

FIITJEE RET – 11

(2017 – 2019)(2ND YEAR_CHAMPIONS)

IIT-2015 (P2)

DATE: 08.10.2018

Time: 3 hours

Maximum Marks: 240

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 **8 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 paragraphs** type questions. Each paragraph describes an experiment, a situation or a problem. Two multiple choice questions will be asked based on this paragraph. One or more than one option can be correct.

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 **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.

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.

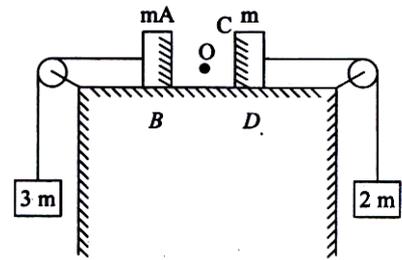
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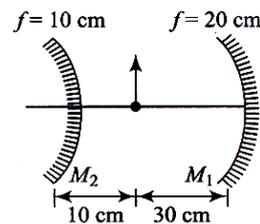
PAPER – II
PART I: PHYSICS
SECTION 1 (Maximum Marks: 32)

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

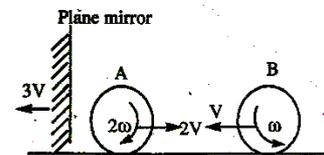
1. Two blocks, each of mass m , lie on a smooth table. They are attached to two other masses as shown in figure. The pulleys and strings are light. An object O is kept at rest on the table. The sides AB and CD of the two blocks are made reflecting. If the acceleration of two images formed in these two reflecting surfaces w.r.t. each other is given by $\frac{17g}{k_0}$ then value of k_0 is _____



2. In figure, find the magnitude of total magnification after two successive reflections first on M_1 and then on M_2 .



3. An object is placed in front of a convex mirror at a distance of 50 cm. A plane mirror is introduced covering the lower half of the convex mirror. If the distance between the object and the plane mirror is 30 cm, it is found that there is no gap between the images formed by the two mirrors. If the radius of the convex mirror is R_0 cm then value of $\sqrt{R_0}$ is _____
4. Two identical balls are rolling without slipping on a horizontal plane as shown in figure. They undergo a perfect elastic collision. Just after collision, the velocity of image of the bottom point of A with respect to the plane mirror is xV , then $x =$ _____.



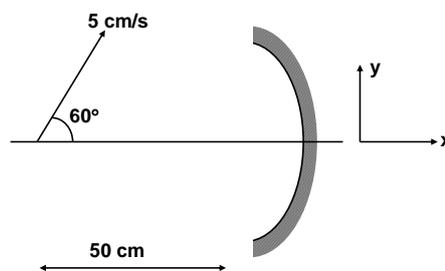
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5. An object is approaching a fixed plane mirror with velocity 3 m/s at an angle of 45° with normal, in a medium of refractive index $4/3$. The speed of the image with respect to the mirror is _____ m/s.
6. Two monochromatic (wave length = $a/5$) and coherent sources of electromagnetic waves are placed on the x-axis at the points $(2a,0)$ and $(-a,0)$. A detector moves in a circle of radius R ($\gg 2a$) whose centre is at the origin. If N_0 is the total number of maxima detected during one circular revolution by the detector then value of $\frac{N_0}{10}$ is _____
7. In YDSE how many maxima can be obtained on the screen if wavelength of light used is 200nm and $d = 700$ nm.
8. In Young's double slit experiment, the wavelength of red light is 7800 \AA and that of blue light is 5200 \AA . The value of n for which n^{th} bright band due to red light coincides with $(n+1)^{\text{th}}$ bright band due to blue light, is

SECTION 2 (Maximum Marks: 32)

- ◆ This section contains **EIGHT** 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
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9. An object is moving with a velocity of 5 cm/s at an angle of 60° with respect to the optic axis of a concave mirror. The object is at a distance of 50 cm from the mirror. The velocity of image at the given instant is found to be $-10\hat{i} + K\sqrt{3}\hat{j}$ cm/sec (K is a positive integer)

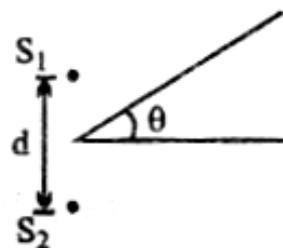


- (A) the focal length of the mirror is 100 cm
- (B) the value of K is 5
- (C) the image must be real
- (D) the image must be virtual

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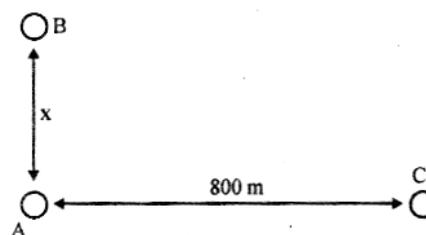
10. In an interference arrangement similar to Young's double – slit experiment, the slits S_1 and S_2 are illuminated with coherent microwave sources, each of frequency 10^6 Hz. The sources are synchronized to have zero phase difference. The slits are separated by a distance $d = 150$ m. The intensity $I(\theta)$ is measured as a function of θ , where θ is defined as shown. If I_0 is the maximum intensity then $I(\theta)$ for $0 \leq \theta \leq 90^\circ$ is given by

- (A) $I(\theta) = \frac{I_0}{2}$ for $\theta = 30^\circ$ (B) $I(\theta) = \frac{I_0}{4}$ for $\theta = 90^\circ$
 (C) $I(\theta) = I_0$ for $\theta = 0^\circ$
 (D) $I_0(\theta)$ is constant for all values of θ

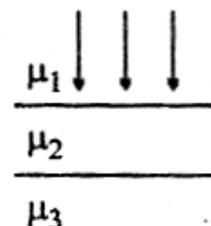


11. A radio transmitter at position A operates at a wavelength of 20 m. A second, identical transmitter is located at a distance x from the first transmitter, at position B. The transmitters are phase locked together such that the second transmitter is lagging $\pi/2$ out of phase with the first. For which of the following values of $BC - CA$ will the intensity at C be max

- (A) $BC - CA = 60$ m (B) $BC - CA = 65$ m
 (C) $BC - CA = 55$ m (D) $BC - CA = 75$ m



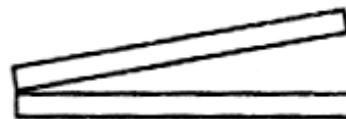
12. Consider a case of thin film interference as shown. Thickness of film is equal to wavelength of light in μ_2
- (A) Reflected light will be maxima if $\mu_1 < \mu_2 < \mu_3$
 (B) Reflected light will be maxima if $\mu_1 < \mu_2 > \mu_3$
 (C) Transmitted light will be maxima if $\mu_1 > \mu_2 > \mu_3$
 (D) Transmitted light will be maxima if $\mu_1 > \mu_2 < \mu_3$



Space for rough work

13. When monochromatic light is incident normally on a wedge-shaped thin air film, refer figure, an interference pattern may be seen by reflection. Which of the following is/are correct ?

(A) Parallel fringes are observed
 (B) If water is introduced into the region between the plates, the fringe separation decreases
 (C) If the angle of the wedge is increased, the fringe separation decreases
 (D) When white light is used there will not be a completely dark fringe



14. A real object is moving towards a fixed spherical mirror. The image
 (A) must move away from the mirror (B) may move away from the mirror
 (C) may move towards the mirror if mirror is concave
 (D) must move towards the mirror if mirror is convex

15. A reflecting surface is represented by the equation $Y = \frac{2L}{\pi} \sin\left(\frac{\pi x}{L}\right), 0 \leq x \leq L$.

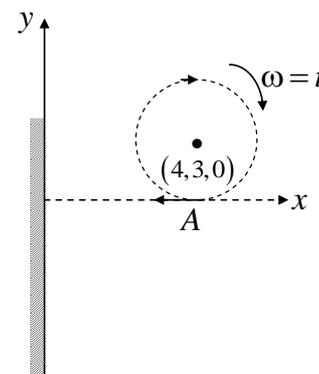
A ray travelling horizontally becomes vertical after reflection. The coordinates of the point (s) where this ray is incident is



(A) $\left(\frac{L}{4}, \frac{\sqrt{2L}}{\pi}\right)$ (B) $\left(\frac{L}{3}, \frac{\sqrt{3L}}{\pi}\right)$ (C) $\left(\frac{3L}{4}, \frac{\sqrt{2L}}{\pi}\right)$ (D) $\left(\frac{2L}{3}, \frac{\sqrt{3L}}{\pi}\right)$

16. A plane mirror is placed in the $y-z$ plane; a point object is moving in a circular path of radius 3 m and centre $(4, 3, 0)$ in $x-y$ plane, with variable angular velocity given by $\omega = t$ (rad/sec).

(A) At time $\sqrt{5\pi}$, the relative velocity of object with respect to the image will be zero for the third time
 (B) At time $\sqrt{\pi}$, the relative velocity of object with respect to the image will be zero for the third time
 (C) The line joining object and image is always perpendicular to the mirror.
 (D) The line joining object and image is always perpendicular to the mirror, at time $n\sqrt{\pi}$ only (where 'n' is integer)



Space for rough work

SECTION 3 (Maximum Marks: 16)

- ◆ This section contains **TWO** paragraphs
- ◆ Based on each paragraph, there will be **TWO** questions
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- ◆ For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
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Paragraph-1

The Young's double – slit interference arrangement is modified by placing an isotropic transparent plate of high melting point in front of one of the slits. The refractive index of the plate is $\mu_0 = 1.5$ at room temperature and its interposing thickness is $t_0 = 2\text{cm}$. The temperature coefficient of refractive index of the plate (i.e. the fractional change in refractive index per unit rise in temperature) is $2 \times 10^{-6}/^\circ\text{C}$. The arrangement is illuminated by a monochromatic coherent source of wavelength $\lambda = 6000\text{\AA}$

17. The central maximum normally occurs at a spot on the screen midway between the two slits at room temperature. On insertion of the transparent plate
- (A) this spot will be a maxima
 - (B) this spot will now become a minima
 - (C) the spot will be neither a minima nor a maxima
 - (D) this spot will be either a minima or a maxima
18. The plate is heated at the rate of $1^\circ\text{C}/\text{min}$, for 5 minutes. How many fringes will cross a point on the screen, if linear expansion is neglected ?
- (A) 100/3 (B) 10/3 (C) 1/3 (D) 1/2

Space for rough work

Paragraph-2

A point object is placed on the principal axis of a concave mirror quite far away from the pole and moved at a constant speed 0.5 cm/sec towards the pole. Its image also moves. It is found that the object and the image cross each other at a point which is at a distance 50 cm from the pole.

19. Focal length of the mirror is
 (A) 50 cm (B) 35 cm (C) 25 cm (D) 15 cm
20. Position of the image when the object is at a distance 30 cm from the pole is
 (A) 150 cm from the pole in front of the reflecting surface
 (B) 120 cm from the pole behind the mirror
 (C) 150 cm from the pole behind the mirror
 (D) 120 cm from the pole in front of the reflecting surface

PART II: CHEMISTRY
SECTION 1 (Maximum Marks: 32)

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21. What is the oxidation state of Fe in fool's gold?
22. Epsom salt is $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$, what is the value of "x" in Epsom salt?
23. Galena $\xrightarrow{\text{Roasting}}$ Metal oxide + Gas .
 What is the difference between the oxidation state of sulphur in product and reactant?

Space for rough work

24. Find the number of native ores out of given ores.
Pyrolusite, Chromite, Siderite, Cassiterite, Calamine, Argentite, Lime stone, Chalcopyrite
25. Total number of metals given below which can replace Mg^{2+} ion from aq. Solution of $MgCl_2$. Sodium, Gold, Copper, Lithium, Aluminium, Silver, Zinc.
26. A molten mixture contain following substance,
Cu, FeO, PbO, CaO, MgO, Ag
Find total number of substances which are removed when molten mixture is treated with SiO_2 .
27. How many Metals among the following do not form amalgam are
Fe, Pt, Zn, Au
28. How many alkali earth metals is/are present in dolomite?

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29. Metals which are extracted by smelting process
(A) Pb (B) Fe (C) Zn (D) Mg
30. Zone refining is used for purification of
(A) Ge (B) Si (C) Ga (D) Se
31. Auto reduction process is used in extraction of
(A) Cu (B) Hg (C) Al (D) Fe

Space for rough work

32. In the manufacturing of metallic sodium by fused salt electrolysis method (Down's process), small amount of CaCl_2 that added is known as auxiliary electrolyte and is used to
(A) improve the electrical conductance (B) decrease the melting point of NaCl
(C) stabilize the metallic sodium (D) increase the temperature of electrolysis
33. Extraction of silver from argentiferrous lead ($\text{PbS} + \text{Ag}_2\text{S}$) involves
(A) distillation method (B) cupellation
(C) froth flotation method (D) treatment with NaCl
34. Metallurgical process of zinc involves roasting of zinc sulphide followed by reduction. Metallic zinc distills over as it is volatile and impurities like Cd, Pd and Fe gets condensed. The crude metal obtained is called spelter, which may be purified by
(A) electrolysis process (B) fractional distillation
(C) polling (D) heating with iodine
35. Calcination and roasting processes of reduction of ores to their oxides are beneficial
(A) to convert ores into porous form so that their reduction becomes easier
(B) as volatile impurities like P, As, Sb, S are removed
(C) as organic impurities are removed
(D) as the ores are converted into oxide form which makes the reduction easier
36. Which of the following statements is correct regarding the slag formation during the extraction of a metal like copper or iron ?
(A) The slag is lighter and has lower melting point than the metal
(B) The slag is heavier and has lower melting point than the metal
(C) The slag is lighter and has higher melting point than the metal
(D) The slag is heavier and has higher melting point than the metal

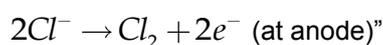
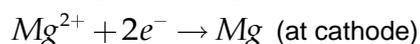
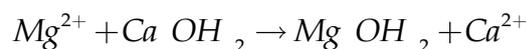
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SECTION 3 (Maximum Marks: 16)

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Paragraph-1

Dow's process of extraction of Mg involves extraction of Mg from sea water. Sea water is concentrated in sun-light and is then treated with slaked lime. Magnesium hydroxide is heated in a stream of HCl to give $MgCl_2$ which is electrolysed to discharge Mg. The mixture is in the ratio 35% $MgCl_2$ + 50% $NaCl$ + 15% $CaCl_2$. $NaCl$ and $CaCl_2$ are added to lower the fusion temperature and to increase the conductance.



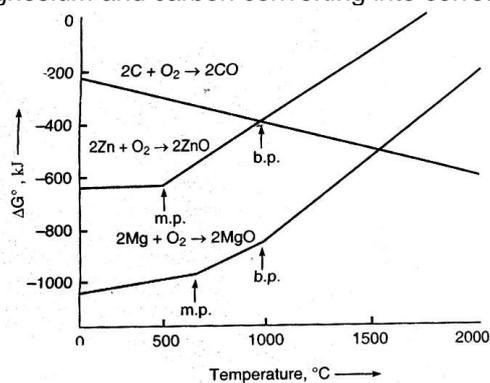
Mg electrolysed is protected from atmospheric oxidation by a blanket of inert gases.

37. In the hydrated chloride of Mg the value of x is
 (A) 6 (B) 4 (C) 8 (D) 10
38. Molten mixture contains Mg^{2+} , Na^+ and Ca^{2+} but at cathode only Mg^{2+} is discharged because
 (A) standard reduction potential of Mg^{2+} is least among the three
 (B) standard oxidation potential of Mg is the least among the three
 (C) discharge potential of Mg^{2+} is highest
 (D) none of these

Space for rough work

Paragraph-2

The Ellingham diagram for zinc, magnesium and carbon converting into corresponding oxides is shown below



39. At what temperature, zinc and carbon have equal affinity for oxygen?
 (A) 1000°C (B) 1500°C (C) 500°C (D) 1200°C
40. To make the following reduction process spontaneous, temperature should be
 $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$
 (A) 1000°C (B) $> 1100^{\circ}\text{C}$ (C) $< 500^{\circ}\text{C}$ (D) $< 1000^{\circ}\text{C}$

Space for rough work

PART III: MATHEMATICS
SECTION 1 (Maximum Marks: 32)

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0 In all other cases

41. The number of integral solutions of the equation $x_1 \cdot x_2 \cdot x_3 \cdot x_4 \cdot x_5 = 2310$ are $k \times 5^5$, then $\frac{k}{4}$ is equal to
42. In a certain test there are n questions. In this test 2^{n-i} students gave wrong answers to at least i question, where $i = 1, 2, \dots, n$. If the total number of Wrong answers given is 2047, then $(n - 3)$ is equal to
43. A cricket player played n ($n > 1$) matches during his career and made a total of $\frac{(n+1)(2^{n+1} - n - 2)}{4}$ runs. If the player made $k \cdot 2^{n-k+1}$ runs in the k^{th} match ($1 \leq k \leq n$), find n .
44. The sum of the factors of $7!$, which are odd and are of the form $3t + 1$ where t is a whole number, is
45. All the five digits number in which each successive digit exceeds its predecessor are arranged in the increasing order of their magnitude. The 97th number in the list does not contain the digit.....
46. Number of zeroes at the end of ${}^{2002}C_{1001}$ is.....
47. The last digit of $(1! + 2! + \dots + 2005!)^{500}$ is
48. The exponent of 7 in ${}^{100}C_{50}$ is

Space for rough work

SECTION 2 (Maximum Marks: 32)

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49. For the equation $x + y + z + w = 16$, the no. of positive integral solutions is equal to
- (A) The no. of ways in which 12 identical things can be distributed among 4 persons.
 (B) The no. of ways in which 16 identical things can be distributed among 4 persons.
 (C) coefficient of x^{16} in $(x^0 + x^1 + x^2 + \dots + x^{16})^4$
 (D) coefficient of x^{16} in $(x^1 + x^2 + x^3 + \dots + x^{16})^4$
50. Suppose a set A contains $(2n+1)$ elements. Let the number of subsets of A containing at most n elements and the number of subsets of A containing more than n elements, then
- (A) $N_1 = N_2$ (B) $N_1 + N_2 = 2^{2n+1}$
 (C) $N_1 + 3N_2 = 2^{2n+2}$ (D) none of these
51. For the equation $x + y + z + w = 19$, the number of positive integral solutions is equal to
- (A) the number of ways in which 15 identical things can be distributed among 4 persons
 (B) the number of ways in which 19 identical things can be distributed among 4 persons
 (C) coefficient of in $(x^0 + x^1 + x^2 + \dots + x^{19})^4$
 (D) coefficient of in $(x + x^2 + x^3 + \dots + x^{19})^4$
52. The number of ordered triplets of positive integers which satisfy the inequality $20 \leq x + y + z \leq 50$.
- (A) ${}^{50}C_2 - {}^{19}C_2$ (B) ${}^{50}C_3 - {}^{19}C_3$ (C) ${}^{51}C_3 - {}^{21}C_3$ (D) ${}^{49}C_3 - {}^{19}C_3$

Space for rough work

53. If n is number of necklaces which can be formed using 17 identical pearls and two identical diamonds and similarly m is number of necklaces which can be formed using 17 identical pearls and different diamonds, then
 (A) $n = 9$ (B) $m = 18$ (C) $n = 18$ (D) $m = 9$
54. If $10! = 2^p \cdot 3^q \cdot 5^r \cdot 7^s$, then
 (A) $2q = p$
 (B) $pqrs = 64$
 (C) number of divisors of $10!$ is 280
 (D) number of ways of putting $10!$ as a product of two natural numbers is 135
55. Triplet (x, y, z) is chosen from the set $\{1, 2, 3, \dots, n\}$, such that $x \leq y < z$. The number of such triplet is
 (A) n^3 (B) ${}^{n+1}C_3$ (C) nC_2 (D) ${}^nC_2 + {}^nC_3$
56. In a class tournament when the participants were to play one game with another, two class players fell ill having played 3 games each. If the total number of games played is 84, the number of participants at the beginning was
 (A) 15 (B) 20 (C) 6C_2 (D) 6C_3

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Space for rough work

Paragraph-1

Tom has 15 ping-pong balls each uniquely numbered from 1 to 15. He also has a red box, a blue box, and a green box.

57. How many ways can Tom place the 15 distinct balls into the three boxes so that no box is empty?
 (A) $3^{15} - 2 \cdot 2^{15} + 3$ (B) $3^{15} - 3 \cdot 2^{15} + 2$ (C) $2^{15} - 3 \cdot 2^{15} + 3$ (D) $3^{15} - 3 \cdot 2^{15} + 3$
58. Suppose now that Tom has placed 5 ping-pong balls in each box. How many ways can he choose 5 balls from the three boxes so that he chooses at least one from each box ?
 (A) 750 (B) 2284 (C) 2250 (D) 1500

Paragraph-2

A coaching institute for IIT has 4 batches. Number of boys and girls in each batch is given below

Batch	No. of Boys	No. of Girls
A	25	14
B	20	15
C	28	18
D	35	25

59. In how many ways two prizes can be given to two students of different gender in batch B
 (A) 35 (B) 300 (C) 600 (D) none of these
60. In how many ways three prizes can be given if atleast one prize is given to a girl.
 (A) $3 \left({}^{180}C_3 - {}^{108}C_3 \right)$ (B) $\left({}^{180}C_3 - {}^{108}C_3 \right)$ (C) $\left({}^{180}C_3 - {}^{72}C_3 \right)$ (D) 451024

Space for rough work

FIITJEE RET – 11

(2017 – 2019)(2ND YEAR_CHAMPIONS)

IIT-2015 (P2)

DATE: 08.10.2018

ANSWERS

PHYSICS

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

CHEMISTRY

21.	2	22.	7	23.	6	24.	0
25.	0	26.	4	27.	2	28.	2
29.	A, B, C	30.	A, B, C	31.	A, B	32.	A, B, C
33.	A, B, C	34.	A, B	35.	A, B, C, D	36.	A
37.	Bonus	38.	B,C	39.	A	40.	B

MATHEMATICS

41.	Bonus	42.	8	43.	7	44.	8
45.	Bonus	46.	1	47.	1	48.	0
49.	AD	50.	ABC	51.	Bonus	52.	B
53.	AD	54.	ACD	55.	BD	56.	AC
57.	D	58.	C	59.	B or C	60.	A or B