

Physics

- If the frequency of an alternating current is 60 Hz then the time taken for the change from zero to positive peak value and positive peak value to negative peak value of current are respectively
 A) 1/240 sec, 1/120 sec B) 1/120 sec, 1/240 sec
 C) 240 sec, 120 sec D) 1/60 sec, 1/120 sec
- What will be the equation of an alternating current of frequency 60 Hz if its r.m.s. value is 15 A?
 A) $i = 15 \sin 120\pi t$ B) $i = 15\sqrt{2} \sin 120\pi t$
 C) $i = \frac{15}{\sqrt{2}} \sin 120\pi t$ D) $i = 15\sqrt{2} \sin 60\pi t$
- At what time (from zero) does the alternating current become $1/\sqrt{2}$ times of its peak value? Where T is the periodic time.
 A) $T/2$ sec B) $T/4$ sec
 C) $T/8$ sec D) $T/16$ sec
- The peak value of an alternating voltage is given by $V = V_0 \sin(\omega t)$ is 20 volts and its frequency is 50 Hz. At time $t = \frac{1}{300}$ sec, the instantaneous voltage is
 A) 10 V B) $10\sqrt{3}$ V
 C) 5 V D) 20 V
- The instantaneous value of alternating voltage in a circuit is given by $V = 5 \sin(200\pi t + \frac{\pi}{6})$ volts. The value of the voltage at the beginning where $t = 0$ will be
 A) 5 V B) $\frac{5}{2}$ V
 C) $\frac{5\sqrt{3}}{2}$ V D) $5\sqrt{3}$ V
- The voltage of an alternating source varies with time according to the equation $V = 60 \sin(150\pi t) \cos(150\pi t)$ where t is in seconds and V is in volts. Then
 A) The peak voltage of the source is 60 volts B) The peak voltage of the source is 30 volts
 C) The peak voltage of the source is $60/\sqrt{2}$ volts D) The frequency of the source is 75 Hz
- If the frequency of an alternating current is 40 Hz then the time taken for the change from zero to positive peak value and positive peak value to negative peak value of current are respectively
 A) 1/160 sec, 1/80 sec B) 1/80 sec, 1/160 sec
 C) 160 sec, 80 sec D) 1/40 sec, 1/80 sec
- In an alternating current circuit, the voltage and current are given by $V = 200 \sin(100t)$ volt and $i = 100 \sin(100t + \pi/3)$ mA. The power dissipated in the circuit is
 A) 5 watt B) 10 watt
 C) 2.5 watt D) 0.5 watt
- In a circuit, an alternating current and a direct current are supplied simultaneously. The expression for the instantaneous current is given as $i = 4 + 8 \sin(\omega t)$. Then the root mean square value of the current is
 A) 4 A B) 8 A
 C) $4\sqrt{2}$ A D) $4\sqrt{3}$ A
- The root mean square value of an alternating e.m.f. given by $E = (12 \sin(\omega t) + 9 \sin(2\omega t))$ V is
 A) 15 V B) $7.5\sqrt{2}$ V
 C) 10.6 V D) 21.2 V
- Voltage and current in an alternating current circuit are given by $V = 10 \sin(50\pi t + \frac{\pi}{6})$ and $i = 5 \sin(50\pi t - \frac{\pi}{3})$. The phase relationship between them is
 A) Voltage leads the current by 30° B) Current leads the voltage by 30°
 C) Voltage leads the current by 90° D) Current leads the voltage by 90°
- The instantaneous values of current and potential difference in an alternating circuit are $i = 2 \sin(\omega t)$ and $E = 200 \cos(\omega t)$ respectively. The root mean square value of wattless current (in amp) in the circuit is
 A) 1 B) $\sqrt{2}$
 C) $2\sqrt{2}$ D) 0

13. If the frequency of an alternating current is 50 Hz, then the time taken for the change from zero to positive peak value and positive peak value to negative peak value of current are respectively

- A) 1/200 sec, 1/100 sec B) 1/100 sec, 1/200 sec
C) 200 sec, 100 sec D) 1/50 sec, 1/100 sec

14. If the frequency of an alternating current is 80 Hz, then the time taken for the change from zero to positive peak value and positive peak value to negative peak value of current are respectively

- A) 1/320 sec, 1/160 sec B) 1/160 sec, 1/320 sec
C) 320 sec, 160 sec D) 1/80 sec, 1/160 sec

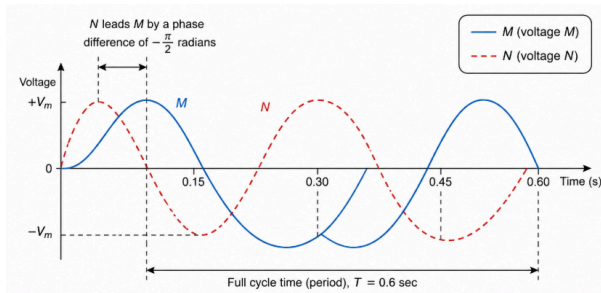
15. The impedance of an ac circuit is 250Ω and the phase angle between current and e.m.f is 60° . What is the resistance of the circuit?

- A) 50Ω B) 125Ω
C) 250Ω D) $125\sqrt{3} \Omega$

16. An alternating voltage source given by $E = 200 \sin 100t$ is connected to a device that offers a resistance of 50Ω and allows current to flow in one direction only. The r.m.s. value of current in the circuit will be

- A) 1.00 A B) 1.41 A
C) 2.00 A D) 2.82 A

17. Two sinusoidal alternating voltages of the same frequency are given in a circuit. Voltage M has a time period of 0.6 sec and a phase lag, whereas voltage N leads M by a phase difference of $-\frac{\pi}{2}$ radians, with a full cycle time period of 0.6 sec. What is the frequency and the phase relationship between the voltages?



- A) 1.67 Hz, $-\frac{\pi}{4}$ B) 1.67 Hz, $+\frac{\pi}{2}$
C) 1.67 Hz, $-\frac{\pi}{2}$ D) 1.67 Hz, $-\frac{\pi}{4}$

18. In a resistive circuit $R = 20 \Omega$ and applied alternating voltage $V = 200 \sin 200 \pi t$, find the peak current, r.m.s. current, average current, and frequency respectively

- A) 10 A, $5\sqrt{2}$ A, 6.37 A, 50 Hz B) 10 A, 10 A, 6.37 A, 100 Hz
C) $10\sqrt{2}$ A, 10 A, 5 A, 50 Hz D) 10 A, $5\sqrt{2}$ A, 6.37 A, 100 Hz

19. The voltage of an alternating source varies with time according to the equation $V = 80 \sin(100\pi t) \cos(100\pi t)$ where t is in seconds and V is in volts. Then

- A) The peak voltage of the source is 80 volts B) The peak voltage of the source is 40 volts
C) The peak voltage of the source is $80/\sqrt{2}$ volts D) The frequency of the source is 100 Hz

20. In a purely inductive circuit, if inductance $L = \frac{200}{\pi} \times 10^{-3}$ H and applied alternating voltage is given by $V = 200 \sin 200 \pi t$, find the frequency and inductive reactance respectively.

- A) 100 Hz, 40Ω B) 50 Hz, 20Ω
C) 100 Hz, 80Ω D) 50 Hz, 40Ω

21. An alternating voltage $E = 150\sqrt{2} \sin(100t)$ is connected to a $2 \mu\text{F}$ capacitor through an AC ammeter. What will be the reading of the ammeter?

- A) 10 mA B) 20 mA
C) 30 mA D) 40 mA

22. The current and voltage in an alternating current circuit are given by $i = 2 \sin(314t)$ and $e = 400 \sin(314t + \frac{\pi}{3})$. If the resistance of the circuit is 100Ω , then the inductive reactance of the circuit is

- A) $100\sqrt{3} \Omega$ B) 200Ω
C) $100/\sqrt{3} \Omega$ D) $200\sqrt{3} \Omega$

23. If the frequency of an alternating current is 50 Hz then the time taken for the change from zero to positive peak value and positive peak value to negative peak value of current are respectively

- A) 1/200 sec, 1/100 sec B) 1/100 sec, 1/200 sec
C) 200 sec, 100 sec D) 1/50 sec, 1/100 sec

24. In a circuit, an alternating current and a direct current are supplied simultaneously. The expression for the instantaneous current is given as $i = 6 + 10 \sin(\omega t)$. Then the root mean square value of the current is

- A) 5 A B) 10 A
C) $5\sqrt{2}$ A D) $5\sqrt{3}$ A

25. In an alternating current circuit containing a series combination of an inductance of 0.2 H and a capacitance of $50 \mu\text{F}$, the current is found to be maximum. Find the angular frequency of the input alternating voltage.

- A) 200 rad/sec B) 500 rad/sec
C) 1000 rad/sec D) 2000 rad/sec

26. The root mean square value of an alternating e.m.f. given by $E = (8 \sin(\omega t) + 6 \sin(2\omega t))$ V is

- A) 5 V B) $5\sqrt{2}$ V
C) 10 V D) $10\sqrt{2}$ V

27. If the equation of an alternating current is

$i = 40\sqrt{2} \sin 50\pi t$ ampere, then the frequency and the root mean square value of the current are respectively:

- A)** 50 Hz, 40 amp **B)** 25 Hz, $40\sqrt{2}$ amp
C) 25 Hz, 40 amp **D)** 100 Hz, $40\sqrt{2}$ amp

28. In an AC circuit containing an inductance and a capacitance in series, the current is found to be maximum when the value of inductance is 0.5 H and the capacitance is $8 \mu\text{F}$. The angular frequency of the input AC voltage must be equal to:

- A)** 250 rad/sec **B)** 500 rad/sec
C) 1000 rad/sec **D)** 2000 rad/sec

29. If the equation of an alternating current is given by $i = 30\sqrt{2} \sin 50\pi t$ ampere, then find the frequency and the root mean square value of the alternating current.

- A)** 50 Hz, $30\sqrt{2}$ A **B)** 25 Hz, 30 A
C) 50 Hz, 30 A **D)** 25 Hz, $30\sqrt{2}$ A

30. In an ac circuit, containing an inductance and a capacitor in series, the current is found to be maximum when the value of inductance is 2 henry and a capacitance of $2 \mu\text{F}$. The angular frequency of the input ac voltage must be equal to

- A)** 250 rad/sec **B)** 500 rad/sec
C) 1000 rad/sec **D)** 5000 rad/sec

31. In an alternating current circuit, the voltage and current are given by $V = 300 \sin(200t)$ volt and $i = 50 \sin(200t + \frac{\pi}{3})$ mA. The power dissipated in the circuit is

- A) 3.75 watt** **B) 7.5 watt**
C) 1.875 watt **D) 0.75 watt**

32. The impedance of an ac circuit is $100\ \Omega$ and the phase angle between current and e.m.f is 60° . What is the resistance of the circuit?

- A) $25\ \Omega$** **B) $50\ \Omega$**
C) $100\ \Omega$ **D) $50\sqrt{3}\ \Omega$**

33. Find out instantaneous current value for
 $I = I_0 \sin(\omega t)$ **at** $t = \frac{T}{6}$

- A)** $\frac{I_0}{2}$ **B)** $\frac{I_0}{\sqrt{2}}$
C) $\frac{\sqrt{3}I_0}{2}$ **D)** I_0

34. Find out instantaneous voltage for
 $V = 200 \sin(400\pi t)$ **at** $t = \frac{1}{800}$ **sec**

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

35. Find the time taken by an alternating current of frequency 60 Hz to reach $\frac{I_0}{2}$ from zero.

- A) 1.39 ms** **B) 2.08 ms**
C) 4.17 ms **D) 8.33 ms**

36. If an alternating current main supply is given to be 220 V, what would be the average e.m.f. during a complete cycle?

- A) 198 V** **B) 0 V**
C) 311 V **D) 155 V**

37. Find the RMS value of the current given by

$$I = 3 + 2 \sin \left(\omega t + \frac{\pi}{3} \right)$$

- A)** $\sqrt{11}$ **B)** $\sqrt{13}$
C) $\sqrt{15}$ **D)** $\sqrt{17}$

38. Find the RMS value of the current represented by the equation $I = 5 + 6 \sin(\omega t)$

- A)** $\sqrt{43}$ **B)** $\sqrt{25}$
C) $\sqrt{27}$ **D)** $\sqrt{29}$

39. The current and voltage in an alternating circuit are given by $i = 4.5 \sin \left(314t + \frac{\pi}{6} \right)$ A and $V = 32 \sin \left(314t - \frac{\pi}{6} \right)$ V. Find (a) the time period of the current and (b) the phase difference between the voltage and the current.

- A)** $T = 0.02$ s, $\Delta\phi = 30^\circ$ **B)** $T = 0.02$ s, $\Delta\phi = 60^\circ$
C) $T = 0.01$ s, $\Delta\phi = 60^\circ$ **D)** $T = 0.01$ s, $\Delta\phi = 30^\circ$

40. Two alternating voltages are given by
 $V_1 = V_0 \sin(\omega t)$ and $V_2 = V_0 \sin\left(\omega t + \frac{\pi}{2}\right)$. **Find the resultant of the two voltages.**

- A)** $V_0 \sin(\omega t + \frac{\pi}{4})$ **B)** $\sqrt{2}V_0 \sin(\omega t + \frac{\pi}{4})$
C) $\sqrt{3}V_0 \sin(\omega t + \frac{\pi}{4})$ **D)** $2V_0 \sin(\omega t + \frac{\pi}{4})$

41. An alternating voltage given by $E = 150 \sin(500t)$ volt is connected across an inductor of $20 \mu\text{H}$, then write down the equation of current.

- A)** $7500 \sin(500t - \frac{\pi}{2})$ A **B)** $15000 \sin(500t - \frac{\pi}{2})$ A
C) $7500 \sin(500t + \frac{\pi}{2})$ A **D)** $150 \sin(500t - \frac{\pi}{2})$ A

42. An alternating voltage given by

$E = 100\sqrt{2} \sin(200t)$ V is applied to a 0.5 H inductor through an alternating current ammeter. What will be the reading of the ammeter?

- A) 1.0 A** **B) 1.41 A**
C) 2.0 A **D) 0.7 A**

43. If the equation of an alternating current is $i = 30\sqrt{2} \sin 200\pi t$ ampere, then the frequency and the root mean square value of the current are respectively:

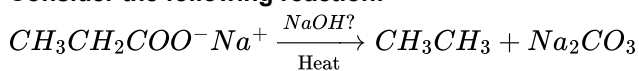
- A)** 100 Hz, $30\sqrt{2}$ amp **B)** 50 Hz, 100 amp
C) 100 Hz, 30 amp **D)** 200 Hz, $30\sqrt{2}$ amp

44. If the equation of an alternating current is given by $i = 40\sqrt{2} \sin 100\pi t$ ampere, then find the frequency and the root mean square value of the alternating current.
- A) 50 Hz, $40\sqrt{2}$ A B) 100 Hz, 40 A
C) 50 Hz, 40 A D) 200 Hz, $40\sqrt{2}$ A

45. In an AC circuit containing an inductance and a capacitor in series, the current is found to be maximum when the value of inductance is 0.2 H and the capacitance is $5 \mu\text{F}$. The angular frequency of the input AC voltage must be equal to:
- A) 1000 rad/sec B) 500 rad/sec
C) 2000 rad/sec D) 10000 rad/sec

Chemistry

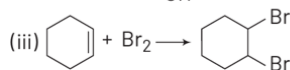
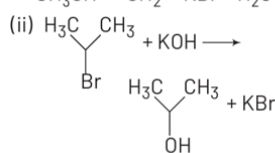
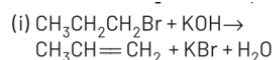
46. Consider the following reaction:



Consider the above reaction and identify the missing reagent/chemical.

- A) B_2H_6 B) Red phosphorus
C) CaO D) DIBAL-H
47. Elimination reaction of 2-bromopentane to form pent-2-ene is 1. β -elimination reaction. 2. Follows Zaitsev rule. 3. Dehydrohalogenation reaction. 4. Dehydration reaction.
- A) (1), (3), (4) B) (2), (3), (4)
C) (1), (2), (4) D) (1), (2), (3)

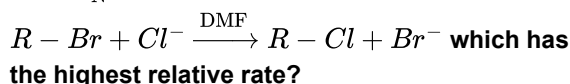
48. For the following reactions, which statement is



correct?

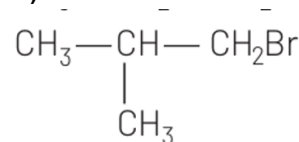
- A) (i) is elimination reaction, (ii) is substitution and (iii) is addition reaction
B) (i) is elimination, (ii) and (iii) are substitution reactions
C) (i) is substitution, (ii) and (iii) are addition reactions
D) (i) and (ii) are elimination reactions and (iii) is addition reaction

49. In an $\text{S}_{\text{N}}2$ substitution reaction

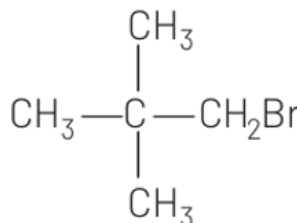


- A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$

- B)



- C)



- D) $\text{CH}_3\text{CH}_2\text{Br}$

50. Which of the following undergoes nucleophilic substitution exclusively by $\text{S}_{\text{N}}1$ mechanism?

- A) Benzyl chloride B) Ethyl chloride
C) Chlorobenzene D) Isopropyl chloride

51. Chloropicrin is obtained by the reaction of

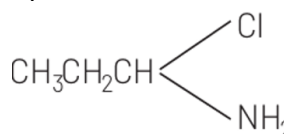
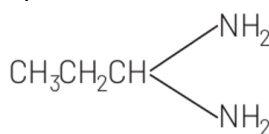
- A) Steam on carbon tetrachloride B) Nitric acid on chlorobenzene
C) Chlorine on picric acid D) Nitric acid on chloroform

52. Which is responsible for depletion of the ozone layer in the upper strata of the atmosphere?

- A) Polyhalogens B) Ferrocenes
C) Fullerenes D) Freons

53. When $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$ is treated with NaNH_2 , the product formed is

- A) $\text{CH}_3-\text{CH}=\text{CH}_2$ B) $\text{CH}_3-\text{C}\equiv\text{CH}$
C) D)



54. $\text{CH}_3\text{CH}_2\text{Cl} \xrightarrow{\text{NaCN}} \text{X} \xrightarrow{\text{Ni}/\text{H}_2} \text{Y} \xrightarrow{\text{acetic anhydride}} \text{Z}$
In above reaction sequence, Z is

- A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NHCOCH}_3$ B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
C) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CONHCH}_3$ D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CONHCOCH}_3$

55. Reactivity order of halides for dehydrohalogenation is

- A) $\text{R}-\text{F} > \text{R}-\text{I} > \text{R}-\text{Cl}$ B) $\text{R}-\text{F} > \text{R}-\text{Br} > \text{R}-\text{Cl} > \text{R}$
C) $\text{R}-\text{I} > \text{R}-\text{F} > \text{R}-\text{Cl}$ D) $\text{R}-\text{I} > \text{R}-\text{Br} > \text{R}-\text{Cl} > \text{R}$

56. An organic compound $A(C_4H_9Cl)$ reacts with Na/diethyl ether to give a hydrocarbon which on monochlorination gives only one chloro derivative. A is

- A) tert-Butyl chloride B) sec-Butyl chloride
C) Isobutyl chloride D) n-Butyl chloride

57. 2-Bromopentane is heated with potassium ethoxide in ethanol. The major product obtained is

- A) 2-Ethoxypentane B) Pentene-1
C) trans-Pentene-2 D) cis-Pentene-2

58. The alkyl halide is converted into an alcohol by

- A) Addition B) Substitution
C) Dehydrohalogenation D) Elimination

59. When chlorine is passed through propene at $400^\circ C$, which is formed?

- A) PVC B) Allyl chloride
C) Nickel chloride D) 1,2-Dichloroethane

60. Industrial preparation of chloroform employs acetone and

- A) Phosgene B) Calcium hypochlorite
C) Chlorine gas D) Sodium chloride

61. When hydrochloric acid gas is treated with propene in the presence of benzoyl peroxide, it gives

- A) 2-Chloropropane B) Alkyl chloride
C) No reaction D) n-Propyl chloride

62. Chlorobenzene reacts with Mg in dry ether to give compound A, which further reacts with ethanol to yield

- A) Phenol B) Benzene
C) Ethylbenzene D) Phenyl ether

63. HBr reacts fastest with

- A) 2-Methylpropan-1-ol B) 2-Methylpropan-2-ol
C) Propan-2-ol D) Propan-1-ol

64. In compound X, all the bond angles are exactly $109^\circ 28'$. X is

- A) Chloromethane B) Carbon tetrachloride
C) Iodoform D) Chloroform

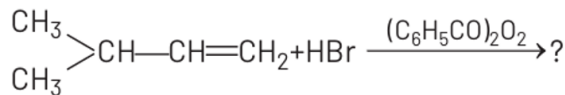
65. The $Cl - C - Cl$ angle in 1,1,2,2-tetrachloroethene and tetrachloromethane will be about

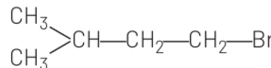
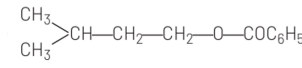
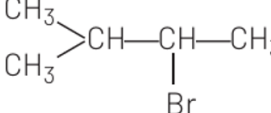
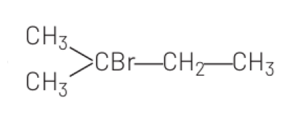
- A) 120° and $109^\circ 28'$ B) 90° and 109.5°
C) 109.5° and 90° D) 109.5° and 120°

66. Phosgene is a common name for

- A) Phosphonyl chloride B) Thionyl chloride
C) Carbon dioxide and phosphine D) Carbonyl chloride

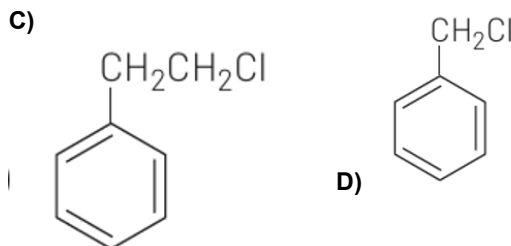
67. The major product of the following chemical reaction is



- A)  B) 
C)  D) 

68. Which of the following will not undergo S_N1 reaction with OH^- ?

- A) $\text{CH}_2 = \text{CH} - \text{CH}_2\text{Cl}$ B) $(\text{CH}_3)_3\text{CCl}$



69. The compound C_7H_8 undergoes the following

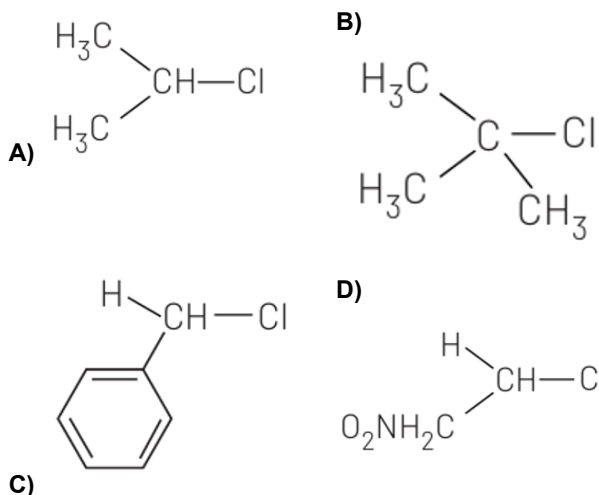
reactions: $C_7H_8 \xrightarrow{3\text{Cl}_2/\Delta} A \xrightarrow{\text{Br}_2/\text{Fe}} B \xrightarrow{\text{Zn}/\text{HCl}} C$
The product 'C' is:

- A) 3-bromo-2,4,6-trichlorotoluene B) o-bromotoluene
C) m-bromotoluene D) p-bromotoluene

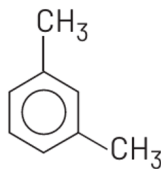
70. Which of the following can be used as the halide component for Friedel-Crafts reaction?

- A) Chlorobenzene B) Bromobenzene
C) Chloroethene D) Isopropyl chloride

71. In which of the following compounds, the C-Cl bond ionisation shall give most stable carbonium ion?



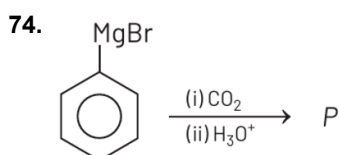
72. What products are formed when the following compound is treated with Br_2 in the presence of



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

73. Trichloroacetaldehyde, CCl_3CHO reacts with chlorobenzene in the presence of sulphuric acid and produces

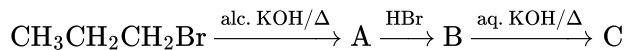
- A)
- B)
- C)
- D)



In the above reaction product 'P' is:

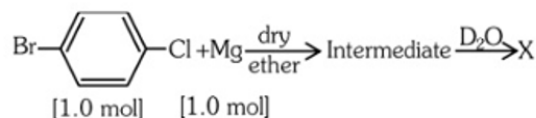
- A)
- B)
- C)
- D)

75. The major product C in the below mentioned reaction is:



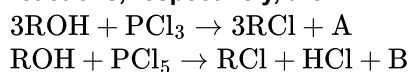
- A) Propan-1-ol B) Propan-2-ol
C) Propane D) Propyne

76. Identify 'X' in the following reaction.



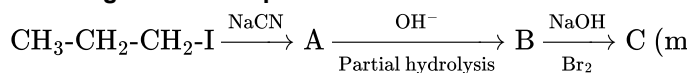
- A)
- B)
- C)
- D)

77. The products A and B obtained in the following reactions, respectively, are:



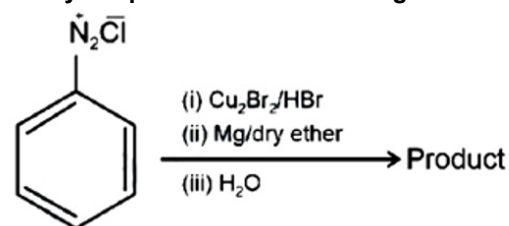
- A) $POCl_3$ and H_3PO_3 B) $POCl_3$ and H_3PO_4
C) H_3PO_4 and $POCl_3$ D) H_3PO_3 and $POCl_3$

78. Identify the major product C formed in the following reaction sequence:



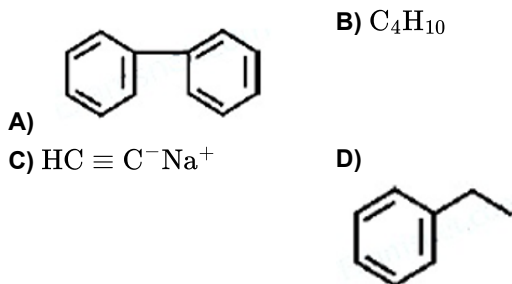
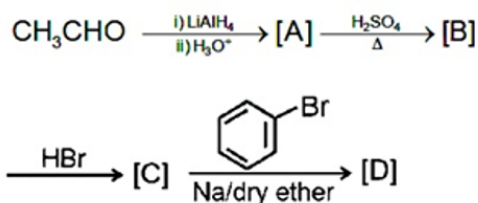
- A) propylamine B) butylamine
C) butanamide D) α -bromobutanoic acid

79. Identify the product in the following reaction:

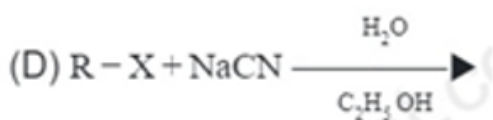
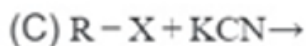
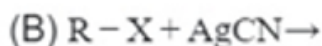
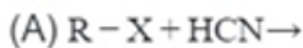


- A)
- B)
- C)
- D)

80. Identify the final product [D] obtained in the following sequence of reactions.



81. Which amongst the following reactions of alkyl halides produces isonitrile as a major product?

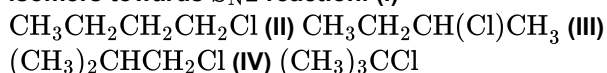


- A) (D) only B) (C) and (D) only
C) (B) only D) (A) and (B) only

82. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A) : Chlorine is an electron withdrawing group but it is ortho, para directing in electrophilic aromatic substitution. Reason (R) : Inductive effect of chlorine destabilises the intermediate carbocation formed during the electrophilic substitution, however due to the more pronounced resonance effect, the halogen stabilises the carbocation at ortho and para positions. In the light of the above statements, choose the most appropriate answer from the options given below :

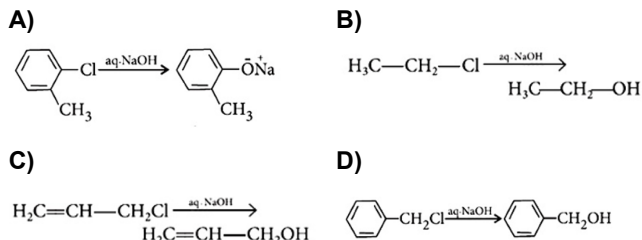
- A) (A) is not correct but (R) is correct B) Both (A) and (R) are correct and (R) is the correct explanation of (A).
C) Both (A) and (R) are correct but (R) is not the correct explanation of (A) D) (A) is correct but (R) is not correct.

83. Predict the order of reactivity of the following four isomers towards S_N2 reaction. (I)

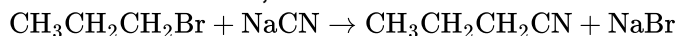


- A) (IV) > (II) > (III) > (I) B) (IV) > (III) > (II) > (I)
C) (I) > (II) > (III) > (IV) D) (I) > (III) > (II) > (IV)

84. The hydrolysis reaction that takes place at the slowest rate, among the following is:



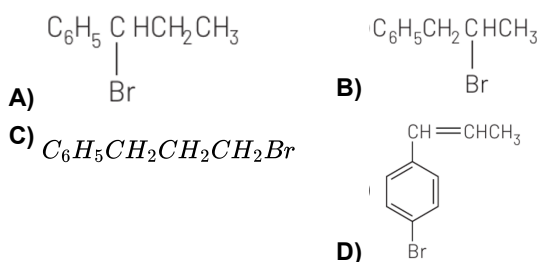
85. Consider the reaction,



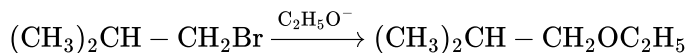
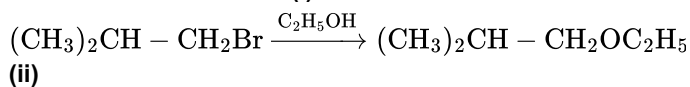
. This reaction will be the fastest in:

- A) ethanol B) methanol
C) N, N'-dimethylformamide (DMF) D) water

86. The reaction of C₆H₅CH = CHCH₃ with HBr produces:



87. Consider the reactions: (i)



The mechanisms of reactions (i) and (ii) are respectively:

- A) S_N1 and S_N2 B) S_N1 and S_N1
C) S_N2 and S_N2 D) S_N2 and S_N1

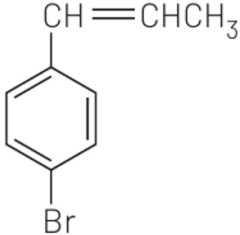
88. Replacement of Cl of chlorobenzene to give phenol requires drastic conditions. But chlorine of 2,4-dinitrochlorobenzene is readily replaced because:

- A) -NO₂ donates e⁻ at the meta position B) -NO₂ withdraws e⁻ from ortho/para positions
C) -NO₂ makes the ring electron-rich at ortho and para positions D) -NO₂ withdraws e⁻ from the meta position

89. Reaction of t-butyl bromide with sodium methoxide produces:

- A) sodium t-butoxide B) t-butyl methyl ether
C) methyl t-butyl ether D) isobutylene

90. The reaction of $C_6H_5CH = CHCH_3$ with HBr produces

- A) A) $C_6H_5\overset{\text{Br}}{\underset{|}{C}}HCH_2CH_3$ B) $C_6H_5CH_2\overset{\text{Br}}{\underset{|}{C}}HCH_3$
- C) $C_6H_5CH_2CH_2CH_2Br$ D) 

Botany

91. In the *E. coli* cloning vector pBR322, how many selectable markers are present?

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

92. The specific DNA sequence responsible for controlling the copy number of the linked insert DNA in a vector is called:

- A) Ori B) Rop
C) Selectable marker D) Polylinker

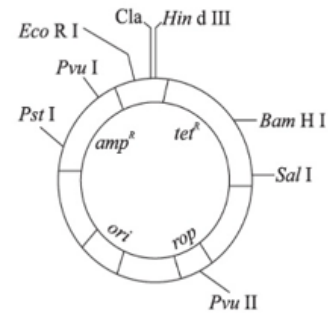
93. If a researcher inserts a foreign gene at the *Bam*HI site of pBR322, the recombinant plasmid will:

- A) Gain resistance to ampicillin B) Lose resistance to tetracycline
C) Lose resistance to ampicillin D) Gain resistance to tetracycline

94. It is advantageous to use a cloning vector containing multiple cloning sites (MCS) because it:

- A) Contains many copies of cloned genes B) Contains multiple copies of the same restriction site
C) Allows flexibility in the choice of restriction enzymes D) Increases the copy number automatically

95. The figure above shows the diagrammatic representation of the *E. coli* vector pBR322. Which one of the given options correctly identifies its components?



- A) amp^R, tet^R — antibiotic resistance genes B) ori — original restriction enzyme
C) rop — reduced osmotic pressure D) HindIII, EcoRI — selectable markers

96. Which vector is best suited for cloning large DNA fragments of about 100–300 kb, such as during the Human Genome Project?

- A) pBR322 B) Bacteriophage λ
C) BAC (Bacterial Artificial Chromosome) D) pUC19

97. In blue-white screening selection, recombinants form white colonies due to:

- A) Insertional inactivation of the ampicillin gene B) Insertional inactivation of the β -galactosidase gene (*lacZ*)
C) Active synthesis of glycosidic bonds D) Loss of the Ori sequence

98. Assertion (A): Host cells containing recombinant plasmids cut at the *Bam*HI site of pBR322 will fail to grow on a medium supplemented with tetracycline. Reason (R): The ligation of foreign DNA at the *Bam*HI site disrupts the functional reading frame of the ampicillin resistance gene.

- A) If both Assertion and Reason are true and Reason is the correct explanation of Assertion. B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
C) If Assertion is true but Reason is false. D) If both Assertion and Reason are false.

99. Assertion (A): Selection of recombinants using antibiotic resistance genes is a cumbersome and tedious procedure. Reason (R): It requires simultaneous plating on two different antibiotic plates to differentiate between transformants and non-transformants.

- A) If both Assertion and Reason are true and Reason is the correct explanation of Assertion. B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
C) If Assertion is true but Reason is false. D) If both Assertion and Reason are false.

100.

Why must DNA be treated with a specific concentration of a divalent cation like Calcium (Ca^{2+}) to make a bacterial host cell competent?

- A) It breaks open the nuclear membrane of the bacterium
 B) It increases the efficiency with which DNA enters the bacterium through its cell wall pores
 C) It neutralizes the hydrophobic nature of the plasmid membrane
 D) It acts as a cofactor for DNA ligase enzyme

101.

Arrange the following cloning vectors in ascending order based on their maximum foreign DNA insert carrying capacity:

- A) Cosmid → Plasmid → BAC → YAC
 B) Plasmid → Cosmid → BAC → YAC
 C) YAC → BAC → Cosmid → Plasmid
 D) Plasmid → BAC → Cosmid → YAC

102.

When utilizing the Ti-plasmid of *Agrobacterium tumefaciens* to insert a gene into a dicotyledonous plant cell, which specific segment of the plasmid physically migrates and integrates into the plant's genomic DNA?

- A) The vir (virulence) region
 B) The ori region
 C) The T-DNA (Transfer DNA) region
 D) The entire Ti-plasmid molecule

103.

DNA cannot pass through a cell membrane naturally because it is a:

- A) Hydrophobic molecule charged positively
 B) Hydrophilic molecule charged negatively
 C) Hydrophobic molecule charged negatively
 D) Hydrophilic molecule charged positively

104.

In the chemical transformation protocol of *E. coli*, what is the temperature and sequence of the thermal treatment given to the host cells?

- A) Keep on ice → Heat at 37°C → Keep on ice
 B) Keep on ice → Heat at 42°C → Plating directly
 C) Keep on ice → Heat at 42°C → Keep on ice
 D) Heat at 42°C → Freeze at 0°C → Incubation at room temperature

105.

Which of the following vectorless gene transfer methods is specifically designed for target plant tissues containing rigid cell walls?

- A) Micro-injection
 B) Biolistics or Gene Gun
 C) Heat shock method
 D) Disarmed retrovirus transformation

106.

Read the given statements carefully: Statement-1: Gold and Tungsten are chosen for coating foreign DNA in biolistic methods because they are biologically inert and heavy. Statement-2: Electroporation forces target DNA into host tissues by creating permanent, irreversible structural tears in the plasma membrane.

- A) Both Statement-1 and Statement-2 are correct.
 B) Both Statement-1 and Statement-2 are incorrect.
 C) Statement-1 is correct but Statement-2 is incorrect.
 D) Statement-1 is incorrect but Statement-2 is correct.

107.

Match the host transformation method in Column-I with its primary target or key feature in Column-II:

Column-I (Transformation Method)	Column-II (Target / Feature)
(a) Micro-injection	(i) Uses high-velocity Au or W micro-particles
(b) Biolistics	(ii) Delivers genes directly into the animal cell nucleus
(c) Chemical Method	(iii) Uses electrical voltage to disrupt membranes
(d) Electroporation	(iv) Utilizes divalent Ca^{2+} ice-heat cycles

Correct Coding Option:

- A) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
 B) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
 C) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)
 D) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

108.

A mixture of recombinant host cells, non-recombinant transformants, and non-transformants are plated on an ampicillin-containing medium. If the recombinant plasmid carries an insert within the ampicillin resistance gene (amp^R), which cells will grow?

- A) Recombinant transformants only
 B) Non-recombinant transformants only
 C) Both recombinant and non-recombinant transformants
 D) Non-transformants only

109.

Assertion (A): Plant cells cannot be easily transformed by simply treating them with ice-cold Calcium chloride followed by a 42°C heat shock. Reason (R): Unlike animal cells, plant cells possess a thick, rigid cellulosic cell wall that acts as a formidable physical barrier to naked DNA uptake.

- A) Both Assertion and Reason are true and Reason is the correct explanation.
 B) Both Assertion and Reason are true but Reason is not the correct explanation.
 C) Assertion is true but Reason is false.
 D) Both Assertion and Reason are false.

110.

To produce a target recombinant protein on a commercial large scale, cells are continuously cultured in a bioreactor where:

- A) The entire medium is drained periodically and replaced all at once. B) Fresh medium is added from one side while the used medium is drained out from the other side.
- C) No fresh medium is added, and cells are left to reach their decline phase. D) High pressure is maintained to eliminate the need for an agitator system.

111.

What is the primary operational advantage of a stirred-tank bioreactor over a simple non-stirred culture vessel?

- A) It purifies the protein directly inside the tank. B) It ensures regular, uniform oxygen availability and mixing throughout the reactor.
- C) It allows translation to occur without any mRNA transcript intermediates. D) It completely eliminates the production of foam during high-speed fermentation.

112.

Which of the following processes is NOT a component of downstream processing?

- A) Separation of biomass from the culture broth B) Purification of the target protein using chromatography
- C) Biosynthesis of the expression vector inside the host nucleus D) Addition of preservatives to increase the shelf-life of the product

113.

Assertion (A): Every recombinant therapeutic drug produced via biotechnology must undergo strict clinical trials and quality control testing before commercial marketing. **Reason (R):** Quality control testing is a crucial part of upstream processing designed to optimize the log phase of the host cells.

- A) Both Assertion and Reason are true and Reason is the correct explanation. B) Both Assertion and Reason are true but Reason is not the correct explanation.
- C) Assertion is true but Reason is false. D) Both Assertion and Reason are false.

114.

Match the bioreactor component/process in Column-I with its primary operational function in Column-II:

Column-I (Component/Process)	Column-II (Primary Function)
(a) Foam Breaker	(i) Delivers sterile air into the bottom of the vessel
(b) Sparger	(ii) Prevents gas accumulation at the top from choking the system
(c) Impeller blades	(iii) Isolates the pure gene product from complex mixtures
(d) Purification stage	(iv) Facilitates continuous agitation and mixing of the contents

Correct Coding Option:

- A) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv) B) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
- C) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii) D) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

115.

Read the given statements carefully: Statement-1: Downstream processing protocols and parameters remain identical for every type of biotechnological product, regardless of its chemical nature.

Statement-2: The flat-bladed impeller in a standard bioreactor helps in mixing the contents but plays no role in air distribution.

- A) Both Statement-1 and Statement-2 are correct. B) Both Statement-1 and Statement-2 are incorrect.
- C) Statement-1 is correct but Statement-2 is incorrect. D) Statement-1 is incorrect but Statement-2 is correct.

116.

Downstream processing of a biotechnological product begins immediately after which stage of the production pipeline?

- A) Isolation of the genetic material B) Insertion of recombinant DNA into the host cell
- C) Completion of the biosynthetic (fermentation) stage D) Formulation of marketing campaigns

117.

Which of the following represents the correct chronological sequence of steps in downstream processing?

- A) Purification → Separation → Formulation → Quality Control Testing B) Separation → Purification → Formulation → Quality Control Testing
- C) Formulation → Separation → Purification → Quality Control Testing D) Separation → Formulation → Quality Control Testing → Purification

118.

A student successfully cuts a pBR322 vector with EcoRI and ligates a foreign gene into it. How will this insertion affect the antibiotic resistance profile of the transformed E. coli cells?

- A) They will lose resistance to ampicillin but retain tetracycline resistance.
- B) They will lose resistance to tetracycline but retain ampicillin resistance.
- C) They will remain resistant to both ampicillin and tetracycline.
- D) They will become sensitive to both ampicillin and tetracycline.

119.

Why is a single unique restriction site for a specific endonuclease preferred within a cloning vector's Multiple Cloning Site (MCS)?

- A) Multiple sites allow the plasmid to replicate much faster.
- B) Presence of more than one site will cut the vector into multiple fragments, complicating gene cloning.
- C) It ensures that the lacZ gene is activated automatically.
- D) Multiple sites prevent the binding of DNA ligase.

120.

A circular plasmid vector of 5.0 kb has one recognition site for EcoRI and two recognition sites for HindIII. If this plasmid is completely digested with BOTH EcoRI and HindIII simultaneously, how many linear fragments will be generated?

- A) 2
- B) 3
- C) 4
- D) 5

121.

Why is blue-white color screening considered structurally superior to antibiotic-selection methods using pBR322?

- A) It completely eliminates the requirement for an origin of replication.
- B) It allows direct visual identification of recombinants on a single culture plate without tedious replica-plating.
- C) It works with equal efficiency in both prokaryotic and eukaryotic plant cells.
- D) It prevents host restriction endonucleases from destroying the insert.

122.

While plants are transformed using Agrobacterium vectors, mammalian animal cells are typically transformed using disarmed:

- A) Bacteriophage lambda lines
- B) Retroviruses
- C) pUC plasmids
- D) Root-inducing (Ri) plasmids

123.

When a protein-encoding gene is expressed in a host cell belonging to a completely different species, the protein produced is referred to as a:

- A) Homologous protein
- B) Recombinant protein
- C) Structural protein
- D) Non-recombinant protein

124.

Why is a naked molecule of recombinant DNA unable to cross a biological cell membrane without treatment?

- A) It is highly hydrophobic.
- B) It is a hydrophilic macromolecule.
- C) It lacks an origin of replication sequence.
- D) Its molecular weight is too low.

125.

Which of the following hosts is categorized as a "heterologous host" when expressing human growth hormone?

- A) A human tissue culture cell
- B) Escherichia coli cell
- C) An identical human twin
- D) An autologous stem cell

126.

In blue-white selection screening, a white colony indicates that:

- A) The host cell has died due to antibiotic toxicity.
- B) The cell wall has been completely stripped by calcium chloride.
- C) Insertional inactivation of the β -galactosidase (lacZ) gene has occurred due to foreign DNA integration.
- D) The recombinant plasmid failed to enter the host cell.

127.

In a bioreactor, which component is explicitly responsible for continuously mixing the culture to ensure uniform nutrient and oxygen distribution?

- A) Sparger
- B) Foam breaker
- C) Agitator system (Impeller)
- D) Sampling port

128.

Which component of a bioreactor allows technicians to safely pull out a small volume of the culture to check cell density or contamination without exposing the main tank to outside air?

- A) Sparger
- B) Cooling jacket
- C) Sampling port
- D) Foam breaker

129.

In a continuous culture system (chemostat), upstream processing is optimized by:

- | | |
|---|--|
| A) Allowing the culture to dry out completely before harvesting. | B) Adding fresh medium while simultaneously draining out an equal volume of used medium containing cells and product. |
| C) Sealing the tank and letting it run for weeks without adding any new materials. | D) Keeping the agitation system turned off to avoid disrupting the cells. |

130.

Consider the statements below regarding the expression of foreign gene products: **Statement I: To produce large quantities of a recombinant protein, continuous culture systems are utilized where fresh medium is added from one side while used medium is drained from the other. Statement II: A continuous culture keeps the cells in their physiologically most active stationary phase. Choose the correct option:**

- | | |
|---|---|
| A) Both Statement I and Statement II are correct. | B) Both Statement I and Statement II are incorrect. |
| C) Statement I is correct but Statement II is incorrect. | D) Statement I is incorrect but Statement II is correct. |

131.

The Origin of Replication (ori) sequence in a cloning vector plays a double role. It initiates replication and:

- | | |
|---|--|
| A) Codes for resistance to the antibiotic ampicillin. | B) Directs the synthesis of restriction endonucleases. |
| C) Controls the copy number of the linked foreign DNA. | D) Determines the target host's optimal growth temperature. |

132.

Which of the following sets of genes function as the standard selectable markers in *Escherichia coli* cloning vectors like pBR322?

- | | |
|--|---|
| A) lacZ and cry genes | B) Genes resistance to heavy metals like iron and copper |
| C) Ampicillin and tetracycline resistance genes | D) Taq polymerase and DNA ligase genes |

133.

Why should a cloning vector ideally contain only a single recognition site for a particular restriction enzyme?

- | | |
|---|---|
| A) Multiple sites will deactivate the origin of replication completely. | B) Multiple sites will generate several fragments, which complicates the gene cloning process. |
| C) The restriction enzyme can only bind to a plasmid if it contains exactly three sites. | D) A single site makes the plasmid completely hydrophobic. |

134.

In the standard cloning vector pBR322, the restriction sites for the enzymes BamHI and Sall are located within which gene?

- | | |
|---|---|
| A) <i>amp^R</i> (ampicillin resistance gene) | B) <i>tet^R</i> (tetracycline resistance gene) |
| C) rop gene | D) ori region |

135.

In the pBR322 vector, the rop gene codes for:

- | | |
|--|---|
| A) Proteins involved in the replication of the plasmid. | B) Restriction endonucleases like EcoRI. |
| C) Resistance against the antibiotic kanamycin. | D) The promoter for the beta-galactosidase enzyme. |

Zoology

136.

Consider the following statements regarding reproductive health: **1. Reproductive health refers to total well-being in all aspects of reproduction. 2. It includes physical, emotional, behavioural and social aspects related to reproduction. 3. Merely being free from reproductive diseases is sufficient to be considered reproductively healthy. 4. Awareness about reproductive processes and responsible reproductive behaviour are important components. Which of the above statements are correct?**

- | | |
|---------------------------|-------------------------|
| A) 1, 2 and 4 only | B) 1 and 3 only |
| C) 2, 3 and 4 only | D) 1, 2, 3 and 4 |

137.

A national programme aims to improve reproductive health among adolescents. Which combination would most appropriately contribute to this objective? **Providing correct information about reproductive organs and processes 1. Creating awareness regarding sexually transmitted infections 2. Promoting responsible sexual behaviour 3. Encouraging misconceptions regarding contraception**

- | | |
|---------------------------|-------------------------|
| A) 1, 2 and 3 only | B) 1 and 4 only |
| C) 2 and 4 only | D) 1, 2, 3 and 4 |

138.

Which of the following statements regarding population growth is most appropriate?

- | | |
|--|--|
| A) A high birth rate combined with reduced mortality can contribute to rapid population growth. | B) Improved medical facilities always decrease population size immediately. |
| C) Increased life expectancy necessarily results in a decline in population. | D) Population growth is completely unrelated to reproductive behaviour. |

139.

Consider the following statements about contraceptive methods: 1. Contraception can help prevent unwanted pregnancies. 2. Some contraceptive methods also provide protection against certain sexually transmitted infections. 3. Every contraceptive method is equally effective in preventing STIs. 4. The choice of contraceptive method may depend upon individual circumstances. Which are correct?

- | | |
|------------------------|---------------------------|
| A) 1 and 2 only | B) 1, 2 and 4 only |
| C) 2 and 3 only | D) 1, 3 and 4 only |

140.

Which of the following correctly represents the major objectives of contraception?

- | | |
|---|---|
| A) Prevention of conception and spacing/prevention of unwanted pregnancies | B) Permanent elimination of reproductive capacity in all individuals |
| C) Prevention of all reproductive diseases irrespective of the method used | D) Suppression of puberty in adolescents |

141.

A couple wants a contraceptive method that is reversible and does not require permanent alteration of reproductive organs. Which category would best satisfy this requirement?

- | | |
|--|--|
| A) Surgical sterilisation only | B) Reversible contraceptive methods |
| C) Permanent surgical contraception | D) Removal of reproductive organs |

142.

Which statement regarding condoms is most appropriate?

- | | |
|---|--|
| A) Condoms prevent only fertilisation and have no role in preventing STIs. | B) Condoms can help prevent conception and also reduce transmission of several sexually transmitted infections. |
| C) Condoms permanently suppress gamete production. | D) Condoms are effective only when used after fertilisation. |

143.

A woman uses an intrauterine contraceptive device (IUCD). Which mechanism is most closely associated with its contraceptive action?

- | | |
|---|--|
| A) Complete destruction of the ovaries | B) Alteration of the uterine environment and interference with sperm movement/fertilisation depending on the type of IUCD |
| C) Permanent blockage of the vagina | D) Destruction of all ova throughout reproductive life |

144.

Which one of the following correctly differentiates MTP from contraception?

- | | |
|--|---|
| A) MTP prevents conception before fertilisation, whereas contraception terminates an established pregnancy. | B) MTP refers to intentional termination of pregnancy under appropriate medical conditions, whereas contraception primarily prevents conception. |
| C) Both are exactly the same process. | D) MTP refers exclusively to treatment of infertility. |

145.

Why is MTP considered safer when performed during the early stages of pregnancy under appropriate medical supervision?

- | | |
|--|--|
| A) Complications generally increase as pregnancy advances. | B) The embryo cannot be affected during early pregnancy. |
| C) MTP becomes completely risk-free during early pregnancy. | D) Fertilisation has not occurred during early pregnancy. |

146.

Which of the following is an example of a natural/traditional method of contraception?

- | | |
|-----------------------------------|---------------------------------|
| A) Periodic abstinence | B) Copper-releasing IUCD |
| C) Oral contraceptive pill | D) Vasectomy |

147.

In periodic abstinence, couples avoid sexual intercourse during a particular period of the menstrual cycle because:

- | | |
|---|---|
| A) Spermatogenesis completely stops during this period | B) The probability of fertilisation is relatively high around the fertile period |
| C) The ovary permanently stops releasing ova | D) The uterus becomes incapable of implantation throughout the cycle. |

148.

Which of the following pairs is incorrectly matched?

- | | |
|--|--|
| A) Vasectomy — male sterilisation | B) Tubectomy — female sterilisation |
| C) Condom — barrier method | D) Lactational amenorrhea — permanent contraception |

149.

A woman is exclusively breastfeeding her infant after childbirth and has not resumed menstruation. Under suitable conditions, lactational amenorrhea may act as a natural contraceptive method because:

- | | |
|---|---|
| A) Suckling can suppress ovarian activity and ovulation. | B) Breastfeeding permanently destroys ovarian follicles. |
| C) Lactation prevents sperm formation in the male partner. | D) Lactation physically blocks the fallopian tubes. |

150.

Consider the following statements about oral contraceptive pills: 1. They generally contain hormones. 2. They can prevent ovulation. 3. They may alter cervical mucus and/or reproductive tract conditions. 4. They permanently destroy ovarian follicles. Which statements are correct?

- | | |
|------------------------|---------------------------|
| A) 1 and 2 only | B) 1, 2 and 3 only |
| C) 2 and 4 only | D) 1, 3 and 4 only |

151.

Which contraceptive method is correctly matched with its primary category?

- | | |
|---------------------------------------|--|
| A) Condom — barrier method | B) Oral pill — surgical method |
| C) Vasectomy — hormonal method | D) Copper IUCD — natural method |

152.

A couple desires a highly effective, long-term but reversible contraceptive method Which option is most appropriate?

- | | |
|------------------------------|---|
| A) IUCD | B) Periodic abstinence |
| C) Coitus interruptus | D) Lactational amenorrhea irrespective of conditions |

153.

Which of the following statements regarding surgical contraception is correct?

- | | |
|--|---|
| A) Vasectomy involves cutting and tying the vas deferens. | B) Tubectomy involves cutting and tying the fallopian tubes. |
| C) Both A and B | D) Neither A nor B |

154.

A male undergoes vasectomy. Which statement is correct?

- | | |
|---|---|
| A) Testosterone secretion immediately stops. | B) Sperm transport through the reproductive tract is interrupted, while hormonal function of the testes is not the intended target of the procedure. |
| C) The testes are surgically removed | D) Semen production completely ceases. |

155.

Which contraceptive method provides a dual benefit of preventing conception and reducing the risk of several STIs?

- | | |
|-----------------------|-------------------------------|
| A) Condom | B) Tubectomy |
| C) Copper IUCD | D) Periodic abstinence |

156.

Assertion: Reproductive health programmes should include sex education and awareness about reproductive organs and processes.

Reason: Correct information can help individuals make responsible decisions regarding reproductive health and avoid misconceptions.

- | | |
|---|---|
| A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. | B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion. |
| C) Assertion is true, but Reason is false. | D) Both Assertion and Reason are false. |

157.

Assertion: Condoms are useful in controlling the spread of sexually transmitted infections. Reason: Condoms act as a physical barrier that reduces contact between infected body fluids and the partner.

- | | |
|---|---|
| A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. | B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion. |
| C) Assertion is true, but Reason is false. | D) Both Assertion and Reason are false. |

158.

Assertion: Vasectomy prevents sperm from entering the semen. Reason: In vasectomy, the vas deferens is cut and tied

- | | |
|---|---|
| A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. | B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion. |
| C) Assertion is true, but Reason is false. | D) Both Assertion and Reason are false. |

159.

Assertion: Tubectomy is a permanent method of contraception. Reason: The fallopian tubes are cut and tied, thereby preventing the meeting of sperm and ovum.

- | | |
|---|---|
| A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. | B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion. |
| C) Assertion is true, but Reason is false. | D) Both Assertion and Reason are false. |

160.

Assertion: Lactational amenorrhea can be used as a natural contraceptive method for a limited period after childbirth. **Reason:** Intensive breastfeeding can suppress ovulation and menstruation in the early postpartum period

- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
 B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
 C) Assertion is true, but Reason is false.
 D) Both Assertion and Reason are false.

161.

Assertion: MTP can be used as a method of routine contraception. **Reason:** MTP involves termination of an established pregnancy rather than prevention of conception.

- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
 B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
 C) Assertion is true, but Reason is false.
 D) Both Assertion and Reason are false.

162.

Assertion: Amniocentesis is legally prohibited for determining the sex of the foetus in India **Reason:** Misuse of prenatal diagnostic techniques for sex determination can contribute to female foeticide and sex-selective practices.

- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
 B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
 C) Assertion is true, but Reason is false.
 D) Both Assertion and Reason are false.

163.

Assertion: All contraceptive methods protect against sexually transmitted infections. **Reason:** Prevention of conception and prevention of infection are identical objectives.

- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
 B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
 C) Assertion is true, but Reason is false.
 D) Both Assertion and Reason are false.

164.

Assertion: Infertility may occur due to problems in either the male or female partner. **Reason:** Normal reproduction requires coordinated functioning of reproductive organs and processes in both partners.

- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
 B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
 C) Assertion is true, but Reason is false.
 D) Both Assertion and Reason are false.

165.

Assertion: Assisted reproductive technologies can help some infertile couples achieve pregnancy. **Reason:** Techniques such as IVF-ET can facilitate fertilisation or early embryonic development outside the body before transfer.

- A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
 B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
 C) Assertion is true, but Reason is false.
 D) Both Assertion and Reason are false.

166.

Match Column I with Column II.

Column I	Column II
A) Condom	1. Male sterilisation
B) Vasectomy	2. Barrier method
C) Tubectomy	3. Female sterilisation
D) IUCD	4. Intrauterine contraception

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

167.

Match:

Column I	Column II
A) Periodic abstinence	1. Natural method
B) Coitus interruptus	2. Natural method
C) Lactational amenorrhea	3. Natural method
D) Condom	4. Barrier method

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

168.

Match the following:

Column I	Column II
A) MTP	1. Medical termination of pregnancy
B) Amniocentesis	2. Prenatal diagnostic technique
C) IVF	3. Fertilisation outside the body
D) IUD	4. Intrauterine contraceptive device

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

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

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

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

169.

Match the following assisted reproductive technologies with their descriptions:

Column I	Column II
A) IVF-ET	1. Fertilisation outside the body followed by embryo transfer
B) ZIFT	2. Transfer of zygote/early embryo into fallopian tube
C) IUT	3. Transfer of embryo into uterus
D) GIFT	4. Transfer of gametes into fallopian tube

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

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

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

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

170.

Match the reproductive health problem/intervention:

Column I	Column II
A) Infertility	1. Inability to conceive despite attempts
B) IVF	2. In vitro fertilisation
C) Vasectomy	3. Male sterilisation
D) Tubectomy	4. Female sterilisation

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

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

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

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

171.

Which of the following combinations contains only sexually transmitted infections/diseases?

A) Gonorrhoea, syphilis, genital herpes, HIV/AIDS

B) Malaria, typhoid, gonorrhoea, syphilis

C) Tuberculosis, malaria, AIDS, cholera

D) Hepatitis A, typhoid, malaria, gonorrhoea

172.

Which statement regarding sexually transmitted diseases is incorrect?

A) Some STDs can be asymptomatic, particularly during early stages.

B) Early diagnosis and appropriate treatment are important.

C) Avoiding unprotected sexual contact can reduce transmission risk.

D) Every STD inevitably causes infertility immediately after infection.

173.

A young adult presents with symptoms suggestive of an STD) Which approach is most appropriate?

A) Ignore the symptoms because STDs always disappear spontaneously.

B) Seek medical advice, undergo appropriate testing and follow recommended treatment.

C) Self-medicate indefinitely without diagnosis.

D) Assume that absence of symptoms proves absence of infection.

174.

Infertility is best understood as:

A) The inability to produce gametes under any circumstances in every infertile individual.

B) Inability to conceive despite regular unprotected intercourse for an appropriate period, with causes potentially arising from either partner.

C) A condition found exclusively in females.

D) A condition that can always be corrected using contraception.

175.

A couple cannot conceive because of a problem preventing fertilisation within the female reproductive tract. Which ART could potentially overcome the requirement for fertilisation to occur naturally inside the body?

A) IVF followed by embryo transfer

B) Periodic abstinence

C) Vasectomy

D) Tubectomy

176.

Which of the following correctly describes ZIFT?

A) Transfer of sperm directly into the uterus

B) Transfer of zygote or early embryo into the fallopian tube

C) Transfer of gametes into the uterus

D) Transfer of a fully developed foetus into the uterus

177.

Which statement correctly distinguishes GIFT from ZIFT?

A) GIFT involves transfer of gametes, whereas ZIFT involves transfer of a zygote/early embryo.

B) GIFT involves transfer of a foetus, whereas ZIFT involves transfer of sperm.

C) Both involve exactly the same material and site.

D) ZIFT occurs before gamete formation.

178.

Consider the following statements: 1. Condoms are barrier contraceptives. 2. Vasectomy involves the vas deferens. 3. Tubectomy involves the fallopian tubes. 4. IUCDs are placed inside the uterus. 5. All of these methods provide equal protection against STDs. Which option is correct?

- A) 1, 2, 3 and 4 only B) 1, 3 and 5 only
C) 2, 4 and 5 only D) All five

179.

A couple seeks medical assistance for infertility. The physician explains that depending on the cause, assisted reproductive techniques may be considered. Which sequence correctly represents the principle of IVF-ET?

- A) Gamete fusion outside body → early embryo development → embryo transfer into uterus B) Embryo formation in uterus → removal → gamete transfer into ovary
C) Sperm production outside body → ovarian removal → embryo transfer D) Implantation → fertilisation → gamete formation

180.

Consider the following statements: 1. Reproductive health encompasses physical, emotional, behavioural and social well-being related to reproduction. 2. Condoms can help prevent both conception and transmission of several STDs. 3. Vasectomy prevents sperm transport but does not involve removal of the testes. 4. MTP is the same as contraception. 5. Amniocentesis has legitimate prenatal diagnostic applications, but its misuse for sex determination is prohibited. 6. IVF involves fertilisation outside the body. 7. ZIFT involves transfer of a zygote or early embryo into the fallopian tube. 8. GIFT involves transfer of gametes into the fallopian tube. Which combination is correct?

- A) 1, 2, 3, 5, 6, 7 and 8 only B) 1, 2, 4, 5, 6 and 7 only
C) 2, 3, 4, 6, 7 and 8 only D) 1, 3, 4, 5, 6 and 8 only

ANSWER KEY

Physics

1.	1	13.	1	25.	3	37.	1
2.	2	14.	1	26.	2	38.	1
3.	3	15.	2	27.	1	39.	2
4.	2	16.	3	28.	2	40.	2
5.	2	17.	3	29.	3	41.	2
6.	2	18.	4	30.	2	42.	1
7.	1	19.	2	31.	1	43.	3
8.	1	20.	1	32.	2	44.	3
9.	4	21.	3	33.	3	45.	1
10.	3	22.	4	34.	2		
11.	3	23.	1	35.	1		
12.	3	24.	4	36.	2		

Chemistry

46.	3	58.	2	70.	4	82.	4
47.	4	59.	2	71.	3	83.	4
48.	1	60.	2	72.	3	84.	1
49.	4	61.	1	73.	4	85.	3
50.	1	62.	2	74.	2	86.	3
51.	4	63.	2	75.	2	87.	3
52.	4	64.	2	76.	1	88.	2
53.	2	65.	1	77.	4	89.	4
54.	1	66.	4	78.	1	90.	1
55.	2	67.	1	79.	1		
56.	1	68.	3	80.	4		
57.	3	69.	3	81.	3		

Botany

91.	3	103.	2	115.	2	127.	3
92.	1	104.	3	116.	3	128.	3
93.	2	105.	2	117.	2	129.	2
94.	3	106.	3	118.	3	130.	3
95.	1	107.	2	119.	2	131.	3
96.	3	108.	2	120.	2	132.	3
97.	2	109.	1	121.	2	133.	2
98.	3	110.	2	122.	2	134.	2
99.	1	111.	2	123.	2	135.	1
100.	2	112.	3	124.	2		
101.	2	113.	3	125.	2		
102.	3	114.	2	126.	3		

Zoology

136.	1	137.	1	138.	1	139.	2
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140.	1	151.	1	162.	1	173.	2
141.	2	152.	1	163.	4	174.	2
142.	2	153.	3	164.	1	175.	1
143.	2	154.	2	165.	1	176.	2
144.	2	155.	1	166.	1	177.	1
145.	1	156.	1	167.	1	178.	1
146.	1	157.	1	168.	1	179.	1
147.	2	158.	1	169.	1	180.	1
148.	4	159.	1	170.	1		
149.	1	160.	1	171.	1		
150.	2	161.	4	172.	4		

SOLUTIONS

Q1.

Answer: A

Explanation:

The time taken to reach from zero to the positive peak value is one-fourth of the time period ($T/4$), and the time taken for the change from the positive peak to the negative peak is half of the time period ($T/2$). Using the given frequency of 60 Hz, the time period is $T = 1/f = 1/60$ sec. Substituting this gives the respective time intervals.

Q2.

Answer: B

Explanation:

The general equation for an alternating current is given by $i = i_0 \sin(\omega t)$, where i_0 is the peak (maximum) current and ω is the angular frequency. The peak value is calculated by multiplying the r.m.s. value by $\sqrt{2}$, and the angular frequency is given by $\omega = 2\pi\nu$. Substituting the given values yields the correct equation.

Q3.

Answer: C

Explanation:

The alternating current can be represented as a sine wave starting from zero. To find the time when the current reaches $1/\sqrt{2}$ of its peak value, we substitute this value into the general equation of alternating current and solve for time t in terms of the time period T .

Q4.

Answer: B

Explanation:

The instantaneous voltage in an AC circuit is calculated using the time-dependent sine function formula. By substituting the given peak voltage, angular frequency, and specific time into the equation, we can evaluate the trigonometric term to find the instantaneous voltage.

Q5.

Answer: B

Explanation:

To find the instantaneous value of the alternating voltage at the beginning, we substitute $t = 0$ into the given voltage equation and evaluate the sine of the phase angle.

Q6.

Answer: B

Explanation:

Using the trigonometric identity $\sin(2\theta) = 2 \sin \theta \cos \theta$, the given equation can be rewritten in the standard form of an alternating voltage, $V = V_0 \sin(\omega t)$, allowing us to directly identify the peak voltage and the frequency of the source.

Q7.

Answer: A

Explanation:

The time taken to reach from zero to the positive peak value is one-fourth of the time period ($T/4$), and the time taken from the positive peak to the negative peak is half of the time period ($T/2$). Using the frequency $\nu = 40$ Hz, we calculate $T = 1/\nu$, leading to time values of $1/160$ sec and $1/80$ sec respectively.

Q8.

Answer: A

Explanation:

The power dissipated in an alternating current circuit is given by the formula $P = \frac{1}{2} V_0 I_0 \cos \phi$, where V_0 is the peak voltage, I_0 is the peak current, and ϕ is the phase difference between voltage and current. Substituting the given peak values $V_0 = 200$ V, $I_0 = 100$ mA, and phase difference $\phi = \frac{\pi}{3}$, we get the power as 5 watt.

Q9.

Answer: D

Explanation:

The given current is a combination of a direct current component and an alternating current component. The root mean square value of such a combined current is calculated using the square root of the sum of the square of the direct current value and the square of the root mean square value of the alternating current.

Substituting $I_{dc} = 4$ A and $I_{ac,rms} = \frac{8}{\sqrt{2}} = 4\sqrt{2}$ A, we get

$$I_{rms} = \sqrt{4^2 + (4\sqrt{2})^2} = 4\sqrt{3} \text{ A.}$$

Q10.

Answer: C

Explanation:

The root mean square value of a complex alternating waveform consisting of multiple harmonic components with different frequencies is calculated by taking the square root of the sum of the square of the individual root mean square values of each harmonic component. Alternatively, the peak value of the waveform is found using

$$E_0 = \sqrt{E_1^2 + E_2^2} = \sqrt{12^2 + 9^2} = 15 \text{ V, and the root mean square value is } E_{rms} = \frac{E_0}{\sqrt{2}} = \frac{15}{\sqrt{2}} \approx 10.6 \text{ V.}$$

Q11.

Answer: C

Explanation:

The phase angle of the voltage is $\phi_V = \frac{\pi}{6}$ and the phase angle of the current is $\phi_i = -\frac{\pi}{3}$. The phase difference relative to the current is $\Delta\phi = \phi_V - \phi_i = \frac{\pi}{6} - (-\frac{\pi}{3}) = \frac{\pi}{2}$, which means the voltage leads the current by 90° .

Q12.

Answer: C

Explanation:

The root mean square value of the wattless component of current in an AC circuit is given by $\frac{I_0}{\sqrt{2}} \sin \phi$, where I_0 is the peak current and ϕ is the phase difference between the current and the potential difference. Substituting the peak current $I_0 = 2$ A and phase difference $\phi = \frac{\pi}{2}$, we obtain the root mean square wattless current as $2\sqrt{2}$ A.

Q13.

Answer: A

Q14.

Answer: A

Q15.

Answer: B

Explanation:

In an AC circuit containing resistance and reactance, the relationship between impedance (Z), resistance (R), and the phase angle (ϕ) between the current and voltage is given by the power factor formula $\cos \phi = \frac{R}{Z}$. By substituting the given values of impedance and phase angle, we can solve for the resistance.

Q16.

Answer: C

Explanation:

Since the device restricts the flow of current to one direction only, it acts as a half-wave rectifier, allowing current to flow only during the positive half-cycle. The r.m.s. value of current for a half-wave rectified alternating current is given by $I_{rms} = \frac{I_0}{2}$, where I_0 is the peak current. By finding the peak voltage from the given equation and dividing by twice the resistance, we can determine the r.m.s. value.

Q17.

Answer: C

Explanation:

The frequency is calculated as the reciprocal of the time period $T = 0.6$ sec, giving $f = \frac{1}{0.6} = 1.67$ Hz. The phase difference between the two sinusoidal waves is identified directly from their relative displacement on the time axis, which corresponds to $-\frac{\pi}{2}$.

Q18.

Answer: D

Explanation:

The peak current is obtained by dividing the peak voltage by resistance ($I_0 = V_0/R$). The r.m.s. current is $I_0/\sqrt{2}$, the average current over a half-cycle is $\frac{2}{\pi}I_0$, and the frequency is determined from the angular frequency $\omega = 200\pi$.

Q19.

Answer: B

Q20.

Answer: A

Explanation:

The frequency of the alternating current is determined from the angular frequency coefficient in the given voltage equation. The inductive reactance is then calculated using the formula $X_L = 2\pi\nu L$.

Q21.

Answer: C

Explanation:

The alternating ammeter measures the root mean square (r.m.s.) value of the current flowing through the circuit. By identifying the root mean square value of the applied alternating voltage and calculating the capacitive reactance based on the angular frequency and capacitance, we can determine the r.m.s. current using Ohm's law for AC circuits.

Q22.

Answer: D

Explanation:

The total impedance of an AC circuit containing resistance and inductance is determined using the peak values of the voltage and current. By applying the relation between total impedance, resistance, and inductive reactance in an RL series circuit, we can calculate the exact inductive reactance.

Q23.

Answer: A

Explanation:

The time taken to reach from zero to the positive peak value is one-fourth of the time period ($T/4$), and the time taken for the change from the positive peak to the negative peak is half of the time period ($T/2$). Using the given frequency of 50 Hz, the time period is $T = 1/f = 1/50$ sec. Substituting this gives the respective time intervals.

Q24.

Answer: D

Explanation:

The given current is a combination of a direct current component and an alternating current component. The root mean square value of such a combined current is calculated using the square root of the sum of the square of the direct current value and the square of the root mean square value of the alternating current. Substituting $I_{dc} = 5$ A and $I_{ac,rms} = \frac{10}{\sqrt{2}} = 5\sqrt{2}$ A, we get

$$I_{rms} = \sqrt{5^2 + (5\sqrt{2})^2} = 5\sqrt{3} \text{ A.}$$

Q25.

Answer: C

Explanation:

The current in a series L-C-R or L-C alternating current circuit is maximum at resonance. The angular frequency at resonance is given by the formula $\omega_0 = \frac{1}{\sqrt{LC}}$. Substituting the given values of inductance and capacitance yields the angular frequency.

Q26.

Answer: B

Explanation:

The root mean square value of a multi-harmonic alternating waveform is calculated by taking the square root of the sum of the square of the individual root mean square values of each harmonic component. Alternatively, the net peak value is found using $E_0 = \sqrt{E_1^2 + E_2^2} = \sqrt{8^2 + 6^2} = 10 \text{ V}$, and the root mean square value is $E_{\text{rms}} = \frac{E_0}{\sqrt{2}} = \frac{10}{\sqrt{2}} = 5\sqrt{2} \text{ V}$.

Q27.

Answer: A

Explanation:

By comparing the given alternating current equation with the standard equation $i = i_0 \sin \omega t$, we can determine the peak current i_0 and angular frequency ω . From ω , we calculate the frequency $\nu = \frac{\omega}{2\pi}$, and using $i_{\text{rms}} = \frac{i_0}{\sqrt{2}}$, we find the root mean square value of the current.

Q28.

Answer: B

Explanation:

In an AC circuit containing an inductor and a capacitor in series, the current is maximum at electrical resonance where the inductive reactance equals the capacitive reactance. The resonant angular frequency is given by the formula $\omega_0 = \frac{1}{\sqrt{LC}}$. Substituting the given values of inductance and capacitance into this formula yields the required angular frequency.

Q29.

Answer: C

Explanation:

By comparing the given alternating current equation with the standard form $i = i_0 \sin \omega t$, we find the peak current i_0 and the angular frequency ω . The frequency is then calculated using the formula $\nu = \frac{\omega}{2\pi}$, and the root mean square current is obtained using the formula $i_{\text{rms}} = \frac{i_0}{\sqrt{2}}$.

Q30.

Answer: B

Explanation:

The current in a series LC circuit reaches its maximum value at resonance condition, where the inductive reactance equals the capacitive reactance. The angular frequency at resonance is given by the formula $\omega_0 = \frac{1}{\sqrt{LC}}$.

Q31.

Answer: A

Explanation:

The power dissipated in an alternating current circuit is calculated using the formula $P = \frac{1}{2} V_0 I_0 \cos \phi$, where V_0 is the peak voltage, I_0 is the peak current, and ϕ is the phase difference between the voltage and the current. Substituting the given peak values $V_0 = 300 \text{ V}$, $I_0 = 50 \text{ mA}$, and phase difference $\phi = \frac{\pi}{3}$, we obtain the total power dissipated as 3.75 watt.

Q32.

Answer: B

Explanation:

In an alternating current circuit, the relationship between impedance, resistance, and the phase angle between the current and voltage is given by the power factor formula $\cos \phi = \frac{R}{Z}$. Substituting the given impedance of 100Ω and phase angle of 60° into the formula yields the resistance of 50Ω .

Q33.

Answer: C

Explanation:

To find the instantaneous current at a given time fraction of the time period, substitute $t = \frac{T}{6}$ into the standard alternating current equation $I = I_0 \sin(\omega t)$ and simplify using the angular frequency relation $\omega = \frac{2\pi}{T}$.

Q34.

Answer: B

Explanation:

To find the instantaneous voltage at a specific time, substitute $t = \frac{1}{800} \text{ sec}$ into the given voltage function $V = 200 \sin(400\pi t)$ and evaluate the resulting sine value.

Q35.

Answer: A

Explanation:

The instantaneous value of alternating current starting from zero is given by $I = I_0 \sin(\omega t)$. By equating this to $\frac{I_0}{2}$, we find the corresponding phase angle $\frac{\pi}{6}$ and use the angular frequency relation to calculate the time elapsed.

Q36.

Answer: B

Explanation:

The average value of a sinusoidal alternating current or voltage over one complete time period (full cycle) is always zero because the positive half cycle and the negative half cycle completely cancel each other out.

Q37.

Answer: A

Explanation:

To find the root-mean-square (RMS) value of a combined DC and AC current, we compute the square root of the average of the squared instantaneous current over a full cycle. The time average of a squared sine function over a full cycle is one-half, and the time average of a single sine term is zero.

Q38.

Answer: A

Explanation:

To find the root-mean-square value of a current containing both a DC component and a sinusoidal AC component, we evaluate the square root of the average of the squared current over a complete cycle. The average value of $\sin^2(\omega t)$ over a full cycle is one-half, and the average value of $\sin(\omega t)$ is zero.

Q39.

Answer: B

Explanation:

The time period of an alternating waveform depends on its angular frequency and is calculated using the relation $T = \frac{2\pi}{\omega}$. The phase difference between the voltage and current is determined by finding the absolute difference between their respective phase angles given in their sinusoidal expressions.

Q40.

Answer: B

Explanation:

The resultant of two sinusoidal voltages of the same frequency and amplitude with a phase difference is found using phasor addition. By applying the parallelogram law of vector addition with a phase angle of ninety degrees, the resultant amplitude becomes $\sqrt{V_0^2 + V_0^2 + 2V_0V_0 \cos(90^\circ)}$, which simplifies to $\sqrt{2}V_0$, and the phase leads by forty-five degrees.

Q41.

Answer: B

Explanation:

In a purely inductive AC circuit, the alternating current lags behind the applied alternating voltage by a phase angle of $\frac{\pi}{2}$ radians. The peak current is calculated by dividing the peak voltage by the inductive reactance $X_L = \omega L$.

Q42.

Answer: A

Explanation:

The reading of an alternating current ammeter corresponds to the root mean square value of the current, which is determined by dividing the root mean square value of the applied voltage by the inductive reactance of the circuit.

Q43.

Answer: C

Explanation:

By comparing the given alternating current equation with the standard equation $i = i_0 \sin \omega t$, we can determine the peak current i_0 and angular frequency ω . From ω , we calculate the frequency $\nu = \frac{\omega}{2\pi}$, and using $i_{\text{rms}} = \frac{i_0}{\sqrt{2}}$, we find the root mean square value of the current.

Q44.

Answer: C

Explanation:

By comparing the given alternating current equation with the standard form $i = i_0 \sin \omega t$, we find the peak current i_0 and the angular frequency ω . The frequency is then calculated using the formula $\nu = \frac{\omega}{2\pi}$, and the root mean square current is obtained using the formula $i_{\text{rms}} = \frac{i_0}{\sqrt{2}}$.

Q45.

Answer: A

Explanation:

In an AC circuit containing an inductor and a capacitor in series, the current is maximum at resonance. The resonant angular frequency is given by the formula $\omega_0 = \frac{1}{\sqrt{LC}}$. Substituting the given values of inductance and capacitance into the formula yields the angular frequency.

Q46.

Answer: C

Explanation:

The reaction shown is a decarboxylation reaction, which involves the heating of a sodium salt of a carboxylic acid with soda lime (a mixture of NaOH and CaO in a 3:1 ratio).

Q47.

Answer: D

Explanation:

Formation of pent-2-ene from 2-bromopentane involves β -elimination, follows Zaitsev's rule, and is a dehydrohalogenation reaction. It is not dehydration, because water is not eliminated.

Q48.

Answer: A

Explanation:

Reaction (i) eliminates HBr to form an alkene, reaction (ii) replaces the halogen by OH, and reaction (iii) adds Br₂ across a double bond.

Q49.

Answer: D

Explanation:

S_N2 reactions are fastest for the least sterically hindered alkyl halides: $\text{CH}_3\text{X} > 1^\circ > 2^\circ > 3^\circ$

Q50.

Answer: A

Explanation:

Benzyl chloride readily forms a resonance-stabilized benzyl carbocation.

Q51.

Answer: D

Explanation:

Chloroform reacts with nitric acid to produce chloropicrin, also called nitroform.

Q52.

Answer: D

Explanation:

Freons (CFCs) release chlorine radicals under UV radiation, which catalytically destroy ozone.

Q53.

Answer: B

Explanation:

Sodamide, NaNH_2 , is a strong base. Under heating, successive dehydrohalogenation produces an alkyne.

Q54.

Answer: A

Explanation:

NaCN increases the carbon chain by one carbon. Reduction converts the nitrile to a primary amine, which is acetylated by acetic anhydride.

Q55.

Answer: B

Explanation:

Dehydrohalogenation requires breaking the C–X bond. The C–I bond is weakest and easiest to break.

Q56.

Answer: A

Explanation:

Wurtz reaction of tert-butyl chloride gives highly symmetrical 2,2,3,3-tetramethylbutane, which has equivalent hydrogen environments and therefore gives only one monochloro derivative.

Q57.

Answer: C

Explanation:

Alcoholic ethoxide promotes elimination. The Zaitsev product, pent-2-ene, is favored, and the trans isomer is more stable than the cis isomer.

Q58.

Answer: B

Explanation:

The halogen atom is replaced by the hydroxyl group.

Q59.

Answer: B

Explanation:

At high temperature, chlorine undergoes allylic substitution rather than addition across the double bond.

Q60.

Answer: B

Explanation:

Acetone undergoes the haloform reaction with chlorine generated from calcium hypochlorite.

Q61.

Answer: A

Explanation:

The peroxide effect is observed with HBr, not HCl. Therefore HCl adds normally according to Markovnikov's rule.

Q62.

Answer: B

Explanation:

Chlorobenzene forms the Grignard reagent phenylmagnesium chloride. Ethanol provides an acidic hydrogen that converts it into benzene.

Q63.

Answer: B

Explanation:

2-Methylpropan-2-ol is a tertiary alcohol and forms the most stable tertiary carbocation.

Q64.

Answer: B

Explanation:

CCl_4 has a perfectly symmetrical tetrahedral structure around carbon.

Q65.

Answer: A

Explanation:

The carbon atoms in tetrachloroethene are sp^2 , while the carbon atom in CCl_4 is sp^3 .

Q66.

Answer: D

Explanation:

Phosgene is carbonyl chloride, $COCl_2$.

Q67.

Answer: A

Explanation:

In the presence of peroxide, HBr undergoes radical anti-Markovnikov addition.

Q68.

Answer: C

Explanation:

An S_N1 reaction requires formation of a sufficiently stable carbocation. Option C would produce a primary carbocation that is not resonance-stabilized.

Q69.

Answer: C

Explanation:

Side-chain chlorination of toluene (C_7H_8) gives benzotrichloride (A). The strongly electron-withdrawing $-CCl_3$ group directs electrophilic bromination to the meta-position, forming B. Reduction of $-CCl_3$ back to $-CH_3$ using Zn/HCl yields m-bromotoluene (C).

Q70.

Answer: D

Explanation:

In chlorobenzene, bromobenzene, and chloroethene, the lone pair of electrons on the halogen atom is delocalized with the aromatic or olefinic π -bonds, giving the C-X bond partial double bond character which prevents its cleavage. Isopropyl chloride has a normal, cleavable single covalent bond that yields a stable 2° carbocation.

Q71.

Answer: C

Explanation:

Ionization of the $C-Cl$ bond in benzyl chloride yields the benzyl carbocation ($C_6H_5\overset{+}{C}H_2$), which is exceptionally stable due to the delocalization of the positive charge across the aromatic ring via resonance.

Q72.

Answer: C

Explanation:

In m-xylene (1,3-dimethylbenzene), both methyl groups are ortho/para-directing. Electrophilic aromatic substitution occurs at position 4, which is ortho to one methyl and para to the other. Position 2 is heavily deactivated due to severe steric hindrance.

Q73.

Answer: D

Explanation:

Trichloroacetaldehyde (chloral) undergoes a condensation reaction with two molecules of chlorobenzene in the presence of concentrated sulfuric acid (acting as a dehydrating agent) to produce DDT.

Q74.

Answer: B

Explanation:

The nucleophilic phenyl group of the Grignard reagent attacks electrophilic carbon dioxide (CO_2) to form a magnesium carboxylate salt, which yields benzoic acid upon acidic hydrolysis.

Q75.

Answer: B

Explanation:

The reaction sequence begins with a β -elimination of 1-bromopropane to form propene, followed by Markovnikov addition of HBr to form 2-bromopropane, which undergoes nucleophilic substitution with aqueous KOH to yield propan-2-ol.

Q76.

Answer: A

Explanation:

Due to the lower bond dissociation energy of the C — Br bond compared to the C — Cl bond, magnesium selectively inserts into the C — Br bond to form a Grignard reagent, which on deuterolysis with D_2O yields 4-chlorodeuteriobenzene.

Q77.

Answer: D

Explanation:

The reaction of three moles of alcohol with PCl_3 yields three moles of alkyl chloride and phosphorus acid (H_3PO_3). The reaction of one mole of alcohol with PCl_5 yields alkyl chloride, hydrochloric acid (HCl), and phosphorus oxychloride ($POCl_3$).

Q78.

Answer: A

Explanation:

Nucleophilic substitution of 1-iodopropane with NaCN gives butanenitrile (A). Partial hydrolysis of this nitrile gives butanamide (B), which undergoes Hoffmann bromamide degradation to yield propylamine (C).

Q79.

Answer: A

Explanation:

First, benzenediazonium chloride is converted to bromobenzene via the Sandmeyer reaction. Bromobenzene then forms phenylmagnesium bromide, which is protonated by water to yield benzene.

Q80.

Answer: D

Explanation:

Acetaldehyde is reduced to ethanol (A), which is dehydrated to ethene (B). Hydrobromination of ethene yields ethyl bromide (C), which undergoes a Wurtz-Fittig coupling reaction with bromobenzene to form ethylbenzene (D).

Q81.

Answer: C

Explanation:

Unlike ionic KCN and NaCN which present free nucleophilic carbon, AgCN is covalent. The nucleophilic attack occurs through the lone pair of the nitrogen atom, producing alkyl isonitrile.

Q82.

Answer: D

Q83.

Answer: D

Explanation:

The rate of an S_N2 substitution reaction is dominated by steric hindrance at the reaction center. Reactivity decreases in the order: primary unbranched > primary branched > secondary > tertiary.

Q84.

Answer: A

Explanation:

In o-chlorotoluene, the carbon-chlorine bond possesses partial double bond character due to resonance delocalization of the chlorine lone pair, making it extremely difficult to hydrolyze under normal conditions.

Q85.

Answer: C

Explanation:

This reaction is a bimolecular nucleophilic substitution (S_N2) of a primary alkyl halide. S_N2 reactions are accelerated by polar aprotic solvents like DMF which do not solvate and deactivate the nucleophile.

Q86.

Answer: C

Explanation:

Electrophilic addition of HBr to 1-phenylprop-1-ene goes through the more stable, highly resonance-stabilized benzylic carbocation intermediate ($C_6H_5\overset{+}{CH} - CH_2CH_3$) to yield $C_6H_5CH(Br)CH_2CH_3$.

Q87.

Answer: C

Explanation:

Since the substrate is a primary alkyl halide, the formation of an unstable primary carbocation is avoided in both cases. Therefore, both reactions proceed via the bimolecular S_N2 mechanism.

Q88.

Answer: B

Explanation:

Nitro groups placed at the ortho and para positions act as strong electron-withdrawing groups via resonance, stabilizing the negative charge on the Meisenheimer intermediate during nucleophilic aromatic substitution.

Q89.

Answer: D

Explanation:

As a tertiary alkyl halide, t-butyl bromide is extremely sterically hindered. Treatment with a strong base like sodium methoxide results in rapid $E2$ elimination to yield isobutylene as the major product.

Q90.

Answer: A

Explanation:

Electrophilic addition of HBr to the unsymmetrical alkene proceeds via the most stable benzylic carbocation intermediate ($C_6H_5\overset{+}{C}H-CH_2CH_3$), which is highly resonance-stabilized by the phenyl group.

Q91.

Answer: C

Q92.

Answer: A

Q93.

Answer: B

Q94.

Answer: C

Q95.

Answer: A

Q96.

Answer: C

Q97.

Answer: B

Q98.

Answer: C

Q99.

Answer: A

Q100.

Answer: B

Q101.

Answer: B

Q102.

Answer: C

Q103.

Answer: B

Q104.

Answer: C

Q105.

Answer: B

Q106.

Answer: C

Q107.

Answer: B

Q108.

Answer: B

Q109.

Answer: A

Q110.

Answer: B

Q111.

Answer: B

Q112.

Answer: C

Q113.

Answer: C

Q114.

Answer: B

Q115.

Answer: B

Q116.

Answer: C

Q117.

Answer: B

Q118.

Answer: C

Q119.

Answer: B

Q120.

Answer: B

Q121.

Answer: B

Q122.

Answer: B

Q123.

Answer: B

Q124.

Answer: B

Q125.

Answer: B

Q126.

Answer: C

Q127.

Answer: C

Q128.

Answer: C

Q129.

Answer: B

Q130.

Answer: C

Q131.

Answer: C

Q132.

Answer: C

Q133.

Answer: B

Q134.

Answer: B

Q135.

Answer: A

Q136.

Answer: A

Q137.

Answer: A

Q138.

Answer: A

Q139.

Answer: B

Q140.

Answer: A

Q141.

Answer: B

Q142.

Answer: B

Q143.

Answer: B

Q144.

Answer: B

Q145.

Answer: A

Q146.

Answer: A

Q147.

Answer: B

Q148.

Answer: D

Q149.

Answer: A

Q150.

Answer: B

Q151.

Answer: A

Q152.

Answer: A

Q153.

Answer: C

Q154.

Answer: B

Q155.

Answer: A

Q156.

Answer: A

Q157.

Answer: A

Q158.

Answer: A

Q159.

Answer: A

Q160.

Answer: A

Q161.

Answer: D

Q162.

Answer: A

Q163.

Answer: D

Q164.

Answer: A

Q165.

Answer: A

Q166.

Answer: A

Q167.

Answer: A

Q168.

Answer: A

Q169.

Answer: A

Q170.

Answer: A

Q171.

Answer: A

Q172.

Answer: D

Q173.

Answer: B

Q174.

Answer: B

Q175.

Answer: A

Q176.

Answer: B

Q177.

Answer: A

Q178.

Answer: A

Q179.

Answer: A

Q180.

Answer: A