

PHYSICS: Complete Reflection (100%) (exclude problems involving relative motion and differential and integral calculus)

CHEMISTRY: Atomic Structure : Fundamental Particles - their characteristics; Thomson's, Rutherford's atomic model, Planck's Quantum theory, Bohr's atomic model, Applications of Bohr's atomic model - calculation of radius, velocity, frequency, time period and energy of electron in an orbit, Electromagnetic spectra, Hydrogen spectrum, Photoelectric effect (100%)

MATHS: Real numbers, Factor Theorem, Remainder Theorem, Finding roots of Polynomial Equation using Factor Theorem, Finding Polynomial with given roots, Wavy curve method, Rational Inequations, Irrational Equation & Inequation, Modulus: Its properties & graph, Logarithm: Its properties & graph, Equations/Inequation involving Logarithms, Exponentials, Modulus; Greatest Integer, Least Integer, Fractional Part Functions & their graph (100%)

JEE-ADVANCE-2016-Model

IMPORTANT INSTRUCTIONS

Max Marks: 186

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 5)	Questions with Single Correct Choice	3	-1	5	15
Sec – II(Q.N : 6 – 13)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 14 – 18)	Questions with Integer Answer Type	3	0	5	15
Total				18	62

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 19 – 23)	Questions with Single Correct Choice	3	-1	5	15
Sec – II(Q.N : 24 – 31)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 32 – 36)	Questions with Integer Answer Type	3	0	5	15
Total				18	62

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 37 – 41)	Questions with Single Correct Choice	3	-1	5	15
Sec – II(Q.N : 42 – 49)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 50 – 54)	Questions with Integer Answer Type	3	0	5	15
Total				18	62

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Page 2

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 5 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

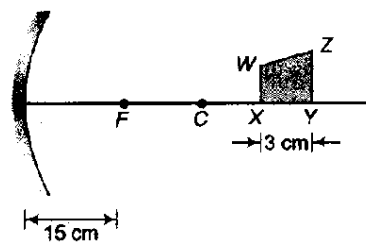
Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.

1. The sun (diameter = D) subtends an angle of θ radians at the pole of concave mirror of focal length f . The diameter of the image of the sun formed by the mirror is
A) $f.\theta$ B) $2f.\theta$ C) $\frac{f^2\theta}{D}$ D) $D.\theta$
2. You walk slowly toward a large concave mirror. At first, you see your inverted image moving toward you. After you pass a certain point, you no longer see your image clearly. Moving still closer, you see a clear, enlarged and erect image of yourself behind the mirror. During the time when you cannot see a clear image
A) You are closer to the mirror than the focal point and the image is now virtual and invisible
B) You are between the center of curvature and the focal point, and the image is now behind you
C) You are between the center of curvature and the focal point, and the image is now virtual and invisible
D) You are closer to the mirror than the focal point and the image is now behind you

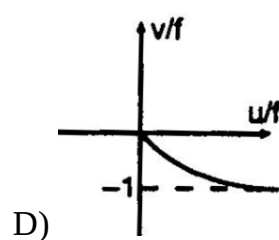
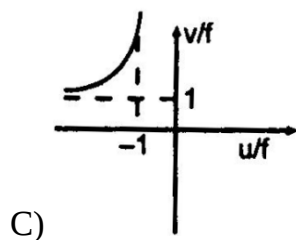
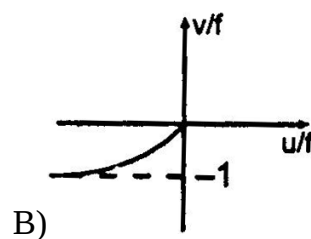
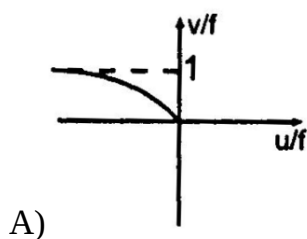
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Page 3

3. Referring to the figure, the image of the quadrilateral XYZW placed in front of the concave mirror



- A) will be congruent to itself
 B) will be similar to itself
 C) neither be congruent nor be similar
 D) None of the above
4. A virtual erect image in a convex mirror is represented by: (u , v , f are co-ordinates)



space for rough work

Page 4

5. An unnumbered wall clock shows time 04:25:37, what time will its image in a plane mirror show.

A) 08:35:23 B) 07:35:23 C) 07:34:23 D) none of these

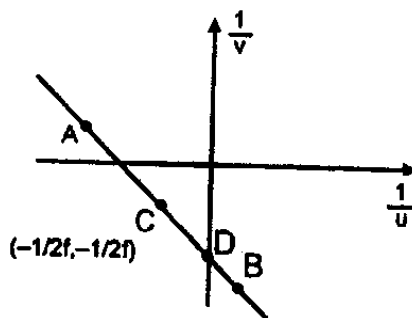
SECTION – II
(MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

Marking scheme: +4 for all correct options & +1 partial marks, 0 if not attempted and -2 in all wrong cases

6. The following graph represents the variation of $(1/v)$ with $(1/u)$ of a spherical mirror.

Which of the following is correct:

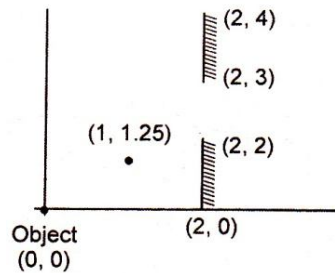


- A) Point A represents a magnified virtual image of a real object
B) Point B represents a diminished real image of a real object
C) Point C represents a same size real inverted image
D) The spherical mirror is Concave

space for rough work

Page 5

7. Two plane mirrors are placed as shown in the figure. The object is kept at the origin of coordinate axes. Which of the following is correct:

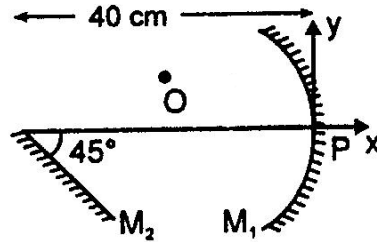


- A) Two different images will be formed
 B) (4,0) will be the coordinate of a virtual image formed
 C) The incident rays passing through (1, 1.25) will take part in image formation
 D) An observer located at (2,2.5) will not be able to see any image
8. Two long plane mirrors OA and OB are kept such that their reflecting surfaces are at an angle of 60° with each other. An object P is kept in front of them such that the angle OP makes with OA is thrice the angle that OP makes with OB. Which of the following is correct:
- A) Total 5 distinct images will be formed
 B) Total 6 distinct images will be formed
 C) All the images formed and the object will lie on a regular convex polygon with O as its centre
 D) The ratio of length of any two adjacent sides of the polygon on which the object and all its images lie will be $(1+\sqrt{3})$

space for rough work

Page 6

9. As shown in the figure, an object O is at the position $(-10, 2)$ with respect to the origin P. The concave mirror M_1 has radius of curvature 30 cm. A plane mirror M_2 is kept at a distance 40 cm in front of the concave mirror. Considering first reflection of the concave mirror M_1 and second on the plane mirror M_2 . Find the coordinates of the second image w.r.t the origin P.



- A) The x-coordinate of the final image formed is -46
B) The y-coordinate of the final image formed is -70
C) The final image is formed due to convergence of reflected rays
D) The final image will be visible from $(-50, 0)$
10. When you walk away from a plane mirror fixed on a vertical wall of a room having horizontal floor:
- A) Your image walks away from you
B) Your image becomes smaller in height
C) The minimum height of mirror required to see your complete image decreases
D) If you did not see the image of your shoes initially, you will never see them

space for rough work

Page 7

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11. Which of the following is correct for a concave mirror:
- A) It never forms diminished virtual image
 - B) It always forms real image of a virtual object
 - C) The ray incident parallel to the principal axis with angle of incidence 60° passes through the pole after reflection
 - D) Magnified image is always farther from the mirror than its object
12. Which of the following is correct for a convex mirror:
- A) It never forms real image
 - B) It may form magnified virtual image for virtual objects
 - C) If the incident rays appear to converge at its center of curvature, virtual image is formed
 - D) It may form inverted image for virtual objects
13. Which of the following is correct for a plane mirror:
- A) The field of view of the image is independent of object distance for a point object
 - B) The deviation produced in a ray decreases with increase in the angle of incidence
 - C) There is no lateral inversion if we see over image in a plane mirror of circular aperture
 - D) A virtual object forms real image of same size

SECTION – III

(INTEGER ANSWER TYPE)

This section contains 5 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).

Marking scheme +3 for correct answer, 0 if not attempted and 0 in all other cases.

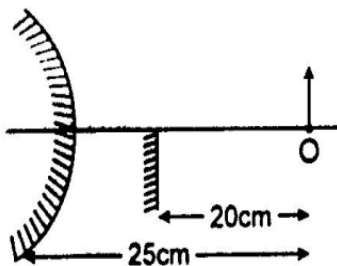
14. Consider the following two cases:

a) A plane mirror is kept midway between a wall and a point source.

b) A point source is kept midway between a concave mirror and a wall.

The radius of curvature of concave mirror, the radius of circular aperture of the two mirrors and the distance between the mirrors and wall are all equal to 'd'. Find the ratio of radius of shadow formed on the wall in case a) and spot formed on the wall in case b).

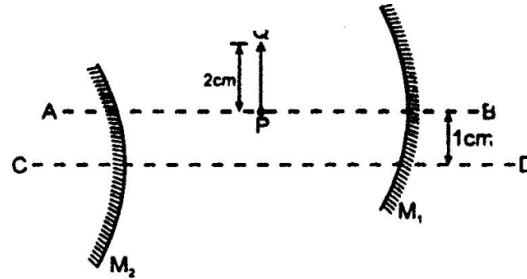
15. In the figure, an object is placed 25cm from the surface of a convex mirror, and a vertical plane mirror is set so that the image formed by the two mirrors lie adjacent to each other in the same vertical plane. The plane mirror is placed at 20cm from the object. The radius of curvature of the convex mirror is 15N cm. Find N.



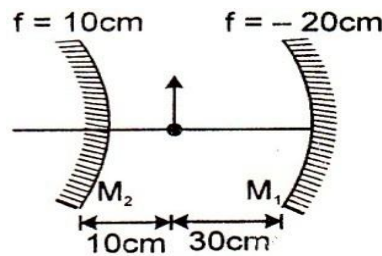
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16. In the figure shown M_1 and M_2 are two spherical mirrors of focal length 20cm each. AB and CD are their principal axes respectively. Which are separated by 1cm. PQ is an object of height 2cm and kept at distance 30cm from M_1 . The separation between the mirrors is 50cm. Consider two successive reflections first on M_1 then on M_2 . Find the size of the 2nd image (in cm)



17. A thin rod of length $f/3$ is placed also the optic axis of a concave mirror of focal length f such that its image which is magnified, just touches the rod. The magnitude of magnification of the rod is $N/2$. Find N .
18. In the figure shown find the total magnification after two successive reflections first on M_1 & then on M_2



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SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 5 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.

19. How many of the following statements are true for the fundamental particles of an atom
- I. $e < p < n \rightarrow$ absolute mass
 - II. $n < p < e \rightarrow e/m$ ratio
 - III. Anode ray is the ray of gaseous ion
- A) Only I B) I and II C) II and III D) I, II and III
20. In Li^{2+} ion line corresponding to 3rd line of paschen series will have same energy in H-atom corresponding to
- A) $4 \rightarrow 3$ transition B) $3 \rightarrow 1$ transition
- C) $2 \rightarrow 1$ transition D) No such transition is possible in H- atom
21. In H- atom sample radius of two different orbits are 4R and 9R respectively then the ratio of time period of revolution of e^- in these two orbits (respectively)
- A) $\frac{64}{729}$ B) $\frac{8}{27}$ C) $\frac{27}{8}$ D) $\frac{1}{8}$

space for rough work

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22. In the closest distance of approach calculation let us assume that this distance is giving radius of nucleus. Now two experiments are done. In 1st experiment speed of particle is V and it is giving true radius of the nucleus then what % of error is there in another experiment if α particle of speed $V/2$ is used for the measurement of closest distance of approach

- A) 0% B) 100% C) 300% D) 400%

23. Identify **false** statement

- A) In cathode ray experiment 'e/m' ratio is independent of the nature of gas
B) In anode ray experiment 'e/m' ratio is independent of nature of gas
C) Rutherford model is unable to explain the observation of hydrogen spectrum
D) Thomson model can explain conduction of electricity in gases

SECTION – II

(MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

Marking scheme: +4 for all correct options & +1 partial marks, 0 if not attempted and -2 in all wrong cases

24. A mixture is containing H-atom and Li^{2+} ions. Electron in H-atom is in 3rd excited state and e^- in Li^{2+} is in 5th excited state. Then which is/are true about the spectral lines observed for the mixture

- A) Emitted radiation will contain 21 lines
B) Emitted radiation will contain 19 lines
C) More than 10 lines are in U.V range
D) If sample contains only H-atom then emission spectrum contains two visible lines

space for rough work

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25. Which is/are true for the particle nature of light
- A) Energy $\propto$ frequency
 - B) Energy $\propto$ intensity
 - C) When light of frequency $\nu > \nu_0$ falls on metal surface the ejected e^- must have $K.E. = h(\nu - \nu_0)$
 - D) Energy emitted or absorbed by body in the form of radiation is not in a continuous manner
26. Radius of 1st excited state in H- atom is x unit and velocity of 3rd excited state of He^+ is y unit. Then for the e^- in 2nd excited state of Li^{2+} which is/are correct
- A) Radius of orbit $= \frac{9x}{4}$
 - B) velocity of $e^- = 2y$
 - C) Time period of revolution $= \frac{3\pi x}{4y}$
 - D) P.E. $= -4m_e y^2$
27. Which is/are true if the symbols have usual meaning (Bohr model is applicable)
- A) $K.E = \frac{n^2 h^2}{4\pi^2 r^2 m}$, $m = \text{mass of } e^-$
 - B) $T.E = -K.E$, in an orbit
 - C) Force of attraction on the $e^- \propto \frac{z^3}{n^4}$
 - D) Frequency of revolution (f) $\propto \frac{n^3}{z^2}$

28. Which is/are true for H-Spectrum
- A) Presence of closely spaced lines (doublets) cannot be explained using Bohr model
 - B) Lowest energy line of Balmer series is red in colour
 - C) In Balmer series 3rd line from red end is green in colour
 - D) In Paschen series transition takes place from higher state to $n=4$
29. Which is/are not true for the Bohr model
- A) Electrons do not follow Maxwell electromagnetic radiation theory in stationary orbit
 - B) Electrons can move only in those orbits whose angular momentum is $\frac{h}{2\pi}$ times of orbit number
 - C) Wavelength of e^- in an orbit can be calculated by $\frac{2\pi r}{n}$
 - D) Total energy of e^- in an orbit changes with time
30. Which is/are true with increase in 'n' (n = orbit number)
- A) K.E energy
 - B) P.E increases
 - C) Total energy increases
 - D) Nuclear attraction increases
31. A H-like sample has 1st excitation energy of 91.8 eV, electron is present in 4th excited state. Electron makes transition up to ground state then identify true statements
- A) Sample is Be^{3+}
 - B) Total 10 spectral lines are observed
 - C) 3 lines are in visible range
 - D) No lines are in visible range

space for rough work

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SECTION – III
(INTEGER ANSWER TYPE)

This section contains 5 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).

Marking scheme +3 for correct answer , 0 if not attempted and 0 in all other cases

32. A light of wavelength 200nm falls upon a surface and two different wavelength photons $\lambda = 800nm$ and $\lambda = 400nm$ are emitted from the surface. 80% of the energy absorbed is re-emitted in the form of photon. Number of photons emitted as $\lambda = 800nm$ is 3 times that of number of photons emitted as $\lambda = 400nm$. If the ratio of total absorbed photon to total emitted photon is x. then find the numerical value of **(12.8x)**
33. A light of wavelength 3000 falls on a metal surface. Ejected e^- is further accelerated by a potential difference of 2V, then final K.E of the e^- is found to be $8 \times 10^{-19} J$. If threshold energy for the metal surface is ' ϕ ' eV. Then find the numerical value of **(8 ϕ)**
34. In H sample, e^- is present in the orbit in which angular momentum of e^- is $\frac{2h}{\pi}$. Electron make transition upto ground state. If 3rd highest energy photon has energy of X eV then approximate numerical value of **$\left(\frac{2x}{5}\right)$** is
35. In He^+ ion sample e^- is in ground state, if photon of energy 52.24eV is given to the sample all the atom goes to higher energy state. It again falls back up to ground state. If it is not emitting any lines in Balmer series then what is the maximum possible number of spectral lines observed
36. An element with mass number 95 have 4 unit positive charge and 25% more neutrons than electrons in the given ionic state. Its atomic number is Z, then find the value of **(Z/10)**.

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**SECTION – I
(SINGLE CORRECT ANSWER TYPE)**

This section contains 5 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.

37. If x_1, x_2, x_3, x_4 are the roots of $x^4 + 2x^3 + ax^2 + bx + c = 0$ where a, b, c are real numbers such that $x_1 + x_2 = x_3 + x_4$, then $b - c =$ _____
 A) 2 B) -2 C) 1 D) -1
38. If $\log_{\frac{1}{2}} \left(\log_6 \left(\frac{x^2 + x}{x + 4} \right) \right) < 0$, then the sum of all the integral values of x lying in $[1, 100]$ is ____
 A) 13 B) 14 C) 15 D) 16
39. If $K = \frac{\log_2^{24}}{\log_9^2} - \frac{\log_2^{192}}{\log_{12}^2}$, then the values $\log_{81}^{K^{100}}$ of is _____
 A) 50 B) 25 C) 100 D) $\frac{25}{2}$
40. The area of the region representation by $[x+y] + [x-y] = 5$ for $x \geq 0, y \geq 0$ and $x \geq y$ ($[.]$ denotes greatest integer function) is _____ (in SU) $[.]$ denotes G.I.F
 A) 4 B) 5 C) 6 D) 7
41. The number of real values of x satisfying the equation $\log(1+x^{2018}) + \log(1+x^2+x^4+\dots+x^{2016}) = \log 2018 + 2017 \log x$ is
 A) 0 B) 1 C) 1004 D) 2018

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SECTION – II

(MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

Marking scheme: +4 for all correct options & +1 partial marks, 0 if not attempted and -2 in all wrong cases

42. $\sum_{r=1}^{2017} \frac{(8r-1)9^r}{r^2+r} = \frac{9^{K_1}}{K_2} - K_3$, where $k_1, k_2, k_3 \in \mathbb{N}$ and K_2 is not a multiple of 9, then which of following is/are true?
- A) $K_1=2017$ B) $K_1-K_2+2K_3=18$
C) $K_2=2018$ D) $3K_2+8=35$
43. If $\log_{10}^2=0.301$, $\log_{10}^3=0.4771$, $\log_{10}^5=0.699$ and $n(N)$ denotes the number of digits in the natural number N and $m(N)$ denotes the number of zeros between the decimal point and first significant figure where $\frac{1}{N} \in I^+$, then which of the following is/are true?
- A) $n(6^{40}) = 33$ B) $m(30^{-300}) = 147$ C) $n(15^{50}) = 59$ D) $m(12^{-60}) = 64$
44. If $x = 3 + \sqrt[3]{3} + \sqrt[3]{9}$ then $x^3 - 9x^2 + 18x = k$ where a divisor of k is / are
- A) 3 B) 4 C) 5 D) 6
45. If $S_n = 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots + \frac{1}{2^n - 1}$, then which of the following is/are true?
- A) $S_{100} < 100$ B) $S_{200} > 100$ C) $S_{200} < 200$ D) $S_{50} > 25$

space for rough work

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46. If $a_1, a_2, a_3, a_4, a_5, a_6$ are real numbers such that $a_1 + a_2 + a_3 + a_4 + a_5 + a_6 = \alpha$, $a_1a_3 + a_2a_4 + a_3a_5 + a_4a_6 + a_1a_5 + a_2a_6 = \beta$ and $a_1a_3a_5 + a_2a_4a_6 = \gamma$ ($a_1 < a_2 < a_3 < a_4 < a_5 < a_6$), then a root of the equation $2x^3 - \alpha x^2 + \beta x - \gamma = 0$ lies in

- A) (a_1, a_2) B) (a_2, a_3) C) (a_4, a_1) D) (a_4, a_5)

47. If x, y, z are positive integers such that $4x^2 + 25y^2 + 49z^2 - 10xy - 35yz - 14zx = 0$ then which of the following is/are true?

- A) minimum value of $x+y+z$ is 59 B) minimum value of $x+2y+3z$ is 93
C) minimum value of $2x+y+2z$ is 104 D) minimum value of $x+3y+z$ is 87

48. If $K_1 = 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5} - \frac{1}{6} + \dots - \frac{1}{2018}$, $K_2 = \frac{1}{1015} + \frac{1}{1016} + \frac{1}{1017} + \dots + \frac{1}{2018}$

Then which of the following is/are true?

- A) $k_1^2 - k_2^2 = \frac{1}{2018}$ B) $k_1^3 - k_2^3 + \frac{1}{(2018)^3} = 0$
C) $k_1^2 - k_2^2 = 0$ D) $k_1 - k_2 = 0$

space for rough work

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49. If $f(x) = \frac{4^x}{4^x + 2}$, then which of the following is/are true?

A) $f\left(\frac{1}{2017}\right) + f\left(\frac{2}{2017}\right) + f\left(\frac{3}{2017}\right) + \dots + f\left(\frac{2016}{2017}\right) = 1008$

B) $f\left(\frac{1}{2019}\right) + f\left(\frac{2}{2019}\right) + f\left(\frac{3}{2019}\right) + \dots + f\left(\frac{2018}{2019}\right) = 1009$

C) $f\left(\frac{1}{1997}\right) + f\left(\frac{2}{1997}\right) + f\left(\frac{3}{1997}\right) + \dots + f\left(\frac{1996}{1997}\right) = 998$

D) $f\left(\frac{1}{999}\right) + f\left(\frac{2}{999}\right) + f\left(\frac{3}{999}\right) + \dots + f\left(\frac{998}{999}\right) = 998$

SECTION – III
(INTEGER ANSWER TYPE)

This section contains 5 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).

Marking scheme +3 for correct answer , 0 if not attempted and 0 in all other cases

50. If $x > 0$ and $x, [x], \{x\}$ when $[.]$ denotes greatest integer function and $\{.\}$ denotes fractional part function, are in A.P then the number of possible values of x is _____

51. If $a_1, a_2, a_3, \dots$ are real numbers such that $a_1 = \frac{1}{2}, a_{n+1} = a_n^2 + a_n \forall n \in N$ and

$S = \frac{1}{a_1 + 1} + \frac{1}{a_2 + 1} + \frac{1}{a_3 + 1} + \dots + \frac{1}{a_{2017} + 1}$ then $[S] =$ - ($[.]$ denotes greatest integer function)

space for rough work

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52. If $f(x)$ is a least degree polynomial satisfying $f(x) = \frac{1}{x}$ for $x=1,2,3,\dots,2017$ then the value of $2018f(2018)$
53. If $p(x,y)$ satisfies $[x+y-1]=[x]$, $0 \leq x \leq 5$, then the area of the region formed by all positions of P is-([.]denotes greatest integer function)
54. If $-\frac{\pi}{2} < \alpha_1 < \alpha_2 < \alpha_3 < \frac{\pi}{2}$, then the number of values of $\theta \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) (\tan \theta - \tan \alpha_1)(\tan \theta - \tan \alpha_2)(\tan \theta - \tan \alpha_3) - 3\tan \theta + \tan \alpha_1 + \tan \alpha_2 + \tan \alpha_3 = 0$ is_____

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Master JEE CLASSES

Kukatpally, Hyderabad.

JEE-ADVANCE MODEL PAPER

Max.Marks: 186

KEY SHEET

PHYSICS

1	A	2	B	3	C	4	A	5	C
6	ABCD	7	BD	8	AD	9	AB	10	AD
11	ABCD	12	BCD	13	BD	14	2	15	5
16	8	17	3	18	2				

CHEMISTRY

19	D	20	C	21	C	22	C	23	B
24	CD	25	AD	26	BCD	27	BCD	28	AB
29	CD	30	BC	31	B	32	5	33	9
34	4	35	6	36	4				

MATHS

37	C	38	B	39	B	40	C	41	B
42	BCD	43	ABCD	44	ACD	45	ABCD	46	AD
47	ABCD	48	CD	49	ABC	50	1	51	1
52	4	53	5	54	3				

SOLUTIONS

PHYSICS:

1. $\theta = \frac{hi}{f}$
2. Conceptual
3. Conceptual
4. $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\frac{f}{v} + \frac{1}{u} = 1$ $\frac{1}{y} + \frac{1}{x} = 1$
5. The sum of time of clock and its image size will be 12 hours.
6. Concave mirror
7. Only one image formed
8. As the object is not on the bisector, the polygon will be irregular.

$$\frac{l_1}{l_2} = \frac{r \sin 45^\circ}{r \sin 15^\circ}$$

9. 1st Image $u = -10$ $f = -15$

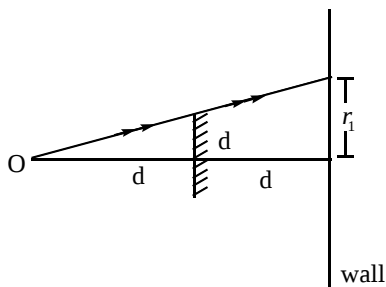
$$v = \frac{uf}{u - f} = 30 \text{ cm} \quad hi = mh_0 = 6 \text{ cm}$$

2nd Image – x & y interchange w.r.t.

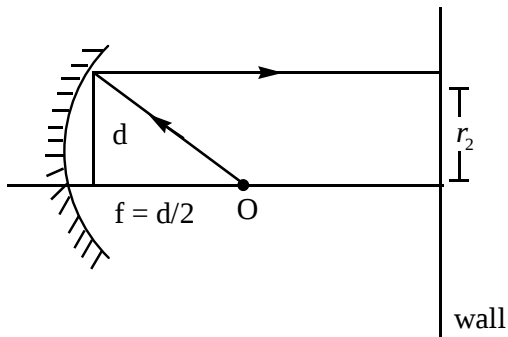
The plane mirror.

(-50, 0) is on the non-reflecting side

10. Conceptual
11. Conceptual
12. Conceptual
13. Conceptual
14. Case a) $r_1 = 2d$



Case b) $r_2 = d$



15. Image by convex mirror:

$$v = \frac{uf}{u - f} = \frac{(-25)(f)}{-25 - f}$$

Image by plane mirror:

$$v = -15$$

$$\frac{25f}{25 + f} = 15$$

Get $R = 75$

16. First image

$$v = \frac{(-30)(-20)}{(-30) - (-20)} = -60 \quad hi = -4$$

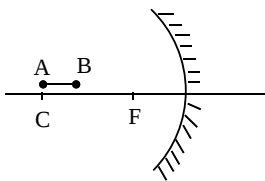
Second image

$$v = \frac{(+10)(+20)}{(+10) - (+20)} = -20$$

$$hi = -8$$

17. Image of A at C

Image of B:



$$v = \frac{\left(-\frac{5f}{3}\right)(-f)}{\left(-\frac{5f}{3}\right) - (-f)} = -\frac{5f}{2}$$

Length of image = $f / 2$

Magnification = $3 / 2$.

18. $m = m_1 m_2$.

CHEMISTRY:

20. 3rd line as paschen series $6 \rightarrow 3$

$$\Rightarrow (\Delta E)_{3 \rightarrow 1} \text{ in H-atom} \equiv (\Delta E)_{6 \rightarrow 3} \text{ in } Li^{2+}$$

$$21. \quad r\alpha \cdot \frac{n^2}{z} \Rightarrow \frac{4R}{9R} = \frac{n_1^2}{n_2^2} \Rightarrow \frac{n_1}{n_2} = \frac{2}{3}$$

$$\Rightarrow f\alpha \frac{Z^2}{n^3} \Rightarrow \frac{f_1}{f_2} = \frac{n_2^3}{n_1^3} = \frac{27}{8}$$

22. Closest distance of approach

$$\frac{1}{2}mV^2 = \frac{K(+Ze)Ze}{R}$$

$$\Rightarrow R = \frac{4KZe^2}{m_\alpha V^2}$$

$$\text{If } V \rightarrow V/2 \Rightarrow R^I = 4R$$

$$\text{If } R \text{ is true value then \% error} = \frac{4R - R}{R} \times 100$$

$$24. \quad \text{Total lines of H-atom} = \frac{4(4-1)}{2} = 6$$

$$\text{Total lines of } Li^{2+} \text{ ion} = \frac{6(6-0)}{2} = 15$$

But H $2 \rightarrow 1$ has same energy that $3 \rightarrow 6$ in Li^{2+}

Hence total lines are = $15+6-1=20$

If sample is containing only H then there are 2 Balmer lines

In Li^{2+} all lyman lines are in U.V=5, all balmer line in uV=4

In Li^{2+} few more lines can be in U.V/

$$26. \quad r = r_0 \times \frac{n^2}{z} \Rightarrow x = r_0 \times \frac{z^2}{1} \Rightarrow r_0 = \frac{x}{4}$$

$$V = V_0 \times \frac{z}{n} \Rightarrow y = V_0 \times \frac{2}{4} \Rightarrow V_0 = 2y$$

$$r_2 = r_0 \times \frac{3^2}{3} = \frac{3x}{4}$$

$$V_n = 2y \times \frac{3}{3}$$

$$\Rightarrow T_n = \frac{2\pi r_n}{V_n} = \frac{2\pi \times 3x}{4 \times 2y} = \frac{3\pi x}{4y}$$

$$KE = \frac{1}{2} m_e \times (2y)^2 = 2m_e y^2$$

$$27. \quad mvr = \frac{nh}{2\pi} \Rightarrow C = \frac{nh}{2\pi mr} \Rightarrow K.E = \frac{1}{2} mv^2 = \frac{1}{2} \frac{n^2 h^2}{4\pi^2 mr^2}$$

$$30. \quad \text{as } n \uparrow, v \downarrow$$

$$\Rightarrow K.E. \downarrow, T.E. \uparrow, P.E. \uparrow$$

$$31. \quad 1^{\text{st}} \text{ excitation energy} = 10.2Z^2$$

$$\Rightarrow 10.2Z^2 = 91.8$$

$$\Rightarrow Z = 3$$

Total lines = 10

$$\text{Energy of lines } 5 \rightarrow 4 = 9 \times (0.85 - 0.54)$$

$$= 9 \times 0.31$$

$$= 2.79$$

Hence it is in visible range

$$32. \quad \frac{n_1}{2000} \times 0.8 = \frac{3n_2}{8000} + \frac{n_2}{4000}$$

$$\Rightarrow \frac{n_1 \times 0.8}{2000} = \frac{5n_2}{8000}$$

$$\Rightarrow \frac{n_1}{n_2} = \frac{5}{4 \times 0.8}$$

$$\Rightarrow \frac{n_1}{4n_2} = \frac{5}{16 \times 0.8} = \frac{5}{12.8}$$

$$33. \quad \text{Total } K.E = \frac{8 \times 10^{-13}}{1.6 \times 10^{-13}} = 5eV$$

$$\Rightarrow K.E \text{ of ejected } e^- = 3eV$$

$$3 = \frac{12400}{3000} - \phi$$

$$\Rightarrow \phi = 4.13 - 3 = 1.13eV$$

$$34. \quad n \frac{h}{2\pi} = \frac{2h}{\pi} \Rightarrow n = 4$$

$$3^{\text{rd}} \text{ highest energy} = 2 \rightarrow 1 = 10.2eV$$

$$\Rightarrow \frac{10.2 \times 2}{5} = 4$$

35. $13.6 \times 2^2 \left(1 - \frac{1}{n^2} \right) = 52.24$

$$\Rightarrow 13.6 - \frac{13.6}{n^2} = 13.06$$

$$\Rightarrow \frac{13.6}{n^2} = 0.54$$

$$\Rightarrow n = 5$$

$$\text{Total line} = \frac{5(5-1)}{2} = 10$$

But it is not emitting balmer lines hence

$$\Rightarrow \text{total line} = 10 - 3 = 7$$

But it will also not emit $2 \rightarrow 1$ line

$$\text{Hence total line} = 7 - 1 = 6$$

36. ${}_Z M^{4+}$ total $e^- = Z - 4 \Rightarrow Z + (Z - 4) \times 1.25 = 95$

$$\Rightarrow 2.25Z = 95 - 5 = 90$$

$$\Rightarrow Z = 40$$