

Chemistry

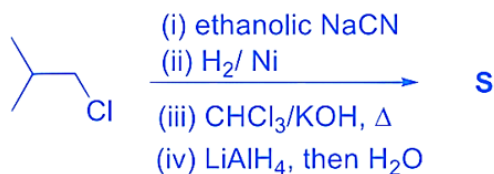
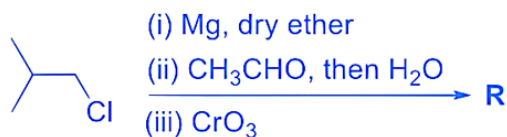
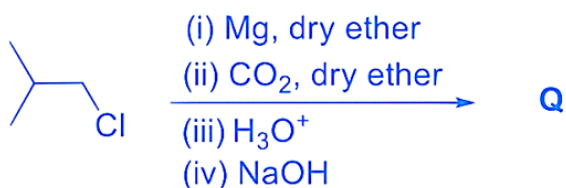
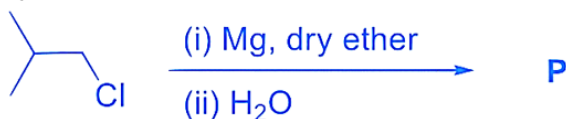
1. For the reaction sequence given below, the correct statement(s) is(are)



(In the options, X is any atom other than carbon and hydrogen, and it is different in P, Q and R.)

- | | |
|---|--|
| <p>A) C – X bond length in P, Q and R follows the order $Q > R > P$.</p> <p>C) Relative reactivity toward S_N2 reaction in P, Q and R follows the order $P > R > Q$.</p> | <p>B) C – X bond enthalpy in P, Q and R follows the order $R > P > Q$.</p> <p>D) pK_a value of the conjugate acids of the leaving groups in P, Q and R follows the order $R > Q > P$.</p> |
|---|--|

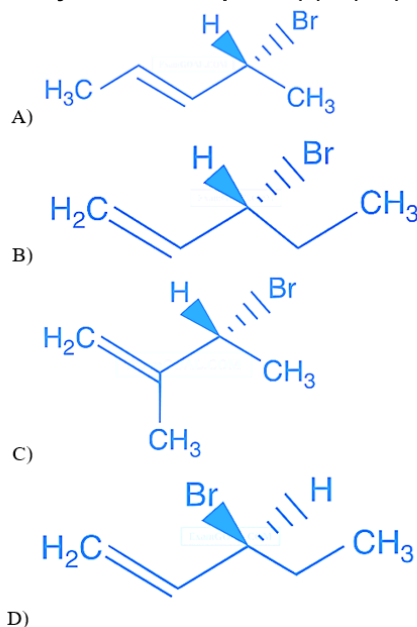
2. In the following reactions, P, Q, R, and S are the major products.



The correct statement about P, Q, R, and S is:

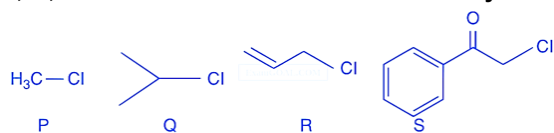
- | | |
|---|--|
| <p>A) P is a primary alcohol with four carbons.</p> <p>C) R has six carbons and it undergoes Cannizzaro reaction.</p> | <p>B) Q undergoes Kolbe's electrolysis to give an eight-carbon product.</p> <p>D) S is a primary amine with six carbons.</p> |
|---|--|

3. Compound(s) that on hydrogenation produce(s) optically inactive compound(s) is(are)



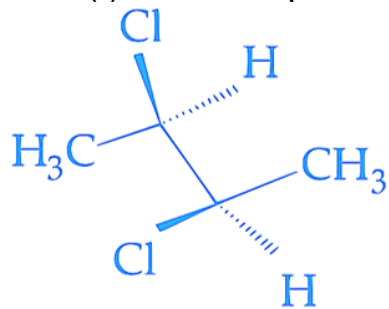
- | | |
|---------|---------|
| A) B, D | B) C, D |
| C) A, D | D) D, C |

4. KI in acetone, undergoes S_N2 reaction with each of P, Q, R and S. The rates of the reaction vary as:



- | | |
|--------------------|--------------------|
| A) $P > Q > R > S$ | B) $S > P > R > Q$ |
| C) $P > R > Q > S$ | D) $R > P > S > Q$ |

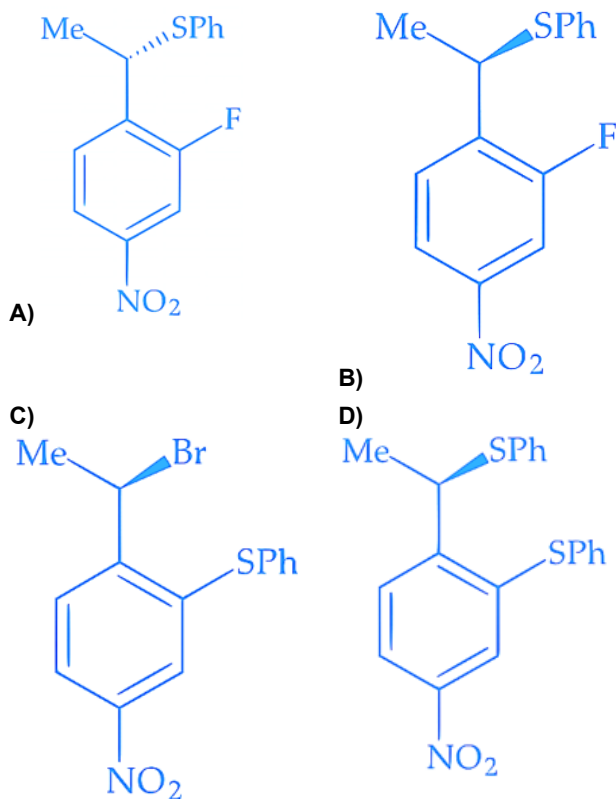
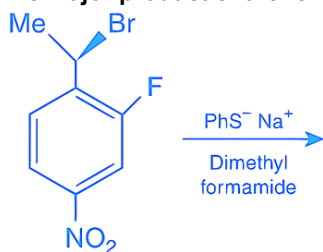
5. The correct statement(s) about the compound shown



below is(are):

- | | |
|---------|---------|
| A) B, D | B) C, D |
| C) A, D | D) D, C |
- The compound is optically active. B) The compound possesses center of symmetry. C) The compound possesses plane of symmetry. D) The compound possesses axis of symmetry.

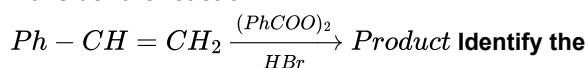
6. The major product of the following reaction is:



7. Statement 1 : Bromobenzene upon reaction with Br_2/Fe gives 1, 4-dibromobenzene as the major product. and Statement 2: In bromobenzene, the inductive effect of the bromo group is more dominant than the mesomeric effect in directing the incoming electrophile.

- A) Statement 1 is True, Statement 2 is True;
Statement 2 is a correct explanation for Statement 1.
- B) Statement 1 is True, Statement 2 is True;
Statement 2 is a NOT correct explanation for Statement 1.
- C) Statement 1 is True, Statement 2 is False.
- D) Statement 1 is False, Statement 2 is True.

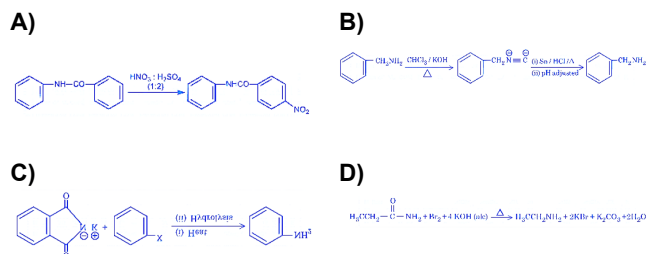
8. Consider the reaction:



Identify the correct statements and choose the correct answer from the options given below: A. The reaction proceeds through a more stable radical intermediate. B. The role of peroxide is to generate $\text{H}^\bullet$ (Hydrogen radical). C. During this reaction, benzene is formed as a byproduct. D. 1-Bromo-2-phenylethane is formed as the minor product. E. The same reaction in absence of peroxide proceeds via carbocation intermediate.

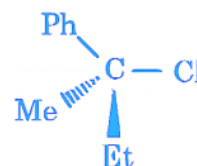
- A) A & E Only
C) A, C & E Only
- B) A, B & D Only
D) C, D & E Only

9. Consider the following reactions giving the major product. Identify the correct reaction.



10. Given below are two statements: Statement I:

$\text{C}-\text{Cl}$ bond is stronger in $\text{CH}_2=\text{CH}-\text{Cl}$ than $\text{CH}_3-\text{CH}_2-\text{Cl}$. Statement II: The given optically



active molecule, In the light of the above statements, choose the correct answer from the options given below:

- A) Statement I is false but Statement II is true
- B) Statement I is true but Statement II is false
- C) Both Statement I and Statement II are true
- D) Both Statement I and Statement II are false

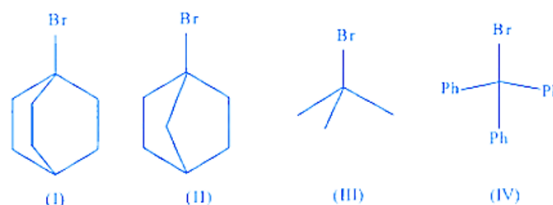
11. Match the

List-I Chloro derivative	List-II Example
A. Vinyl Chloride	I. $\text{CH}_2=\text{CH}-\text{CH}_2\text{Cl}$
B. Benzyl Chloride	II. $\text{CH}_3-\text{CH}(\text{Cl})\text{CH}_3$
C. Alkyl Chloride	III. $\text{CH}_2=\text{CHCl}$
D. Allyl Chloride	IV.

Choose the correct answer from the options given below:

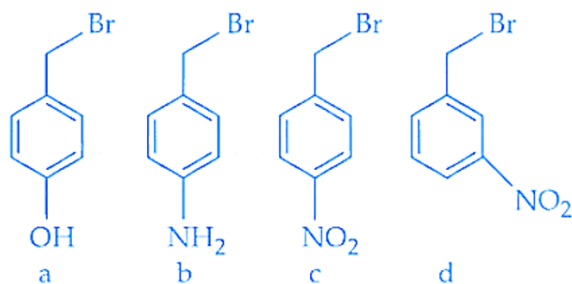
- A) A-III, B-IV, C-I, D-II
- B) A-IV, B-I, C-III, D-II
- C) A-III, B-IV, C-II, D-I
- D) A-I, B-II, C-IV, D-III

12. The correct order of the rate of reaction of the following reactants with nucleophile by $\text{S}_\text{N}1$ mechanism is: (Given : Structures I and II are rigid)



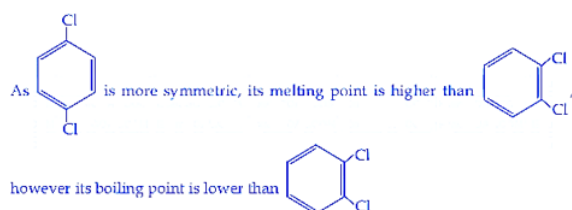
- A) $\text{I} < \text{II} < \text{III} < \text{IV}$
- B) $\text{II} < \text{I} < \text{III} < \text{IV}$
- C) $\text{III} < \text{I} < \text{II} < \text{IV}$
- D) $\text{IV} < \text{III} < \text{II} < \text{I}$

13. The correct order of reactivity of the following benzyl halides towards reaction with KCN is:



- A) $a > b > c > d$ B) $b > a > d > c$
 C) $b > a > c > d$ D) $a > b > d > c$

14. Given below are two statements: Statement I: Due to increase in van der Waals forces, the order of boiling points is $CH_3CH_2CH_2I > CH_3CH_2I > CH_3I$. Statement II:



In the light of the above statements, choose the correct answer from the options given below :

- A) Both Statement I and Statement II are true B) Both Statement I and Statement II are false
 C) Statement I is true but Statement II is false D) Statement I is false but Statement II is true

15. Match the LIST-I with LIST-II

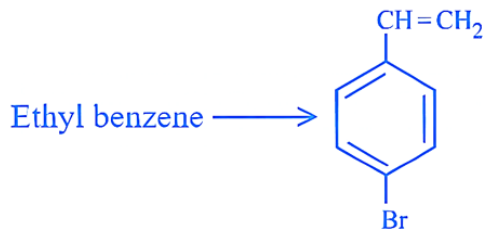
LIST-I Name of reaction	LIST-II Reagent or catalyst used
A. Friedel-Crafts reaction	I. BF_3
B. Swarts reaction	II. Na, dry ether
C. Sandmeyer's reaction	III. NaI
D. Fittig reaction	IV. $CuCl_2$

- A) A-I, B-IV, C-III, D-III B) A-III, B-I, C-IV, D-II
 C) A-IV, B-II, C-I, D-III D) A-I, B-III, C-II D-IV

16. Given below are two statements: Statement (I): Benzyl chloride reacts faster in S_N1 mechanism than ethyl chloride. Statement (II): Ethyl carbocation intermediate is less stabilized by hyperconjugation than benzyl carbocation by resonance. In the light of the above statements, choose the correct answer from the options given below:

- A) Both Statement I and Statement II are true B) Both Statement I and Statement II are false
 C) Statement I is true but Statement II is false D) Statement I is false but Statement II is true

17. Choose the correct set of reagents for the following conversion:

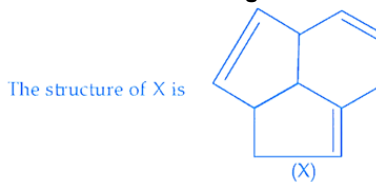


- A) $Cl_2/\text{anh. } AlCl_3$; Br_2/Fe ; alc. KOH B) Cl_2/Fe ; $Br_2/\text{anh. } AlCl_3$; aq. KOH
 C) Br_2/Fe ; Cl_2, Δ ; alc. KOH D) $Br_2/\text{anh. } AlCl_3$; Cl_2, Δ ; aq. KOH

18. Which one of the following reactions will not lead to the desired ether formation in major proportion? (iso-Bu $\Rightarrow$ isobutyl, sec-Bu $\Rightarrow$ sec-butyl, nPr $\Rightarrow$ n-propyl, t Bu $\Rightarrow$ tert-butyl, Et $\Rightarrow$ ethyl)

- A) $Na^+ O^- \text{C}_6\text{H}_5 + n\text{-PrBr} \rightarrow n\text{-Pr-O-C}_6\text{H}_5$ B) $sec\text{-BuO}^-Na^+ + sec\text{-BuBr} \rightarrow sec\text{-I}$
 C) $\text{Cyclohexyl-O}^-Na^+ + CH_3Br \rightarrow \text{Cyclohexyl-O-CH}_3$ D) $t\text{BuO}^-Na^+ + EtBr \rightarrow t\text{Bu-O-Et}$

19. Consider the following molecule (X).



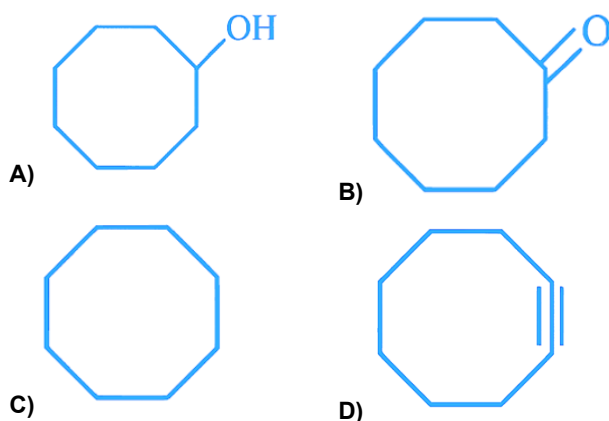
The structure of X is

The major product formed when the given molecule (X) is treated with HBr (1 eq) is:

- A)
- B)
- C)
- D)

20. 1,2-dibromocyclooctane $\xrightarrow[\text{(iv) Zn-Hg / H}^+]{\text{(i) KOH (alc.)}, \text{(ii) NaNH}_2, \text{(iii) Hg}^{2+} / \text{H}^+}$ P
major product

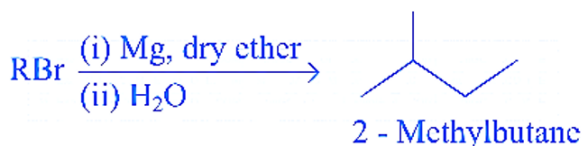
Identify the major product P.



21. Consider all the structural isomers with molecular formula $C_5H_{11}Br$ that are separately treated with $KOH(aq)$ to give respective substitution products, without any rearrangement. The number of products which can exhibit optical isomerism from these is _____.

22. RMgI when treated with ice cold water liberated a gas which occupied $1.4 \text{ dm}^3 \text{ g}^{-1}$ at STP. The gas produced is further reacted with iodine in presence of HIO_3 to give compound (X). Compound (X) in presence of Na and dry ether produced compound (Y). Molar mass of compound (Y) is _____ g mol^{-1} . (Nearest integer)

23. The maximum number of RBr producing 2-methylbutane by above sequence of reactions is _____. (Consider the structural isomers only)

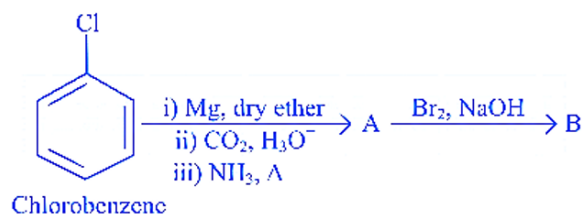


24. 2-Bromopentane $\xrightarrow{\text{alcoholic KOH}}$ P $\xrightarrow{\text{Br}_2}$ Q



Mass of product Q obtained is _____ g. (Given molar mass in g mol^{-1} : H = 1, C = 12, O = 16, Br = 80) -

25. Consider the following sequence of reactions:



11.25 mg of chlorobenzene will produce _____ $\times 10^{-1}$ mg of product B. (Consider the reactions result in complete conversion.) (Given molar mass of C, H, O, N and Cl as 12, 1, 16, 14 and 35.5 g mol^{-1} respectively)

Maths

26. If the latus rectum of an ellipse be equal to half of its minor axis, then its eccentricity is:



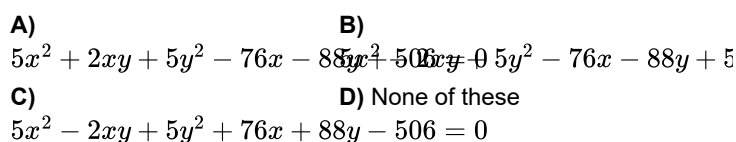
27. If the distance between the directrices be thrice the distance between the foci, then eccentricity of the ellipse is:



28. The equation $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents an ellipse if:



29. Equation of the ellipse whose focus is (6, 7), directrix is $x + y + 2 = 0$, and $e = \frac{1}{\sqrt{3}}$ is:



30. The equation of the ellipse whose centre is at the origin and which passes through the points $(-3, 1)$ and $(2, -2)$ is:



31. The latus rectum of an ellipse is 10 and the minor axis is equal to the distance between the foci. The equation of the ellipse is:



32. If the distance between the foci of an ellipse be equal to its minor axis, then its eccentricity is:



33. The equation of the ellipse whose centre is $(2, -3)$, one of the foci is $(3, -3)$ and the corresponding vertex is $(4, -3)$ is:

- A) $\frac{(x-2)^2}{3} + \frac{(y+3)^2}{4} = 1$ B) $\frac{(x-2)^2}{4} + \frac{(y+3)^2}{3} = 1$
C) $\frac{x^2}{3} + \frac{y^2}{4} = 1$ D) None of these

34. Eccentricity of the ellipse

$$4x^2 + y^2 - 8x + 2y + 1 = 0 \text{ is:}$$

- A) $\frac{1}{\sqrt{3}}$ B) $\frac{\sqrt{3}}{2}$
C) $\frac{1}{2}$ D) None of these

35. The equation of ellipse whose distance between the foci is equal to 8 and distance between the directrix is 18, is:

- A) $5x^2 - 9y^2 = 180$ B) $9x^2 + 5y^2 = 180$
C) $x^2 + 9y^2 = 180$ D) $5x^2 + 9y^2 = 180$

36. In an ellipse the distance between its foci is 6 and its minor axis is 8. Then its eccentricity is:

- A) $\frac{4}{5}$ B) $\frac{1}{\sqrt{52}}$
C) $\frac{3}{5}$ D) $\frac{1}{2}$

37. The eccentricity of an ellipse is $\frac{2}{3}$, latus rectum is 5 and centre is $(0, 0)$. The equation of the ellipse is:

- A) $\frac{x^2}{81} + \frac{y^2}{45} = 1$ B) $\frac{4x^2}{81} + \frac{4y^2}{45} = 1$
C) $\frac{x^2}{9} + \frac{y^2}{5} = 1$ D) $\frac{x^2}{81} + \frac{y^2}{45} = 5$

38. The foci of the ellipse $25(x+1)^2 + 9(y+2)^2 = 225$ are at:

- A) $(-1, 2)$ and $(-1, -6)$ B) $(-2, 1)$ and $(-2, 6)$
C) $(-1, -2)$ and $(-2, -1)$ D) $(-1, -2)$ and $(-1, -6)$

39. If the co-ordinates of two points A and B are $(\sqrt{7}, 0)$ and $(-\sqrt{7}, 0)$ respectively and P is any point on the conic, $9x^2 + 16y^2 = 144$, then $PA + PB$ is equal to:

- A) 8 B) 9
C) 16 D) 6

40. Let an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a < b$, pass through the point $(4, 3)$ and have eccentricity $\frac{\sqrt{5}}{3}$. Then the length of its latus rectum is:

- A) $\frac{4\sqrt{5}}{3}$ B) $2\sqrt{5}$
C) $\frac{7\sqrt{5}}{3}$ D) $\frac{8\sqrt{5}}{3}$

41. If the length of the minor axis of an ellipse is equal to one fourth of the distance between the foci, then the eccentricity of the ellipse is:

- A) $\frac{3}{\sqrt{19}}$ B) $\frac{\sqrt{3}}{16}$
C) $\frac{4}{\sqrt{17}}$ D) $\frac{\sqrt{5}}{7}$

42. The length of the latus-rectum of the ellipse, whose foci are $(2, 5)$ and $(2, -3)$ and eccentricity is $\frac{4}{5}$, is:

- A) $\frac{50}{3}$ B) $\frac{18}{5}$
C) $\frac{6}{5}$ D) $\frac{10}{3}$

43. If the length of the minor axis of an ellipse is equal to half of the distance between the foci, then the eccentricity of the ellipse is:

- A) $\frac{1}{\sqrt{3}}$ B) $\frac{2}{\sqrt{5}}$
C) $\frac{\sqrt{3}}{2}$ D) $\frac{\sqrt{5}}{3}$

44. Let $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a > b$ be an ellipse, whose eccentricity is $\frac{1}{\sqrt{2}}$ and the length of the latus rectum is $\sqrt{14}$. Then the square of the eccentricity of $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is:

- A) 3 B) $\frac{7}{2}$
C) $\frac{3}{2}$ D) $\frac{5}{2}$

45. If the length of the latus rectum of the ellipse $x^2 + 4y^2 + 2x + 8y - \lambda = 0$ is 4, and l is the length of its major axis, then $\lambda + l$ is equal to:

- A) 65 B) 70
C) 75 D) 80

46. The distance between the directrices of the ellipse $(4x+8)^2 + 16y^2 = (x+\sqrt{3}y+10)^2$ is K . Find $\frac{K}{2}$:

47. If parabolas

$$y^2 = \lambda x \text{ and } 25((x-3)^2 + (y+2)^2) = (3x-4y-2)^2$$

are equal, then value of λ is

48. An ellipse has its center at $(1, -2)$, one focus at $(3, -2)$ and one vertex at $(5, -2)$. Then the length of its latus rectum is:

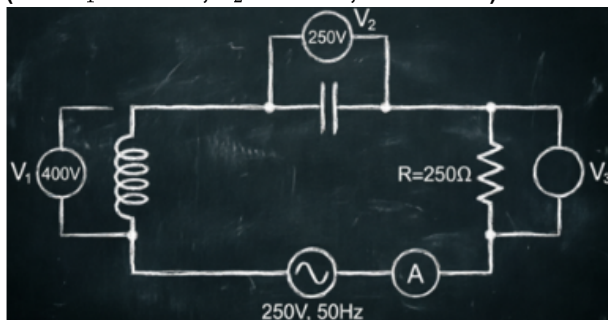
49. Let the length of a latus rectum of an ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \text{ be } 10. \text{ If its eccentricity is the minimum value of the function } f(t) = t^2 + t + \frac{11}{12}, t \in R, \text{ then } a^2 + b^2 \text{ is equal to:}$$

50. Let the eccentricity of an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a > b$, be $\frac{1}{4}$. If this ellipse passes through the point $(-4\sqrt{\frac{2}{5}}, 3)$, then $a^2 + b^2$ is equal to:

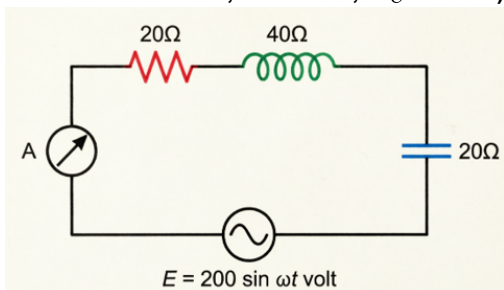
Physics

51. A capacitor, a resistor and an inductor are connected in series to an ac-source of 250 V and frequency 50 Hz. Find reading of voltmeter V_3 and ammeter in the given LCR-series circuit from the image given below (with $V_1 = 400\text{ V}$, $V_2 = 250\text{ V}$, $R = 250\ \Omega$).



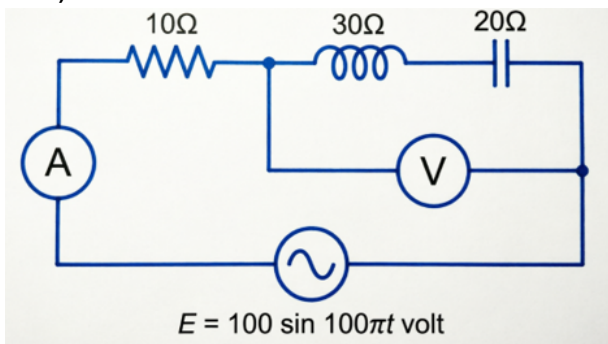
- A) $V_3 = 200\text{ V}$, $I = 0.8\text{ A}$ B) $V_3 = 250\text{ V}$, $I = 1\text{ A}$
 C) $V_3 = 150\text{ V}$, $I = 0.6\text{ A}$ D) $V_3 = 200\text{ V}$, $I = 0.4\text{ A}$

52. Find out reading of A.C. ammeter and also calculate the potential difference across resistance and capacitor from the image given below (with $E = 200 \sin \omega t$ volt, $R = 20\ \Omega$, $X_C = 20\ \Omega$).



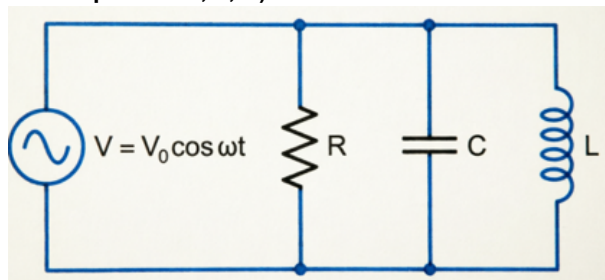
- A) Ammeter = 10 A, $V_R = V_C = 200\text{ V}$ B) Ammeter = 5 A, $V_R = V_C = 50\text{ V}$
 C) Ammeter = 5 A, $V_R = V_C = 100\text{ V}$ D) Ammeter = 7.07 A, $V_R = V_C = 141.4\text{ V}$

53. In given circuit find the reading of ammeter and voltmeter from the image given below (with $E = 100 \sin 100\pi t$ volt, and resistors $10\ \Omega$, $30\ \Omega$, $20\ \Omega$).



- A) Ammeter = 2.5 A, Voltmeter = 25 V B) Ammeter = 10 A, Voltmeter = 100 V
 C) Ammeter = 5 A, Voltmeter = 50 V D) Ammeter = 7.07 A, Voltmeter = 70.7 V

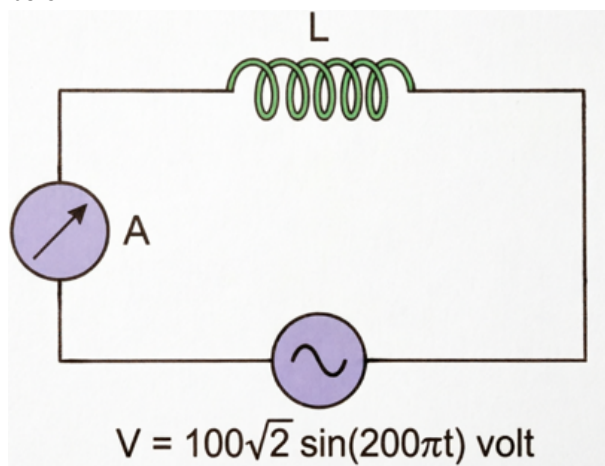
54. For the circuit shown in figure, write down the instantaneous current through each element from the image given below (with $V = V_0 \cos \omega t$ applied across parallel R, L, C).



- A) $i_R = \frac{V_0}{R} \cos \omega t$, $i_L = -\frac{V_0}{\omega L} \sin \omega t$, $i_C = V_0 \omega C \sin \omega t$
 B) $i_R = \frac{V_0}{R} \cos \omega t$, $i_L = \frac{V_0}{\omega L} \sin \omega t$, $i_C = -V_0 \omega C \sin \omega t$
 C) $i_R = \frac{V_0}{R} \sin \omega t$, $i_L = \frac{V_0}{\omega L} \cos \omega t$, $i_C = V_0 \omega C \cos \omega t$
 D) $i_R = \frac{V_0}{R} \cos \omega t$, $i_L = -\frac{V_0}{\omega L} \cos \omega t$, $i_C = V_0 \omega C \sin \omega t$

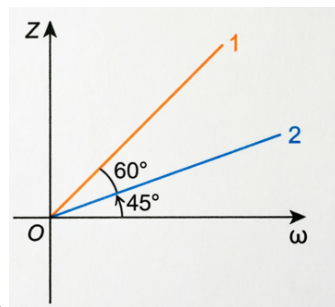
55. In given circuit applied voltage

$V = 100\sqrt{2} \sin(200\pi t)$ volt and ammeter reading is 4 A then calculate value of L from the image given below.



- A) $\frac{1}{2\pi}\text{ H}$ B) $\frac{1}{4\pi}\text{ H}$
 C) $\frac{1}{8\pi}\text{ H}$ D) $\frac{1}{6\pi}\text{ H}$

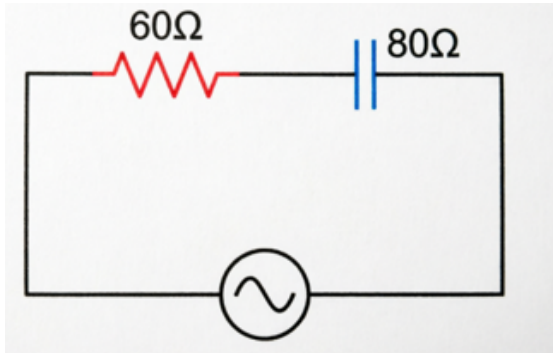
56. Across two different inductors same alternating source is connected. For this Z versus ω graph is given. Find out the ratio $\frac{L_1}{L_2}$ from the image given below (line 1 makes 60° and line 2 makes 45° with



the ω -axis).

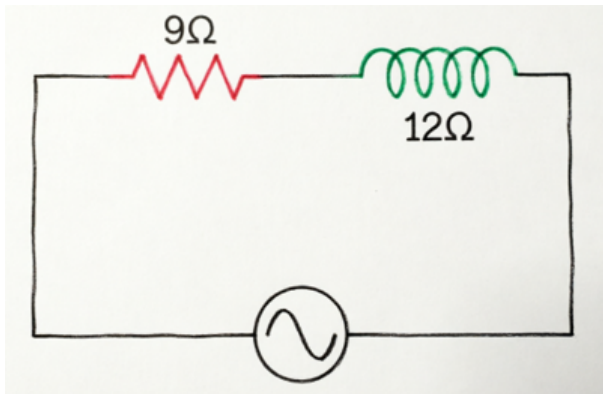
- A) 3 B) $\sqrt{3}$
 C) $\frac{1}{\sqrt{3}}$ D) $\frac{1}{3}$

57. Calculate the impedance of the circuit shown from the image given below (a series RC circuit with resistance $R = 60\ \Omega$ and capacitive reactance $X_C = 80\ \Omega$).



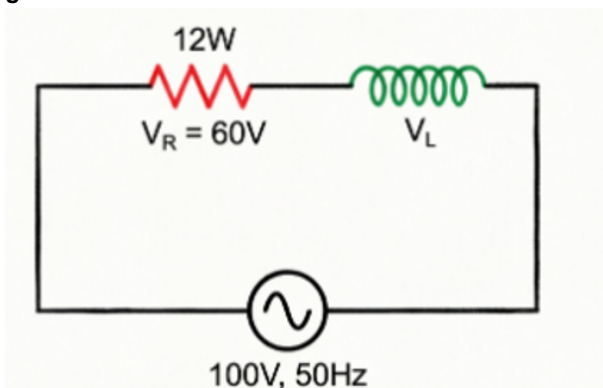
- A) $140\ \Omega$ B) $100\ \Omega$
C) $60\ \Omega$ D) $80\ \Omega$

58. Calculate the impedance of the circuit shown from the image given below (a series RL circuit with resistance $R = 9\ \Omega$ and inductive reactance $X_L = 12\ \Omega$).



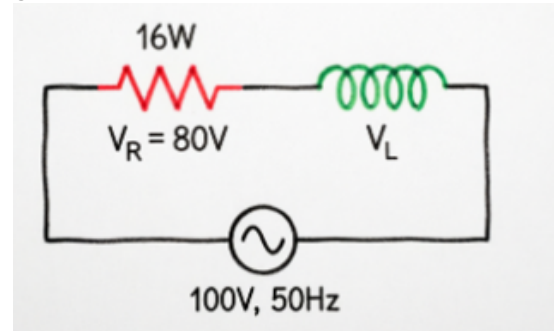
- A) $21\ \Omega$ B) $3\ \Omega$
C) $12\ \Omega$ D) $15\ \Omega$

59. Find out the required inductance to put in series of bulb (12 W, 60 V) to run it safely across an alternating supply of 100 V, 50 Hz from the image given below.



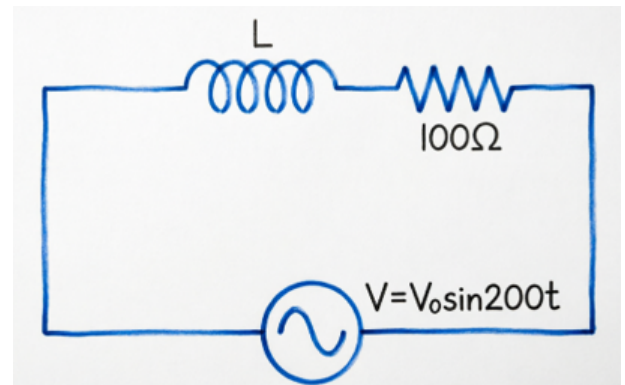
- A) $\frac{2}{\pi}\ \text{H}$ B) $\frac{4}{\pi}\ \text{H}$
C) $\frac{3}{\pi}\ \text{H}$ D) $\frac{5}{\pi}\ \text{H}$

60. Find out the required inductance to put in series of bulb (16 W, 80 V) to run it safely across an alternating supply of 100 V, 50 Hz from the image given below.



- A) $\frac{2}{\pi}\ \text{H}$ B) $\frac{3}{\pi}\ \text{H}$
C) $\frac{4}{\pi}\ \text{H}$ D) $\frac{5}{\pi}\ \text{H}$

61. From the image given below, the current in the shown circuit is found to be $i = 3 \sin(200t - \frac{\pi}{4})\ \text{A}$. Find the value of inductance.



- A) 0.25 H B) 1.0 H
C) 0.5 H D) 2.0 H

62. Match the following circuit components connected across an a.c. source of angular frequency $\omega = 1000\ \text{rad/s}$ with the phase difference between current and source voltage.

Column I	Column II
(A) Series combination of $10\sqrt{3}\ \Omega$ and $100\ \mu\text{F}$	(p) $\frac{\pi}{2}$
(B) Pure inductor of 0.02H	(q) $\frac{\pi}{6}$
(C) Pure capacitor of $200\ \mu\text{F}$	(r) $\frac{\pi}{4}$
(D) Series combination of $10\ \Omega$ and $\frac{\sqrt{3}}{100}\ \text{H}$	(s) $\frac{\pi}{3}$
(E) Series combination of 0.02H and $50\ \mu\text{F}$	(t) 0

- A) A-p, B-q, C-p, D-s, E-t B) A-q, B-r, C-p, D-s, E-t
C) A-q, B-p, C-p, D-s, E-t D) A-q, B-p, C-s, D-p, E-t

63. A variable frequency alternating voltage source with voltage amplitude 250 V is connected across a series combination of $L = 4.0\ \text{H}$, $C = 25\ \mu\text{F}$ and $R = 50\ \Omega$. Calculate (a) The angular frequency of the source at resonance. (b) Amplitude of current at resonance frequency.

- A) (a) 50 rad/s, (b) 3.5 A B) (a) 100 rad/s, (b) 5 A
C) (a) 100 rad/s, (b) 7 A D) (a) 200 rad/s, (b) 5 A

64. A series LCR circuit with $L = 0.1 \text{ H}$, $C = 100 \text{ nF}$, $R = 40 \Omega$ is connected to a 200 V variable frequency supply. Find – (a) Source frequency for which current is maximum. (b) Q-factor of the given circuit.

- A) (a) $3.18 \times 10^3 \text{ Hz}$, (b) $Q = 12.5$
 B) (a) $1.59 \times 10^3 \text{ Hz}$, (b) $Q = 25$
 C) (a) $1.59 \times 10^3 \text{ Hz}$, (b) $Q = 50$
 D) (a) $6.37 \times 10^2 \text{ Hz}$, (b) $Q = 25$

65. An inductor of $\frac{20}{\pi} \text{ mH}$ is connected across an ac-source of 100 V, 50 Hz. Find out impedance, root mean square current, peak current, and the equation of current.

- A) $Z = 1 \Omega$, $I_{rms} = 100 \text{ A}$, $I_0 = 100\sqrt{2} \text{ A}$,
 $I = 100\sqrt{2} \sin(100\pi t - \frac{\pi}{2})$
 B) $Z = 2 \Omega$, $I_{rms} = 25 \text{ A}$, $I_0 = 25\sqrt{2} \text{ A}$,
 $I = 25\sqrt{2} \sin(100\pi t + \frac{\pi}{2})$
 C) $Z = 4 \Omega$, $I_{rms} = 25 \text{ A}$, $I_0 = 25\sqrt{2} \text{ A}$,
 $I = 25\sqrt{2} \sin(100\pi t - \frac{\pi}{2})$
 D) $Z = 2 \Omega$, $I_{rms} = 50 \text{ A}$, $I_0 = 50\sqrt{2} \text{ A}$,
 $I = 50\sqrt{2} \sin(100\pi t - \frac{\pi}{2})$

66. An alternating current source $E = 100 \sin(500t)$ volt is connected through an inductor of 20 mH then write down the equation of current.

- A) $20 \sin(500t - \frac{\pi}{2}) \text{ A}$
 B) $10 \sin(500t + \frac{\pi}{2}) \text{ A}$
 C) $10 \sin(500t - \frac{\pi}{2}) \text{ A}$
 D) $10 \cos(500t) \text{ A}$

67. An alternating current source $E = 250 \sin(2500t)$ volt is connected through an inductor of 20 mH then write down the equation of current.

- A) $50 \sin(2500t - \frac{\pi}{2}) \text{ A}$
 B) $5 \sin(2500t + \frac{\pi}{2}) \text{ A}$
 C) $25 \sin(2500t - \frac{\pi}{2}) \text{ A}$
 D) $5 \sin(2500t - \frac{\pi}{2}) \text{ A}$

68. When a series combination of inductance and resistance are connected with a 25 V, 50 Hz a.c. source, a current of 5 A flows in the circuit. The voltage leads the current by a phase angle of 53 degree (given $\cos 53^\circ = 0.6$, $\sin 53^\circ = 0.8$). Calculate the values of resistance and inductive reactance.

- A) $R = 4 \Omega$, $X_L = 3 \Omega$
 B) $R = 3 \Omega$, $X_L = 5 \Omega$
 C) $R = 3 \Omega$, $X_L = 4 \Omega$
 D) $R = 5 \Omega$, $X_L = 3 \Omega$

69. A $\frac{50}{\pi} \mu\text{F}$ capacitor and 150-ohm resistance are joined in series to an ac source of 200 volt and 50 Hz frequency. The power factor of the circuit and the power dissipated in it

- A) 0.8, 48 W
 B) 0.6, 48 W
 C) 0.6, 96 W
 D) 0.8, 96 W

70. Find out instantaneous voltage for $V = 400 \sin(800\pi t)$ at $t = \frac{1}{3200} \text{ sec}$

- A) 200 V
 B) 400 V
 C) $200\sqrt{2} \text{ V}$
 D) $100\sqrt{2} \text{ V}$

71. A current of 4 A flows in a coil when connected to a 24 V dc source. If the same coil is connected to a 24 V, 40 rad/s a.c. source, a current of 2.4 A flows in the circuit. Determine the inductance of the coil will be ___mH.

72. Find out instantaneous voltage for $V = 200 \sin(600\pi t)$ at $t = \frac{1}{3600} \text{ sec}$ ___V

73. The peak value of an alternating e.m.f. E is given by $E = E_0 \cos \omega t$ is 20 volts and its frequency is 50 Hz. At time $t = \frac{1}{300} \text{ sec}$, the instantaneous e.m.f. is ___V

74. The instantaneous value of current in an ac circuit is $i = 4 \sin(50\pi t + \pi/6)$ A. The current at the beginning ($t = 0$) will be ___A

75. In an ac circuit, V and i are given by $V = 200 \sin(200t)$ volt, and $i = 200 \sin(200t + \frac{\pi}{3})$ mA. The power dissipated in circuit is ___Watt

ANSWER KEY

Chemistry

1.	2	8.	3	15.	2	22.	30
2.	2	9.	4	16.	1	23.	4
3.	1	10.	2	17.	3	24.	184
4.	2	11.	3	18.	2	25.	93
5.	3	12.	2	19.	1		
6.	1	13.	2	20.	2		
7.	3	14.	1	21.	3		

Maths

26.	2	33.	2	40.	4	47.	6
27.	3	34.	2	41.	3	48.	6
28.	2	35.	4	42.	2	49.	126
29.	2	36.	3	43.	2	50.	31
30.	2	37.	2	44.	3		
31.	1	38.	1	45.	3		
32.	2	39.	1	46.	8		

Physics

51.	1	58.	4	65.	4	72.	100
52.	3	59.	2	66.	3	73.	10
53.	3	60.	2	67.	4	74.	2
54.	2	61.	3	68.	3	75.	10
55.	3	62.	3	69.	3		
56.	2	63.	2	70.	3		
57.	2	64.	2	71.	200		

SOLUTIONS

Q1.

Answer: B

Explanation:

The halogen atoms in P, Q, and R are bromine (Br), iodine (I), and fluorine (F), respectively. Bond strength and bond enthalpy depend on atomic size: smaller atoms form shorter, stronger bonds with higher bond enthalpies. Since fluorine is the smallest, the C – F bond (R) has the highest bond enthalpy, while iodine is the largest, making the C – I bond (Q) the weakest. Thus, the bond enthalpy order is $R > P > Q$.

Q2.

Answer: B

Explanation:

The starting material, 1-chloro-2-methylpropane, forms a Grignard reagent upon reaction with magnesium in dry ether. Reaction with H_2O (P) yields isobutane (C_4). Reaction with CO_2 followed by acidification (Q) yields 3-methylbutanoic acid (C_5). When Q undergoes Kolbe's electrolysis, coupling of the alkyl radicals produces an eight-carbon alkane (2,5-dimethylhexane).

Q3.

Answer: A

Explanation:

Hydrogenation of the given unsaturated bromoalkanes involves the addition of hydrogen (H_2) across the carbon-carbon double bond, and the bromine atom may also be replaced or retained depending on the reaction conditions (or standard catalytic reduction of multiple bonds). An optically inactive product is typically achieved if the resulting molecule possesses a plane of symmetry (POS), a center of symmetry (COS), or is an achiral meso compound / possesses a plane of symmetry due to internal compensation.

Q4.

Answer: B

Explanation:

The rate of the S_N2 reaction depends strongly on steric hindrance and electronic factors (such as the presence of electron-withdrawing groups that stabilize the transition state). Compound S contains an alpha-haloketone group where the carbonyl group stabilizes the transition state via resonance, making it the most reactive. Compounds P, R, and Q experience varying degrees of steric hindrance, where smaller primary alkyl halides react faster than bulkier branched or homologated structures.

Q5.

Answer: C

Explanation:

The given compound is a chiral stereoisomer of 2,3-dichlorobutane (specifically the C_2 symmetric form) that lacks both a center of symmetry and a plane of symmetry. Because it is non-superimposable on its mirror image, it is optically active. Furthermore, rotating the molecule by 180° around an axis perpendicular to the central C–C bond yields an equivalent configuration, meaning it possesses an axis of symmetry (C_2).

Q6.

Answer: A

Explanation:

Alkyl halides undergo nucleophilic substitution much more readily than aryl halides due to partial double-bond character in aryl systems. With PhS^- (a strong nucleophile) and DMF (a polar aprotic solvent), the reaction proceeds via an S_N2 mechanism at the 2° benzylic carbon attached to the bromine atom. Stereochemically, the S_N2 pathway involves a Walden inversion of configuration at the chiral carbon atom, replacing the bromine with the $-SPh$ group while leaving the meta- NO_2 and ortho- F substituents on the benzene ring intact.

Q7.

Answer: C

Explanation:

Bromine orientation on the benzene ring is controlled by its mesomeric effect (+M), which stabilizes the arenium ion and directs the incoming electrophile predominantly to the ortho and para positions (giving 1,4-dibromobenzene as the major product). Therefore, Statement 1 is true. However, Statement 2 is false because the mesomeric effect (+M) of the bromo group is more dominant than its inductive effect (-I) in directing the incoming electrophile during electrophilic aromatic substitution.

Q8.

Answer: C

Explanation:

In the presence of organic peroxide, the addition of HBr to unsymmetrical alkenes like styrene proceeds via a free-radical mechanism (peroxide effect) to yield 1-bromo-2-phenylethane as the major product through a resonance-stabilized benzylic radical intermediate. Phenyl radicals from the peroxide can abstract hydrogen from HBr to yield benzene as a byproduct. In the absence of peroxide, the reaction shifts to an electrophilic addition via a carbocation intermediate following Markovnikov's rule.

Q9.

Answer: D

Explanation:

Reaction D represents the Hofmann bromamide degradation reaction, where an amide is treated with bromine and an aqueous or alcoholic solution of sodium/potassium hydroxide to give a primary amine with one carbon atom less than the parent amide. All the stoichiometry and products in option D are correctly balanced for ethylamide converting to ethylamine.

Q10.

Answer: B

Explanation:

Statement I is true because the C – Cl bond in vinyl chloride ($CH_2 = CH - Cl$) acquires partial double-bond character due to resonance, making it shorter and stronger than the pure single C – Cl bond in ethyl chloride ($CH_3 - CH_2 - Cl$). Statement II is false because the hydrolysis of the chiral tertiary chloride proceeds via an S_N1 mechanism through a planar carbocation intermediate, leading to racemic mixture formation (racemization), which is optically inactive and cannot rotate plane-polarized light.

Q11.

Answer: C

Explanation:

Halo derivatives are classified based on the position of the halogen atom relative to double bonds, saturated carbon chains, or aromatic rings. By matching each specific structural feature to its appropriate category, we find the correct correspondence between List-I and List-II.

Q12.

Answer: B

Explanation:

The rate of an S_N1 reaction is directly proportional to the stability of the carbocation formed after the departure of the leaving group (Br^-). Structures (I) and (II) are bridgehead halides in rigid polycyclic systems (bicyclo compounds). According to Bredt's rule, forming a planar carbocation at a bridgehead carbon is highly unstable or prohibited due to extreme ring strain. Therefore, (I) and (II) react the slowest. Between them, (I) has a greater $+I$ (inductive) effect from alkyl carbons, making its carbocation slightly more stable than (II). Structure (III) forms a secondary carbocation. Structure (IV) forms a highly stable tri-phenylmethyl (trityl) carbocation, which is extensively resonance-stabilized by three benzene rings. Thus, the overall reactivity order is $III > IV > I > II$.

Q13.

Answer: B

Explanation:

The reaction of benzyl halides with KCN proceeds via the S_N1 mechanism. Therefore, the rate of the reaction depends directly on the stability of the carbocation formed after the departure of the bromide ion (Br^-). Electron-donating groups stabilize the carbocation and increase reactivity, whereas electron-withdrawing groups destabilize it and decrease reactivity.

Q14.

Answer: A

Explanation:

The boiling point of haloalkanes depends on the molecular mass and surface area, which determine the magnitude of van der Waals forces. For isomeric dihalobenzenes, the para-isomer has a higher melting point due to better crystal lattice packing, but its boiling point is lower because the ortho-isomer possesses a higher net dipole moment resulting in stronger intermolecular dipole-dipole interactions.

Q15.

Answer: B

Explanation:

The question requires matching well-known organic name reactions related to haloalkanes and haloarenes with their respective reagents or catalysts.

Q16.

Answer: A

Explanation:

The rate of an S_N1 reaction depends directly on the stability of the carbocation formed after the departure of the leaving group. Benzyl chloride forms a resonance-stabilized benzyl carbocation, whereas ethyl chloride forms an ethyl carbocation stabilized only by weaker hyperconjugation, making benzyl chloride much more reactive.

Q17.

Answer: C

Explanation:

To convert ethyl benzene into 1-(1-bromoethyl)benzene, we need to selectively brominate the benzylic position (α -carbon) of the ethyl side chain. Since direct bromination of the ring gives nuclear substitution, we can introduce a halogen or use free radical side-chain halogenation, or alternatively use specific halogenation steps followed by elimination and addition. Looking at the options and standard pathways, choice C utilizes side-chain bromination or a reaction sequence involving Br_2/Fe (or Br_2/Δ) to functionalize the side chain.

Q18.

Answer: B

Explanation:

Williamson ether synthesis involves the reaction of a metal alkoxide with a primary alkyl halide via an S_N2 mechanism. When a secondary or tertiary alkyl halide is used, steric hindrance promotes elimination ($E2$) over substitution (S_N2). In option B, both the secondary alkoxide and the secondary alkyl halide ($sec-BuBr$) are sterically hindered, which predominantly leads to elimination rather than ether formation.

Q19.

Answer: A

Explanation:

The reaction involves the electrophilic addition of hydrogen bromide (HBr) across a carbon-carbon double bond in a polycyclic system. The regioselectivity is determined by the stability of the carbocation intermediate formed during the rate-determining step. Protonation occurs to generate the most stable carbocation, followed by the nucleophilic attack of bromide (Br^-) to yield the major product represented in Option A.

Q20.

Answer: B

Explanation:

The reaction sequence converts 1,2-dibromocyclooctane into a cyclooctyne intermediate via successive double elimination steps. Oxymercuration-hydration of the alkyne yields a ketone (cyclooctanone), which upon Clemmensen reduction would typically reduce to cyclooctane, but based on the provided options showing standard functional group progression or intermediate hydration products for this classic question, let's trace each step precisely. Correction/Refinement based on standard options: Step (iii) adds Hg^{2+}/H^+ to convert the alkyne/cycloalkyne into a ketone ($C=O$).

Q21.

Answer: 3

Explanation:

Aqueous KOH promotes nucleophilic substitution (S_N1 or S_N2) converting alkyl bromides ($C_5H_{11}Br$) into their corresponding pentanols without carbocation rearrangement. By examining all structural isomers of $C_5H_{11}Br$ and finding their respective alcohol substitution products, we identify those containing a chiral carbon atom (a carbon bonded to four different groups).

Q22.

Answer: 30

Explanation:

Grignard reagent (RMgI) reacts with water to form an alkane (R-H). Based on the given STP volume, the alkane is identified as methane (CH_4). Methane reacts with iodine and HIO_3 to give iodomethane (CH_3I), which upon Wurtz reaction with sodium in dry ether yields ethane (C_2H_6). The molar mass of ethane is calculated as 30 g mol^{-1} .

Q23.

Answer: 4

Explanation:

When a bromoalkane (RBr) reacts with Mg in dry ether, it forms a Grignard reagent (RMgBr), which upon hydrolysis with H_2O yields an alkane (RH). To form 2-methylbutane (C_5H_{12}), the alkyl group must have the carbon skeleton of 2-methylbutane. Replacing each hydrogen atom of 2-methylbutane with a bromine atom one by one yields different structural isomers of RBr. Accounting for all distinct positions where the bromine can be attached without duplicating identical structural isomers gives a total of 4 bromoalkane isomers.

Q24.

Answer: 184

Explanation:

When 2-bromopentane undergoes dehydrohalogenation with alcoholic KOH, it follows Saytzeff's rule to yield pent-2-ene as the major product (P). Subsequent bromination of pent-2-ene adds bromine across the double bond to form 2,3-dibromopentane (Q). Accounting for the given 80% reaction yield of product P and 100% conversion to Q, the final mass of product Q obtained is calculated to be 184 g.

Q25.

Answer: 93

Explanation:

The reaction sequence converts chlorobenzene to aniline via a Grignard reagent and carboxylation, followed by Hofmann bromamide degradation. Stoichiometrically, 1 mole of chlorobenzene yields 1 mole of product B (aniline). Using the molar masses of chlorobenzene and aniline, the mass of product B produced from 11.25 mg of chlorobenzene is calculated directly by proportionality.

Q26.

Answer: B

Explanation:

The length of the latus rectum of an ellipse is given by $\frac{2b^2}{a}$ and its minor axis is $2b$. Setting the latus rectum equal to half of the minor axis yields the ratio of the semi-minor axis to the semi-major axis ($\frac{b}{a}$), which is then used to compute the eccentricity (e).

Q27.

Answer: C

Explanation:

The distance between the directrices is $\frac{2a}{e}$ and the distance between the foci is $2ae$. Using the given condition, we find the relation for e^2 and solve for the eccentricity e .

Q28.

Answer: B

Explanation:

For a general second-degree equation to represent a non-degenerate real conic, the discriminant Δ must be non-zero ($\Delta \neq 0$). For the conic to be an ellipse, the algebraic condition $h^2 < ab$ must also be satisfied.

Q29.

Answer: B

Explanation:

Using the focus-directrix property of conics, $SP = e \cdot PM$, where $S(6, 7)$ is the focus and PM is the perpendicular distance from any point $P(x, y)$ on the ellipse to the directrix $x + y + 2 = 0$.

Q30.

Answer: B

Explanation:

Assume the standard form of the ellipse centered at the origin, $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. Substitute both points to get a system of linear equations in $\frac{1}{a^2}$ and $\frac{1}{b^2}$ and solve for the denominators.

Q31.

Answer: A

Explanation:

Given the length of the latus rectum $\frac{2b^2}{a} = 10$ and the relationship between the minor axis ($2b$) and the focal distance ($2ae$), we find a^2 and b^2 to write the equation of the ellipse.

Q32.

Answer: B

Explanation:

Equating the focal distance ($2ae$) to the minor axis ($2b$) allows us to solve for e using the relation $b^2 = a^2(1 - e^2)$.

Q33.

Answer: B

Explanation:

Since the y-coordinates of the centre, focus, and vertex are all -3 , the major axis is horizontal. We calculate the parameters a and b using the coordinates and write down the standard equation.

Q34.

Answer: B

Explanation:

Convert the given general equation to standard form by completing the square. Since the major axis is vertical, calculate the eccentricity e using the vertical ellipse relation.

Q35.

Answer: D

Explanation:

Use the two distance formulas $2ae = 8$ and $\frac{2a}{e} = 18$ to solve for a^2 , e , and b^2 , and then write down the standard equation of the ellipse.

Q36.

Answer: C

Explanation:

Using the given values of focal distance ($2ae = 6$) and minor axis ($2b = 8$), we find the values of a and b to solve for e .

Q37.

Answer: B

Explanation:

Using $e = \frac{2}{3}$ and the latus rectum formula $\frac{2b^2}{a} = 5$, we form a system of equations to solve for a and b , and find the equation of the ellipse.

Q38.

Answer: A

Explanation:

Convert the equation to standard form to find the centre and determine that the major axis is vertical ($b > a$). Compute e and write the foci coordinates $(h, k \pm be)$.

Q39.

Answer: A

Explanation:

By writing the equation of the conic in standard form, we identify it as an ellipse and verify that the points A and B are its foci. According to the focal property of an ellipse, the sum of the distances from any point on the curve to the foci is constant and equal to the length of the major axis $2a$.

Q40.

Answer: D

Explanation:

For a vertical ellipse where $a < b$, the eccentricity is given by the relation $a^2 = b^2(1 - e^2)$. By substituting the eccentricity and the given point into the ellipse equation, we can determine a^2 and b^2 , then compute the latus rectum $\frac{2a^2}{b}$.

Q41.

Answer: C

Explanation:

By equating the minor axis $2b$ to one-fourth of the focal distance $2ae$, we obtain a direct relationship between b , a , and e . We can then solve for the eccentricity e using the relation $b^2 = a^2(1 - e^2)$.

Q42.

Answer: B

Explanation:

Since the x -coordinates of the foci are equal, the major axis is vertical. The distance between the foci is $2be$. Knowing the distance and the eccentricity allows us to determine the semi-axes a and b , and find the latus rectum $\frac{2a^2}{b}$.

Q43.

Answer: B

Explanation:

Equating the minor axis $2b$ to half of the distance between the foci $2ae$ yields $2b = ae$. We can substitute this relation into the eccentricity definition to find the value of e .

Q44.

Answer: C

Explanation:

Using the parameters of the ellipse, we find the ratio $\frac{b^2}{a^2}$. The square of the eccentricity of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is given by $1 + \frac{b^2}{a^2}$, which we calculate directly.

Q45.

Answer: C

Explanation:

By completing the square, we convert the equation of the ellipse into standard form. Using the length of the latus rectum, we find the value of λ and then calculate the length of the major axis l .

Q46.

Answer: 8

Explanation:

Identify the focus, directrix, and eccentricity of the ellipse by rewriting the equation in the standard focus-directrix form $SP^2 = e^2 PM^2$. Use these to solve for K^2 .

Q47.

Answer: 6

Explanation:

Two parabolas are equal if their latus recta are equal in length. We find the latus rectum of the first parabola using the focus-to-directrix distance and equate it to the latus rectum of the second parabola (2α) to solve for α .

Q48.

Answer: 6

Explanation:

Since the y -coordinates of the center, focus, and vertex are identical, the ellipse has a horizontal major axis. Using the distances from the center to the focus and vertex, we find the semi-major axis a and eccentricity e , which allow us to compute the semi-minor axis b and the length of the latus rectum.

Q49.

Answer: 126

Explanation:

We first find the minimum value of the quadratic function $f(t)$ to obtain the eccentricity e . Using the latus rectum value of 10 and the relationship between a , b , and e , we solve for the values of a^2 and b^2 to compute their sum.

Q50.

Answer: 31

Explanation:

Substitute the relation between a^2 and b^2 derived from the eccentricity $e = \frac{1}{4}$ into the ellipse equation using the given coordinate point. Solving the resulting equation yields the values of a^2 and b^2 .

Q51.

Answer: A

Explanation:

Apply the LCR series circuit voltage relationship formula:

$$V^2 = V_3^2 + (V_1 - V_2)^2 \text{ Substitute the given values } (V = 250 \text{ V}$$

$$, V_1 = 400 \text{ V}, V_2 = 250 \text{ V}): (250)^2 = V_3^2 + (400 - 250)^2$$

$$\text{Calculate: } 62500 = V_3^2 + (150)^2 \quad 62500 = V_3^2 + 22500 \text{ Solve}$$

$$\text{for } V_3: V_3^2 = 62500 - 22500 = 40000 \quad V_3 = \sqrt{40000} = 200 \text{ V}$$

Step 5: Calculate the current using Ohm's law:

$$I = \frac{V_3}{R} = \frac{200}{250} = 0.8 \text{ A}$$

Q52.

Answer: C

Explanation:

The rms voltage is $E_{rms} = \frac{200}{\sqrt{2}} = 100\sqrt{2} \text{ V}$. The net reactance is $X_L - X_C = 40 - 20 = 20 \Omega$, so the impedance is

$$Z = \sqrt{20^2 + 20^2} = 20\sqrt{2} \Omega. \text{ The ammeter reads}$$

$$I_{rms} = \frac{100\sqrt{2}}{20\sqrt{2}} = 5 \text{ A, giving } V_R = 5 \times 20 = 100 \text{ V and}$$

$$V_C = 5 \times 20 = 100 \text{ V.}$$

Q53.

Answer: C

Explanation:

The rms source voltage is $E_{rms} = \frac{100}{\sqrt{2}} = 50\sqrt{2} \text{ V}$. The net reactance of the L-C branch is $X_L - X_C = 30 - 20 = 10 \Omega$, so

the impedance is $Z = \sqrt{10^2 + 10^2} = 10\sqrt{2} \Omega$. The ammeter

$$\text{reads } I_{rms} = \frac{50\sqrt{2}}{10\sqrt{2}} = 5 \text{ A, and the voltmeter across the L-C}$$

$$\text{combination reads } V = I_{rms}(X_L - X_C) = 5 \times 10 = 50 \text{ V.}$$

Q54.

Answer: B

Explanation:

In a parallel combination the same voltage $V = V_0 \cos \omega t$ appears across each element. The resistor current is in phase,

$$i_R = \frac{V}{R} = \frac{V_0}{R} \cos \omega t. \text{ The inductor current is}$$

$$i_L = \frac{1}{L} \int V dt = \frac{V_0}{\omega L} \sin \omega t \text{ (lags by 90 degrees). The capacitor current is } i_C = C \frac{dV}{dt} = -V_0 \omega C \sin \omega t \text{ (leads by 90 degrees).}$$

Q55.

Answer: C

Explanation:

The rms voltage is $V_{rms} = \frac{100\sqrt{2}}{\sqrt{2}} = 100 \text{ V}$. Since the circuit

contains only the inductor, $X_L = \frac{V_{rms}}{I_{rms}} = \frac{100}{4} = 25 \Omega$. With

$$\omega = 200\pi \text{ rad/s, the inductance is } L = \frac{X_L}{\omega} = \frac{25}{200\pi} = \frac{1}{8\pi} \text{ H.}$$

Q56.

Answer: B

Explanation:

For a pure inductor the impedance is $Z = \omega L$, so each Z versus ω line is straight with slope equal to the inductance L . Therefore

$$\frac{L_1}{L_2} = \frac{\tan 60^\circ}{\tan 45^\circ} = \frac{\sqrt{3}}{1} = \sqrt{3}.$$

Q57.

Answer: B

Explanation:

For a series RC circuit the impedance is

$$Z = \sqrt{R^2 + X_C^2} = \sqrt{60^2 + 80^2} = \sqrt{3600 + 6400} = \sqrt{10000} = 10 \Omega.$$

Q58.

Answer: D

Explanation:

For a series RL circuit the impedance is

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{9^2 + 12^2} = \sqrt{81 + 144} = \sqrt{225} = 15 \Omega.$$

Q59.

Answer: B

Explanation:

The bulb runs safely at its rated values, so the current is

$$I = \frac{P}{V_R} = \frac{12}{60} = 0.2 \text{ A. The inductor must take the remaining}$$

$$\text{voltage: } V_L = \sqrt{V^2 - V_R^2} = \sqrt{100^2 - 60^2} = 80 \text{ V. Hence}$$

$$X_L = \frac{V_L}{I} = \frac{80}{0.2} = 400 \Omega, \text{ and } L = \frac{X_L}{2\pi f} = \frac{400}{100\pi} = \frac{4}{\pi} \text{ H.}$$

Q60.

Answer: B

Explanation:

The bulb runs safely at its rated values, so the current is

$$I = \frac{P}{V_R} = \frac{16}{80} = 0.2 \text{ A. The inductor must take the remaining}$$

$$\text{voltage: } V_L = \sqrt{V^2 - V_R^2} = \sqrt{100^2 - 80^2} = 60 \text{ V. Hence}$$

$$X_L = \frac{V_L}{I} = \frac{60}{0.2} = 300 \Omega, \text{ and } L = \frac{X_L}{2\pi f} = \frac{300}{100\pi} = \frac{3}{\pi} \text{ H.}$$

Q61.

Answer: C

Explanation:

The current lags the source voltage by $\phi = \frac{\pi}{4}$. For a series RL

$$\text{circuit, } \tan \phi = \frac{X_L}{R}, \text{ so } X_L = R \tan \frac{\pi}{4} = 100 \times 1 = 100 \Omega.$$

$$\text{With } \omega = 200 \text{ rad/s, the inductance is } L = \frac{X_L}{\omega} = \frac{100}{200} = 0.5 \text{ H.}$$

Q62.

Answer: C

Explanation:

$$\text{Using } X_L = \omega L, X_C = \frac{1}{\omega C} \text{ and } \tan \phi = \frac{|X_L - X_C|}{R}: \text{ (A)}$$

$$X_C = 10 \Omega \text{ with } R = 10\sqrt{3} \Omega \text{ gives } \tan \phi = \frac{1}{\sqrt{3}}, \text{ so } \phi = \frac{\pi}{6}$$

$$\text{(q). (B) Pure inductor gives } \phi = \frac{\pi}{2} \text{ (p). (C) Pure capacitor gives}$$

$$\phi = \frac{\pi}{2} \text{ (p). (D) } X_L = 10\sqrt{3} \Omega \text{ with } R = 10 \Omega \text{ gives}$$

$$\tan \phi = \sqrt{3}, \text{ so } \phi = \frac{\pi}{3} \text{ (s). (E) } X_L = X_C = 20 \Omega, \text{ resonance,}$$

$$\text{so } \phi = 0 \text{ (t).}$$

Q63.

Answer: B

Explanation:

At resonance the angular frequency is

$$\omega_r = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{4.0 \times 25 \times 10^{-6}}} = \frac{1}{\sqrt{10^{-4}}} = 100 \text{ rad/s. At}$$

resonance the impedance reduces to $Z = R$, so the current

$$\text{amplitude is } I_0 = \frac{V_0}{R} = \frac{250}{50} = 5 \text{ A.}$$

Q64.

Answer: B

Explanation:

The current is maximum at resonance, where

$$\omega_r = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.1 \times 100 \times 10^{-9}}} = 10^4 \text{ rad/s, so}$$

$$f_r = \frac{\omega_r}{2\pi} = \frac{10^4}{2\pi} \approx 1.59 \times 10^3 \text{ Hz. The Q-factor is}$$

$$Q = \frac{\omega_r L}{R} = \frac{10^4 \times 0.1}{40} = 25.$$

Q65.

Answer: D

Explanation:

The impedance of a pure inductor is

$$Z = X_L = \omega L = 2\pi f L = 2\pi \times 50 \times \frac{20}{\pi} \times 10^{-3} = 2 \Omega. \text{ The rms current is } I_{rms} = \frac{V}{Z} = \frac{100}{2} = 50 \text{ A, the peak current is}$$

$$I_0 = \sqrt{2} \times 50 = 50\sqrt{2} \text{ A, and since the current lags the voltage by } \frac{\pi}{2} \text{ in a pure inductor, } I = 50\sqrt{2} \sin(100\pi t - \frac{\pi}{2}).$$

Q66.

Answer: C

Explanation:

The inductive reactance is $X_L = \omega L = 500 \times 20 \times 10^{-3} = 10$

Ω , so the peak current is $I_0 = \frac{E_0}{X_L} = \frac{100}{10} = 10 \text{ A}$. In a pure

inductor the current lags the voltage by $\frac{\pi}{2}$, giving

$$I = 10 \sin(500t - \frac{\pi}{2}) \text{ A.}$$

Q67.

Answer: D

Explanation:

The inductive reactance is

$X_L = \omega L = 2500 \times 20 \times 10^{-3} = 50 \Omega$, so the peak current is

$$I_0 = \frac{E_0}{X_L} = \frac{250}{50} = 5 \text{ A. In a pure inductor the current lags the}$$

voltage by $\frac{\pi}{2}$, giving $I = 5 \sin(2500t - \frac{\pi}{2}) \text{ A}$.

Q68.

Answer: C

Explanation:

The impedance of the circuit is $Z = \frac{V}{I} = \frac{25}{5} = 5 \Omega$. The

resistance is $R = Z \cos \phi = 5 \times 0.6 = 3 \Omega$ and the inductive

reactance is $X_L = Z \sin \phi = 5 \times 0.8 = 4 \Omega$.

Q69.

Answer: C

Explanation:

$$\text{The capacitive reactance is } X_C = \frac{1}{\omega C} = \frac{1}{2\pi \times 50 \times \frac{50}{\pi} \times 10^{-6}} = 200$$

Ω . The impedance is

$$Z = \sqrt{R^2 + X_C^2} = \sqrt{150^2 + 200^2} = 250 \Omega, \text{ so the power}$$

factor is $\cos \phi = \frac{R}{Z} = \frac{150}{250} = 0.6$. The current is

$$I = \frac{V}{Z} = \frac{200}{250} = 0.8 \text{ A, giving power dissipated}$$

$$P = I^2 R = 0.64 \times 150 = 96 \text{ W.}$$

Q70.

Answer: C

Explanation:

Substituting the time, the phase angle is $800\pi \times \frac{1}{3200} = \frac{\pi}{4}$, so

$$V = 400 \sin \frac{\pi}{4} = 400 \times \frac{1}{\sqrt{2}} = 200\sqrt{2} \text{ V.}$$

Q71.

Answer: 200

Explanation:

With dc, the coil offers only its resistance, so

$$R = V/I_{dc} = 24/4 = 6 \Omega. \text{ With ac, the coil offers impedance}$$

$$Z = V/I_{ac} = 24/2.4 = 10 \Omega. \text{ Using } Z^2 = R^2 + (\omega L)^2, \text{ the}$$

reactance is $\omega L = \sqrt{10^2 - 6^2} = 8 \Omega$, giving $L = 8/40 = 0.2$

H = 200 mH.

Q72.

Answer: 100

Explanation:

Substituting the time, the phase angle is $600\pi \times \frac{1}{3600} = \frac{\pi}{6}$, so

$$V = 200 \sin \frac{\pi}{6} = 200 \times \frac{1}{2} = 100 \text{ V.}$$

Q73.

Answer: 10

Explanation:

The angular frequency is $\omega = 2\pi f = 100\pi \text{ rad/s}$, so at $t = \frac{1}{300} \text{ s}$

the phase is $\omega t = \frac{100\pi}{300} = \frac{\pi}{3}$. Hence

$$E = 20 \cos \frac{\pi}{3} = 20 \times \frac{1}{2} = 10 \text{ V.}$$

Q74.

Answer: 2

Explanation:

At the beginning, $t = 0$, so the current is

$$i = 4 \sin(\pi/6) = 4 \times \frac{1}{2} = 2 \text{ A.}$$

Q75.

Answer: 10

Explanation:

The power dissipated is

$$P = V_{rms} I_{rms} \cos \phi = \frac{V_0}{\sqrt{2}} \times \frac{I_0}{\sqrt{2}} \times \cos \frac{\pi}{3} = \frac{200 \times 0.2}{2} \times \frac{1}{2} = 20 \times \frac{1}{2}$$

W.