $m$  suspended from a spring of spring constant  $k$  is given by  $f = Cm^x k^y$ , where  $C$  is dimensionless constant. Then the value of  $(x + y)$  is \_\_\_\_
20. To find the distance  $d$  over which a signal can be seen clearly in foggy conditions, a railways engineer uses dimensional analysis and assumes that the distance depends on the mass density ( $\rho$ ) of the fog, intensity  $\left[ S = \frac{\text{Power}}{\text{Area}} \right]$  of the light from the signal, and its frequency ' $f$ '. The engineer finds that ' $d$ ' is proportional to  $S^{1/n}$ . The value of ' $n$ ' is

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***Space for rough work***

## PART II: CHEMISTRY

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

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

21. Identify the correct statement  
 (A) Electrons are also called as cathode rays  
 (B)  $e/m$  of electron is equal to  $1.758 \times 10^{11}$  C/kg  
 (C) mass of proton and neutron are almost same.  
 (D) size of atom is around  $10^5$  times the size of nucleus.
22.  ${}_{15}^{31}\text{P}$  has  
 (A) 31 nucleons (B) 15 protons (C) 16 neutrons (D) 1 Isotopic number( $n-p$ )
23. The total charge of  $\text{He}^+$  ion, is same as that of  
 (A)  $\text{He}^{+2}$  (B)  $\text{Li}^+$  (C)  $\text{H}^+$  (D)  $\text{Li}^{+2}$
24. Isodiaphers among the following  
 (A)  ${}_5\text{B}^{11}$   ${}_{11}\text{Na}^{23}$  (B)  ${}_{24}\text{Cr}^{54}$   ${}_{29}\text{Cu}^{64}$  (C)  ${}_6\text{C}^{12}$   ${}_{19}\text{K}^{40}$  (D) None
25. Which of the following properties is/are proportional to the energy of electromagnetic radiation?  
 (A) frequency (B) wave number (C) wavelength (D) number of photons
26. Rutherford's experiment established that  
 (A) inside the atom there is a heavy positive centre  
 (B) nucleus contains protons and neutrons  
 (C) most of the space in an atom is empty  
 (D) size of nucleus is very small
27. An isotone of  ${}_{32}^{76}\text{Ge}$  is  
 (A)  ${}_{32}^{77}\text{Ge}$  (B)  ${}_{33}^{77}\text{As}$  (C)  ${}_{34}^{77}\text{Se}$  (D)  ${}_{34}^{78}\text{Se}$

**Space for rough work**

28. The atomic nucleus contains  
(A) protons (B) neutrons (C) electrons (D) photons
29.  $\text{NH}_3$  is isoelectronic with  
(A)  $\text{H}_2\text{O}$  (B) Ne (C)  $\text{CH}_4$  (D)  $\text{C}_2\text{H}_4$
30. Which of the following is a characteristic of Planck's quantum theory of radiation ?  
(A) Radiations are associated with energy  
(B) Magnitude of energy associated with a quantum is equal to  $h\nu$   
(C) Radiation energy is neither emitted nor absorbed continuously  
(D) A body can emit less or more than a quantum of energy.

### SECTION – II: (Integer value type)

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

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31. Oxygen consists of isotopes  $\text{O}^{16}$ ,  $\text{O}^{17}$ ,  $\text{O}^{18}$  and carbon consists of isotopes  $\text{C}^{12}$  and  $\text{C}^{13}$ . The number of  $\text{CO}_2$  molecules formed is X. What is  $X/2$  ?
32. The wavelength of an ultraviolet wave, with frequency  $12 \times 10^{16}$  cycles per second is  $x \times 10^{-9}$  m. The value of  $2x$  is
33. A radio station in broadcasting programmes at 100 MHz frequency. If the distance between the radio station and receiver set is 300 km. The time taken by wave to reach the receiver is  $y \times 10^{-3}$  s. Find y ?
34. The specific charge of  $\text{A}^{(+)}$  ion is  $1.97 \times 10^{-7}$  C / kg. The mass of A atom is  $a \times 10^{-26}$  kg. Find a ?
35. The radius of the nucleus in Fermi whose mass number is equal to 64.
36. The sum of electrons present in H,  $\text{He}^+$ ,  $\text{Li}^{+2}$ ,  $\text{Li}^+$  and  $\text{Be}^{+2}$ .
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***Space for rough work***

37. The ratio of energies of two radiations one with  $\lambda = 1250 \text{ \AA}$  and other with  $\lambda = 5000 \text{ \AA}$ .
38. The frequency of radiation of wavelength 600 nm is  $x \times 10^{14} \text{ s}^{-1}$ . Then x is
39. A certain dye absorbs light of  $1000 \text{ \AA}$  wavelength and emits  $4000 \text{ \AA}$  wavelength. If 50% of absorbed energy is emitted then ratio of number of quanta emitted out to the number of quanta absorbed.
40. Maximum of photons of light of  $\lambda = 4000 \text{ \AA}$ . Which provide 2J energy is equal to  $x \times 10^{18}$ . Then x is

### PART III: MATHEMATICS

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

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

41. How many terms of the series 54, 51, 48, ..... be taken so that their sum is 513  
 (A) 18 (B) 19 (C) 20 (D) 21
42.  $(x - 1)(x - 2)^2(x - 3)^3(x - 4)^4(x - 5)^5 \leq 0$ , then  $x \in$   
 (A)  $(-\infty, \infty)$  (B)  $(-\infty, 1] \cup [2, 3] \cup [4, 5]$   
 (C)  $(-\infty, 1] \cup [3, 5] \cup \{2\}$  (D)  $[1, 3] \cup [5, \infty)$
43. If  $f(x) = x^2 + 12x + 40$ ,  $g(x) = -x^2 + 5x - 6$ , then the values of x for which  $\frac{f(x)}{g(x)} \leq 0$   
 (A)  $x \in (2.5, 2.75)$  (B)  $x = 4$  (C)  $x = -2$  (D)  $x \in (4, \infty)$
44. Solution of  $\log_{1/3}(2x^2 + 5x + 1) < 0$  is  
 (A)  $\left(-\infty, -\frac{5}{2}\right)$  (B)  $(0, \infty)$  (C)  $\left(-\frac{5}{2}, 0\right)$  (D)  $\left[-\frac{5}{2}, 8\right)$
45. Solve:  $|3x - 8| > 4$   
 (A)  $x < 4$  (B)  $x > 4$  (C)  $x > 0$  (D)  $x < 0$

*Space for rough work*



46. Solve:  $|8x - 9| > -2$   
 (A)  $x > \frac{9}{8}$  (B)  $x > \frac{7}{8}$  (C)  $x < \frac{9}{8}$  (D) R
47. Solve:  $||x - 2| - 1| \geq 3$   
 (A)  $(-\infty, -2]$  (B)  $\left(-\infty, \frac{8}{5}\right]$  (C)  $[6, \infty)$  (D)  $[5, \infty)$
48. If  $\log_{0.5}(x - 1) < \log_{0.25}(x - 1)$ , then x lies in the interval  
 (A)  $(2, \infty)$  (B)  $(3, \infty)$  (C)  $(-\infty, 0)$  (D)  $(0, 3)$
49. If  $\log_2(3^{2x-2} + 7) = 2 + \log_2(3^{x-1} + 1)$ , then x equals  
 (A) 0 (B) 1 (C) 2 (D) 3
50. If x satisfies  $\log_3(2x + 1) < \log_3 5$ , then x contains the interval  
 (A)  $\left(-\frac{1}{2}, 0\right)$  (B)  $[0, 2)$  (C)  $[1, 2)$  (D)  $(2, 3)$

### SECTION – II: (Integer value type)

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51. The sum of all integers satisfying the inequality  $(4 - x^2)(x^2 - 4x - 5) > 0$
52. Number of integral values of x which satisfies the inequality  $(11x^2 + 45x + 34) < 0$  is k, then units digit of k is
53. If  $a_1, a_2, \dots, a_n$  is in A.P with common difference as 'd' and  $b_1, b_2, \dots, b_n$  is also in A.P with common difference as '2d' with  $a_1 = b_1 = 0$ , then  $\frac{a_{101}}{b_{26}} =$

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**Space for rough work**

54. If 3 sides of a triangle are in A.P, and the perimeter of the triangle is 12cm, then find the number of triangles where sides of the triangle are natural numbers ?
55. If  $a_1, a_2, \dots, a_{50}$  is in A.P, where  $a_1 = 2$  and  $a_{10} = 20$  and  $b_1, b_2, \dots, b_{75}$  is in A.P where  $b_1 = 1$  and  $b_{50} = 99$ , then find the number of common terms in both series
56. The number of positive integer values of  $x$  for which the inequalities  $x^2 - 3x - 10 < 0$  and  $10x - x^2 - 16 > 0$  hold simultaneously is
57. The number of positive integral solution of  $x^2 + 9 < (x + 3)^2 < 8x + 25$  is
58. The number of solutions of the equation  $\log_7 \log_5 (\sqrt{x+5} + \sqrt{x}) = 0$  is
59. If  $\log x^2 - \log 2x = 3 \log 3 - \log 6$ , then  $x$  is equal to
60. The number of solutions of  $\log_4(x - 1) = \log_2(x - 3)$  is

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***Space for rough work***

# FITJEE RET – 9

(2018 – 2020)(1<sup>ST</sup> YEAR\_REGULAR)

IIT-2014 (P1)\_SET-A

DATE: 11.06.2018

## ANSWERS

### PHYSICS

1.	ABD	2.	BCD	3.	ABC	4.	BC
5.	C	6.	Bonus	7.	ABC	8.	D
9.	A,C,D	10.	A	11.	Bonus	12.	6
13.	4	14.	6	15.	5	16.	7
17.	0	18.	2	19.	0	20.	3

### CHEMISTRY

21.	B, C, D	22.	A, B, C, D	23.	B, C	24.	A, B
25.	A, B, D or A, B, C, D						
26.	A, C, D	27.	B, D	28.	A, B		
29.	A, B, C	30.	A, B, C	31.	6	32.	5
33.	1	34.	Bonus	35.	5	36.	7
37.	4	38.	5	39.	2	40.	4

### MATHEMATICS

41.	A, B	42.	C	43.	C, D	44.	A, B
45.	B, D	46.	A, B, C, D	47.	A, C	48.	A, B
49.	B, C	50.	A, B, C	51.	7	52.	2
53.	2	54.	2	55.	0	56.	2
57.	5	58.	2	59.	9	60.	1

# FIITJEE RET – 1

(2018 – 2020)(1<sup>ST</sup> YEAR\_REGULAR)

IIT-2014 (P1)\_SET-B

DATE: 11.06.2018

Time: 3 hours

Maximum Marks: 180

## INSTRUCTIONS:

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NAME:

ENROLLMENT NO.:

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- $\eta$  = coefficient of viscosity
- dv = small change in velocity
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$$3. \quad \text{Energy density} = \frac{\text{Energy}}{\text{Volume}}$$

Curie = number of disintegrations per second

$$\text{surface Tension} = \frac{\text{Force}}{\text{Length}}$$

PAPER-I  
PART I: PHYSICS

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

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 (A)  $[\epsilon_0] = M^{-1}L^{-3}T^2I$       (B)  $[\epsilon_0] = M^{-1}L^{-3}T^4I^{-2}$       (C)  $[\mu_0] = MLT^{-2}I^{-2}$       (D)  $[\mu_0] = ML^2T^{-1}I$
2. Which of the following pairs has/have the same dimensions?  
 (A) Reynold number and coefficient of friction      (B) Curie and frequency of light wave  
 (C) Latent heat and gravitational potential      (D) Planck's constant and torque
3. Suppose a quantity P can be represented in terms of M, L and T, i.e.  $[P] = M^a L^b T^c$ . The quantity mass  
 (A) can always be dimensionally represented in terms of L, T and P  
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4. If the speed v of a particle of mass m as function of time t is given by  $v = \omega A \sin\left[\left(\sqrt{\frac{k}{m}}\right)t\right]$ . Where A has dimension of length.  
 (A) The argument of trigonometric function must be a dimensionless quantity  
 (B) Dimensional formula of  $\omega$  is  $[LT^{-1}]$   
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5. If instead of mass, length and time as fundamental quantities, we choose velocity, acceleration and force as fundamental quantities express their dimensions by v, a and F respectively, then the dimensions of Young's modulus will be expressed as.  
 (A)  $[Fa^2v^{-4}]$       (B)  $[F^2v^{-1}a]$       (C)  $[Fa^2v^{-1}]$       (D)  $[Fa v^{-2}]$

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**Space for rough work**

6. Which of the following pairs has the same dimensions?  
 (A) torque and work (B) angular momentum and Planck's constant  
 (C) energy and Young's modulus (D) Light year and wavelength
7. Which of the following pairs have different dimensions?  
 (A) Frequency and angular velocity. (B) Tension and surface tension.  
 (C) Density and energy density. (D) Linear momentum and angular momentum.
8. Pressure is dimensionally  
 (A) Force per unit area (B) Energy per unit volume  
 (C) Momentum per unit area per second (D) Momentum per unit volume
9. Choose the correct statement(s).  
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 (B) A dimensionally correct equation may be correct.  
 (C) A dimensionally incorrect equation must be incorrect.  
 (D) A dimensionally incorrect equation may be correct.
10. Consider three quantities :  $x = \frac{E}{b}$ ,  $y = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$  and  $z = \frac{\ell}{CR}$ . Here,  $\ell$  is the length of a wire, C is the capacitance, and R is a resistance, E is electric field, b is distance between two point. All other symbols have usual meanings. Then  
 (A) x and y have the same dimensions.  
 (B) x and z have the same dimensions.  
 (C) y and z have the same dimensions.  
 (D) None of the above three pairs have the same dimensions.

### SECTION – II: (Integer value type)

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

11. The speed of light ( $c$ ), gravitational constant ( $G$ ) and Planck's constant ( $h$ ) are taken as the fundamental units in a system. Then if sum of mod of exponents of dimensions of time in this new system is  $x/2$ , then the value of x is?

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**Space for rough work**

12. The sum of exponents of dimensions of  $e^2 / 4\pi\epsilon_0 hc$ , where  $e, \epsilon_0, h$  and  $c$  are electronic charge, electric permittivity, Planck's constant and velocity of light in vacuum respectively is?
13. If frequency  $F$ , velocity  $V$ , and density  $D$  are considered fundamental units and the dimensional formula for momentum is found to be  $D^a V^b F^c$  then  $(a + b + c)$  is \_\_\_\_
14. The frequency  $f$  of vibrations of a mass  $m$  suspended from a spring of spring constant  $k$  is given by  $f = Cm^x k^y$ , where  $C$  is dimensionless constant. Then the value of  $(x + y)$  is \_\_\_\_
15. To find the distance  $d$  over which a signal can be seen clearly in foggy conditions, a railways engineer uses dimensional analysis and assumes that the distance depends on the mass density ( $\rho$ ) of the fog, intensity  $\left[ S = \frac{\text{Power}}{\text{Area}} \right]$  of the light from the signal, and its frequency ' $f$ '. The engineer finds that ' $d$ ' is proportional to  $S^{1/n}$ . The value of ' $n$ ' is
16.  $P$  represents radiation pressure,  $C$  represents the speed of light, and  $Q$  represents radiation energy striking a unit area per second. If non – zero integers  $x, y$  and  $z$  are such that  $P^x Q^y C^z$  is dimensionless, find the value of  $x + 2y + 4z$  is \_\_\_\_
17. The value of Stefan's constant is  $\sigma = 5.67 \times 10^{-8} \text{ J s}^{-1} \text{ m}^{-2} \text{ K}^{-4}$ . Its value in c.g.s. system is approximately  $34/N \times 10^{-5} \text{ erg s}^{-1} \text{ cm}^{-2} \text{ K}^{-4}$ . Find the value of  $N$ .
18. Derive an expression for the rate of flow of a liquid through a capillary tube using dimensional approach. Assume that the rate of flow depends on (1) the pressure gradient  $\left( \frac{P}{\ell} \right)$  (ii) the radius  $r$ , and (iii) the coefficient of viscosity  $\eta$ . The exponent of  $r$  in the derived expression will be equal to

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**Space for rough work**



19. If the unit of length is doubled, mass is tripled and time is halved, by what factor is the unit of pressure effected?
20. The unit of viscosity in the CGS system is poise (P) that in SI is poiseuille (PI). If  $2 \times P = PI$ , then the value of x will be?

## PART II: CHEMISTRY

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

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

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21. Rutherford's experiment established that  
(A) inside the atom there is a heavy positive centre  
(B) nucleus contains protons and neutrons  
(C) most of the space in an atom is empty  
(D) size of nucleus is very small
22. An isotone of  ${}^{76}_{32}\text{Ge}$  is  
(A)  ${}^{77}_{32}\text{Ge}$                       (B)  ${}^{77}_{33}\text{As}$                       (C)  ${}^{77}_{34}\text{Se}$                       (D)  ${}^{78}_{34}\text{Se}$
23. The atomic nucleus contains  
(A) protons                      (B) neutrons                      (C) electrons                      (D) photons
24.  $\text{NH}_3$  is isoelectronic with  
(A)  $\text{H}_2\text{O}$                       (B) Ne                      (C)  $\text{CH}_4$                       (D)  $\text{C}_2\text{H}_4$
25. Which of the following is a characteristic of Planck's quantum theory of radiation ?  
(A) Radiations are associated with energy  
(B) Magnitude of energy associated with a quantum is equal to  $h\nu$   
(C) Radiation energy is neither emitted nor absorbed continuously  
(D) A body can emit less or more than a quantum of energy.

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***Space for rough work***

26. Identify the correct statement  
 (A) Electrons are also called as cathode rays  
 (B)  $e/m$  of electron is equal to  $1.758 \times 10^{11}$  C/kg  
 (C) mass of proton and neutron are almost same.  
 (D) size of atom is around  $10^5$  times the size of nucleus.
27.  ${}^{31}_{15}\text{P}$  has  
 (A) 31 nucleons (B) 15 protons (C) 16 neutrons (D) 1 Isotopic number( $n-p$ )
28. The total charge of  $\text{He}^+$  ion, is same as that of  
 (A)  $\text{He}^{+2}$  (B)  $\text{Li}^+$  (C)  $\text{H}^+$  (D)  $\text{Li}^{+2}$
29. Isodiaphers among the following  
 (A)  ${}_5\text{B}^{11}$   ${}_{11}\text{Na}^{23}$  (B)  ${}_{24}\text{Cr}^{54}$   ${}_{29}\text{Cu}^{64}$  (C)  ${}_6\text{C}^{12}$   ${}_{19}\text{K}^{40}$  (D) None
30. Which of the following properties is/are proportional to the energy of electromagnetic radiation?  
 (A) frequency (B) wave number (C) wavelength (D) number of photons

### SECTION – II: (Integer value type)

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

31. The sum of electrons present in  $\text{H}$ ,  $\text{He}^+$ ,  $\text{Li}^{+2}$ ,  $\text{Li}^+$  and  $\text{Be}^{+2}$ .
32. The ratio of energies of two radiations one with  $\lambda = 1250 \text{ \AA}$  and other with  $\lambda = 5000 \text{ \AA}$ .
33. The frequency of radiation of wavelength 600 nm is  $x \times 10^{14} \text{ s}^{-1}$ . Then  $x$  is
34. A certain dye absorbs light of  $1000 \text{ \AA}$  wavelength and emits  $4000 \text{ \AA}$  wavelength. If 50% of absorbed energy is emitted then ratio of number of quanta emitted out to the number of quanta absorbed.

**Space for rough work**

35. Maximum of photons of light of  $\lambda = 4000 \text{ \AA}$ . Which provide 2J energy is equal to  $x \times 10^{18}$ . Then x is
36. Oxygen consists of isotopes  $O^{16}$ ,  $O^{17}$ ,  $O^{18}$  and carbon consists of isotopes  $C^{12}$  and  $C^{13}$ . The number of  $CO_2$  molecules formed is X. What is  $X/2$  ?
37. The wavelength of an ultraviolet wave, with frequency  $12 \times 10^{16}$  cycles per second is  $x \times 10^{-9}$  m. The value of 2x is
38. A radio station in broadcasting programmes at 100 MHz frequency. If the distance between the radio station and receiver set is 300 km. The time taken by wave to reach the receiver is  $y \times 10^{-3}$  s. Find y ?
39. The specific charge of  $A^{(+)}$  ion is  $1.97 \times 10^{-7}$  C / kg. The mass of A atom is  $a \times 10^{-26}$  kg. Find a ?
40. The radius of the nucleus in Fermi whose mass number is equal to 64.

### PART III: MATHEMATICS

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

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

41. Solve:  $|8x - 9| > -2$   
 (A)  $x > \frac{9}{8}$       (B)  $x > \frac{7}{8}$       (C)  $x < \frac{9}{8}$       (D) R
42. Solve:  $||x - 2| - 1| \geq 3$   
 (A)  $(-\infty, -2]$       (B)  $\left(-\infty, \frac{8}{5}\right]$       (C)  $[6, \infty)$       (D)  $[5, \infty)$
43. If  $\log_{0.5}(x - 1) < \log_{0.25}(x - 1)$ , then x lies in the interval  
 (A)  $(2, \infty)$       (B)  $(3, \infty)$       (C)  $(-\infty, 0)$       (D)  $(0, 3)$

**Space for rough work**

44. If  $\log_2(3^{2x-2} + 7) = 2 + \log_2(3^{x-1} + 1)$ , then  $x$  equals  
 (A) 0 (B) 1 (C) 2 (D) 3
45. If  $x$  satisfies  $\log_3(2x + 1) < \log_3 5$ , then  $x$  contains the interval  
 (A)  $\left(-\frac{1}{2}, 0\right)$  (B)  $[0, 2)$  (C)  $[1, 2)$  (D)  $(2, 3)$
46. How many terms of the series 54, 51, 48, ..... be taken so that their sum is 513  
 (A) 18 (B) 19 (C) 20 (D) 21
47.  $(x - 1)(x - 2)^2(x - 3)^3(x - 4)^4(x - 5)^5 \leq 0$ , then  $x \in$   
 (A)  $(-\infty, \infty)$  (B)  $(-\infty, 1] \cup [2, 3] \cup [4, 5]$   
 (C)  $(-\infty, 1] \cup [3, 5] \cup \{2\}$  (D)  $[1, 3] \cup [5, \infty)$
48. If  $f(x) = x^2 + 12x + 40$ ,  $g(x) = -x^2 + 5x - 6$ , then the values of  $x$  for which  $\frac{f(x)}{g(x)} \leq 0$   
 (A)  $x \in (2.5, 2.75)$  (B)  $x = 4$  (C)  $x = -2$  (D)  $x \in (4, \infty)$
49. Solution of  $\log_{1/3}(2x^2 + 5x + 1) < 0$  is  
 (A)  $\left(-\infty, -\frac{5}{2}\right)$  (B)  $(0, \infty)$  (C)  $\left(-\frac{5}{2}, 0\right)$  (D)  $\left[-\frac{5}{2}, 8\right)$
50. Solve:  $|3x - 8| > 4$   
 (A)  $x < 4$  (B)  $x > 4$  (C)  $x > 0$  (D)  $x < 0$

### SECTION – II: (Integer value type)

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

51. The number of positive integer values of  $x$  for which the inequalities  $x^2 - 3x - 10 < 0$  and  $10x - x^2 - 16 > 0$  hold simultaneously is
52. The number of positive integral solution of  $x^2 + 9 < (x + 3)^2 < 8x + 25$  is

*Space for rough work*

53. The number of solutions of the equation  $\log_7 \log_5 (\sqrt{x+5} + \sqrt{x}) = 0$  is
54. If  $\log x^2 - \log 2x = 3 \log 3 - \log 6$ , then x is equal to
55. The number of solutions of  $\log_4(x-1) = \log_2(x-3)$  is
56. The sum of all integers satisfying the inequality  $(4-x^2)(x^2-4x-5) > 0$
57. Number of integral values of x which satisfies the inequality  $(11x^2 + 45x + 34) < 0$  is k, then units digit of k is
58. If  $a_1, a_2, \dots, a_n$  is in A.P with common difference as 'd' and  $b_1, b_2, \dots, b_n$  is also in A.P with common difference as '2d' with  $a_1 = b_1 = 0$ , then  $\frac{a_{101}}{b_{26}} =$
59. If 3 sides of a triangle are in A.P, and the perimeter of the triangle is 12cm, then find the number of triangles where sides of the triangle are natural numbers ?
60. If  $a_1, a_2, \dots, a_{50}$  is in A.P, where  $a_1 = 2$  and  $a_{10} = 20$  and  $b_1, b_2, \dots, b_{75}$  is in A.P where  $b_1 = 1$  and  $b_{50} = 99$ , then find the number of common terms in both series

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***Space for rough work***

# FITJEE RET – 9

(2018 – 2020)(1<sup>ST</sup> YEAR\_REGULAR)

IIT-2014 (P1)\_SET-B

DATE: 11.06.2018

## ANSWERS

### PHYSICS

1. Bonus	2. ABC	3. D	4. A,C,D
5. A	6. ABD	7. BCD	8. ABC
9. BC	10. C	11. 7	12. 0
13. 2	14. 0	15. 3	16. Bonus
17. 6	18. 4	19. 6	20. 5

### CHEMISTRY

21. A, C, D	22. B, D	23. A, B	24. A, B, C
25. A, B, C	26. B, C, D	27. A, B, C, D	28. B, C
29. A, B	30. A, B, D or A, B, C, D		
31. 7	32. 4		
33. 5	34. 2	35. 4	36. 6
37. 5	38. 1	39. Bonus	40. 5

### MATHEMATICS

41. A, B, C, D	42. A, C	43. A, B	44. B, C
45. A, B, C	46. A, B	47. C	48. C, D
49. A, B	50. B, D	51. 2	52. 5
53. 2	54. 9	55. 1	56. 7
57. 2	58. 2	59. 2	60. 0