JEE (Mains & Advanced) & NEET

Max Marks: 300

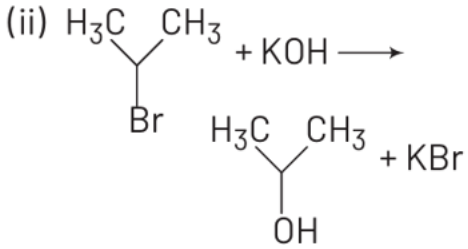
**SR_WEEK-4 (06-07-2026)**

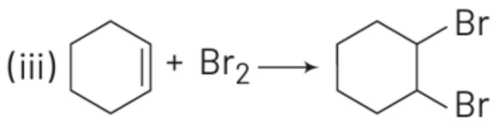
Time: 180 mins

## Chemistry

**1. For the following reactions Which of the following statements is correct?**

(i) $CH_3CH_2CH_2Br + KOH \rightarrow CH_3CH{=}CH_2 + KBr + H_2O$





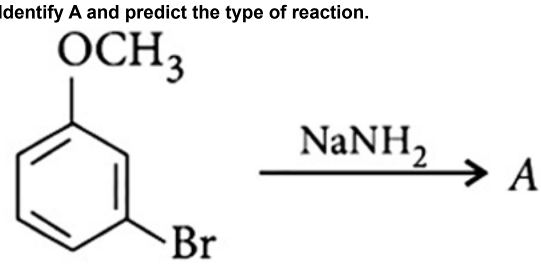
**A)** (i) is elimination reaction, (ii) is substitution and (iii) is addition reaction

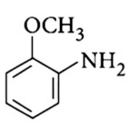
**B)** (i) is elimination, (ii) and (iii) are substitution reactions

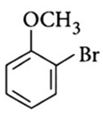
**C)** (i) is substitution, (ii) and (iii) are addition reactions

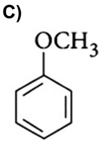
**D)** (i) and (ii) are elimination reactions and (iii) is addition reaction

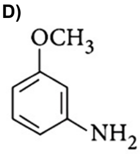
**2. Identify A and predict the type of reaction.**



**A)**  and elimination addition reaction

**B)**  and cine substitution reaction

**C)**  and cine substitution

**D)**  and substitution reaction

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

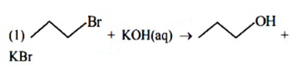
**A)** sodium t-butoxide

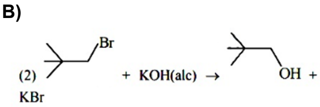
**B)** t-butyl methyl ether

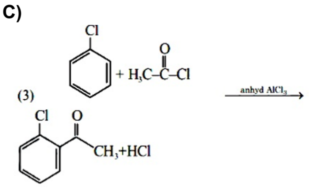
**C)** isobutane

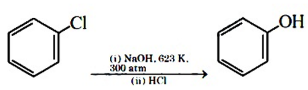
**D)** isobutylene

**4. Identify the incorrect option from the following:**

**A)** 

**B)** 

**C)** 

**D)** 

**5. The major product in the reaction:**

$$CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-Cl + \overset{+}{K}\ \overset{-}{O}-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-CH_3 \longrightarrow ?\ \text{is :}$$

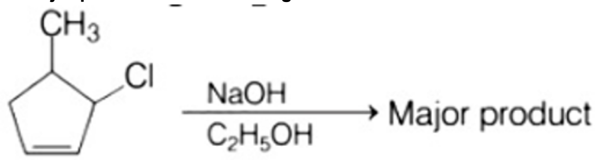
**A)** t-Butyl ethyl ether

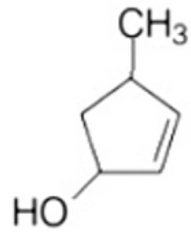
**B)** 2,2-Dimethyl butane

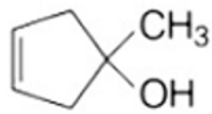
**C)** 2-Methyl pent-1-ene

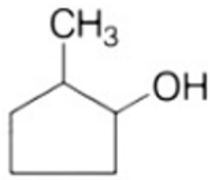
**D)** 2-Methyl prop-1-ene

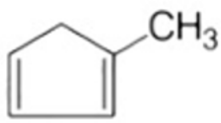
**6. The major product of the following reaction is:**



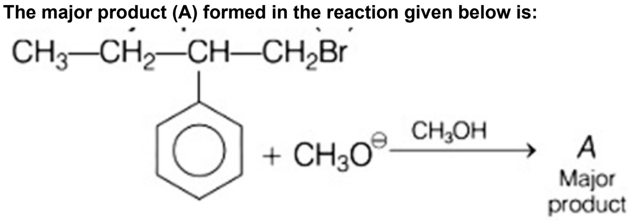
**A)** 

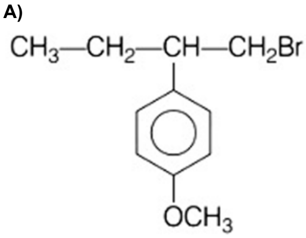
**B)** 

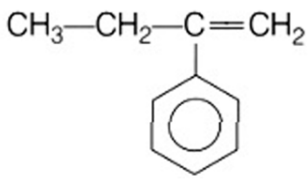
**C)** 

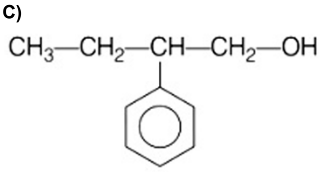
**D)** 

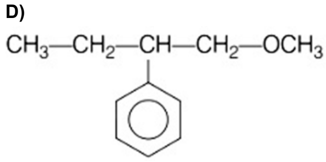
**7. The major product (A) formed in the reaction given below is:**



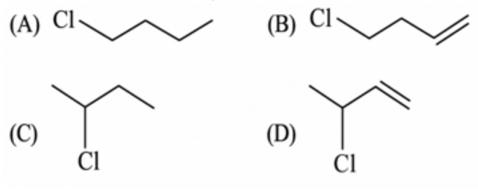
**A)** 

**B)** 

**C)** 

**D)** 

**8. The decreasing order of reactivity towards dehydrohalogenation ($E_1$) reaction of the following compounds is:**

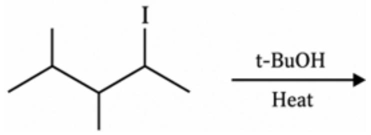


**A)** $D > B > C > A$ **B)** $B > D > A >$
**C)** $B > D > C > A$ **D)** $B > A > D > C$

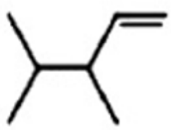
**9. Consider the following reactions: (1)** $(CH_3)_3CCH(OH)CH_3 \xrightarrow{conc.H_2SO_4}$ **(2)** $(CH_3)_2CHCH(Br)CH_3 \xrightarrow{alc.KOH}$ **(3)** $(CH_3)_2CHCH(Br)CH_3 \xrightarrow{(CH_3)_3O^-K^+}$ **(4)** $(CH_3)_3CCH(OH)CH_3 \xrightarrow{\text{conc. } H_2SO_4}$ **Which of these reaction(s) will not produce Saytzeff product?**

**A)** (1), (3) and (4) **B)** (4) only
**C)** (3) only **D)** (2) and (4)

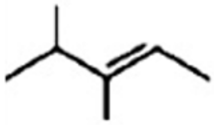
**10. The major product in the following reaction is:**



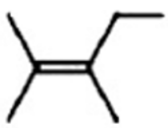
**A)**



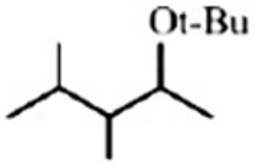
**B)**



**C)**



**D)**



**11. The major product obtained from E2-elimination of 3-bromo-2-fluoropentane is:**

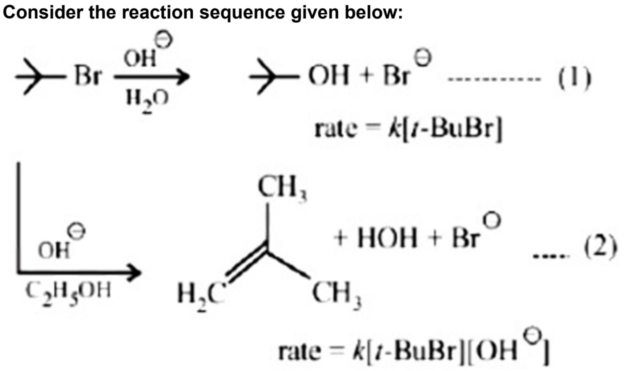
**A)** $CH_3CH_2-\underset{}{\overset{Br}{|}}{CH}-CH=CH_2$

**B)** $CH_3CH_2CH=\underset{CH_3}{\underset{|}{C}}-F$

**C)** $CH_3-CH=CH-\overset{F}{\overset{|}{CH}}-CH_3$

**D)** $CH_3-CH_2-\overset{Br}{\overset{|}{C}}-CH=CH_3$

**12. Consider the reaction sequence given below:**



**Which of the following statements is true?**

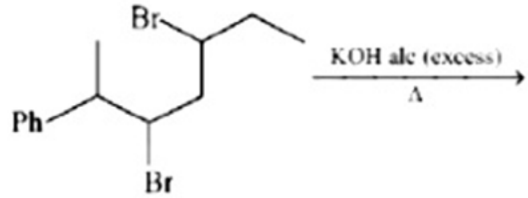
**A)** Changing the base from $OH^-$ to $^-OR$ will have no effect on reaction (2).

**B)** Changing the concentration of base will have no effect on reaction (1).

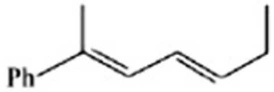
**C)** Doubling the concentration of base will double the rate of both the reactions.

**D)** Changing the concentration of base will have no effect on reaction (2).

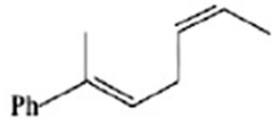
**13. The major product of the following reaction is:**



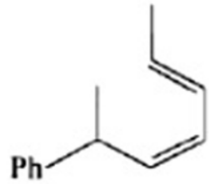
**A)**



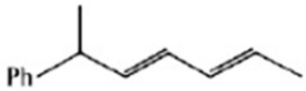
**B)**



**C)**



**D)**



**14. The major product of the following reaction is:**

$$CH_3-\underset{CH_3}{\underset{|}{CH}}-\underset{Br}{\underset{|}{CH}}-CH_3 \xrightarrow[CH_3OH]{CH_3O^-}$$

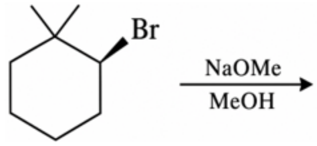
**A)** $CH_3-\overset{CH_3}{\overset{|}{\underset{H}{\underset{|}{C}}}}=CH=CH_2$

**B)** $CH_3-\overset{CH_3}{\overset{|}{C}}=CHCH_3$

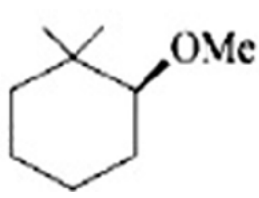
**C)** $CH_3-\overset{CH_3}{\overset{|}{\underset{OCH_3}{\underset{|}{C}}}}=CH_2CH_3$

**D)** $CH_3-\overset{CH_3}{\overset{|}{\underset{H}{\underset{|}{C}}}}=\underset{OCH_3}{\underset{|}{CHCH_3}}$

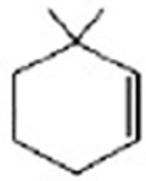
**15. The major product of the following reaction is:**



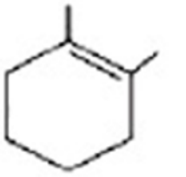
**A)**



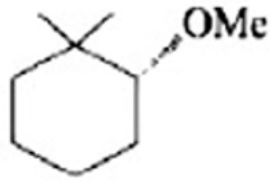
**B)**



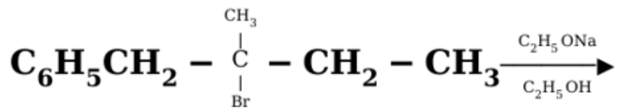
**C)**



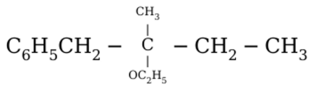
**D)**



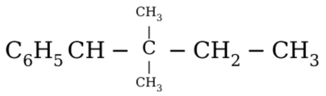
**16. The major product of the following reaction is:**



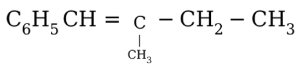
A)



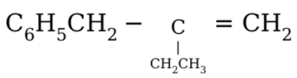
B)



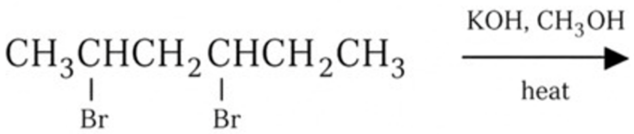
C)



D)

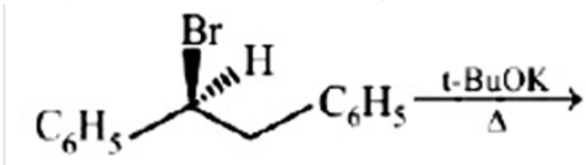


**17. The major product of the following reaction is:**



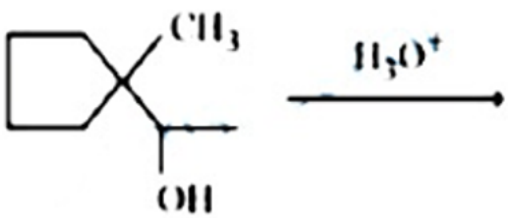
A) $CH_2 = CHCH_2CH = CHCH_2CH_3$
B) $CH_2 = CHCH = CHCH_2CH_3$
C) $CH_3CH = C = CHCH_2CH_3$
D) $CH_3CH = CH - CH = CHCH_3$

**18. The major product obtained in the following reaction is:**

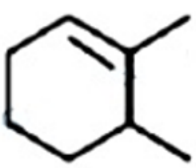


A) $(\pm)C_6H_5CH(O^tBu)CH_2C_6H_5$
B) $C_6H_5CH = CHC_6H_5$
C) $(+)C_6H_5CH(O^tBu)CH_2C_6H_5$
D) $(-)C_6H_5CH(O^tBu)CH_2C_6H_5$

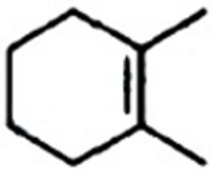
**19. Find out the major product for the following reaction.**



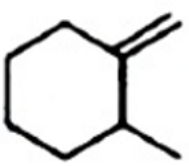
A)



B)



C)



D)

**20. Reaction of trans2-phenyl-1-bromocyclopentane on reaction with alcoholic OH produces:**

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

**21. The total number of alkenes possible by dehydrobromination of 3-bromo-3-cyclopentylhexane using alcoholic KOH is:**

**22. Match the following:**

| Column I |
|---|
| **A.** $CH_3 - CHBr - CD_3$ **on treatment with alc. KOH gives** $CH_2 = CH - CD_3$ **as a major product.** |
| **B.** $Ph - CHBr - CH_3$ **reacts faster than** $Ph - CHBr - CD_3$. |
| **C.** $Ph - CH_2 - CH_2Br$ **on treatment with** $C_2H_5OD/C_2H_5O^-$ **giv** $Ph - CD = CH_2$ **as the major product.** |
| **D.** $PhCH_2CH_2Br$ **and** $PhCD_2CH_2Br$ **react with same rate.** |

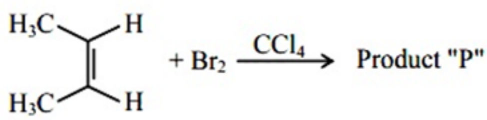
**How many of the following are the correct matchings.**
$A \to Q, \quad B \to Q, \quad C \to R, S, \quad D \to P, S$

**23. The major product 'A' of the following given reaction has _____ $sp^2$ hybridized carbon atoms.**

$$2,7 - Dimethyl - 2,6 - Octadiene \xrightarrow{H^+} \underset{Major\ Product}{A}$$

**24. In the presence of sunlight, benzene reacts with $Cl_2$ to give product, X. The number of hydrogens in X is _________. [26-Jul-2022-Shift-1]**

**25. Consider the above chemical reaction. The total number of stereoisomers possible for Product 'P' is __________. [25 Jul 2021 Shift**



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## Maths

**26. Find the equation of the circle passing through the points of intersection of the circles $x^2 + y^2 - 6x - 4y + 3 = 0$ and $x^2 + y^2 - 2x + 8y + 9 = 0$, and whose center lies on the y-axis.**

A) $x^2 + y^2 - 14y - 3 = 0$
B) $x^2 + y^2 + 14y + 3 = 0$
C) $x^2 + y^2 - 10y - 6 = 0$
D) $x^2 + y^2 - 20y - 3 = 0$

**27. Find the equation of the circle passing through the intersection points of the circles $x^2 + y^2 - 2x - 4y - 4 = 0$ and $x^2 + y^2 + 8x - 6y = 0$, and whose center lies on the x-axis.**

A) $x^2 + y^2 + 18x - 12 = 0$
B) $x^2 + y^2 - 18x + 12 = 0$
C) $x^2 + y^2 - 22x - 12 = 0$
D) $x^2 + y^2 + 22x + 12 = 0$

**28. Find the equation of the circle passing through the intersection of the circles $x^2 + y^2 - 4x - 6y - 3 = 0$ and $x^2 + y^2 + 2x + 4y + 1 = 0$, and which passes through the origin $(0, 0)$.**

A) $3x^2 + 3y^2 + 2x + 6y = 0$
B) $4x^2 + 4y^2 + 2x + 6y = 0$
C) $4x^2 + 4y^2 - 2x - 6y = 0$
D) $2x^2 + 2y^2 - x - 3y = 0$

**29. Given the circle $x^2 + y^2 = 9$ and the line $x + 2y = 2$ intersect at two distinct points $A$ and $B$. Find the equation of the circle with $AB$ as a diameter.**

A) $x^2 + y^2 - 4x - 8y + 5 = 0$
B) $x^2 + y^2 - \frac{4}{5}x - \frac{8}{5}y - \frac{41}{5} = 0$
C) $x^2 + y^2 - \frac{4}{5}x - \frac{8}{5}y + \frac{41}{5} = 0$
D) $x^2 + y^2 + 4x + 8y - 5 = 0$

**30. Given the circle $x^2 + y^2 = 4$ and the line $2x - y = 1$ intersect at two distinct points $A$ and $B$. Find the equation of the circle with $AB$ as a diameter.**

A) $5x^2 + 5y^2 - 4x + 2y - 18 = 0$
B) $5x^2 + 5y^2 + 4x - 2y - 18 = 0$
C) $x^2 + y^2 - 4x + 2y - 4 = 0$
D) $5x^2 + 5y^2 - 4x + 2y - 22 = 0$

**31. Find the equation of the circle described on the common chord of the circles $x^2 + y^2 - 4 = 0$ and $x^2 + y^2 - 4x - 4y + 4 = 0$ as a diameter.**

A) $x^2 + y^2 - 2x - 2y = 0$
B) $x^2 + y^2 - x - y - 2 = 0$
C) $x^2 + y^2 - 2x - 2y + 2 = 0$
D) $x^2 + y^2 - 4x - 4y = 0$

**32. Given the circle $x^2 + y^2 = 9$ and the line $x + 2y = 2$ intersect at two distinct points $A$ and $B$. Find the equation of the circle with $AB$ as a diameter.**

A) $x^2 + y^2 - 4x - 8y + 5 = 0$
B) $x^2 + y^2 - \frac{4}{5}x - \frac{8}{5}y - \frac{41}{5} = 0$
C) $x^2 + y^2 - \frac{4}{5}x - \frac{8}{5}y + \frac{41}{5} = 0$
D) $x^2 + y^2 + 4x + 8y - 5 = 0$

**33.** Given the circle $x^2 + y^2 = 4$ and the line $2x - y = 1$ intersect at two distinct points $A$ and $B$. Find the equation of the circle with $AB$ as a diameter.

A) $5x^2 + 5y^2 - 4x + 2y - 18 = 0$ B) $5x^2 + 5y^2 + 4x - 2y - 18 = 0$
C) $x^2 + y^2 - 4x + 2y - 4 = 0$ D) $5x^2 + 5y^2 - 4x + 2y - 22 = 0$

**34.** Find the equation of the circle described on the common chord of the circles $x^2 + y^2 - 4 = 0$ and $x^2 + y^2 - 4x - 4y + 4 = 0$ as a diameter.

A) $x^2 + y^2 - 2x - 2y = 0$ B) $x^2 + y^2 - x - y - 2 = 0$
C) $x^2 + y^2 - 2x - 2y + 2 = 0$ D) $x^2 + y^2 - 4x - 4y = 0$

**35.** Find the equation of the circle passing through the point $Q(1, 1)$ and touching the line $x + y = 2$ at the point $P(2, 0)$.

A) $x^2 + y^2 - 2x + 2y = 0$ B) $x^2 + y^2 - 4x + 2y = 0$
C) $x^2 + y^2 - 2x - 2y = 0$ D) $x^2 + y^2 + 2x - 2y = 0$

**36.** Find the equation of the circle touching the line $x - y = 0$ at the point $(1, 1)$ and passing through the point $(2, 0)$.

A) $x^2 + y^2 - 3x - y + 2 = 0$ B) $x^2 + y^2 - 2x - 2y + 2 = 0$
C) $x^2 + y^2 - 4x + 2 = 0$ D) $x^2 + y^2 - x - 3y + 2 = 0$

**37.** Find the equation of the circle touching the x-axis ($y = 0$) at the origin $(0, 0)$ and passing through the point $(2, 3)$.

A) $3x^2 + 3y^2 - 13x = 0$ B) $3x^2 + 3y^2 - 13y = 0$
C) $x^2 + y^2 - 2x - 3y = 0$ D) $x^2 + y^2 - 4y = 0$

**38.** Find the equation of a circle passing through the point $Q(2, 0)$ and touching the line $x - y = 0$ at the origin $(0, 0)$.

A) $x^2 + y^2 - 2x + 2y = 0$ B) $x^2 + y^2 + 2x - 2y = 0$
C) $x^2 + y^2 - x + y = 0$ D) $x^2 + y^2 - 2x - 2y = 0$

**39.** Find the equation of a circle passing through the point $Q(-1, -1)$ and touching the line $2x - y - 3 = 0$ at the point $P(1, -1)$.

A) $x^2 + y^2 + x - 1 = 0$ B) $x^2 + y^2 + y - 1 = 0$
C) $x^2 + y^2 - y + 1 = 0$ D) $x^2 + y^2 + 2y - 1 = 0$

**40.** Find the equation of a circle passing through $Q(1, 1)$ and touching the line $x + 2y = 0$ at the point $P(-2, 1)$.

A) $x^2 + y^2 + x - 8y + 5 = 0$ B) $x^2 + y^2 - x + 8y - 5 = 0$
C) $x^2 + y^2 + 2x - 4y + 5 = 0$ D) $x^2 + y^2 + x - 6y + 4 = 0$

**41.** Find the length of the chord intercepted by the line $3x + 4y - 15 = 0$ on the circle $x^2 + y^2 = 25$.

A) 6 B) 8
C) 10 D) 12

**42.** Find the length of the chord intercepted by the line $x + y - 1 = 0$ on the circle $x^2 + y^2 - 8x - 2y + 8 = 0$.

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

**43.** Find the length of the chord intercepted by the line $x + 2y - 2 = 0$ on the circle $x^2 + y^2 - 2x - 6y - 15 = 0$.

A) $4\sqrt{5}$ B) $2\sqrt{5}$
C) $5\sqrt{2}$ D) 10

**44.** Tangents are drawn to the circle $x^2 + y^2 = 16$ at the points where it is met by the line $2x + y = 4$. Find the point of intersection of these tangents.

A) $(8, 4)$ B) $(4, 8)$
C) $(4, 2)$ D) $(2, 4)$

**45.** Tangents are drawn to the circle $x^2 + y^2 = 36$ at the points where it is met by the line $3x - 2y = 12$. Find the point of intersection of these tangents.

A) $(9, 6)$ B) $(9, -6)$
C) $(-9, 6)$ D) $(-6, 9)$

**46.** If the straight line $2x + y = \lambda$ touches the circle $x^2 + y^2 = 5$ and is normal to the circle $x^2 + y^2 - 4x - 2by = 0$ where $b \neq 0$, then find the value of $\lambda$.

**47.** If the straight line $3x + 4y = c; c > 0$ touches the circle $x^2 + y^2 - 4x - 2y = 4$ and is normal to the circle $x^2 + y^2 - 2x - 6y = 6$, then the value of $c$ is equal to:

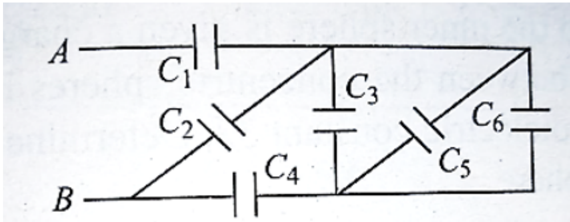
**48.** Let the center of a circle $C$ be $(\alpha, \beta)$ and its radius $r < 4$. Let $4x - 3y = 12$ and $4x - 3y = -8$ be two parallel tangents, and $3x + 4y = 11$ be a normal to $C$. Then the value of $(\alpha - \beta + r)$ is equal to:

**49.** Let the center of a circle $C$ be $(\alpha, \beta)$ and its radius $r < 5$. Let $3x + 4y = 14$ and $3x - 4y = -10$ be two tangents, and $x - y = 1$ be a normal to $C$. Then the value of $(\alpha + \beta + r)$ is equal to:

**50.** The tangents and the normal lines at the point $(3\sqrt{2}, 3\sqrt{2})$ to the circle $x^2 + y^2 = 36$ and the X-axis form a triangle. The area of this triangle (in square units) is:

## Physics

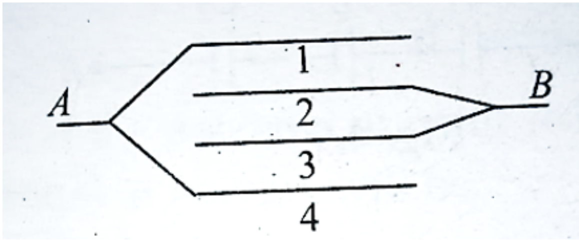
**51.** In the accompanying diagram, if $C_1 = 3\mu F, C_2 = 6\mu F, C_3 = 9\mu F, C_4 = 12\mu F, C_5 = 15\mu F$ and $C_6 = 18\mu F$, then the equivalent capacitance between the ends $A$ and




$B$ is

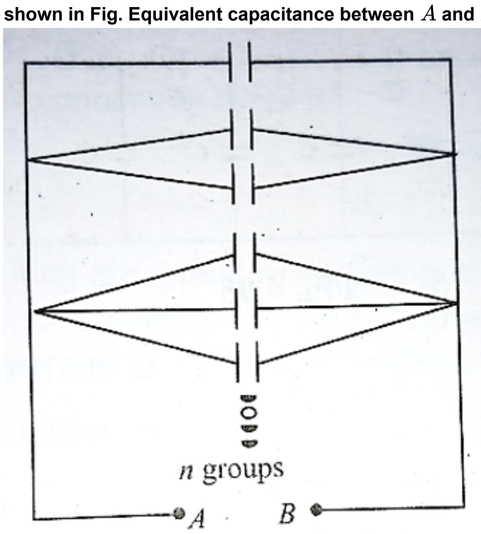
A) $1.22\mu F$ B) $5.16\mu F$
C) $2.25\mu F$ D) $2.51\mu F$

**52.** Four identical metal plates, each with a surface area $A$ (on one side), are placed a distance $d$ from each other as shown in Fig. The two inner plates are connected to point $B$ and the other two plates to another point $A$. Then, the capacitance of the system is



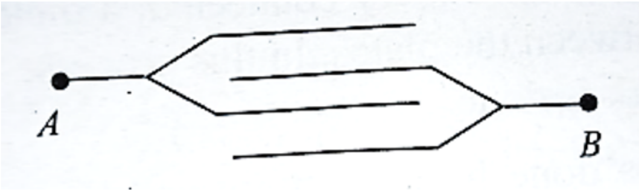

A) $\epsilon_0 A/d$ B) $2\epsilon_0 A/d$
C) $3\epsilon_0 A/d$ D) $2\epsilon_0 A/3d$

**53.** A number of capacitors, each of equal capacitance $C$, are arranged as shown in Fig. Equivalent capacitance between $A$ and $B$ is



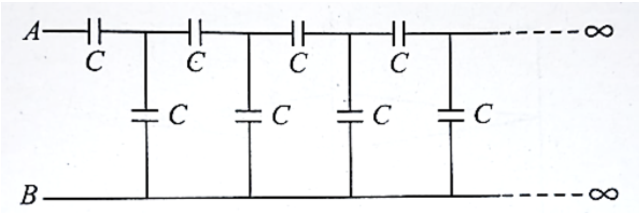

A) $n^2C$ B) $(2n + 1)C$
C) $\frac{(n-1)n}{2}C$ D) $\frac{(n+1)n}{2}C$

**54.** Four metallic plates, each with a surface area of one side $A$, are placed at a distance $d$ from each other. The alternate plates are connected to points $A$ and $B$ as shown in Fig. Then the capacitance of the system is:



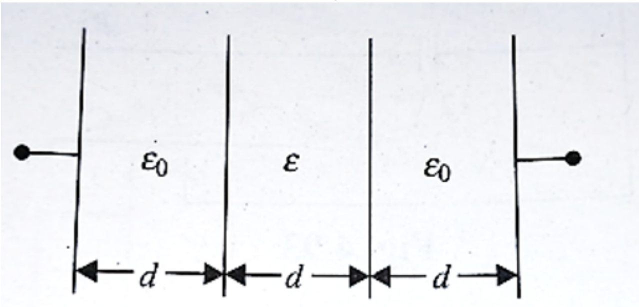

**A)** $\frac{\epsilon_0 A}{d}$
**B)** $\frac{2\epsilon_0 A}{d}$
**C)** $\frac{3\epsilon_0 A}{d}$
**D)** $\frac{4\epsilon_0 A}{d}$

**55.** The capacitance of an infinite circuit formed by the repetition of the same link consisting of two identical capacitors, each with capacitance $C$ is




**A)** zero
**B)** 0.618C
**C)** 2.62C
**D)** infinite

**56.** For configuration of media of permittivity $\varepsilon_0, \varepsilon, \varepsilon_0$ between parallel plates each of area $A$, as shown in Fig, the equivalent capacitance is

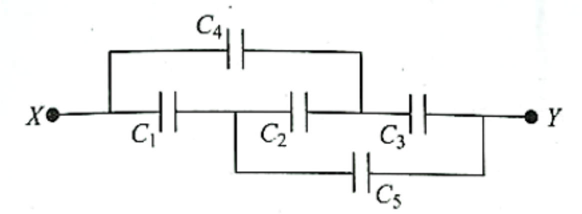



**A)** $\epsilon_0 A/d$
**B)** $\epsilon\epsilon_0 A/d$
**C)** $\frac{\epsilon\epsilon_0 A}{d(\epsilon+\epsilon_0)}$
**D)** $\frac{\epsilon\epsilon_0 A}{(2\epsilon+\epsilon_0)d}$

**57.** Two parallel plate capacitors of capacitances $C$ and 2C are connected in parallel and charged to potential difference $V$. The battery is then disconnected and the region between the plates of $C$ is filled completely with a material of dielectric constant $K$. The common potential difference across the combination becomes

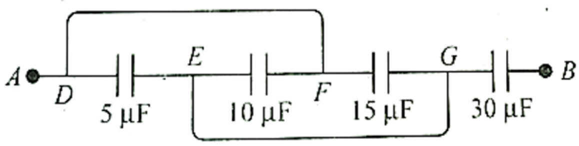
**A)** $\frac{2V}{K+2}$
**B)** $\frac{V}{K+2}$
**C)** $\frac{3V}{K+3}$
**D)** $\frac{3V}{K+2}$

**58.** The effective capacitance between points $X$ and $Y$ in Fig., assuming $C_2 = 10\mu F$ and that outer capacitors are all $4\mu F$ each, is



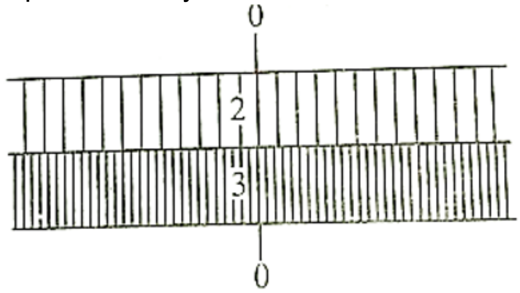

**A)** $1\mu F$
**B)** $3\mu F$
**C)** $4\mu F$
**D)** $5\mu F$

**59.** The resultant capacitance between the points $A$ and $B$ in Fig., is



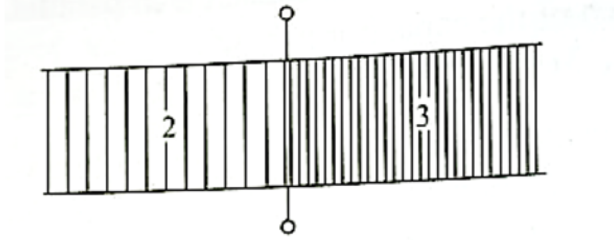

**A)** $15\mu F$
**B)** $30\mu F$
**C)** $60\mu F$
**D)** $45\mu F$

**60.** A parallel plate capacitor with no dielectric has a capacitance of $0.5\mu F$. The space between the plates is filled with equal amounts of two dielectric materials of dielectric constants $2$ and $3$ as shown in Fig. Find the capacitance of the system now.



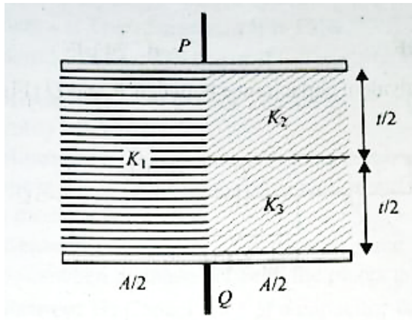

**A)** $1.2\mu F$
**B)** $1.8\mu F$
**C)** $1.25\mu F$
**D)** none of these

**61.** A parallel plate capacitor with no dielectric has a capacitance of $0.5\mu F$. The space between the plates is filled with equal amounts of two dielectric materials of dielectric constants $2$ and $3$ as shown in Fig. Find the capacitance of the system now.



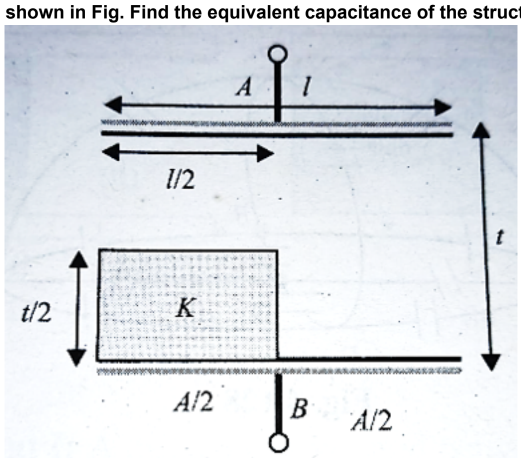

**A)** $1.2\mu$F
**B)** $1.25\mu$F
**C)** $1.80\mu$F
**D)** None of these

**62.** A parallel plate capacitor is constructed using three different dielectric materials as shown in Fig. What is the capacitance across (P) and (Q)?



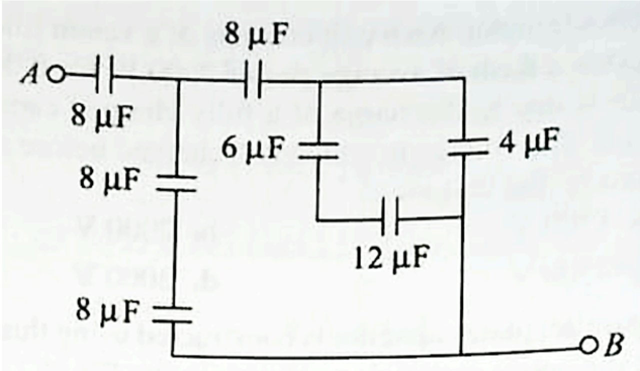

**A)** $\left(\frac{K_1}{2} + \frac{K_2 K_3}{K_2+K_3}\right)\frac{\varepsilon_0 A}{t}$
**B)** B)$\left(K_1 + \frac{K_2 K_3}{K_2+K_3}\right)\frac{\varepsilon_0 A}{t}$
**C)** C)$\left(K_1 + \frac{2K_2 K_3}{K_2+K_3}\right)\frac{\varepsilon_0 A}{t}$
**D)** D)$\left(K_1 + \frac{K_2 K_3}{2(K_2+K_3)}\right)\frac{\varepsilon_0 A}{t}$

**63.** Two square plates $(l \times l)$ and dielectric $\left(\frac{l}{2} \times \frac{t}{2} \times l\right)$ are arranged as shown in Fig. Find the equivalent capacitance of the structure.



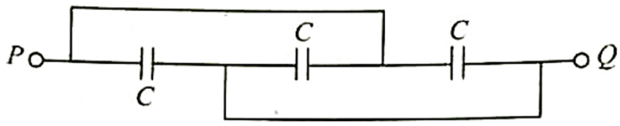

**A)** $\frac{2\varepsilon_0 A}{t}\left(\frac{K+1}{K+3}\right)$
**B)** $\frac{2\varepsilon_0 A}{t}\left(\frac{K+3}{K+1}\right)$
**C)** $\frac{\varepsilon_0 A}{t}\left(\frac{K+1}{K+3}\right)$
**D)** $\frac{\varepsilon_0 A}{t}\left(\frac{2K+1}{2K+3}\right)$

64. The equivalent capacitance across (AB) (Fig) is



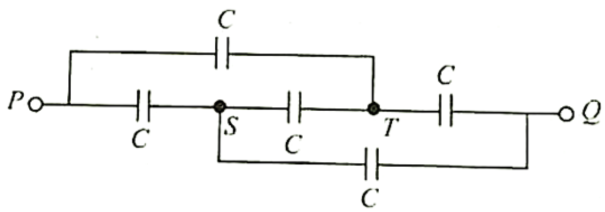

A) $8\mu\mathrm{F}$
B) $12\mu\mathrm{F}$
C) $4\mu\mathrm{F}$
D) $24\mu\mathrm{F}$

65. The equivalent capacitance between (P) and (Q) (Fig) is



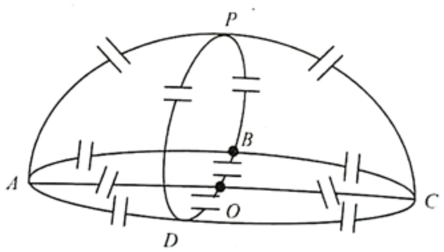

A) $\frac{C}{3}$
B) 3C
C) 2C
D) C

66. The equivalent capacitance between (P) and (Q) (Fig) is




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

67. Find the capacitance between (P) and (O) (Fig).

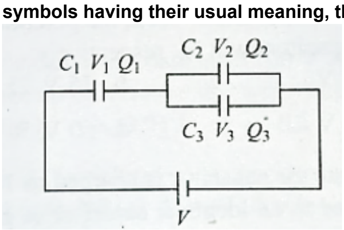



A) 2C
B) 3C
C) 8C
D) 6C

68. A parallel plate capacitor has plates of area $A$ and separation $d$ and is charged to a potential difference $V$. The charging battery is then disconnected and the plates are pulled apart until their separation is $2d$. What is the work required to separate the plates?

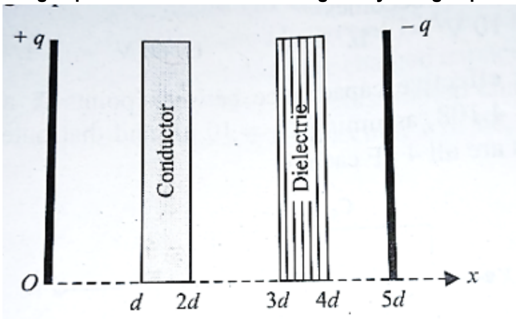
A) $2\varepsilon_0 AV^2/d$
B) $\varepsilon_0 AV^2/d$
C) $3\varepsilon_0 AV^2/2d$
D) $\varepsilon_0 AV^2/2d$

69. In Fig. three capacitors $C_1$, $C_2$ and $C_3$ are joined to a battery. With symbols having their usual meaning, the correct condition will be



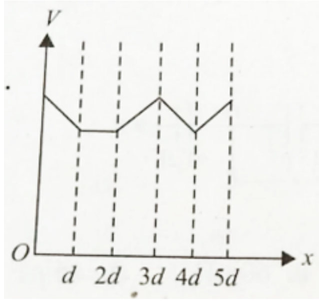

A) $Q_1 = Q_2 = Q_3$ and $V_1 = V_2 = V_3 + V$
B) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2 + V_3$
C) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2$
D) $Q_2 = Q_3$ and $V_2 = V_3$

70. The distance between the plates of a parallel plate capacitor is $5d$. The positively charged plate is at $x = 0$ and the negatively charged plate is

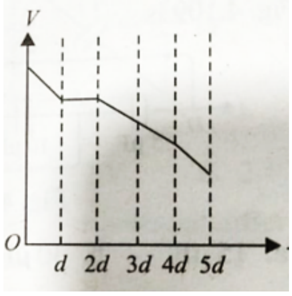



at $x = 5d$.
Two slabs, one of a conductor and the other of a dielectric of same thickness $d$, are inserted between the plates as shown in Fig. The potential $V$ versus distance $x$ graph will be

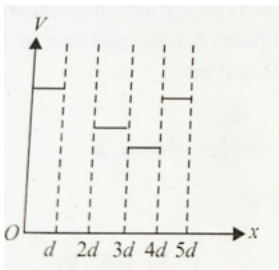
A)




B)

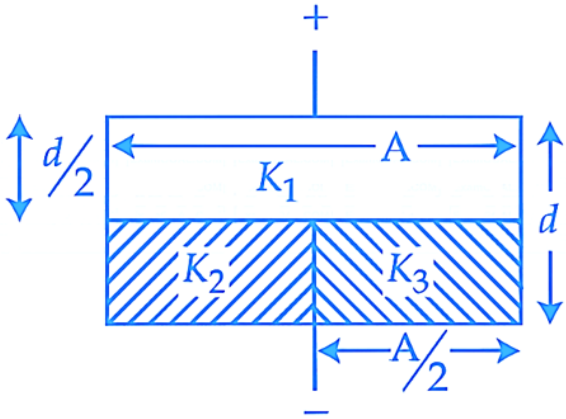



C)



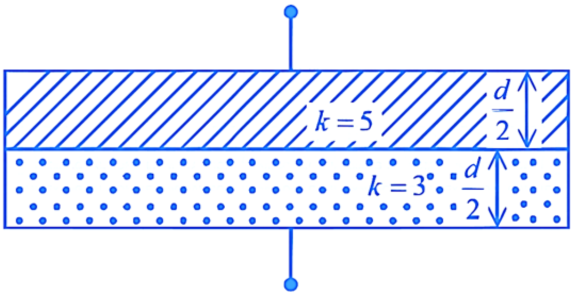

D) None of these

71. The space between the plates of a parallel plate capacitor of capacitance $C$ (without any dielectric) is now filled with three dielectric slabs of dielectric constants $K_1 = 2$, $K_2 = 3$ and $K_3 = 5$ (as shown in figure). If new capacitance is $\frac{n}{3}C$ then the value of $n$ is ______.




72. A parallel plate capacitor is having separation between plates $0.885\ \mathrm{mm}$. It has a capacitance of $1, \mu\mathrm{F}$ when the space between the plates is filled with an insulating material of resistivity $1 \times 10^{13}\ \Omega\mathrm{m}$ and resistance $17.7 \times 10^{14}\ \Omega$. Relative permittivity of the insulating material is $\alpha \times 10^7$. The value of $\alpha$ is ______. (Take permittivity of free space $= 8.85 \times 10^{-12}\ \mathrm{F/m}$)

**73.** Space between the plates of a parallel plate capacitor of plate area $4\ \mathrm{cm}^2$ and separation of $1.77\ \mathrm{mm}$, is filled with uniform dielectric materials with dielectric constants $(3$ and $5)$ as shown in figure. Another capacitor of capacitance $7.5\ \mathrm{pF}$ is connected in parallel with it. The effective capacitance of this combination is __ pF.




(Given $\varepsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F/m}$)

**74.** A capacitor of $10, \mu\mathrm{F}$ capacitance whose plates are separated by $10\ \mathrm{mm}$ through air and each plate has area $4\ \mathrm{cm}^2$ is now filled equally with two dielectric media of $K_1 = 2,\ K_2 = 3$ respectively as shown in figure. If new force between the plates is $8\ \mathrm{N}$. The supply voltage is ____ V.


**75.** The electric field between the two parallel plates of a capacitor of $1.5, \mu\mathrm{F}$ capacitance drops to one third of its initial value in $6.6, \mu\mathrm{s}$ when the plates are connected by a thin wire. The resistance of this wire is ____ $\Omega$. (Given, $\log 3 = 1.1$)

# ANSWER KEY

## Chemistry

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | **1** | 8. | **1** | 15. | **3** | 22. | **3** |
| 2. | **4** | 9. | **3** | 16. | **3** | 23. | **2** |
| 3. | **4** | 10. | **3** | 17. | **4** | 24. | **6 (The integer answer is 6)** |
| 4. | **2** | 11. | **2** | 18. | **2** | 25. | **2** |
| 5. | **4** | 12. | **2** | 19. | **2** | | |
| 6. | **4** | 13. | **1** | 20. | **1** | | |
| 7. | **2** | 14. | **2** | 21. | **5** | | |

## Maths

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 26. | **1** | 33. | **1** | 40. | **1** | 47. | **15** |
| 27. | **3** | 34. | **1** | 41. | **2** | 48. | **2** |
| 28. | **2** | 35. | **1** | 42. | **1** | 49. | **9** |
| 29. | **2** | 36. | **1** | 43. | **1** | 50. | **18** |
| 30. | **1** | 37. | **2** | 44. | **1** | | |
| 31. | **1** | 38. | **1** | 45. | **2** | | |
| 32. | **2** | 39. | **2** | 46. | **5** | | |

## Physics

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 51. | **4** | 58. | **3** | 65. | **2** | 72. | **2** |
| 52. | **2** | 59. | **1** | 66. | **2** | 73. | **15** |
| 53. | **4** | 60. | **1** | 67. | **1** | 74. | **80** |
| 54. | **3** | 61. | **2** | 68. | **4** | 75. | **4** |
| 55. | **2** | 62. | **1** | 69. | **3** | | |
| 56. | **4** | 63. | **1** | 70. | **2** | | |
| 57. | **4** | 64. | **3** | 71. | **8** | | |

# SOLUTIONS

**Q1.**

**Answer:** A

**Explanation:**

Reaction (i) involves the removal of HBrto form an unsaturated alkene, which is an elimination. Reaction (ii) involves the replacement of a bromine atom with a hydroxyl group, which is a substitution. Reaction (iii) involves the adding of $Br_2$ across a double bond, which is an addition reaction.

**Q2.**

**Answer:** D

**Explanation:**

The reaction of $m$-bromoanisole with sodamide ($NaNH_2$) involves an elimination-addition mechanism via a benzyne intermediate. The methoxy group directs the incoming nucleophile ($NH_2^-$) to the metaposition, resulting in 3-methoxyaniline as the product.

**Q3.**

**Answer:** D

**Explanation:**

When a tertiary ($3^\circ$) alkyl halide like t-butyl bromide reacts with a strong base/nucleophile like sodium methoxide, elimination is the exclusive pathway. The methoxide ion acts as a base and abstracts a $\beta$-hydrogen, resulting in the formation of an alkene.

**Q4.**

**Answer:** B

**Explanation:**

The outcome of a reaction with KOH depends on the solvent. Aqueous KOHfavors substitution ($S_N2/S_N1$), while alcoholicKOHacts as a strong base and favors dehydrohalogenation (elimination). In option B, the tertiary alkyl halide reacts with alcoholicKOH to undergo E2 elimination, forming an alkene.

**Q5.**

**Answer:** D

**Explanation:**

The reaction involves a tertiary alkyl halide and a bulky base (potassium t-butoxide). Because the substrate is sterically hindered and the base is also extremely bulky, nucleophilic substitution ($S_N2$) is impossible. Instead, E2 elimination occurs exclusively.

**Q6.**

**Answer:** D

**Explanation:**

The combination of NaOH and ethanol ($C_2H_5OH$) forms ethoxide ions, which promoteE2 elimination. In a cyclic system with an existing double bond, the elimination of HCl leads to the formation of a conjugated diene, which is thermodynamically more stable.

**Q7.**

**Answer:** B

**Explanation:**

The reaction takes place in the presence of sodium methoxide ((\mathrm{CH_3O^-})) in methanol. The substrate undergoes dehydrohalogenation (E2 elimination). Removal of a β-hydrogen and simultaneous elimination of bromide lead to the formation of the more substituted alkene. According to Saytzeff's rule, the more substituted alkene is the major product. Hence, Option B is the correct answer.

**Q8.**

**Answer:** A

**Explanation:**

$E_1$ reactions proceed via a carbocation intermediate. The rate depends on the stability of this carbocation. Allylic carbocations are resonance-stabilized and significantly more stable than secondary or primary alkyl carbocations.

**Q9.**

**Answer:** C

**Explanation:**

The Saytzeff rule states that the more substituted alkene is the major product. This is generally favored by small bases. However, if a bulky base like potassium tertiary-butoxide (used in reaction 3) is used, steric hindrance prevents it from reaching the more substituted carbon, resulting in the Hoffman product (less substituted alkene) instead.

**Q10.**

**Answer:** C

**Explanation:**

This is anE1elimination reaction. The iodine leaves to form a secondary carbocation. A 1,2-hydride shift occurs to form a more stable tertiary carbocation. The subsequent loss of a proton yields the most substituted (Saytzeff) alkene.

**Q11.**

**Answer:** B

**Explanation:**

In $E_2$ elimination, the most acidic hydrogen is abstracted. In 3-bromo-2-fluoropentane, the hydrogen on $C_2$ is the most acidic because it is adjacent to the highly electronegative fluorine atom (-Ieffect). Its removal, along with the leaving of the bromide ion from $C_3$, results in an alkene where the fluorine is attached to the double bond.

**Q12.**

**Answer:** B

**Explanation:**

Reaction (1) is a hydrolysis in water, which for a tertiary halide follows the $S_N1$ mechanism. The rate of $S_N1$ depends only on the concentration of the substrate. Reaction (2) in ethanol favors E2 elimination, where the rate depends on both the substrate and the base concentration.

**Q13.**

**Answer:** A

**Explanation:**

The reaction sequence involves two successive eliminations. Alcoholic KOH removes the first equivalent of HBr to form a vinyl bromide. The much stronger base $NaNH_2$ is then required to eliminate the second equivalent of HBr from the hindered vinyl position, resulting in a terminal alkyne.

**Q14.**

**Answer:** B

**Explanation:**

In a polar protic solvent like methanol, a secondary allylic bromide undergoes $S_N1$ solvolysis. The bromide ion leaves to form a secondary allylic carbocation, which then rearranges (resonance) to form a more stable tertiary allylic carbocation. The nucleophile ($CH_3OH$) then attacks the more stable site.

**Q15.**

**Answer:** C

**Explanation:**

The substrate is a secondary alkyl halide. While NaOMe is a strong nucleophile, the $\beta$-carbon is quaternary (bearing two methyl groups), creating significant steric hindrance for $S_N2$. Thus, E2 elimination occurs at the other available $\beta$-carbon (the $CH_2$ group), forming an alkene.

**Q16.**

**Answer:** C

**Explanation:**

Sodium ethoxide ($C_2H_5ONa$) .is a strong base that facilitates anE2 elimination reaction. In this specific substrate, the hydrogen at the benzylic position is more acidic due to the $-I$ effect of the phenyl ring, and its removal results in a double bond conjugated with the aromatic ring, which is thermodynamically favored.

**Q17.**

**Answer:** D

**Explanation:**

The reaction involves double dehydrohalogenation using alcoholic KOH and heat. The process follows the Saytzeff rule, which states that the more substituted alkene is the major product. Additionally, the formation of a conjugated diene provides extra stability through resonance.

**Q18.**

**Answer:** B

**Explanation:**

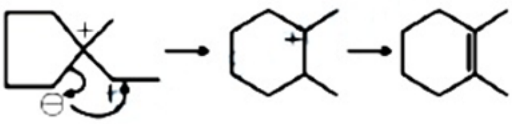
Elimination is highly favored when a bulky base like potassium tert-butoxide ( $t-BuOK$) is used at high temperatures. The reaction results in the loss of HBr to form stilbene, a highly stable conjugated aromatic alkene.

**Q19.**

**Answer:** B

**Explanation:**

(Provide the same solution given in the document (page)) The explanation cannot be reproduced because the source page containing the solution is not included in the uploaded image.



**Q20.**

**Answer:** A

**Explanation:**

This is a dehydrohalogenation (E2) reaction. The double bond forms between the carbons such that it is in conjugation with the phenyl group, which significantly lowers the energy of the product and makes it the major species.

**Q21.**

**Answer:** 5

**Explanation:**

Elimination from -bromo- -cyclopentylhexane can occur at multiple -carbon positions. The total count must include all distinct structural isomers and their respective geometrical isomers ( and configurations).,

**Q22.**

**Answer:** 3

**Explanation:**

**A** [u1] **→ q (E2 reaction):** Formation of $CH_2 = CH - CD_3$ as the major product is due to the primary kinetic isotope effect in a concerted **E2** elimination.

**B → q (E2 reaction):** $Ph - CHBr - CH_3$ reacts faster than $Ph - CHBr - CD_3$ because cleavage of the $\beta$-C–H bond occurs in the rate-determining step, showing a primary isotope effect characteristic of **E2**.

**C → r (E1CB reaction):** In $C_2H_5OD/C_2H_5O^-$, deuterium incorporation before elimination proceeds through a carbanion intermediate, indicating an **E1CB** mechanism.

**D → p, s (E1 reaction; First order reaction):** Both compounds react at the same rate because the rate-determining step is ionization (formation of carbocation), which does not involve C–H/C–D bond cleavage. Hence it is an **E1**, **first-order** reaction.

---

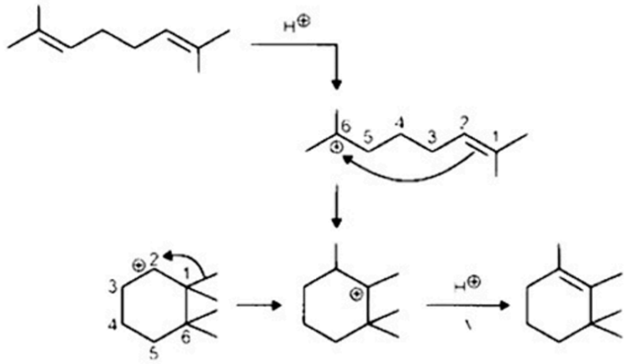
[u1]

**Q23.**

**Answer:** 2

**Explanation:**

(Provide the same solution given in the document (page)) The uploaded image contains only the question and reaction. The options (A–D) and the explanation page are missing, so I cannot reproduce the explanation from the source document or identify the correct option.



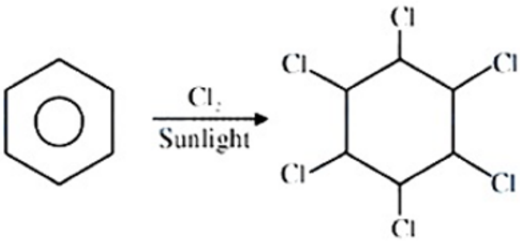

Number of sp$^2$ hybridised carbon atoms = 2

**Q24.**

**Answer:** 6 (The integer answer is 6)

**Explanation:**

(Source Page 25): Benzene undergoes an addition reaction with chlorine under the influence of ultraviolet light (sunlight) to form Benzene Hexachloride (BHC), also known as Gammexane or Lindane. The formula for the product is $C_6H_6Cl_6$.



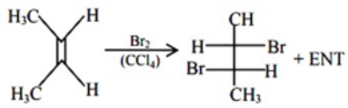

**Q25.**

**Answer:** 2

**Explanation:**

(Source Page 36): The sequence involves anti-Markovnikov addition of $HBr$ followed by a Swarts reaction to substitute the bromine with fluorine. The source indicates that the total number of products/stereoisomers possible for this sequence is 2.

**Solution:**




The total number of products possible = 2

**Q26.**

**Answer:** A

**Explanation:**

The equation of any circle passing through the intersection of two circles $S_1 = 0$ and $S_2 = 0$ is given by $S_1 + \lambda S_2 = 0$. Since the center of the required circle lies on the y-axis, its x-coordinate must be zero ($X_c = 0$). We use this condition to find $\lambda$ and substitute it back into the equation to get the final circle.

**Q27.**

**Answer:** C

**Explanation:**

Any circle through the intersection of the two given circles is of the form $S_1 + \lambda S_2 = 0$. Since the center lies on the x-axis, its y-coordinate must be zero ($Y_c = 0$). This helps resolve the value of $\lambda$.

**Q28.**

**Answer:** B

**Explanation:**

The family of circles passing through the intersection is represented as $S_1 + \lambda S_2 = 0$. Since this required circle passes through the origin $(0, 0)$, substituting $x = 0$ and $y = 0$ allows us to easily compute the value of $\lambda$.

**Q29.**

**Answer:** B

**Explanation:**
The equation of any circle passing through the intersection of a circle $S = 0$ and a line $L = 0$ is given by $S + \lambda L = 0$. Since the line segment $AB$ acts as a diameter of this new circle, the center of the new circle must lie exactly on the given line $L = 0$. We use this geometric constraint to solve for $\lambda$ and find the final equation.

**Q30.**

**Answer:** A

**Explanation:**
Any circle passing through the intersection of the circle and the line can be represented as $S + \lambda L = 0$. Since the chord $AB$ serves as the diameter, the center of this family of circles lies directly on the line $2x - y - 1 = 0$, allowing us to solve for $\lambda$.

**Q31.**

**Answer:** A

**Explanation:**

First, find the equation of the common chord (line) by subtracting the two circle equations ($S_1 - S_2 = 0$). Then, express the family of circles passing through the intersection of the first circle and this line using $S_1 + \lambda L = 0$. Since the common chord is the diameter, the center of the new circle must lie on this chord.

**Q32.**

**Answer:** B

**Explanation:**

The equation of any circle passing through the intersection of a circle $S = 0$ and a line $L = 0$ is given by $S + \lambda L = 0$. Since the line segment $AB$ acts as a diameter of this new circle, the center of the new circle must lie exactly on the given line $L = 0$. We use this geometric constraint to solve for $\lambda$ and find the final equation.

**Q33.**

**Answer:** A

**Explanation:**

Any circle passing through the intersection of the circle and the line can be represented as $S + \lambda L = 0$. Since the chord $AB$ serves as the diameter, the center of this family of circles lies directly on the line $2x - y - 1 = 0$, allowing us to solve for $\lambda$.

**Q34.**

**Answer:** A

**Explanation:**

First, find the equation of the common chord (line) by subtracting the two circle equations ($S_1 - S_2 = 0$). Then, express the family of circles passing through the intersection of the first circle and this line using $S_1 + \lambda L = 0$. Since the common chord is the diameter, the center of the new circle must lie on this chord.

**Q35.**

**Answer:** A

**Explanation:**

The equation of a family of circles touching a given line $L = 0$ at a point $P(x_1, y_1)$ can be represented by treating $P$ as a point-circle: $(x - x_1)^2 + (y - y_1)^2 + \lambda L = 0$. Since the circle passes through a second point $Q$, substituting $Q$'s coordinates into the family equation allows us to find the parameter $\lambda$.

**Q36.**

**Answer:** A

**Explanation:**

We can write the family of circles touching the line $x - y = 0$ at $(1, 1)$ as $(x - 1)^2 + (y - 1)^2 + \lambda(x - y) = 0$. Using the condition that it passes through $(2, 0)$, we find the parameter $\lambda$.

**Q37.**

**Answer:** B

**Explanation:**

The line is $y = 0$ and the point of tangency is $(0, 0)$. The family of circles is $(x - 0)^2 + (y - 0)^2 + \lambda y = 0$. Since it passes through $(2, 3)$, substituting these coordinates lets us solve for $\lambda$.

**Q38.**

**Answer:** A

**Explanation:**

Using the family of circles concept, the equation of any circle touching a given line $L = 0$ at a specific point $(x_1, y_1)$ is written as $(x - x_1)^2 + (y - y_1)^2 + \lambda L = 0$. By substituting the coordinates of the external point $Q$ into this equation, we solve for the parameter $\lambda$ to find the specific circle's equation.

**Q39.**

**Answer:** B

**Explanation:**

Using the family of circles concept, the equation of any circle touching a given line $L = 0$ at a specific point $(x_1, y_1)$ is written as $(x - x_1)^2 + (y - y_1)^2 + \lambda L = 0$. By substituting the coordinates of the external point $Q$ into this equation, we solve for the parameter $\lambda$ to find the specific circle's equation.

**Q40.**

**Answer:** A

**Explanation:**

Using the family of circles concept, the equation of any circle touching a given line $L = 0$ at a specific point $(x_1, y_1)$ is written as $(x - x_1)^2 + (y - y_1)^2 + \lambda L = 0$. By substituting the coordinates of the external point $Q$ into this equation, we solve for the parameter $\lambda$ to find the specific circle's equation.

**Q41.**

**Answer:** B

**Explanation:**

To find the length of the intercepted chord, we first determine the center and radius of the circle. Then, we calculate the perpendicular distance from the center of the circle to the given line. By drawing a perpendicular from the center to the chord, it bisects the chord, forming a right-angled triangle with the radius as the hypotenuse. Applying the Pythagorean theorem allows us to find half the chord's length, which is then doubled to find the full length.

**Q42.**

**Answer:** A

**Explanation:**

To find the length of the intercepted chord, we first determine the center and radius of the circle. Then, we calculate the perpendicular distance from the center of the circle to the given line. By drawing a perpendicular from the center to the chord, it bisects the chord, forming a right-angled triangle with the radius as the hypotenuse. Applying the Pythagorean theorem allows us to find half the chord's length, which is then doubled to find the full length.

**Q43.**

**Answer:** A

**Explanation:**

To find the length of the intercepted chord, we first determine the center and radius of the circle. Then, we calculate the perpendicular distance from the center of the circle to the given line. By drawing a perpendicular from the center to the chord, it bisects the chord, forming a right-angled triangle with the radius as the hypotenuse. Applying the Pythagorean theorem allows us to find half the chord's length, which is then doubled to find the full length.

**Q44.**

**Answer:** A

**Explanation:**

Let the required point of intersection of the tangents be $P(x_1, y_1)$. The line joining the points of tangency is the Chord of Contact for point $P$ with respect to the circle. By writing the equation of the Chord of Contact and comparing it with the given line equation, we can find the coordinates of $P$ since both equations represent the same line.

**Q45.**

**Answer:** B

**Explanation:**

Let the required point of intersection of the tangents be $P(x_1, y_1)$. The line joining the points of tangency is the Chord of Contact for point $P$ with respect to the circle. By writing the equation of the Chord of Contact and comparing it with the given line equation, we can find the coordinates of $P$ since both equations represent the same line.

**Q46.**

**Answer:** 5

**Explanation:**

Since the line $2x + y = \lambda$ touches the circle $x^2 + y^2 = 5$, the perpendicular distance from the origin $(0, 0)$ to the line must equal the radius $\sqrt{5}$. This determines the value of $\lambda$ directly.

**Q47.**

**Answer:** 15

**Explanation:**

A normal to a circle always passes through its center. Therefore, the given line $3x + 4y = c$ must pass through the center of the second circle, which lets us solve for the value of $c$. Once $c$ is known, we can verify that this line is indeed tangent to the first circle by showing that the perpendicular distance from the center of the first circle to the line equals the first circle's radius.

**Q48.**

**Answer:** 2

**Explanation:**

Since the two given tangents are parallel, the distance between them is equal to the diameter $(2r)$ of the circle. The center of the circle must lie exactly halfway between these parallel lines, forming a line parallel to them. The intersection of this midline with the given normal line gives the coordinates of the center $(\alpha, \beta)$.

**Q49.**

**Answer:** 9

**Explanation:**

The center of the circle $(\alpha, \beta)$ must lie on the given normal line since any normal to a circle passes through its center. The perpendicular distance from the center $(\alpha, \beta)$ to both tangent lines must equal the radius $r$. By setting up equations for the normal and equating the distances to both tangents, we can find the coordinates of the center and the radius, checking against the constraint $r < 5$.

**Q50.**

**Answer:** 18

**Explanation:**

To find the area of the triangle, we need to determine its three vertices. These vertices are formed by the intersection of the normal and the X-axis, the tangent and the X-axis, and the point of tangency itself. We first find the equation of the tangent line at the given point and find its x-intercept. Since the normal to a circle with its center at the origin passes through the origin, the origin becomes our second vertex. The distance between the origin and the tangent's x-intercept forms the base of the triangle, and the y-coordinate of the point of tangency serves as its height.

**Q51.**

**Answer:** D

**Explanation:**

$C_3, C_5$ and $C_6$ are in parallel and $C_4$ is in series with it. Then $C_2$ is in parallel and $C_1$ is in series.

**Q52.**

**Answer:** B

**Explanation:**

Plate $2$ and $3$ will be at same potential. So, there will be two capacitors in parallel.

**Q53.**

**Answer:** D

**Explanation:**

$C_{\text{eq}} = C + 2C + 3C + \cdots + nC = \frac{(n+1)n}{2} C$

**Q54.**

**Answer:** C

**Explanation:**

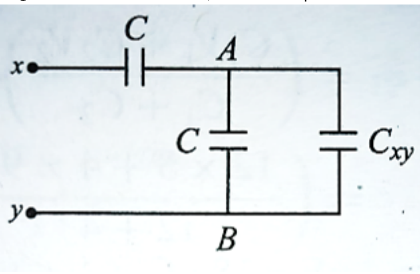
The four plates are alternately connected. They form three capacitors in parallel. Capacity of each capacitor is $\frac{\varepsilon_0 A}{d}$. So, the net capacity is $\frac{3\varepsilon_0 A}{d}$.

**Q55.**

**Answer:** B

**Explanation:**

As $\infty \pm 1 = \infty$ Therefore, if one link is reduced or added to the circuit, the capacitance remains unchanged. If $C_{xy}$is equivalent capacitance between (x) and (y), then the equivalent circuit is shown in figure. The capacitances$C_{xy}$and C connected between (A) and (B) are in parallel. Their effective capacitance$C_1 = C + C_{xy}$. Now, C (connected between (x) and (A)) and$C_1$are in series. Therefore, effective capacitance between (x)




and (y) is$C_{xy} = \frac{CC_1}{C+C_1}$. Hence, $C_{xy} = \frac{C(C+C_{xy})}{C+C+(C_{xy})}$. Solving for $C_{xy}$, we get $C_{xy}$= $\frac{\sqrt{5}-1}{2} C = 0.618C$

**Q56.**

**Answer:** D

**Explanation:**

$C_{\text{eq}} = \frac{\varepsilon_0 A}{\frac{d}{K_1}+\frac{d}{K_2}+\frac{d}{K_3}}$ Here, $K_1 = K_3 = 1, \qquad K_2 = \frac{\varepsilon}{\varepsilon_0}$.

**Q57.**

**Answer:** D

**Explanation:**

$V_C = \frac{Q_1+Q_2}{C_1+C_2} = \frac{CV+2CV}{KC+2C} = \frac{3V}{K+2}$.

**Q58.**

**Answer:** C

**Explanation:**

Wheatstone's bridge will be formed

**Q59.**

**Answer:** A

**Explanation:**

$5\mu\text{F}, 10, mu\text{F}, 15\mu\text{F}$ will be in parallel, then $30\mu\text{F}$ will be in series.

**Q60.**

**Answer:** A

**Explanation:**

$C = \frac{\varepsilon_0 A}{d} = 0.5$ New capacitance $C' = \frac{\varepsilon_0 A}{\dfrac{d/2}{2}+\dfrac{d/2}{3}} = \frac{\varepsilon_0 A}{d}\left[\frac{1}{\dfrac{1}{4}+\dfrac{1}{6}}\right]$

$C' = C \times 2.4 = 1.2\mu\text{F}$

**Q61.**

**Answer:** B

**Explanation:**

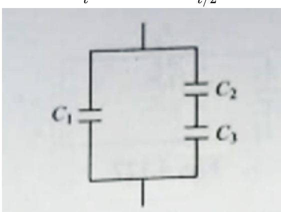
$C' = \frac{2\varepsilon_0 A/2}{d} + \frac{3\varepsilon_0 A/2}{d} = C\left[1 + \frac{3}{2}\right] = \frac{5}{2} \times 0.5 = 1.25\mu\text{F}$

**Q62.**

**Answer:** A

**Explanation:**

$C_1 = \frac{K_1\varepsilon_0 A/2}{t}$ $C_2 = \frac{K_2\varepsilon_0 A/2}{t/2}$ $C_3 = \frac{K_3\varepsilon_0 A/2}{t/2}$ Now, $C_{\text{eq}} = C_1 + \frac{C_2 C_3}{C_2+C_3}$.

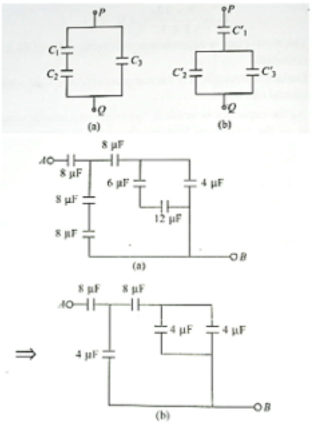


**Q63.**

**Answer:** A

**Explanation:**

We can make equivalent circuit of given system in two ways as in Fig. (a) and (b).

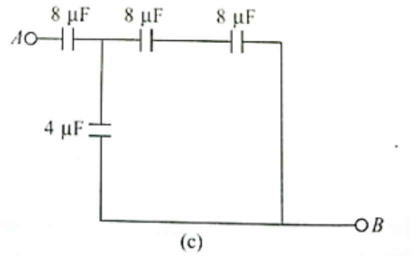


**Q64.**

**Answer:** C

**Explanation:**

Using the method of successive reduction (see Fig).

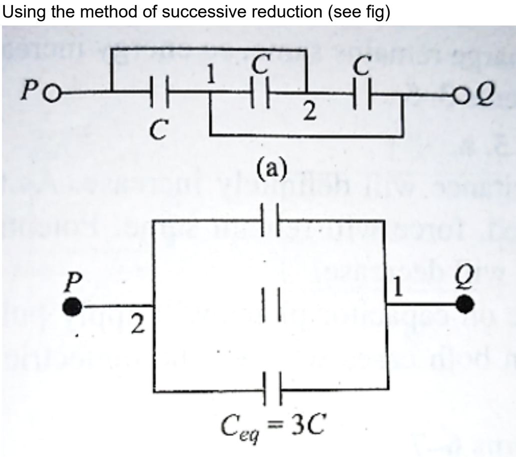



**Q65.**

**Answer:** B

**Explanation:**

Using the method of successive reduction (see fig)

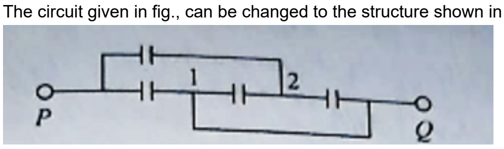



**Q66.**

**Answer:** B

**Explanation:**

The circuit given in fig., can be changed to the structure shown in fig

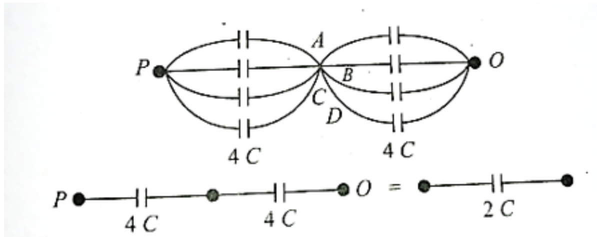



**Q67.**

**Answer:** A

**Explanation:**

A, B, C and D are equipotential points (see fig)




**Q68.**

**Answer:** D

**Explanation:**

$W = U_2 - U_1 = \frac{q^2}{2}\left[\frac{1}{C_2} - \frac{1}{C_1}\right] C_1 = \frac{\varepsilon_0 A}{d}, C_2 = \frac{C_1}{2} = \frac{\varepsilon_0 A}{2d}\ q = C_1 V = \frac{\varepsilon_0 AV}{d}$

Solve to get, $W = \frac{1}{2}\frac{\varepsilon_0 AV^2}{d}$

**Q69.**

**Answer:** C

**Explanation:**

At junction $A$, $Q_1$ will divide into $Q_2$ and $Q_3$. Hence, $Q_1 = Q_2 + Q_3$.
$C_2$ and $C_3$ are in parallel, so potential on them will be same. $V_2 = V_3$
$V$ will divide into $V_1$ and $V_2$ (or $V_3$) Hence, $V = V_1 + V_2$ or $V = V_1 + V_3$

**Q70.**

**Answer:** B

**Explanation:**

Electric field is the $-ve$ of slope of $V - x$ graph. Inside the conductor, electric field is zero, so slope of $V - x$ graph is zero. Inside dielectric, field is decreases, so slope decreases

**Q71.**

**Answer:** 8

**Explanation:**

The capacitance of a parallel plate capacitor without any dielectric is given by:

$$C = \frac{\varepsilon_0 A}{d}$$

where (A) is the area of the plates and (d) is the separation between them.

Capacitor $(C_1), Dielectric constant(K_1 = 2)$.

Thickness $(d_1 = \frac{d}{2}). Area(A_1 = A)$

So, the capacitance is:

$$C_1 = \frac{K_1 \varepsilon_0 A_1}{d_1} = \frac{2\varepsilon_0 A}{d/2} = 4\left(\frac{\varepsilon_0 A}{d}\right) = 4C$$

Capacitor $(C_2)$,Dielectric constant $(K_2 = 3)$.

Thickness $(d_2 = \frac{d}{2})$.Area $(A_1 = \frac{A}{2})$

So, the capacitance is:

$$C_2 = \frac{K_2 \varepsilon_0 A_2}{d_2} = \frac{3\varepsilon_0 (A/2)}{d/2} = 3\left(\frac{\varepsilon_0 A}{d}\right) = 3C$$

Capacitor $(C_3)$,Dielectric constant $(K_3 = 5)$.

Thickness $(d_3 = \frac{d}{2})$.Area $(A_2 = \frac{A}{2})$

So, the capacitance is:

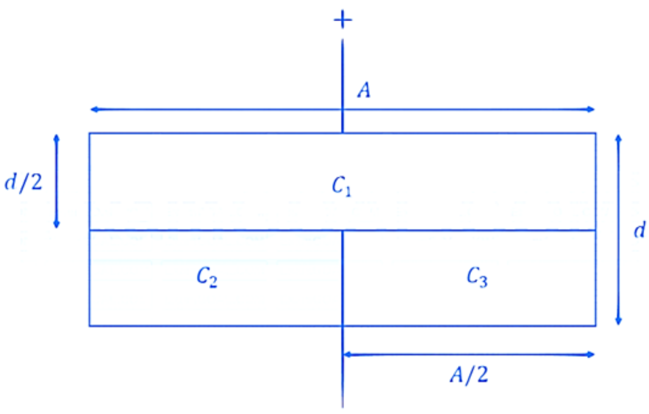
$$C_3 = \frac{K_3 \varepsilon_0 A_3}{d_3} = \frac{5\varepsilon_0 (A/2)}{d/2} = 5\left(\frac{\varepsilon_0 A}{d}\right) = 5C$$

Capacitors $(C_2)$ and $(C_3)$ are in parallel. $C_{23} = C_2 + C_3 \Rightarrow C_{23} = 3C + 5C = 8C$

This combined section $((C_{23}))$ is in series with the first capacitor $((C_1))$. $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_{23}}$
$\Rightarrow \frac{1}{C_{eq}} = \frac{1}{4C} + \frac{1}{8C} \Rightarrow \frac{1}{C_{eq}} = \frac{2+1}{8C} = \frac{3}{8C}$
$\Rightarrow C_{eq} = \frac{8C}{3} = \frac{n}{3}C \therefore\ n = 8$

Therefore, the value of (n) is 8. Hence, the correct answer is 8.

the correct answer is 8.




**Q72.**

**Answer:** 2

**Explanation:**

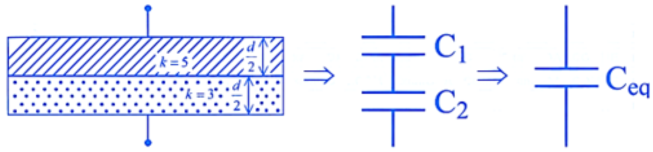
The resistance of a conductor of length $d$ and cross-sectional area $A$ is: $R = \frac{\rho d}{A}$ Where, $\rho$ is the resistivity of the material. The capacitance of a parallel plate capacitor with plate separation $d$ and area $A$ is: $C = \frac{\varepsilon_r \varepsilon_0 A}{d} \Rightarrow R \times C = \left(\frac{\rho d}{A}\right) \times \left(\frac{\varepsilon_r \varepsilon_0 A}{d}\right)$ $\Rightarrow RC = \rho \varepsilon_r \varepsilon_0 \Rightarrow \varepsilon_r = \frac{RC}{\rho \varepsilon_0}$ The resistance of material is $R = 17.7 \times 10^{14}\ \Omega$ The capacitance is $C = 1, \mu\mathrm{F} = 1 \times 10^{-6}\ \mathrm{F}$ The resistivity is $\rho = 1 \times 10^{13}\ \Omega\mathrm{m}$ And the permittivity of free space is $\varepsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F/m}$ Putting the values for relative permittivity, $\varepsilon_r = \frac{(17.7\times10^{14})\times(1\times10^{-6})}{(1\times10^{13})\times(8.85\times10^{-12})} \Rightarrow \varepsilon_r = \frac{17.7\times10^{8}}{8.85\times10^{1}} \Rightarrow \varepsilon_r = 2 \times 10^7 = \alpha \times 10^7$ $\boxed{\alpha = 2}$ Therefore, the value of $\alpha$ is 2.

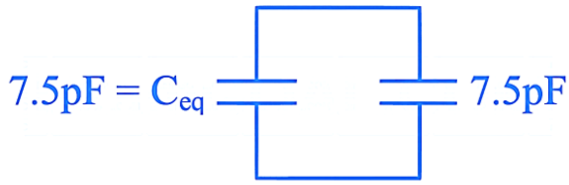
**Q73.**

**Answer:** 15

**Explanation:**

$C_1 = \frac{5\times4\times10^{-4}\times8.85\times10^{-12}}{\frac{1.77}{2}\times10^{-3}} = 20\mathrm{pF}$ $C_2 = \frac{3\times4\times10^{-4}\times8.85\times10^{-12}}{\frac{1.77}{2}\times10^{-3}} = 12\mathrm{pF}$
$C_{eq} = \frac{C_1 C_2}{C_1+C_2} = \frac{12\times20}{12+20} = 7.5\mathrm{pF}$ Finally equivalent capacitance $(C_{eq})_{\mathrm{final}} = 7.5 + 7.5 = 15\mathrm{pF}$

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**Q74.**

**Answer:** 80

**Explanation:**

$C_1 = 10, \mu\mathrm{F}, \qquad C_2 = 15, \mu\mathrm{F}$ $F = F_1 + F_2$ $\frac{(10\times10^{-6})V^2}{2\cdot\frac{d}{2}\cdot\varepsilon_0} + \frac{(15\times10^{-6})V^2}{2\cdot\frac{d}{2}\cdot\varepsilon_0} = 8$
$V^2 = 0.9 \times 10^{-4}$ $V = 0.95 \times 10^{-2}\ \mathrm{V}$

**Q75.**

**Answer:** 4

**Explanation:**

To find the resistance of the wire connecting the two plates of the capacitor, we need to apply the formula that relates the time constant $(\tau)$ $(inseconds)$ of a capacitor-resistor (CR) .circuit to the capacitance (C) (in Farads) and resistance (R) $(inOhms)$. The time constant $(\tau)$ is given by:$\tau = R \times C$

The time constant also defines the time it takes for the voltage across the capacitor (and therefore the electric field between the plates, since they are directly related) to drop to approximately $\frac{1}{e}$

(where (e) is the base of natural logarithms, approximately equal to its initial value. However, the question states that the electric field drops to one-third of its initial value. Using the natural logarithm properties, we can relate this decay process to the concept of the time constant.

The formula for the voltage (or electric field) across a discharging capacitor as a function of time is:$V(t) = V_0 \times e^{-\frac{t}{RC}}$

where:

$(V(t))$ is the voltage across the capacitor at time (t),$(V_0)$ is the initial voltage,

$(R)$ is the resistance,$(C)$ is the capacitance, and $(t)$ is the time.

Given that the electric field drops to one-third of its initial value in $(6.6, \mu s)$, we can set $(V(t))$ to $(\dfrac{1}{3}V_0)$ and solve for (R): $\frac{1}{3}V_0 = V_0 \times e^{-\frac{6.6\mu s}{RC}}$

By dividing both sides by $(V_0)$, we simplify to: $\frac{1}{3} = e^{-\frac{6.6}{R \times 1.5}}$

Taking the natural logarithm of both sides to solve for (R):$\ln\left(\frac{1}{3}\right) = \frac{-6.6}{R \times 1.5}$

Given that$\ln\left(\frac{1}{3}\right) = \ln(3^{-1}) = -\ln(3) = -1.1$

(since $(\log 3 = 1.1)$ and using the natural log instead of common log), we have:

$-1.1 = \frac{-6.6}{R \times 1.5}$

Solving for (R):

$R = \frac{6.6}{1.5 \times 1.1}$Now, calculate the value of (R):$R = \frac{6.6}{1.65} = 4, \Omega$

Therefore, the resistance of the wire connecting the two plates of the capacitor is $(4, \Omega)$.