Master JEE CLASSES
Kukatpally, Hyderabad.

IIT-JEE ADVANCED-2016-P2-MODEL **Max.Marks:186**

PHYSICS: Refraction at plane surface, TIR and Prism,

Refraction at curved surface (exclude problems involving relative motion and differential and integral calculus)

CHEMISTRY: De-Broglie Equation, Heisenberg's Uncertainty principle, Schrodinger's wave equation; Quantum numbers, Pauli's exclusion Principle; Hund's rule; Electronic configuration of the elements, (70%)

Atomic Structure : Fundamental Particles - their characteristics; Thomson's, Rutherford's atomic model, Plank'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, (30%)

MATHS: Real numbers, Factor Theorem, Remainder Theorem, Finding roots of Polynomial Equation, Finding Polynomial with given roots using factor Theorem, Wavy curve method, Rational Inequations, Irrational Equation & Inequation, Modulus & its properties, Logarithm & its properties, Equations/Inequation involving Logarithms, Exponentials, Modulus; Greatest Integer, Least Integer & Fractional Part Functions (30%); Quadratic Equation (70%)

JEE-ADVANCE-2016-P2-Model

Time: 3:00 hours **IMPORTANT INSTRUCTIONS** **Max Marks: 186**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 6)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 7 – 14)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 15 – 18)	Questions with Comprehension Type (2 Comprehensions – 2 + 2 = 4Q)	3	0	4	12
Total				**18**	**62**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 19 – 24)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 25 – 32)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 33 – 36)	Questions with Comprehension Type (2 Comprehensions – 2 + 2 = 4Q)	3	0	4	12
Total				**18**	**62**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 37 – 42)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 43 – 50)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 51 – 54)	Questions with Comprehension Type (2 Comprehensions – 2 + 2 = 4Q)	3	0	4	12
Total				**18**	**62**

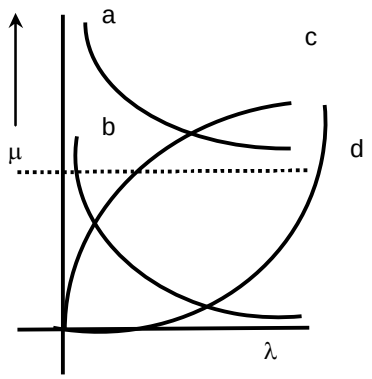
space for rough work

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 6 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. 1.The plot between refractive index of a medium μ and wavelength of the light in vacuum λ for a material medium may be the best represented by



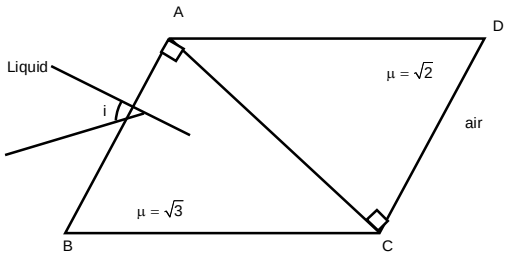
A) a B) b C) c D) d

2. At what angle with the normal (in degree) should a light beam fall on the surface of material with refractive index $\mu = 1.732$, if the angle of refraction was half the angle of incidence?

A) 30^o B) 60^o C) 45^o D) 90^o

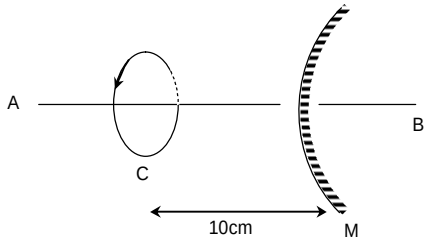
space for rough work

3. A ray of light from a liquid $(\mu = \sqrt{3})$ is incident on a system of two right angled prism of refractive indices $\sqrt{3}$ and $\sqrt{2}$ as shown. The ray suffers zero deviation when emerges into air from CD. The angle of incidence i is



A) 45^0 B) 35^0 C) 20^0 D) 10^0

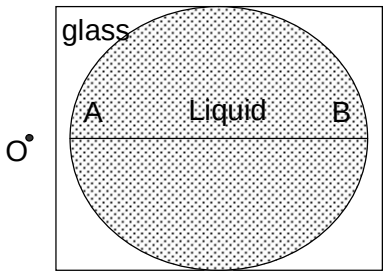
4. A particle revolves in clockwise direction (as seen from point A) in a circle C of a radius 1cm and completes one revolution in 2 sec. The axis of the circle and the principal axis of the mirror M coincide. The radius of curvature of the mirror is 20 cm. Then the direction of revolution (as seen from A) of the image of the particle and its speed is



A) Clockwise, 1.57 cm/s B) Clockwise, 3.14 cm/s

C) Anticlockwise, 1.57 cm/s D) Anticlockwise, 3.14 cm/s

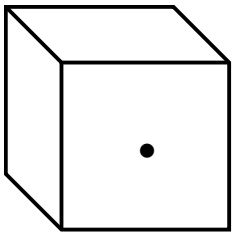
5. The observer 'O' sees the distance AB as infinitely large. If refractive index of liquids is μ_1 and that of glass is μ_2, then $\frac{\mu_1}{\mu_2}$ is



A) 2 B) $\frac{1}{2}$

C) 4 D) None of these

6. A source of light is placed at the centre of a cube of side $\sqrt{2}$ cm and refractive index 2. What is the area of dark region is cm^2 on all faces included as seen from outside? (Consider single refraction or reflection only)



A) $4\pi - 12$ B) $12 - 4\pi$ C) $24 - 4\pi$ D) $4\pi - 25$

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 correct answer, 0 if not attempted and -2 in all other cases

7. A small air bubble is trapped inside a transparent cube of size 12 cm. When viewed from one of the vertical faces, the bubble appears to be at 5 cm from it. When viewed from opposite face, it appears at 3 cm from it.

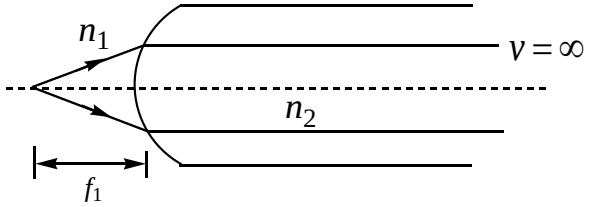
A) The distance of the air bubble from the first face is 7.5 cm

B) The distance of the air bubble from the first face is 9 cm

C) The refractive index of the material of the prism is 2.0.

D) The refractive index of the material of the prism is 1.5.

8. The first focal lentgh f_1 for refraction at a spherical surface is defined as the value of u corresponding to $v = \infty$ (as shown) with refractive indices of two mediums, as n_1 and n_2. The second focal length f_2 is defined as value of v for $u = \infty$.



A) f_2 is equal to $\frac{n_2 R}{(n_2 - n_1)}$

B) f_1 is equal to $\frac{n_2 R}{(n_2 - n_1)}$ s

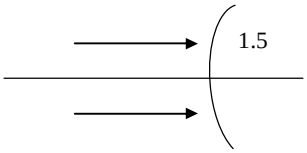
C) f_2 is equal to $(-)\frac{n_1 R}{(n_2 - n_1)}$

D) f_1 is equal to $(-1)\frac{n_1 R}{(n_2 - n_1)}$

9. The x-z plane separates two media A and B of refractive indices $\mu_1 = 1.5$ and $\mu_2 = 2$. A ray of light travels from A to B. Its direction in the two media are given by unit vectors $\vec{U}_1 = a\hat{i}+b\hat{j}$ and $\vec{U}_2 = c\hat{i}+d\hat{j}$. Then

A) $\frac{a}{c} = \frac{4}{3}$ B) $\frac{a}{c} = \frac{3}{4}$ C) $\frac{b}{d} = \frac{4}{3}$ D) $\frac{b}{d} = \frac{3}{4}$

10. Parallel rays of light are falling on convex spherical surface of radius of curvature R = 20 cm. Refractive index of the medium is $\mu = 1.5$. After refraction from the spherical surface parallel rays:



A) actually meet at some point
B) appears to meet after extending the refracted rays backwards
C) meet (or appears to meet) at a distance of 30 cm from the spherical surface
D) meet (or appears to meet) at a distance of 60 cm from the spherical surface

11. A ray of light falls on the surface of a spherical glass paper weight making an angle α with the normal and is refracted in the medium at an angle β. The angle of deviation of the emergent ray from the direction of the incident ray

A) $(\alpha-\beta)$ B) $2(\alpha-\beta)$ C) $(\alpha-\beta)/2$ D) $(\beta-\alpha)$

space for rough work

12. Which of the following statement is/are correct about the refraction of light from a plane surface when light ray is incident from a denser medium. [where C is the critical angle]

A) The maximum angle of deviation during refraction is $\pi/2 - C$, it will be at angle of incidence C.

B) The maximum angle of deviation for all the angle of incidences is $\pi - 2C$, when angle of incidence is slightly greater than C.

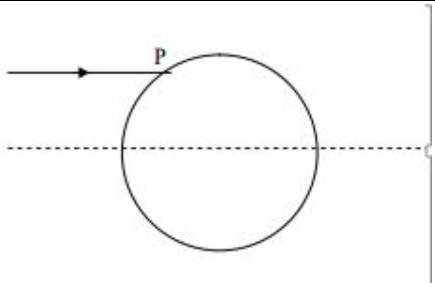
C) If the angle of incidence is less than C then the deviation increases if the angle of incidence is also increased

D) If the angle of incidence is greater than C then the angle of deviation decreases if angle of incidence is increased

13. For a concave mirror of focal length f, image is 2 times larger. Then the object distance from the mirror is

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

14 A sphere of glass is placed symmetrically an x-axis. Aray parallel to x-axis is incident on the sphere at point P and emerges on z-axis. If angle of refraction at P is 30^0, find the refraction index of the glass:



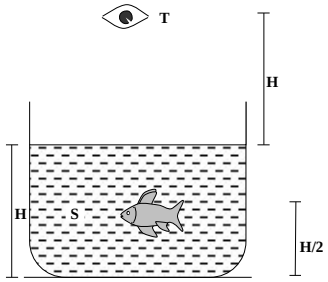
A) $\sqrt{2}$ B) $\sqrt{3}$ C) 1.5 D) $\frac{4}{3}$

SECTION – III
(PARAGRAPH TYPE)

This section contains **2 groups of questions**. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices A), B), C) and D) for its answer, out of which **ONLY ONE** is **correct**.
Marking scheme: +3 for correct answer, 0 if not attempted and 0 in all other cases.

Paragraph For Questions 15 and 16:

Consider the situation in the figure. The bottom of the pot is a reflecting plane mirror, S is a small fish, and T is a human eye. Refractive index of water is μ.



15. At what distance from itself will the fish see or observe the image of eye by observing through mirror?

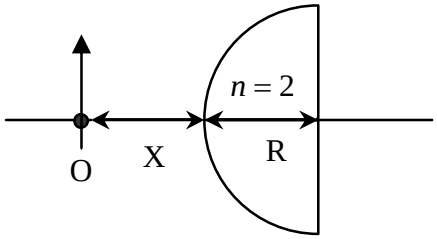
A) $H\left(\frac{3}{2}+\mu\right)$ B) $H\left(\frac{1}{2}+\mu\right)$ C) $H\left(\frac{3+\mu}{2}\right)$ D) $2H\left(\frac{3}{2}+\mu\right)$

16. At what distance from itself will the eye see the image of the fish upon direct observation?

A) $H\left(1+\frac{1}{2\mu}\right)$ B) $2H\left(1+\frac{1}{2\mu}\right)$ C) $2H\left(1-\frac{1}{2\mu}\right)$ D) $H\left(\frac{\mu+1}{2}\right)$

Paragraph For Questions 17 and 18:

Consider a transparent hemisphere $(n=2)$ in front of which a small object is placed in air $(n=1)$ as shown.



17. For which value of x, of the following, will the final image of the object at O be virtual?

A) 2 R B) 3R C) R/2 D) 1.5 R

18. What is the nature of final image of the object when $x=2R$?

A) Erect and magnified B) Inverted and magnified

C) Erect and same size D) inverted and same size

space for rough work

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

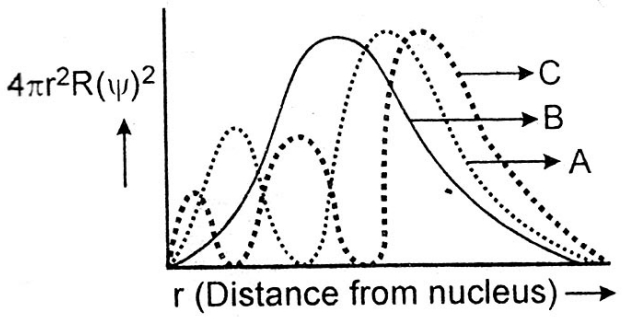
This section contains 6 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

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

19. In hydrogen spectrum v_1 and v_2 are the frequencies series limit for Lyman and Balmer series, Which relation is correct for frequency v_3 of 1st line of Lyman series.

A) $v_3 = v_1 + v_2$ B) $v_3 = v_1 - v_2$ C) $v_3 = v_1 \times v_2$ D) $v_3 = \frac{v_1}{v_2}$

20. Let us consider following graph for radial distribution function. Which of the following has correct matching of curve and orbital?



A) $A(3p)B(3d)C(3s)$ B) $A(3s)B(3p)C(3d)$

C) $A(3d)B(3p)C(3s)$ D) $A(3s)B(3d)C(3p)$

21. Two particles A & B are in motion. If the wavelength associated with particle A is $5\times10^{-8}m$ then the wavelength associated with B, when its momentum is half of A

A) 10^{-2}m B) 10^{-7}m C) 10^{-10}m D) 10m

22. Orbital angular momentum of an electron in a particular subshell is $\sqrt{5}\frac{h}{\pi}$ then the maximum number of electrons that may be present in this subshell are

A) 10 B) 14 C) 18 D) 22

23. The wave function (Ψ) of 2s is given by $(\Psi)_{2s}=\frac{1}{2\sqrt{2}\pi}\left(\frac{1}{a_0}\right)^{1/2}\left(2-\frac{r}{a_0}\right)e^{-r/2a_0}$. At $r=r_0$, radial node is formed. Then r_0 in terms of a_0 is

A) $2a_0$ B) a_0 C) $4a_0$ D) $\frac{a_0}{2}$

24. In Ψ_{321} the sum of angular momentum, spherical nodes and angular node is:

A) $\frac{\sqrt{6}h+4\pi}{2\pi}$ B) $\frac{\sqrt{6}h}{2\pi}+3$ C) $\frac{\sqrt{6}h+2\pi}{2\pi}$ D) $\frac{\sqrt{6}h+8\pi}{2\pi}$

space for rough work

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 correct answer, 0 if not attempted and -2 in all other cases

25. If the wave number of 1st line of Balmer series of H-atom is 'x' then:

A) wave number of 1st line of Lyman series of the He^+ ion will be $\frac{108x}{5}$

B) wave number of 1st line of Lyman series of the He^+ ion will be $\frac{36x}{5}$

C) the wave length of 2nd line of Lyman series of H-atom is $\frac{5}{32x}$

D) the wave length of 2nd line of Lyman series of H-atom is $\frac{32x}{5}$

26. Which of the following are characteristics of wave function ψ?

A) ψ must be single valued

B) ψ must be finite

C) $\int_{-\infty}^{+\infty} \psi^2 dx\, dy\, dz = 1$

D) ψ must be continuous

27. Ground state configuration of Nitrogen atom can be represented by:

A) 

B) 

C) 

D) 

28. The number of electrons in *d*-subshell of Cr^{2+} (Z = 24) is equal to:

A) s-electrons in Ne $(Z=10)$ B) unpaired electrons in $Fe(Z=26)$

C) *p*-electrons in $O(Z=8)$ D) *d*-electrons in $Fe^{3+}(Z=26)$

29. The ratio of de Broglie wavelength of a proton and α – particles will be 1 : 2 if their

A) Velocity are in the ratio 1:8 B) Velocity are in the ratio 8:1

C) Kinetic energy are in the ratio 16:1 D) Kinetic energy are in the ratio 1:16

30. Which of the following sets of quantum number is/are not permitted?

A) $n=3, l=3, m=+1, s=+\frac{1}{2}$ B) $n=3, l=2, m=+2, s=-\frac{1}{2}$

C) $n=3, l=1, m=+2, s=-\frac{1}{2}$ D) $n=3, l=0, m=0, s=+\frac{1}{2}$

31. The angular momentum of electron can have the value(s):

A) $0.5\frac{h}{\pi}$ B) $\frac{h}{\pi}$ C) $\frac{h}{0.5\pi}$ D) $2.5\frac{h}{2\pi}$

32. Select the correct statement(s)

A) The number of maxima in 2s orbital (for radial probability distribution) are two

B) $3d_{x^2-y^2}$ orbital has 2 angular nodes and 1 radial node

C) $3d_{z^2}$ has3 angular nodes

D) *YZ* and *XZ* are nodal planes for d_{xy} orbital

space for rough work

SECTION – III
(PARAGRAPH TYPE)

This section contains **2 groups of questions**. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices A), B), C) and D) for its answer, out of which **ONLY ONE** is **correct**.
Marking scheme: +3 for correct answer, 0 if not attempted and 0 in all other cases.

Paragraph For Questions 33 and 34:

According to Heisenberg., It is impossible to measure simultaneously the position and momentum of small particle with absolute accuracy or certainty. If an attempt is made to measure any one of these two quantities with higher accuracy, the other becomes less accurate. The product of the uncertainty in position (Δx) and uncertainty momentum (Δp) is always constant and is equal to or greater than $h/4\pi$, where h is Planck's constant i.e. $(\Delta x)(\Delta p) \geq \frac{h}{4\pi}$

33. Uncertainty in position is twice the uncertainty in momentum, uncertainty in velocity is

A) $\sqrt{\frac{h}{\pi}}$ B) $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$ C) $\frac{1}{2m}\sqrt{h}$ D) $\frac{1}{2m}\sqrt{\frac{h}{2\pi}}$

34. A golf ball bas a mass of 40g and a speed of $40 ms^{-1}$. If the speed can be measured with an accuracy of 2%, calculate the uncertainty in the position.

A) $1.46\times10^{-33} m$ B) $1.46\times10^{-32} m$

C) $1.46\times10^{-31} m$ D) $1.46\times10^{-30} m$

Paragraph For Questions 35 and 36:

The emission of electrons from a metal surface when exposed to light radiation of appropriate wavelength is called photoelectric effect. The emitted electrons are called photo-electrons. Work function of threshold energy may be defined as the minimum amount of energy required to eject electrons from a metal surface. According to Einstein,

Maximum kinetic energy of ejected electron = Absorbed energy – Work function

$$\frac{1}{2}mv_{max}^2 = h(v) - h(v_0) = hc\left[\frac{1}{\lambda} - \frac{1}{\lambda_0}\right]$$

Where v_0 and λ_0 are threshold frequency and threshold wavelength, respectively.

Stopping potential: It is the minimum potential at which the photoelectric current becomes zero. If V_0 is the stopping potential $eV_0 = h(v - v_0)$

35. When a certain metal was irradiated with light of frequency $1.6\times10^{16}\,Hz$, the photoelectrons emitted had twice the kinetic energy as the photoelectrons emitted when the same metal was irradiated with light of frequency $1.0\times10^{16}\,Hz$. Calculate the threshold frequency (v_0) for the metal.

A) $4\times10^{16}\,Hz$ B) $4\times10^{15}\,Hz$ C) $4\times10^{14}\,Hz$ D) $2\times10^{16}\,Hz$

36. A light source of wavelength λ illuminates a metal and ejects photoelectrons with $(kE)_{max}$ = 1eV. Another light source of wave length $\frac{\lambda}{3}$, ejects photoelectrons from same metal with $(KE)_{max}$ =4eV. Find the value of work function.

A) $1eV$ B) $2eV$ C) $0.5eV$ D) $3eV$

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 6 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. The number of integers not satisfying $\left[|x-1|\right]+\left[|7-x|\right]-6\neq 0$ is ([.] denotes G.I.F)

A) 7 B)6 C)8 D)2

38. Let $\{x_1, x_2, ...x_k\}$ be the set of positive integers 'n' such that n^2+256 is a perfect square.

Then

A) $\sum_{i=1}^{k} x_i = 135$ B) $\sum_{i=1}^{k} x_i = 268$ C) $\sum_{i=1}^{k} x_i = 160$ D) $\sum_{i=1}^{k} x_i = 240$

39. If $\alpha,\beta;\beta,\gamma;\gamma,\alpha$ are the roots of $a_i x^2+b_i x+c_i=0$ for $i=1,2,3(\alpha,\beta,\gamma>0)$ and

If $\sum\alpha+\sum\alpha\beta+\alpha\beta\gamma=\prod_{i=1}^{3}\left(\frac{a_i-b_i+c_i}{a_i}\right)^{1/2}+k$, then k=___

A)2 B)-2 C)1 D)-1

40. $a,b,c>0$ are in $G.P$ and $(a+di)x^2+2(b+ei)x+(c+if)=0$ has one real root then $\frac{a}{b},\frac{b}{c},\frac{c}{f}$ are

in _____$\left(a,b,c,d,e,f\in R, i=\sqrt{-1}\right)$

A) A.P B)G.P C)H.P D)A.G.P

space for rough work

41. Let $\alpha, \beta (0 < \alpha < \beta)$ be the roots of $ax^2 + bx + c = 0$ and $\gamma, \delta\ (\gamma > \delta)$ be the roots of $a^3x^2 + abcx + c^3 = 0$ then $\frac{\gamma^2}{\delta}$ is independent of

A) α, but not β B) β, but not α

C)Both α and β D)neither α nor β

42. The degree of the equation whose roots are integer values of 'x' for which $\log_{[x^2]}(4-|x|) + \log_3\{\sqrt{x}\}$ is real is___([.] denotes G.I.F, $\{.\}$ denotes fraction part).

A)4 B)1 C)2 D)3

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 correct answer, 0 if not attempted and -2 in all other cases

43. Let $f(x) = ax^2 + bx + c, a < o, c > 0$ and $f(\alpha) = 0, \alpha > 0$, Let $A = \sum_{i=1}^{n} f(x_{i-1}), B = \sum_{i=1}^{n} f(x_i), C = \sum_{i=1}^{n} f\left(\frac{x_{i-1} + x_i}{2}\right)$ where $0 \le x_{i-1} < x_i < \alpha$ then

A) $A > B$ B) $B > A$ C) $A + B < 2C$ D) $A + B > 2C$

44. The values of x satisfying $\frac{2\{x\} - 1}{x - 2\{x\}} \ge 0$ given by all the values belongs to___

($\{x\}$ denotes fraction part)

A) $\left[n, n + \frac{1}{2}\right], n \in I^-$ B) $\left[n + \frac{1}{2}, n + 1\right], n \in I^+$

C) $(1, \infty) - I^+$ D) $\left(0, \frac{1}{2}\right]$

space for rough work

45. The exhaustive set of solutions if $\{x-2\}-x(x-2)>0$ is____
($\{.\}$ denotes fraction part)

A) $\left(\frac{3-2\sqrt{3}}{2},2\right)-\{0\}$ B) $\left(\frac{3-\sqrt{13}}{2},2\right)-\{0\}$

C) $\left(\frac{3-\sqrt{14}}{2},\sqrt{3}\right)-\{0\}$ D) $\left(\frac{3-2\sqrt{3}}{2},\sqrt{3}\right)-\{0\}$

46. Let α,β be the roots of $x^2-2x-a^2+1=0$ and γ,δ are the roots of $x^2-2(a+1)x+a(a-1)=0$ such that $\alpha,\beta\in(\gamma,\delta)$. Then the set of values of 'a' is a subset of

A) $\left(-\frac{3}{4},\frac{3}{4}\right)$ B) $(-1,1)$ C) $\left(-\frac{1}{4},1\right)$ D) $\left(-\frac{1}{2},\frac{1}{2}\right)$

47. If $1,1,\alpha$ are the roots of $px^3+q(x^2+x)+r=0$, then

A) $pr<0$ B) $qr<0$ C) $pq<0$ D) $\alpha<0$

48. If the roots of $x^2+(a-b)x+1-a-b=0,\forall b\in R$ are real and unequal then the set of values of 'a' contains.

A) $(0,\infty)-\{1\}$ B) $(1,\infty)$ C) $[2,\infty)$ D) $(-\infty,1)$

49. If x,m satisfy $\log_{1/2}x^2\geq\log_{1/2}(x+2)$ and $49x^2-4m^4\leq 0$, then the exhaustive set of values of x is given by $[a,b]-\{0\}$ and exhaustive set of values of m is given by $R-(c,d)$, then

A) $ab+cd=5$ B) $a+b+c+d=1$ C) $ab+cd=-9$ D) $2ac-bd=0$

50. The number of solutions of the equation $x^3-[x]=3,([.]$ denotes G.I.F) is___

A) 0 B) 1 C) at least 2 D) finite, but at least 3

space for rough work

SECTION – III
(PARAGRAPH TYPE)

This section contains **2 groups of questions**. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices A), B), C) and D) for its answer, out of which **ONLY ONE** is **correct**.
Marking scheme: +3 for correct answer, 0 if not attempted and 0 in all other cases.

Paragraph For Questions 51 and 52:

Let $\alpha,\beta;\alpha,\gamma;\alpha,\delta$ are the roots of $ax^2+2bx+c=0, 2bx^2+cx+a=0, cx^2+ax+2b=0$ where $a,b,c\in N$

51. Least possible integer value of $a+b+c$ is

A) 4 B)5 C)3 D)7

52. $\sum_{r=0}^{99}\alpha^r =$ ____

A) 0 B)1 C)100 D)51

Paragraph For Questions 53 and 54:

Consider the equation $\left|x^2+bx+c\right|=k$ *and* $b^2-4c>0$.

53. The given equation has four real roots if

A) $o<k<\frac{b^2-4c}{4}$ B) $k>\frac{b^2-4c}{4}$ C) $k>\frac{4c-b^2}{4}$ D) $k<\frac{4c-b^2}{4}$

54. The given equation has exactly two real roots if

A) $o<k<\frac{b^2-4c}{4}$ B) $k>\frac{b^2-4c}{4}$ C) $k>\frac{4c-b^2}{4}$ D) $k<\frac{4c-b^2}{4}$

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KEY SHEET
PHYSICS

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

CHEMISTRY

19	**B**	20	**A**	21	**B**	22	**C**	23	**A**
24	**A**	25	**AC**	26	**ABCD**	27	**AD**	28	**ABC**
29	**BC**	30	**AC**	31	**ABC**	32	**AD**	33	**D**
34	**A**	35	**B**	36	**C**				

MATHS

37	**A**	38	**A**	39	**D**	40	**C**	41	**A**
42	**C**	43	**BC**	44	**ABD**	45	**B**	46	**BC**
47	**BCD**	48	**BC**	49	**BCD**	50	**B**	51	**B**
52	**B**	53	**A**	54	**B**				

SOLUTIONS

PHYSICS:

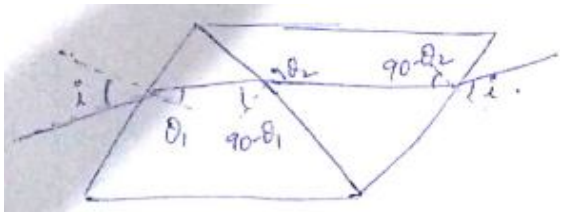
1. $\mu = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4} + ---$

Cauchy's relation

2. $1(\sin\theta) = \sqrt{3}\sin\frac{\theta}{2}$

$\Rightarrow \cos\frac{\theta}{2} = \frac{\sqrt{3}}{2}$

$\theta = 60^0$

3. 

$\sqrt{3}\ \sin i = \sqrt{3}\ \sin\theta_1$

$\sqrt{3}\ \cos\theta_1 = \sqrt{2}\ \sin\theta_2$

$\sqrt{2}\ \cos\theta_2 = \sin i$

solving we get i= 45^0

4. $\frac{1}{-10} + \frac{1}{n} = \frac{1}{10}$

$n = 5$

$m = -\left(\frac{5}{-10}\right) = \frac{1}{2}(\text{Erect image})$

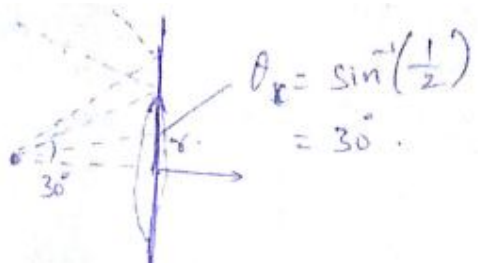
$V = r\omega = \frac{1}{2} \times \frac{2\pi}{2} = \frac{\pi}{2} = 1.57\,cm/s$ samedirection of object

$$\frac{\mu_2}{\nu}-\frac{\mu_1}{u}=\frac{\mu_2-\mu_1}{R}$$

$$0-\frac{\mu_1}{(-2R)}=\frac{\mu_2-\mu_1}{-R}$$

5. $$\frac{\mu_1}{2}=\mu_2$$

$$\frac{\mu_1}{\mu_2}=2$$

6. 

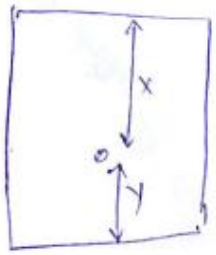
$$\frac{r}{a/2}=\tan 30^0$$

$$r=\frac{a}{2}x\frac{1}{\sqrt{3}}=\sqrt{\frac{2}{3}}$$

$$\text{Total dark area}=6a^2-6\pi r^2$$

$$=12-6\pi\frac{2}{3}$$

$$=12-4\pi$$

7. 

$$\frac{x}{\mu}=5$$

$$\frac{y}{\mu}=3$$

$$x+y=12$$

$$\Rightarrow \mu=1.5$$

$$x=7.5$$

8. $\frac{n_2}{v}-\frac{n_2}{u}=\frac{n_2-n_1}{R}$

or $\frac{n_2}{f_2}-\frac{n_1}{\infty}=\frac{n_2-n_1}{R}$

or $f_2=\frac{n_2R}{(n_2-n_1)}$

Similarly, $\frac{n_2}{\infty}-\frac{n_1}{f_1}=\frac{n_2-n_1}{R}$ will give

$f_1=(-1)\frac{n_1R}{(n_2-n_1)}$

9.

y- axis is the normal .

$$\therefore (1.5)\frac{a}{\sqrt{a^2+b^2}}=2\frac{c}{\sqrt{c^2+d^2}}$$

$$\therefore \frac{a}{c}=\frac{2}{1.5}=\frac{4}{3}$$

10.

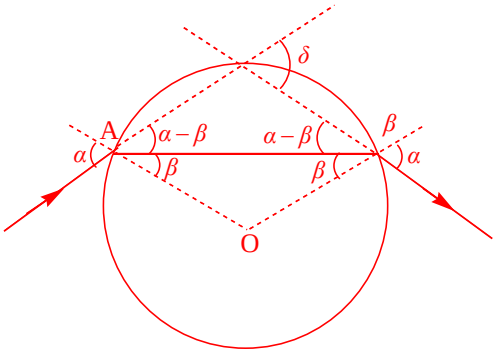
$$\frac{1.5}{\nu}-\frac{1}{\infty}=\frac{0.5}{+R}$$

$$\Rightarrow \nu=3R$$

$\therefore$ Real image is formed at 60cm

11. From the following diagram it is clear that

$$\delta = (\alpha - \beta) + (\alpha - \beta) = 2(\alpha - \beta)$$



12.

At i=c, r=90^0

$\delta = r - i = \frac{\pi}{2} - c$

At i slighthy more than c π R takes place.

$\delta = \pi - 2c$

For refraction δ increase with i

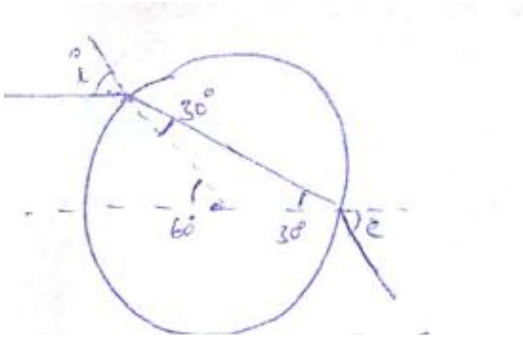
For reflection δ decrease with i

13.

$$\frac{-f}{-f+u} = 2, \quad \frac{-f}{-f+u} = -2$$

$$u = \frac{f}{2} \qquad , u = 3f/2$$

14.

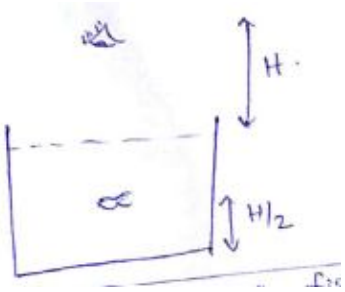


$$\therefore i = e = 60^0 \; \delta = 60^0$$

$$\sin i = \mu \sin 30^0$$

$$\mu = \sqrt{3}$$

15.



Images of eye appears at a distance of $(\mu H + H)$ from mirror

$$d = \frac{H}{2} + \mu H + H = H\left(\mu + \frac{3}{2}\right)$$

16.

$$d = H + \frac{H}{2\mu}$$

17.

$$\frac{2}{\nu} - \frac{1}{-X} = \frac{2-1}{R}$$

$$\frac{2}{\nu} = \frac{1}{R} - \frac{1}{X}$$

for image to be virtual $v < 0$

$\Rightarrow X < R$

18.

$$\frac{2}{\nu} = \frac{1}{R} - \frac{1}{2R}$$

$\nu = 4R$ (Inverted real image)

$\therefore$ Object distance for plane surface is $3R$

$\nu_f = 2(3R) = 6R$

CHEMISTRY

19. For Lyman series limit: $v_1 = cR\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right] = cR$ …… (i)

For Balmer series limit: $v_2 = cR\left[\frac{1}{2^2} - \frac{1}{\infty^2}\right] = \frac{cR}{4}$ ……. (ii)

For Ist line of Lyman series: $v_3 = cR\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3cR}{4}$ …….. (iii)

By (i), (ii) and (iii) $v_1 = v_2 + v_3$

$v_3 = v_1 - v_2$

20. $A(3p)$: Number of radial nodes = n- l- 1

= 3- 1- 1= 1

$B:(3d)$ Number of radial nodes = n- l- 1

= 3- 2- 1= 0

$C(3s)$: Number of radial nodes = n- l- 1

= 3- 0- 1= 2

21. $\lambda = \frac{h}{p}$ $\frac{\lambda_A}{\lambda_B} = \frac{P_B}{P_A}$

$P_B = \frac{1}{2}P_A$ $\frac{\lambda_A}{\lambda_B} = \frac{1}{2}$

$\lambda_B = 2\lambda_A = 2\times 5\times 10^{-8} = 10^{-7} m$

22. Orbital angular momentum = $\sqrt{\ell(\ell+1)}\ \frac{h}{2\pi}$

$\Rightarrow \sqrt{\ell(\ell+1)}\ \frac{h}{2\pi} = \sqrt{5}\ \frac{h}{\pi}$

$\sqrt{\ell(\ell+1)} = 2\sqrt{5} = \sqrt{20}$ $\Rightarrow$ $\ell = 4$

hence maximum number of electrons in this subshell = $2(2\ell + 1) = 18$.

Ans. 18

23. $(\Psi)_{2s} = \frac{1}{2\sqrt{2}\pi}\left(\frac{1}{a_0}\right)^{1/2}\left(2 - \frac{r}{a_0}\right)e^{-r/2a_0}$

For radial node at $r = r_0, \Psi_{2s}^2 = 0$

This is possible only when $\left(2 - \frac{r}{a_0}\right) = 0$

Or $2 = \frac{r_0}{a_0} \Rightarrow r_0 = 2a_0$

24. $\Psi_{321} : n = 3, l = 2, m = 1$

Angular momentum $= \frac{h}{2\pi}\sqrt{l(l+1)} = \frac{\sqrt{6}h}{2\pi}$

Spherical nodes $= 3 - 2 - 1 = 0$; Angular node = 2

Sum of all the above $= \frac{\sqrt{6}h}{2\pi} + 2 = \frac{\sqrt{6}h + 4\pi}{2\pi}$

25. $\bar{\nu} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$x = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = \frac{5R}{36}$

$\bar{v}_1 = Rx2^2\left(1 - \frac{1}{2^2}\right) = 3R = \frac{36}{5} X\, x\, 3 = \frac{108x}{5}$

Wavelength of 2nd line of lyman series of H-atom

$\frac{1}{\lambda} = R\, x 1^2\left(\frac{1}{1^2} - \frac{1}{3^2}\right)$

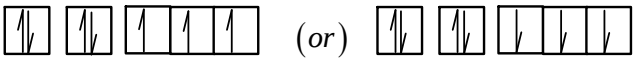
$\frac{1}{\lambda} = R\, x \frac{8}{9}$

$\frac{1}{\lambda} = \frac{36x}{5} x \frac{8}{9}$

$\lambda = \frac{5}{32} x$

26. CONCEPTUAL

27 N = 7 $1s^2 2s^2 2p^3$



28. $Cr^{2+}: 1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$: d-electron = 4

$Ne: 1s^2 2s^2 2p^6$: s-electrons = 2+2 = 4

$Fe: 1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$: d-subshell has 4 unpaired electrons.

$O: 1s^2 2s^2 2p^4$: p-electrons = 4

$Fe^{3+}: 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$: d-electrons = 5

29. $\lambda = \frac{h}{mv}, \frac{\lambda_P}{\lambda_d} = \frac{1}{2} \Rightarrow \frac{(mv)_P}{(mv)_\alpha} = \frac{2}{1}$

$\because m_\alpha = 4m_p \Rightarrow \frac{V_P}{V_\alpha} = \frac{8}{1}$

$\frac{KE_P}{KE_\alpha} = \frac{1/2 m_P V_p^2}{1/2 m_p V_p^2} = \frac{8^2}{4} = 16:1$

30. Conceptual

31. Conceptual

32. Conceptual

33. $\Delta x = 2\Delta p$

Now $\Delta x . \Delta p \geq \frac{h}{4\pi}$

$2\Delta p^2 \geq \frac{h}{4\pi}$; $2(m\Delta v)^2 \geq \frac{h}{4\pi}$; $\Delta v \geq \frac{1}{2m}\sqrt{\frac{h}{2\pi}}$

34. Mass of the ball = 40g = $40 \times 10^{-3} kg$

The uncertainty in the speed

$\Delta v = 45 \times \frac{2}{100} = 0.9 ms^{-1}$

So the uncertainty in position

$\Delta x = \frac{h}{4\pi\delta p} = \frac{h}{4\pi m \Delta v}$

$$= \frac{6.626\times10^{-34}\,Js}{4\times3.14\times\left(40\times10^{-3}kg\right)\times\left(0.9ms^{-1}\right)} = 1.46\times10^{-33}\,m$$

35. $h\nu = h\nu_0 + KE$

$KE_1 = h\left(\nu - \nu_0\right)$

$KE_2 = h\left(\nu_2 - \nu_0\right) = \frac{KE_1}{2}$

$\therefore \frac{\nu_2 - \nu_0}{\nu_1 - \nu_0} = \frac{1}{2} \Rightarrow \frac{1.0\times10^{16} - \nu_0}{1.6\times10^{16} - \nu_0} = \frac{1}{2}$

$\Rightarrow \nu_0 = 4\times10^{15}\,Hz$

36. $\frac{hc}{\lambda} = 1 + \phi.....(i)$

$3\frac{hc}{\lambda} = 4 + \phi.....(ii)$

From Eqs. (i)and (ii),

$\phi = 0.5eV$

MATHS

41. X=1,2,……..7

42. N=12,30,63

43. $\left(1+\alpha\right)\left(1+\beta\right) = \frac{a_1 - b_1 + c_1}{a_1}$

$\therefore \left(1+\alpha\right)\left(1+\beta\right)\left(1+\gamma\right) = \left(\prod_{i=1}^{3}\frac{a_i - b_i + c_i}{a_i}\right)^{1/2}$

44. $a\alpha^2 + 2b\alpha + c + i\left(a\alpha^2 + 2e\alpha + f\right) = 0$

$a\alpha^2 + 2b\alpha + c = 0, d\alpha^2 + 2e\alpha + f = 0$

$a\alpha^2 + 2\sqrt{ac}\alpha + c = 0, \frac{dc}{a} - 2e\frac{\sqrt{c}}{\sqrt{a}} + f = 0$

$\alpha = -\frac{\sqrt{c}}{\sqrt{a}}$ $\qquad$ $\frac{d}{a} - \frac{2e}{b} + \frac{f}{c} = 0$

45. 2 from 1 obtained by $x \to \frac{ax}{c}$

$\gamma = \frac{c}{a}\beta, \delta = \frac{c}{a}\alpha$

46. $x > o, x \notin \left(-\sqrt{2}, \sqrt{2}\right), -4 < x < 4 \Rightarrow x = 2,3$

47. Curve is concave down $\Rightarrow f\left(x_{i-1}\right) > f\left(x_i\right) \Rightarrow A > B$

$and\ C > \frac{A+B}{2}$

48. draw the graphs of $\{x\}, \frac{x}{2}$

$\frac{1}{2} \le \{x\} < \frac{x}{2}$

$\Rightarrow x \in \left[n+\frac{1}{2}, n+1\right), n \in I^+$

$\frac{x}{2} < \{x\} \le \frac{1}{2} \Rightarrow x \in \left(n, n+\frac{1}{2}\right], n \in I^-$

also $n \in \left(0, \frac{1}{2}\right]$

49. draw the graph of $\{x\}, x^2 - 2x$ and solve

50. $\alpha = 1-a, 1+a,\ f(\alpha) < o,\ f(\beta) < 0$

51. $\alpha = -1 \Rightarrow\ pq < 0, qr < 0, pr > 0$

52. $\Delta > 0 \Rightarrow b^2 - 2(a-2)b + a^2 + 4a - 4 > 0, b \in R$

Again $\Delta < 0 \Rightarrow a > 1$

53. $x^2 - x - 2 \le 0 \Rightarrow x \in [-1, 2]\ and\ x \ne 0$

$2m^2 \ge$ maximum of $7|x| \Rightarrow m \in R - \left(-\sqrt{7}, \sqrt{7}\right)$

54. Draw graphs of $x^3, [x] + 3$

Paragraph -I

Put $x = \alpha$ and add all,

Then $\alpha^2 + \alpha + 1 = 0 \quad \therefore a = 2b = c$

1)min value =5 2)1+33(0)=1

Paragraph-II