JEE MAIN- 2024-25 (Part Test-5)

(Physics, Chemistry and Mathematics)

SYLLABUS

Physics :- SHM, Mechanical Waves
Chemistry :- GOC, Isomerism, Nomenclature, Hydrocarbon
Mathematics :- Conic Section, Complex Number

5
PART TEST

CLASS-XIth

Date :- ..... **Time :- 3:00 Hrs.** **Marks :- 300**

Important Instructions :

1. The test duration is of **3 hours**.
2. The Test Booklet consists of 90 questions. The maximum marks are 300.
3. There are **three** parts in the question paper consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each part (subject) has two sections.

   (i) **Section-A:** This section contains 20 multiple choice questions which have only one correct answer. Each question carries **4 marks** for correct answer and **–1 mark** for wrong answer.
   (ii) **Section-B:** This section contains 10 questions. In Section-B, attempt any **five questions out of 10.** The answer to each of the questions is a numerical value. Each question carries **4 marks** for correct answer and **–1 mark** for wrong answer. For Section-B, the answer should be rounded off to the nearest integer.

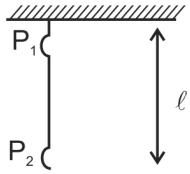
Student's Name :- .....
School Name :- .....

Student's Signature :- ..... **Invigilator's Signature :- .....**

PHYSICS

SECTION-A

1. Two small wave pulses P_1 and P_2 are generated at the top and the bottom, respectively in a freely suspended uniform string of length ℓ. The distance from bottom at which both the pulse will met :

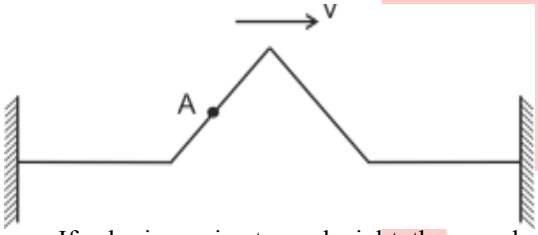


(A) $\ell/2$ (B) $\ell/3$
(C) $\ell/4$ (D) none of these

2. A simple pendulum of length R (R is radius of earth) is performing angular SHM near the earth's surface. Then time period of motion is -

(A) $\pi\sqrt{\frac{2R}{g}}$ (B) $2\pi\sqrt{\frac{2R}{g}}$
(C) $\pi\sqrt{\frac{R}{g}}$ (D) $2\pi\sqrt{\frac{R}{g}}$

3. A triangular wave pulse is traveling through a uniform string as shown in figure:



If pulse is moving towards right, then acceleration of particle A at the instant shown in figure:
(A) is in upward direction
(B) is in downward direction
(C) is zero
(D) it is impossible to find direction of acceleration from given data

4. The time taken by a particle performing SHM on a straight line to pass from point A to B where its velocities are same is 2 seconds. After another 2 seconds it returns to B. The time period of oscillation is (in second):
(A) 2 (B) 4 (C) 6 (D) 8

5. A mono atomic ideal gas of molar mass M, is filled in a closed cylindrical tube of length L. As moving from one end of the tube to another, temperature of the gas increases linearly from T_0 to $4T_0$. Then time taken by the sound wave to travel from one end to another is: (R is gas constant)

(A) $\sqrt{\frac{4ML^2}{15RT_0}}$ (B) $\sqrt{\frac{ML^2}{15RT_0}}$
(C) $\sqrt{\frac{4ML^2}{9RT_0}}$ (D) none of the above

6. Equation of a standing wave is generally expressed as $y = 2A \sin\omega t \cos kx$. In the equation, quantity ω/k represents
(A) the transverse speed of the particles of the string.
(B) the speed of either of the component waves.
(C) the speed of the standing wave.
(D) a quantity that is independent of the properties of the string.

7. A particle of mass m is acted upon by a force $F = t^2 - kx$. Initially the particle is at rest at the origin. Then –
(A) Its displacement will be in simple harmonic
(B) Its velocity will be in simple harmonic
(C) Its acceleration will be in simple harmonic
(D) Particle will move with constant velocity

8. Standing waves are produced in a 10 m long stretched string. If the string vibrates in 5 segment and the wave velocity is 20 m/s, the frequency is -
(A) 2 Hz (B) 4 Hz (C) 5 Hz (D) 10 Hz

9. A string fixed at both ends is vibrating in 1st overtone. Correct statement about motion of particles of the string
(A) All the particles are vibrating in same phase
(B) All the particles will be at mean position simultaneously
(C) All the particles are vibrating with same amplitude
(D) None of these

10. The amplitude of a particle due to superposition of following S.H.Ms. Along the same line is
$X1 = 2 \sin 50\pi t$; $X2 = 10 \sin (50\pi t + 37^\circ)$
$X3 = -4 \sin 50\pi t$; $X4 = -12 \cos 50\pi t$
(A) $4\sqrt{2}$ (B) 4
(C) $6\sqrt{2}$ (D) none of these

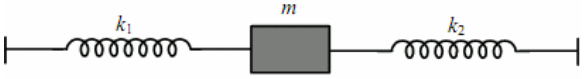
11. The displacement of two identical particles executing SHM are represented by equations $x_1 = 4 \sin\left(10t + \frac{\pi}{6}\right)$ and $x_2 = 5 \cos \omega t$
For what value of ω energy of both are particles is same ?
(A) 16 unit (B) 6 unit
(C) 4 unit (D) 8 unit

12. The maximum velocity of a particle, executing simple harmonic motion with an amplitude 7 mm, is 4.4 m/s. The period of oscillation is :
(A) 100 s (B) 0.01 s (C) 10 s (D) 0.1 s

13. In a stretched string -
(A) only even harmonics are produced
(B) only odd harnonics are produced
(C) even as well as odd harmonics are produced
(D) neither even nor odd harmonics are produced

14. A point mass oscillates along the x-axis according to the law $x = x_0 \cos(\omega t - \pi/4)$. If the acceleration of the particle is written as , $a = A\cos(\omega t + \delta)$, then :
(A) $A = x_0$, $\delta = -\pi/4$ (B) $A = x_0\omega^2$, $\delta = -\pi/4$
(C) $A = x_0\omega^2$, $\delta = -\pi/4$ (D) $A = x_0\omega^2$, $\delta = 3\pi/4$

15. Two springs, of force constants k_1 and k_2, are connected to a mass m as shown. The frequency of oscillation of mass is f. If both k_1 and k_2 are made four times their original values, the frequency of oscillation becomes:



(A) $f/2$ (B) $f/4$ (C) $4f$ (D) $2f$

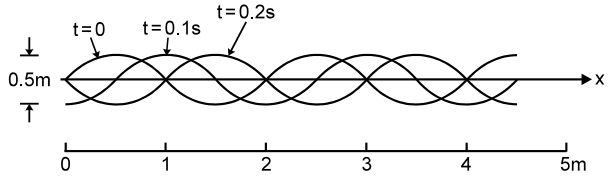
16. A sinusoidal wave with amplitude y_m is travelling with speed V on a string with linear density ρ. The angular frequency of the wave is ω. The following conclusions are drawn. Mark the one which is correct.
(A) doubling the frequency doubles the rate at which energy is carried along the string
(B) if the amplitude were doubled, the rate at which energy is carried would be halved
(C) if the amplitude were doubled, the rate at which energy is carried would be doubled
(D) the rate at which energy is carried is directly proportional to the velocity of the wave.

17. A mass M, attached to a horizontal spring, executes SHM with a amplitude A_1. When the mass M passes through its mean position then a smaller mass m is placed over it and both of them move together with amplitude A_2. The ratio of $\left(\frac{A_1}{A_2}\right)$ is :

(A) $\frac{M}{M+m}$ (B) $\frac{M+m}{M}$

(C) $\left(\frac{M}{M+m}\right)^{1/2}$ (D) $\left(\frac{M+m}{M}\right)^{1/2}$

18. Three consecutive flash photographs of a travelling wave on a string are reproduced in the figure here. The following observations are made. Mark the one which is correct. (Mass per unit length of the string = 3 g/cm.)



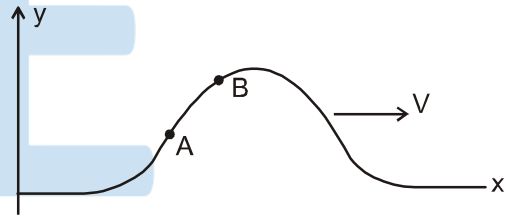
(A) displacement amplitude of the wave is 0.25 m, wavelength is 1 m, wave speed is 2.5 m/s and the frequency of the driving force is 0.2/s.
(B) displacement amplitude of the wave is 2.0 m, wavelength is 2 m, wave speed is 0.4 m/s and the frequency of the driving force is 0.7/s.
(C) displacement amplitude of the wave is 0.25 m, wavelength is 2 m, wave speed is 5 m/s and the frequency of the driving force is 2.5 /s.
(D) displacement amplitude of the wave is 0.5 m, wavelength is 2 m, wave speed is 2.5 m/s and the frequency of the driving force is 0.2/s.

19. Two particles are in SHM with same angular frequency and amplitudes A and 2A respectively along same straight line with same mean position. They cross each other at position $\frac{A}{2}$ distance from mean position in opposite direction. The phase difference between them is

(A) $\frac{5\pi}{6} - \sin^{-1}\left(\frac{1}{4}\right)$ (B) $\frac{\pi}{6} - \sin^{-1}\left(\frac{1}{4}\right)$

(C) $\frac{5\pi}{6} - \cos^{-1}\left(\frac{1}{4}\right)$ (D) $\frac{\pi}{6} - \cos^{-1}\left(\frac{1}{4}\right)$

20. A wave pulse is generated in a string that lies along x-axis. At the points A and B, as shown in figure, if R_A and R_B are ratio of wave speed to the particle speed respectively then :

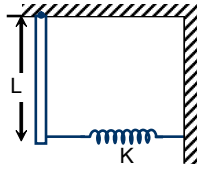


(A) $R_A > R_B$
(B) $R_B > R_A$
(C) $R_A = R_B$
(D) Information is not sufficient to decide.

SECTION-B

21. The sound loudness level at a point 4m from the point source is 10dB and the sound loudness at a distance 2m from the same source is x dB. Find the value of x. (log2 = 0.3)

22. A straight rod of length L and mass m is pivoted freely from a point of the roof. Its lower end is connected to an ideal spring of spring constant K. The other end of the spring is connected to the wall as shown in the figure. The frequency of small oscillation of the system is found to be $\frac{r}{20\pi}\sqrt{\frac{k}{m}+\frac{g}{2L}}$ find r. Take $\sqrt{3} = 1.732$



23. A standing wave $\xi = (5\text{ mm})\sin \pi x.\cos(200\,t)$ is maintained in a homogeneous rod with cross-sectional area 0.04 m^2 and density 1000 kg/m^3. Find the total mechanical-energy in joule confined between the sections corresponding to the adjacent displacement nodes.

24. A body is executing SHM under the action of force whose maximum magnitude is $50\sqrt{2}$ N. The magnitude of force acting on the particle at the instant when its kinetic energy and potential energy are equal is : (Assume potential energy to be zero at mean position)

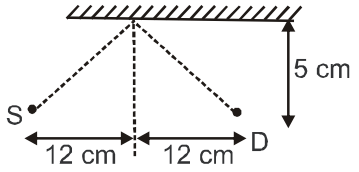
25. A closed organ pipe has length 'ℓ'. The air in it is vibrating in 3rd overtone with maximum amplitude a = 6cm. Find the amplitude (in cm) at a distance of ℓ /7 from closed end of the pipe.

26. A sliver atom in a solid oscillates in simple harmonic motion in some direction with a frequency of 10^{12}/ sec. What is the force constant of the bonds connecting one atom with the other ? (Mole wt. of siver =108 and Avagadro number = 6.02×10^{23} gm $mole^{-1}$)

27. Two adjacent resonance frequencies of an open organ pipe are 1800 and 2100 Hz. Find the length of the tube. The speed of sound in air is 330 m/s.

28. A particle performs simple harmonic motion at a frequency f. The frequency at which its kinetic energy varies is nf. What is the value of n?

29. A sound source, detector and a cardboard are arranged as shown in figure. The wave is reflected from the cardboard at the line of symmetry of source and detector. Initially the path difference between the reflected wave and the direct wave is one third of the wavelength of sound. Find the minimum distance by which the cardboard should be moved upwards so that both waves are in phase.



30. The period of oscillation of a simple pendulum of length L suspended from the roof of a vehicle which moves without friction down on inclined plane of inclination $\alpha = 60°$ is given by $\pi\sqrt{\frac{XL}{g}}$ then find X.

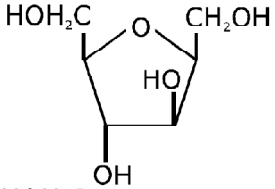
CHEMISTRY

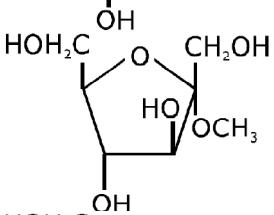
SECTION-A

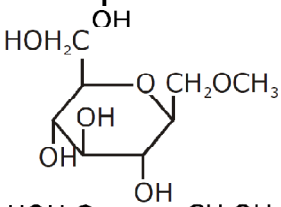
31. The IUPAC name of the compound $CH_3CH=CHCH=CHC\equiv CCH_3$ is -

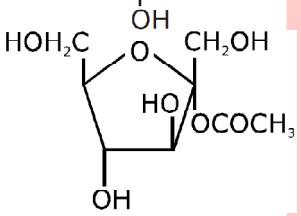
(A) 4, 6-octadien-2-yne (B) 2, 4-octadien -6-yne
(C) 2-octyn - 4, 6-diene (D) 6-octyn-2, 4-diene

32. Which of the following compounds will behave as a reducing sugar in an aqueous KOH solution ?

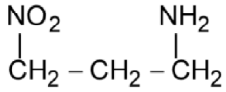
(A) 

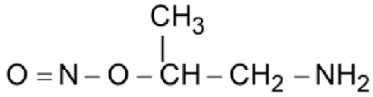
(B) 

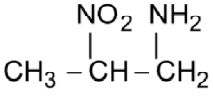
(C) 

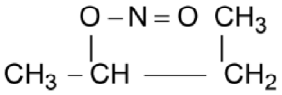
(D) 

33. The structure of 2- nitro-1-propanamine is -

(A) 

(B) 

(C) 

(D) 

34. IUPAC name of carbonyl chloride is -

(A) Phosgene
(B) Chloromethanoyl chloride
(C) Dichloroketone
(D) Dichloromethanone

35. The trans-alkenes are formed by the reduction of alkynes with :

(A) Sn – HCl (B) H_2 – Pd/C, $BaSO_4$
(C) $NaBH_4$ (D) Na/liq. NH_3

36. $C_4H_6O_2$ does not represent : –

(A) A diketone
(B) A compound with two aldehyde
(C) An alkenoic acid
(D) An alkanoic acid

37. Propene and cyclopropane are –

(A) Chain isomers (B) Position isomers
(C) Geometrical isomers (D) None of the above

38. Ethyl acetoacetate shows -

(A) Enantiomorphism
(B) Geometrical isomerism
(C) Diastereoisomerism
(D) Keto-enol tautomerism

39. Arrange in increasing basic strength

(a) $Cl-CH_2-COOH$
(b) $Cl-CH_2-CH_2-CH_2-COOH$
(c) $Cl-CH_2CH_2COOH$

Correct answer is-

(A) (a) < (c) < (b) (B) (b) < (a) < (c)
(C) (c) < (b) < (a) (D) (a) < (b) < (c)

40. Which of the following belongs to $+f^1$ group

(A) -OH (B) $-OCH_3$
(C) -COOH (D) $-CH_3$

41. Which of the following is the strongest - I group -

(A) $-N^+(CH_3)_3$ (B) $-{}^+NH_3$
(C) $-{}^+S(CH_3)_2$ (D) -F

42. Which of the statement is not correct?

(A) $-NH_2$ is ortho-para directing group
(B) –CHO is meta directing group
(C) : CCl_2 is an electrophile
(D) $-\ddot{O}H$ is (– M) group

43. Among the following compounds, the strongest acid is -

(A) $HC\equiv CH$ (B) C_6H_6
(C) C_2H_6 (D) CH_3OH

44. Heterolysis of propane will yield -

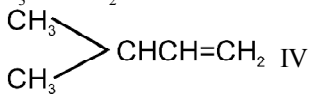
(A) $\dot{C}H_3$ and $\dot{C}_2H_5$ radicals

(B) $^-CH_3$ and $CH_3\overset{\oplus}{C}H_2$ ions

(C) $\overset{\oplus}{C}H_3$ and $CH_3CH_2^-$ ions

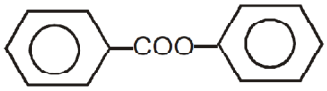
(D) $^-CH_2$ and $\bar{C}H_2$ ions

45. I $CH_3CH=CH_2$ II $CH_3CH_2CH=CH_2$,

III  IV $(CH_3)_3CCH=CH_2$

(A) I > II > III > IV (B) I > III > II > IV

(C) I > IV > III > II (D) IV > III > II > I

46.  electrophilic substitution occurs at

(A) o/p of 1st ring (B) meta at 1st ring

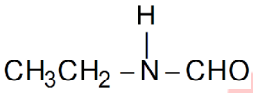
(C) o/p at 2nd ring (D) meta of 2nd ring.

47. A compound can be divided into two equal halves & contains even 'n' asymmetric carbon atoms. The number of optical isomer is –

(A) 2^n (B) $2^{(n-1)}$

(C) $2^{(n/2-1)}$ (D) $2^{n-1} + 2^{(n/2-1)}$

48. One among the following is the correct IUPAC name for the compound



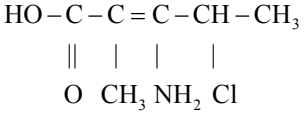
(A) N-Formyl aminoethane

(B) N-Ethyl formyl amine

(C) N-Ethyl methanamide

(D) Ethylamino methanal.

49. The systematic name for

 is

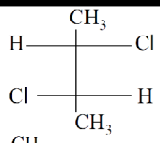
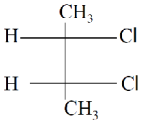
(A) 2-methyl-3-amino-4-chloro-2-pentenoic acid

(B) 1-hydroxy-1-oxo-2-methyl-3-amino-4- chloro-2pentene

(C) 3-amino-4-chloro-2-methyl-2-pentenoic acid

(D) 3-amino-2, 4-dimethyl-4-chloro-2-butenoic acid

SECTION-B

50. If optical rotation produced by  is + 36° then that produced by  is-

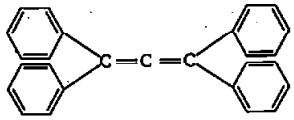
(A) -36° (B) 0°

(C) + 36° (D) Unpredictable

51. How many isomers of $C_4H_{10}O$ reacts Na metal to evolve to H_2 gas ? (excluding steroisomer)

52. How many chiral compounds are possible on monochlorination of 2-Methyl butane?

53. How many 2° carbon in the following?



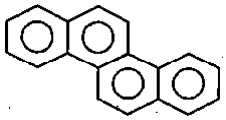
54. Total number of *a* hydrogen in the given following compound is

55. Total number of possible structure isomers of $C_5H_{11}Br$.

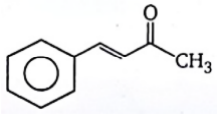
56. Total number of isomers for $C_4H_6Br_2$ containing cyclobutene ring are (including stereoisomer)

57. Total number of structural isomers of C_9H_{18} containing cyclohexane ring.

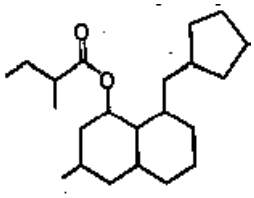
58. Total number of DBE value in:



59. How many carbon atom present in the parent chain in the given following compound?



60. How many chiral centres are in the following compound?



61. If $|z|=1$ and $|\omega-1|=1$ where $z, \omega \in C$, then the largest set of values of $|2z-1|^2+|2\omega-1|^2$ equals
(A) [1, 9] (B) [2, 6]
(C) [2, 12] (D) [2, 18]

62. A root of unity is a complex number that is a solution to the equation, $z^n = 1$ for some positive integer n. Number of non real complex roots of unity that are also the roots of the equation $z^2 + az + b = 0$, for some integer a and b is
(A) 6 (B) 8 (C) 9 (D) 10

63. Let $A(z_1)$ and $B(z_2)$ represent two complex numbers on the complex plane. Suppose the complex slope of the line joining A and B is defined as $\frac{z_1-z_2}{\bar{z}_1-\bar{z}_2}$.
Then the lines l_1 with complex slope ω_1 and l_2 with complex slope ω_2 on the complex plane will be perpendicular to each other if
(A) $\omega_1+\omega_2=0$ (B) $\omega_1-\omega_2=0$
(C) $\omega_1\omega_2=-1$ (D) $\omega_1\omega_2=1$

64. If the length of the latus rectum of ellipse is $\frac{5}{2}$ and eccentricity is $\frac{1}{2}$. Then the equation of the ellipse in standard form is
(A) $\frac{x^2}{9}+\frac{y^2}{16}=1$ (B) $\frac{9x^2}{25}+\frac{12y^2}{25}=1$
(C) $\frac{9x^2}{25}+\frac{y^2}{25}=1$ (D) $\frac{x^2}{25}+\frac{12y^2}{25}=1$

65. A ray emanating from point A (– 3, 0) incidents at the point P on the surface of the ellipse $16x^2+25y^2=400$ and get reflected parallel to minor axis of the ellipse and again reflected at point Q on the surface of the ellipse, then area of ΔAPQ lies in
(A) (5, 10) (B) (10, 15)
(C) (15, 20) (D) (20, 25)

66. If two distinct tangents are drawn from a point $\left(a, \frac{-14}{9}\right)$ to the curve $y=\frac{3}{5}\sqrt{x^2-25}$ then number of integral values of a is
(A) 4 (B) 5 (C) 10 (D) 11

67. A hyperbola passes through the point on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ $(a>b)$ whose eccentric angle is $\frac{\pi}{4}$. If the hyperbola and ellipse have the same foci and eccentricity of hyperbola is e then e^2 is
(A) 0 (B) 1 (C) 2 (D) 5

68. If chords of the hyperbola $x^2-y^2=a^2$ touch the parabola $y^2=4ax$, then the locus of the middle points of these chords is the curve
(A) $y^2(x+a)=x^3$ (B) $y^2(x-a)=x^3$
(C) $y^2(x+2a)=3x^3$ (D) $y^2(x-2a)=2x^3$

69. The tangent at the point A(12, 6) to a parabola intersects its directrix at the point B(–1, 2). The focus of the parabola lies on x-axis. The number of such parabolas is -
(A) 1 (B) 2 (C) 3 (D) 4

70. The minimum area of circle which touches the parabolas $y=\frac{1}{2}(x^2+5)$ and $x=\frac{1}{2}(y^2+5)$ is
(A) π (B) 2π (C) $2\sqrt{2}\pi$ (D) $\sqrt{2}\pi$

71. Let S be the focus of the parabola $x^2 = 16y$ and PQ be the common chord of the circle $x^2+y^2+8x-4y=0$ and the given parabola. The diameter of circumcircle of ΔPQS, is
(A) $2\sqrt{5}$ (B) $3\sqrt{5}$ (C) $4\sqrt{5}$ (D) $5\sqrt{5}$

72. If $\left(\frac{3-z_1}{2-z_1}\right)\left(\frac{2-z_2}{3-z_2}\right)=k$, then points $A(z_1)$, $B(z_2)$, C(3, 0) and D (2, 0) (taken in clockwise sense) will
(A) lie on a circle only for $k>0$
(B) lie on a circle only for $k<0$
(C) lie on a circle $k \in R$
(D) be the vertices of a square $k \in (0, 1)$

73. The value of $\sum_{n=0}^{100} i^{n!}$ equals (where $i=\sqrt{-1}$)
(A) –1 (B) i (C) 2i + 95 (D) 97 + i

74. If the imaginary part of the expression $\frac{z-1}{e^{\theta i}}+\frac{e^{\theta i}}{z-1}$ be zero, then the locus of z is –
(A) a straight line parallel to x-axis
(B) a parabola
(C) a circle of radius 1
(D) None of these

75. If $\alpha, \beta, \gamma, \delta$ are four complex numbers such that $\frac{\gamma}{\delta}$ is real and $\alpha\delta - \beta\gamma \neq 0$, then $z = \frac{\alpha + \beta t}{\gamma + \delta t}$, $t \in R$ represents a

(A) circle (B) parabola
(C) ellipse (D) straight line

76. The greatest and the least value of $|z_1 + z_2|$ if $z_1 = 24 + 7i$ and $|z_2| = 6$ are respectively

(A) 31, 19 (B) 25, 19
(C) 31, 25 (D) None of these

77. The locus of the centre of a circle, which touches the circles $|z - z_1| = a$ and $|z - z_2| = b$ externally will be -

(A) an ellipse (B) a hyperbola
(C) a circle (D) None of these

78. Let z, w be two non zero complex number such that $|z| = |w|$ & $\arg(z) + \arg(w) = \pi$ then $z =$

(A) $\bar{w}$ (B) $-\bar{w}$ (C) w (D) $-w$

79. The relation between the real numbers a and b, which satisfy the equation $\frac{1 - ix}{1 + ix} = a - ib$, for some real value of x, is

(A) $(a - b)(a + b) = 1$ (B) $\left(\frac{a - b}{a + b}\right) = 1$
(C) $a^2 + b^2 = 1$ (D) None of these

80. $Z \in C$ satisfies the condition $|Z| \geq 3$. Then the least value of $\left|Z + \frac{1}{Z}\right|$ is-

(A) $\frac{3}{8}$ (B) $\frac{8}{5}$ (C) $\frac{8}{3}$ (D) $\frac{5}{8}$

SECTION-B

81. Let $P(z) = z^3 + az^2 + bz + c$ where a, b and c are real. There exists a complex number ω such that the three roots of $P(z)$ are $\omega + 3i$, $\omega + 9i$ and $2\omega - 4$ where $i^2 = -1$. Find the value of $|a + b + c|$.

82. Given that z is a non zero complex number, $iz^2 = 1 + \frac{2}{z} + \frac{3}{z^2} + \frac{4}{z^3} + \frac{5}{z^4} + \ldots\ldots + \infty$ and $z = n \pm \sqrt{-i}$ find the value of 100n.

83. An equilateral triangle is inscribed in an ellipse whose equation is $x^2 + 4y^2 = 4$. One vertex of the triangle is (0, 1), one altitude is contained in the y-axis, and the length of each side is $\sqrt{m/n}$, where *m* and *n* are relatively prime positive integers. Find the value of $(m + n)$.

84. Let $P_1, P_2, \ldots\ldots, P_n$ be the points on the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ and $Q_1, Q_2, \ldots\ldots, Q_n$ are the corresponding points on the auxiliary circle of the ellipse. If the line joining C to Q_i (C is centre of ellipse) meets the normal at P_i with respect to the given ellipse at K_i and $\sum_{i=1}^{n} CK_i = 56$, then find the value of n.

85. Suppose an ellipse and a hyperbola have the same pair of foci on the x-axis with centres at the origin and they intersect at M (2, 2). If the eccentricity of ellipse is $\frac{1}{2}$ and eccentricity of hyperbola is $\sqrt{\frac{m}{n}}$ where m, n are coprime, then find the value of (m + n).

86. If the line $lx + my + n = 0$ meets the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ at the extremities of a pair of conjugate diameters, then the relation $a^2l^2 - b^2m^2$ is equal to -

87. A chord PQ is a normal to the parabola $y^2 = 4ax$ at P and subtends a right angle at the vertex. If $SQ = \lambda SP$ where S is the focus then find the value of λ.

88. All the three vertices of an equilateral triangle lie on the parabola $y = x^2$, and one of its sides has a slope of 2. The x-coordinates of the three vertices have a sum equal to p/q where *p* and *q* are relatively prime positive integers. Find the value of (p + q).

89. If $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ are roots of the equation $z^5 + z^4 + z^3 + z^2 + z + 1 = 0$ then $\prod_{i=1}^{5} (2 - \alpha_i)$ is equal to -

90. An arch way is in the slope of a semi-ellipse, the road level being the major axis. If the breadth of the road is 30 m and the height of the arch is 6 m at a distance of 2 m from the side, the greatest height of the arch is –