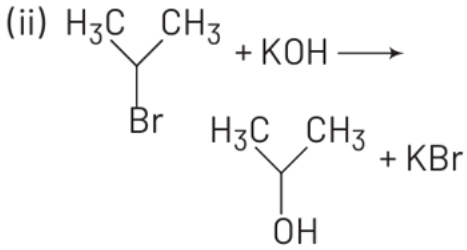
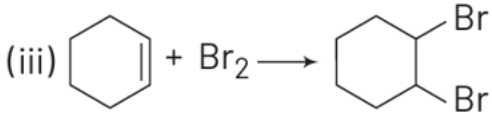
Max Marks: 300 | SR_FTB(WEEK-4) (06-07-2026) | Time: 180 mins

Chemistry

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

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

(ii) 

(iii) 

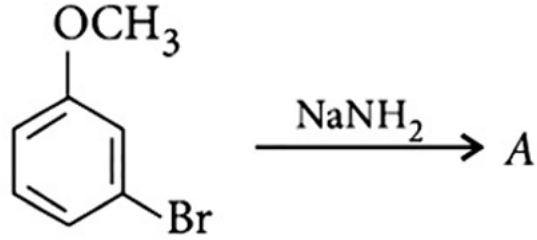
A) (i) is elimination reaction, (ii) is substitution and (iii) is addition reaction

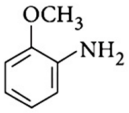
B) (i) is elimination, (ii) and (iii) are substitution reactions

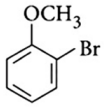
C) (i) is substitution, (ii) and (iii) are addition reactions

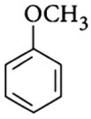
D) (i) and (ii) are elimination reactions and (iii) is addition reaction

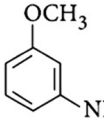
2. Identify A and predict the type of reaction.



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:

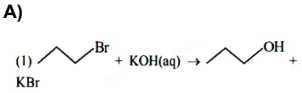
A) sodium t-butoxide

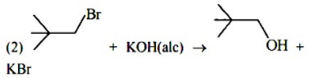
B) t-butyl methyl ether

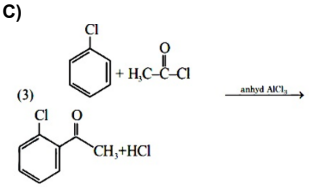
C) isobutane

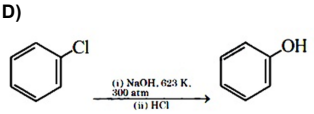
D) isobutylene

4. Identify the incorrect option from the following:

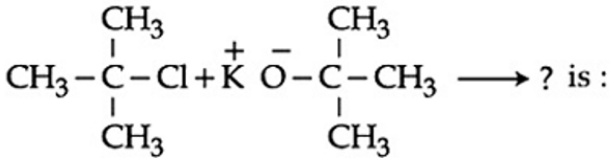
A) 

B) 

C) 

D) 

5. The major product in the reaction:



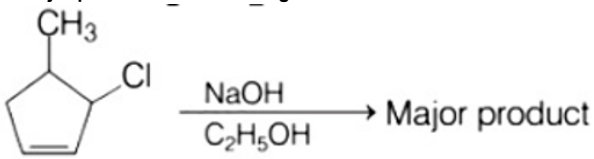
A) t-Butyl ethyl ether

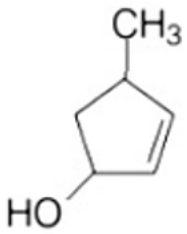
B) 2,2-Dimethyl butane

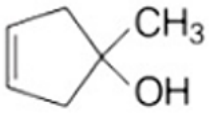
C) 2-Methyl pent-1-ene

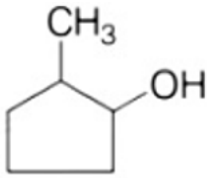
D) 2-Methyl prop-1-ene

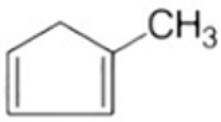
6. The major product of the following reaction is:



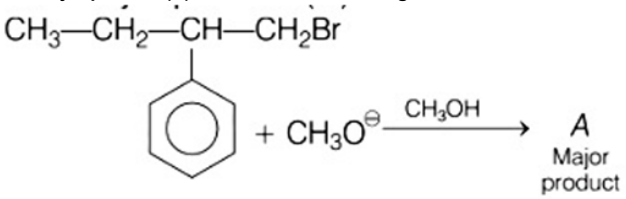
A) 

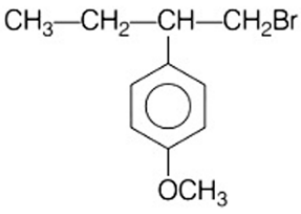
B) 

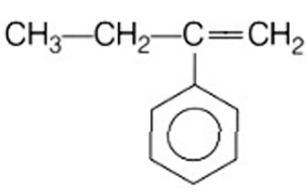
C) 

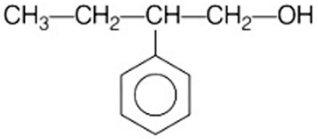
D) 

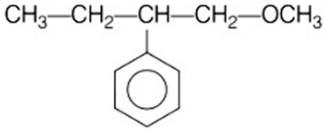
7. The major product (A) formed in the reaction given below is:



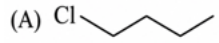
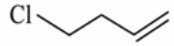
A) 

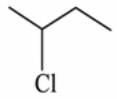
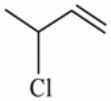
B) 

C) 

D) 

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

(A)  (B) 

(C)  (D) 

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)**

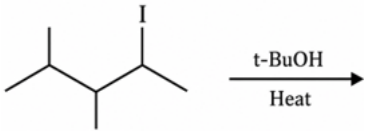
$(CH_3)_2CHCH(Br)CH_3 \xrightarrow{(CH_3)_3O^-K^+}$ **(4)**

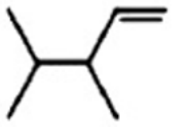
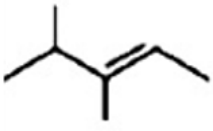
$(CH_3)_3CCH(OH)CH_3 \xrightarrow{conc.\ H_2SO_4}$ **Which of these reaction(s) will not produce Saytzeff product?**

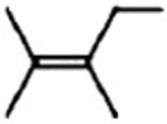
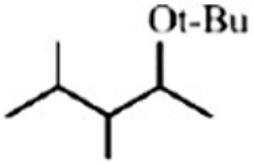
A) (1), (3) and (4) **B)** (4) only

C) (3) only **D)** (2) and (4)

10. The major product in the following reaction is:



A)  **B)** 

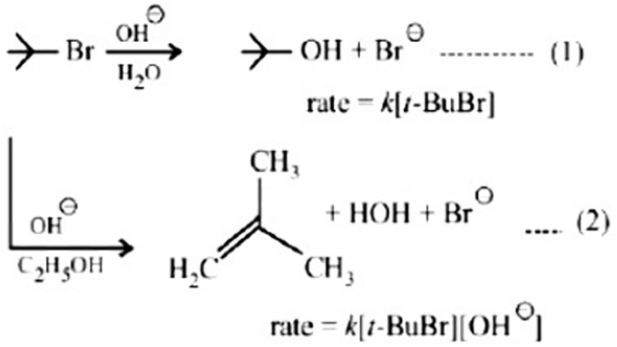
C)  **D)** 

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

A) $CH_3CH_2-\overset{Br}{\underset{|}{C}}H-CH=CH_2$ **B)** $CH_3CH_2CH=\underset{CH_3}{\overset{|}{C}}-F$

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

12. Consider the reaction sequence given below:



Which of the following statements is true?

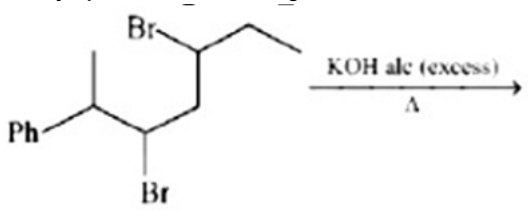
A) Changing the base from OH^- to ^-OR will have no effect on reaction (2).

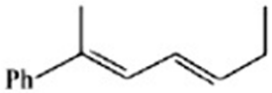
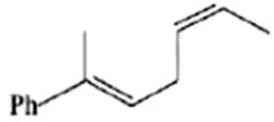
B) Changing the concentration of base will have no effect on reaction (1).

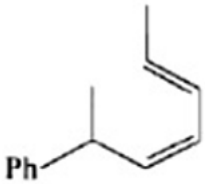
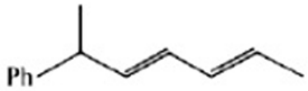
C) Doubling the concentration of base will double the rate of both the reactions.

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

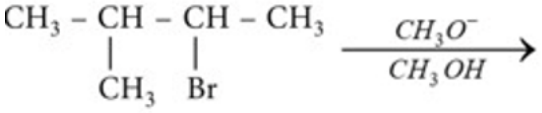
13. The major product of the following reaction is:



A)  **B)** 

C)  **D)** 

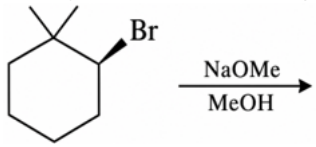
14. The major product of the following reaction is:

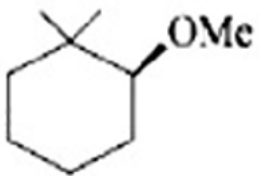
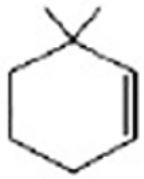


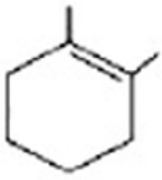
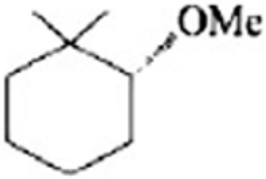
A) $CH_3-\overset{CH_3}{\underset{H}{\overset{|}{\underset{|}{C}}}}=CH=CH_2$ **B)** $CH_3-\overset{CH_3}{\overset{|}{C}}=CHCH_3$

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

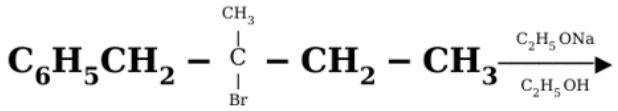
15. The major product of the following reaction is:



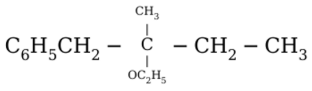
A)  **B)** 

C)  **D)** 

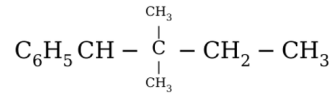
16. The major product of the following reaction is:



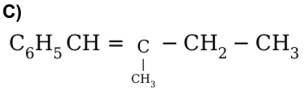
A)



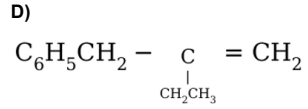
B)



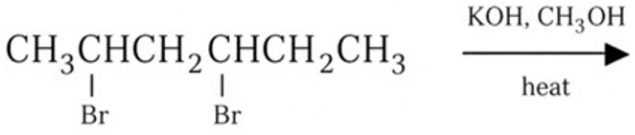
C)



D)



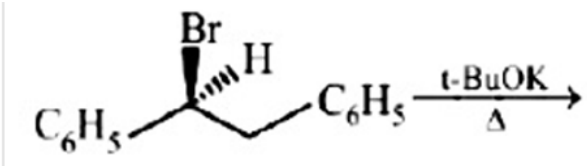
17. The major product of the following reaction is:



A) $CH_2 = CHCH_2CH = CHCH_2CH_3$ **B)** $CH_2 = CHCH = CHCH_2CH_3$

C) $CH_3CH = C = CHCH_2CH_3$ **D)** $CH_3CH = CH - CH = CHCH_3$

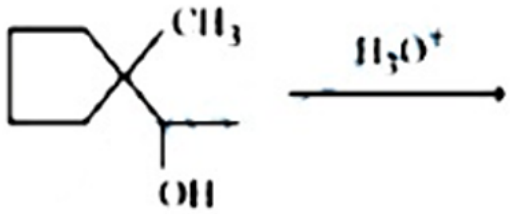
18. The major product obtained in the following reaction is:



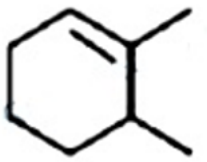
A) $(\pm)C_6H_5CH(O^tBu)CH_2C_6H_5$ **B)** $C_6H_5CH = CHC_6H_5$

C) $(+)C_6H_5CH(O^tBu)CH_2C_6H_5$ **D)** $(-)C_6H_5CH(O^tBu)CH_2C_6H_5$

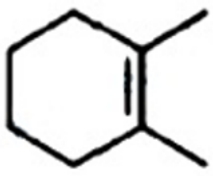
19. Find out the major product for the following reaction.



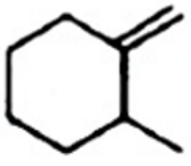
A)



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.

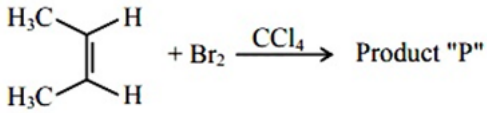
$A \to Q$, $B \to Q$, $C \to R, S$, $D \to P, S$

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 2



Maths

26. Pair of tangents are drawn from point P to the circle$x^2 + y^2 = a^2$ are at 60° angle to each other. Find the locus of P?

A) $x^2 + y^2 = 4a^2$ **B)** $x^2 + y^2 = 2a^2$

C) $x^2 + y^2 = 3a^2$ **D)** $x^2 + y^2 = a^2$

27. The line $y = x$ is a tangent at $(0, 0)$ to a circle of radius is 1, then possible centre of the circle is

A) $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ **B)** $(1, 2)$

C) $\left(-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ **D)** $\left(-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right)$

28. Centre of the circle touching y-axis at $(0, 3)$ and making an intercept 2 units on positive X-axis is

A) $(\sqrt{10}, 3)$ **B)** $(3, \sqrt{10})$

C) $(-\sqrt{10}, 3)$ **D)** $(-\sqrt{10}, -3)$

29. The equation of the chord of $x^2 + y^2 - 4x + 6y + 3 = 0$ whose mid point is $(1, -2)$ is

A) $x + y + 1 = 0$ **B)** $2x + 3y + 4 = 0$

C) $x - y - 3 = 0$ **D)** not existing

30. The line $x\cos\alpha + y\sin\alpha = p$ intersects the circle $x^2 + y^2 = 4$ at A and B. If the chord AB makes an angle 30° at a point on the circumference of the circle, then $p^2 =$

A) 3 **B)** $4\cos^2 15^\circ$

C) 2 **D)** 6

31. The mid point of the chord $x - 2y + 7 = 0$ w.r.t the circle $x^2 + y^2 - 2x - 10y + 1 = 0$ is

A) $(7, 21)$ **B)** $(\frac{7}{4}, \frac{21}{4})$

C) $(\frac{7}{5}, \frac{21}{5})$ **D)** $(-\frac{7}{5}, -\frac{21}{5})$

32. Equation of the circle with centre $(5, -4)$ and touching y-axis is

A) $x^2 + y^2 - 10x + 8y + 16 = 0$ **B)** $x^2 + y^2 + 10x + 8y + 16 = 0$

C) $x^2 + y^2 - 10x - 8y + 16 = 0$ **D)** $x^2 + y^2 + 10x - 8y + 16 = 0$

33. Let AB be a chord of length 12 of the circle $(x-2)^2+(y+1)^2=\frac{169}{4}$. If tangents drawn to the circle at points A and B intersect at the point P, then five times the distance of point P from chord AB is equal to _____.

A) 100 **B)** 216
C) 72 **D)** 580

34. If P is a point on the circle $x^2+y^2=4$, Q is a point on the straight line $5x+y+2=0$ and $x-y+1=0$ is the perpendicular bisector of PQ, then 13 times the sum of abscissa of all such points P is _____.

A) 8 **B)** 2
C) 6 **D)** 5

35. The set of all values of a^2 for which the line $x+y=0$ bisects two distinct chords drawn from a point $P\left(\frac{1+a}{2},\frac{1-a}{2}\right)$ on the circle $2x^2+2y^2-(1+a)x-(1-a)y=0$, is equal to :

A) $(0,4]$ **B)** $(4,\infty)$
C) $(2,12]$ **D)** $(8,\infty)$

36. If one of the diameters of the circle $x^2+y^2-2\sqrt{2}x-6\sqrt{2}y+14=0$ is a chord of the circle $(x-2\sqrt{2})^2+(y-2\sqrt{2})^2=r^2$, then the value of r^2 is equal to _____.

A) 12 **B)** 18
C) 10 **D)** 20

37. If one of the diameters of the circle $x^2+y^2-2x-6y+6=0$ is a chord of another circle 'C', whose center is at $(2,1)$, then its radius is _____.

A) 2 **B)** 3
C) 7 **D)** 5

38. If the length of the chord of the circle, $x^2+y^2=r^2$ $(r>0)$ along the line, $y-2x=3$ is r, then r^2 is equal to :

A) $\frac{9}{5}$ **B)** $\frac{24}{5}$
C) $\frac{12}{5}$ **D)** 12

39. If the angle of intersection at a point where the two circles with radii 5 cm and 12 cm intersect is 90^0, then the length (in cm) of their common chord is :

A) $\frac{13}{5}$ **B)** $\frac{60}{13}$
C) $\frac{120}{13}$ **D)** $\frac{13}{2}$

40. A line drawn through the point $P(4,7)$ cuts the circle $x^2+y^2=9$ at the points A and B. Then $PA\cdot PB$ is equal to :

A) 53 **B)** 56
C) 74 **D)** 65

41. If one of the diameters of the circle, given by the equation, $x^2+y^2-4x+6y-12=0$, is a chord of a circle S, whose centre is at $(-3,2)$, then the radius of S is :

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

42. Let C be the circle with centre $(0,0)$ and radius 3 units. The equation of the locus of the mid points of the chords of the circle C that subtend an angle of $\frac{2\pi}{3}$ at its center is :

A) $x^2+y^2=\frac{3}{2}$ **B)** $x^2+y^2=1$
C) $x^2+y^2=\frac{27}{4}$ **D)** $x^2+y^2=\frac{9}{4}$

43. If the tangents at the points P and Q on the circle $x^2+y^2-2x+y=5$ meet at the point $R\left(\frac{9}{4},2\right)$, then the area of the triangle PQR is :

A) $\frac{13}{8}$ **B)** $\frac{5}{8}$
C) $\frac{5}{4}$ **D)** $\frac{13}{4}$

44. Let O be the origin and OP and OQ be the tangents to the circle $x^2+y^2-6x+4y+8=0$ at the points P and Q on it. If the circumcircle of the triangle OPQ passes through the point $(\alpha,\frac{1}{2})$, then a value of α is :

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

45. Let the tangents at two points A and B on the circle $x^2+y^2-4x+3=0$ meet at origin $O(0,0)$. Then the area of the triangle OAB is :

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

46. If the points $(0,0),(2,0),(0,-2)$, and $(k,-2)$ are concyclic then $k=$

47. Let A be the centre of the circle $x^2+y^2-2x-4y-20=0$. Suppose the tangents at the points $B(1,7)$ and $D(4,-2)$ on the circle meet at C. If area of the quadrilateral $ABCD$ is λ then Find $\lambda/15$.

48. From a point P outside a circle with centre at C, tangents PA and PB are drawn such that $\angle APB=120^\circ$, then the length of chord AB is (Given $CP=16$):

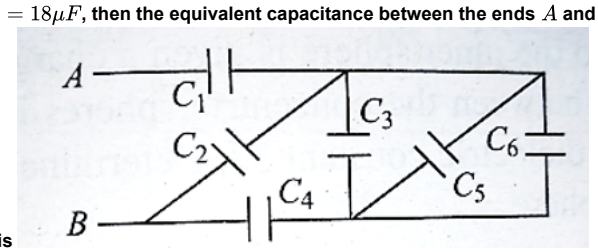
49. If $\left(0,\frac{5}{2}\right)$ is a centre of similitude for the circles $x^2+y^2+6x-2y+1=0$ and $x^2+y^2-2x-6y+9=0$ then the length of the common tangent of the circles through it is

50. There are two circles whose equations are $x^2+y^2=9$ and $x^2+y^2-8x-6y+n^2=0,;n\in\mathbb{Z}$. If two circles have exactly two common tangents then the number of possible values of n is

A) 2 **B)** 8
C) 9 **D)** 10

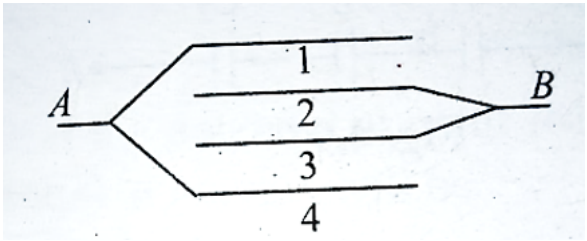
Physics

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



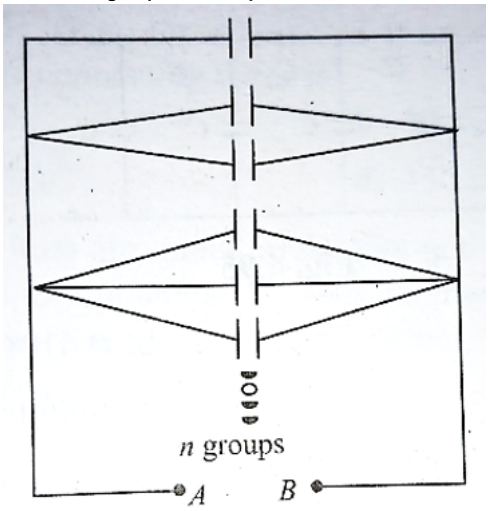
A) $1.22\mu F$ **B)** $5.16\mu F$
C) $2.25\mu F$ **D)** $2.51\mu F$

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



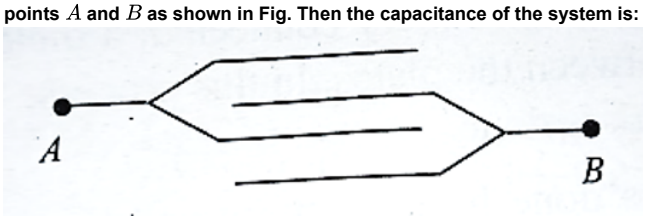
A) $\epsilon_0 A/d$ **B)** $2\epsilon_0 A/d$
C) $3\epsilon_0 A/d$ **D)** $2\epsilon_0 A/3d$

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



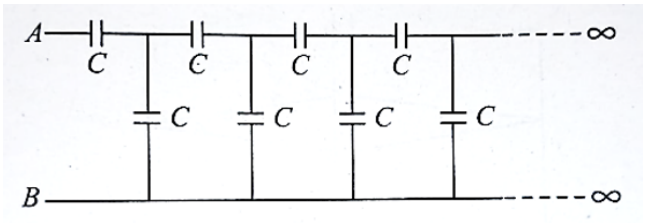
A) n^2C **B)** $(2n+1)C$
C) $\frac{(n-1)n}{2}C$ **D)** $\frac{(n+1)n}{2}C$

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:



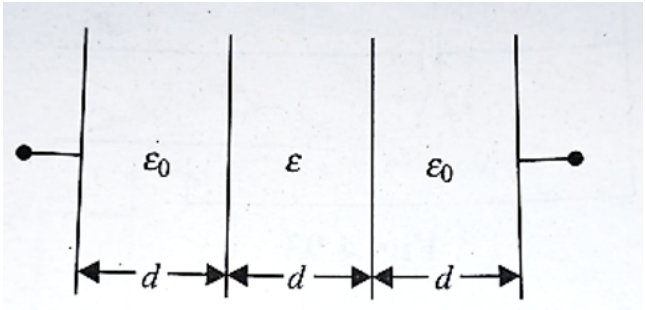
A) $\frac{\epsilon_0 A}{d}$ **B)** $\frac{2\epsilon_0 A}{d}$
C) $\frac{3\epsilon_0 A}{d}$ **D)** $\frac{4\epsilon_0 A}{d}$

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

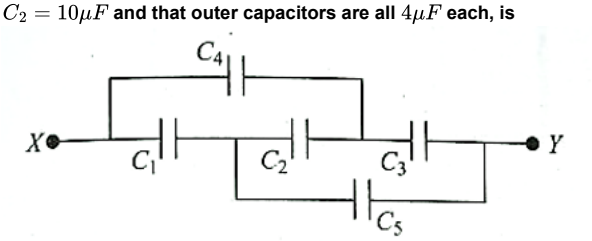


A) $\epsilon_0 A/d$ **B)** $\epsilon\epsilon_0 A/d$
C) $\frac{\epsilon\epsilon_0 A}{d(\epsilon+\epsilon_0)}$ **D)** $\frac{\epsilon\epsilon_0 A}{(2\epsilon+\epsilon_0)d}$

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

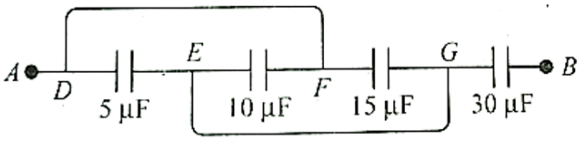
A) $\frac{2V}{K+2}$ **B)** $\frac{V}{K+2}$
C) $\frac{3V}{K+3}$ **D)** $\frac{3V}{K+2}$

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



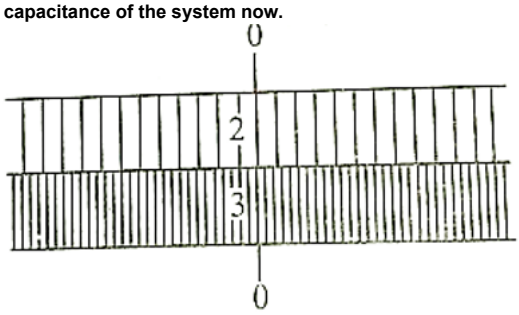
A) $1\mu F$ **B)** $3\mu F$
C) $4\mu F$ **D)** $5\mu F$

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



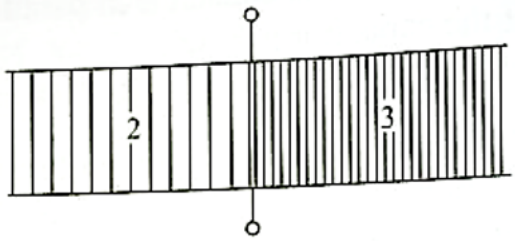
A) $15\mu F$ **B)** $30\mu F$
C) $60\mu F$ **D)** $45\mu F$

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.



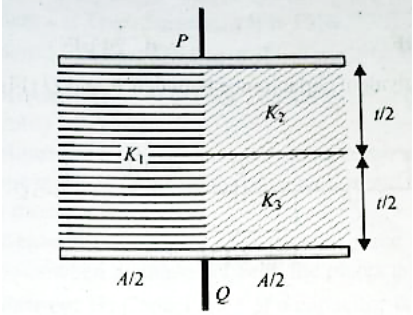
A) $1.2\mu F$ **B)** $1.8\mu F$
C) $1.25\mu F$ **D)** none of these

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.



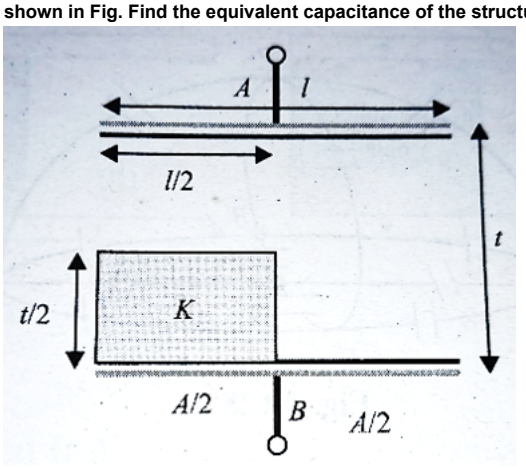
A) 1.2μF **B)** 1.25μF
C) 1.80μF **D)** None of these

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



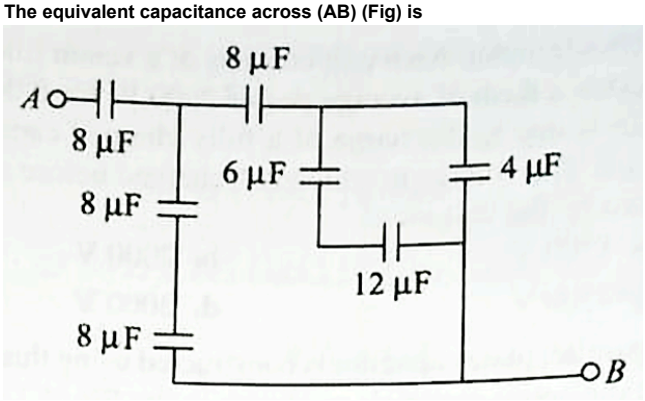
A) $\left(\frac{K_1}{2}+\frac{K_2K_3}{K_2+K_3}\right)\frac{\varepsilon_0 A}{t}$ **B)** B)$\left(K_1+\frac{K_2K_3}{K_2+K_3}\right)\frac{\varepsilon_0 A}{t}$
C) C)$\left(K_1+\frac{2K_2K_3}{K_2+K_3}\right)\frac{\varepsilon_0 A}{t}$ **D)** D)$\left(K_1+\frac{K_2K_3}{2(K_2+K_3)}\right)\frac{\varepsilon_0 A}{t}$

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.



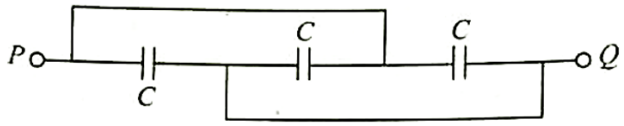
A) $\frac{2\varepsilon_0 A}{t}\left(\frac{K+1}{K+3}\right)$ **B)** $\frac{2\varepsilon_0 A}{t}\left(\frac{K+3}{K+1}\right)$
C) $\frac{\varepsilon_0 A}{t}\left(\frac{K+1}{K+3}\right)$ **D)** $\frac{\varepsilon_0 A}{t}\left(\frac{2K+1}{2K+3}\right)$

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



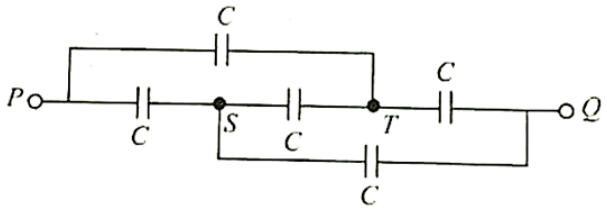
A) $8\mu\text{F}$ **B)** $12\mu\text{F}$
C) $4\mu\text{F}$ **D)** $24\mu\text{F}$

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



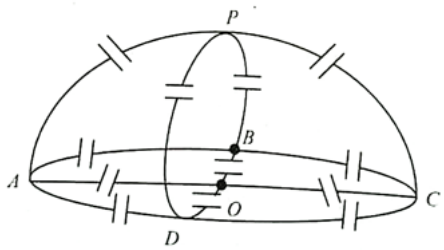
A) $\frac{C}{3}$ **B)** 3C
C) 2C **D)** C

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).

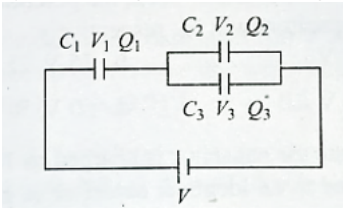


A) 2C **B)** 3C
C) 8C **D)** 6C

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?

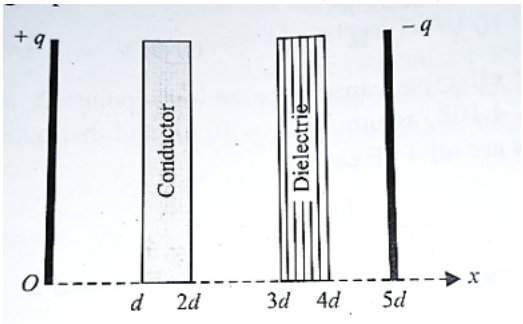
A) $2\varepsilon_0 AV^2/d$ **B)** $\varepsilon_0 AV^2/d$
C) $3\varepsilon_0 AV^2/2d$ **D)** $\varepsilon_0 AV^2/2d$

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



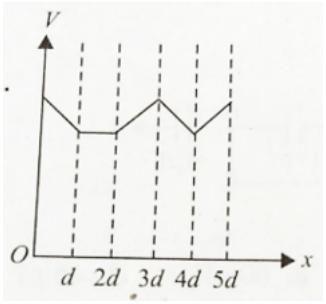
A) $Q_1 = Q_2 = Q_3$ and $V_1 = V_2 = V_3 + V$ **B)** $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2 + V_3$
C) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2$ **D)** $Q_2 = Q_3$ and $V_2 = V_3$

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 $x = 5d$.

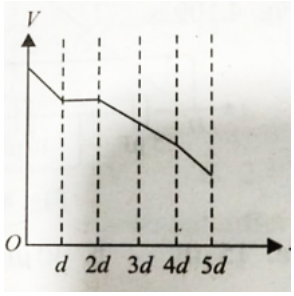


Two slabs, one of a conductor and the other of a dielectric of same thickness d, are inserted between the plates as shown in Fig. The potential V versus distance x graph will be

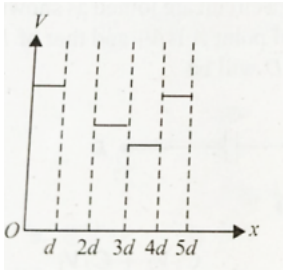
A)



B)

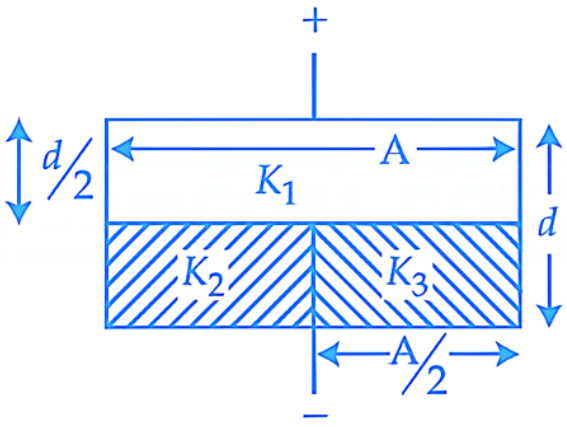


C)



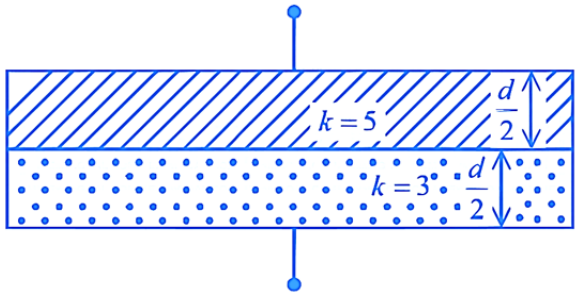
D) None of these

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

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



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

74. A capacitor of $10, \mu\text{F}$ capacitance whose plates are separated by $10\ \text{mm}$ through air and each plate has area $4\ \text{cm}^2$ 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 $8\ \text{N}$. The supply voltage is ____ V.

75. The electric field between the two parallel plates of a capacitor of $1.5, \mu\text{F}$ capacitance drops to one third of its initial value in $6.6, \mu\text{s}$ when the plates are connected by a thin wire. The resistance of this wire is ____ Ω. (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.	**3**	40.	**2**	47.	**5**
27.	**3**	34.	**2**	41.	**4**	48.	**8**
28.	**1**	35.	**4**	42.	**4**	49.	2
29.	**3**	36.	**3**	43.	**2**	50.	**3**
30.	**1**	37.	**2**	44.	**3**		
31.	**3**	38.	**3**	45.	**2**		
32.	**1**	39.	**3**	46.	**2**		

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°) 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 β-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 β-carbon is quaternary (bearing two methyl groups), creating significant steric hindrance for S_N2. Thus, E2 elimination occurs at the other available β-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:

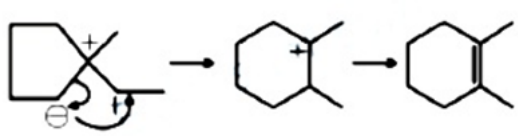
Elimination is highly favored when a bulky base like potassium tert-butoxide ($t-BuOK$) is used at high temperatures. The reaction results in the loss of HBr to form stilbene, a highly stable conjugated aromatic alkene.

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 β-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.

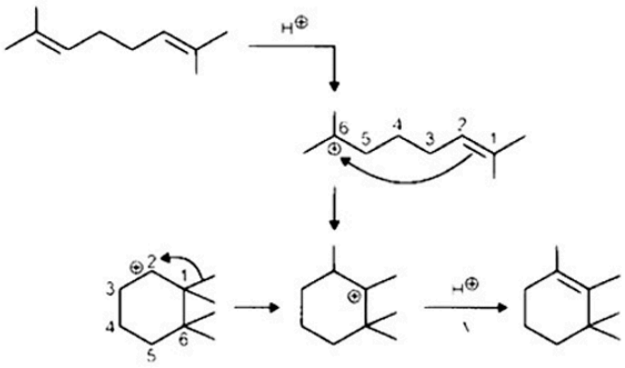
[u1]

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.



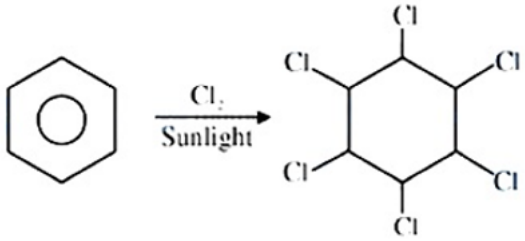
Number of sp^2 hybridised carbon atoms = 2

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 $C_6H_6Cl_6$.



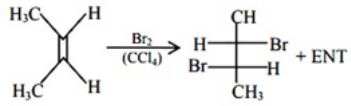
Q25.

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:

From $\triangle ACP$

$\tan 30^\circ = \frac{a}{\sqrt{S_{11}}}$

$\frac{1}{\sqrt{3}} = \frac{a}{\sqrt{S_{11}}}$

$\therefore S_{11} = 3a^2$

Since

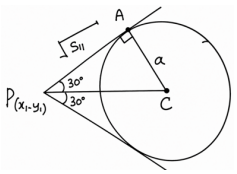
$S_{11} = x_1^2 + y_1^2 - a^2$

$x_1^2 + y_1^2 - a^2 = 3a^2$

$x_1^2 + y_1^2 = 4a^2$

Hence, the locus of $P(x_1, y_1)$ is

$\boxed{x^2 + y^2 = 4a^2.}$



Q27.

Answer: C

Explanation:

Required circle is $x^2 + y^2 + \lambda(y - x) = 0\, r^2 = \frac{\lambda^2}{4} + \frac{\lambda^2}{4} = 1 \Rightarrow \lambda = \sqrt{2}\, \therefore$ centre $= \left(-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$

Q28.

Answer: A

Explanation:

A circle touching the y-axis at $(0, \beta)$ has its centre at (α, β) and radius $r = |\alpha|$. Given the point of contact is $(0, 3)$, the centre is $(\alpha, 3)$. The intercept made on the x-axis by the circle $x^2 + y^2 + 2gx + 2fy + c = 0$ is $2\sqrt{g^2 - c}$. By substituting the circle's parameters into this formula and setting the intercept to 2 units, we can solve for the x-coordinate of the centre.

Q29.

Answer: C

Explanation:

According to the properties of circles provided in the synopsis, the equation of the chord of the circle $S = 0$ whose mid point is (x_1, y_1) is given by the formula $S_1 = S_{11}$. In this notation, S_1 represents the expression $xx_1 + yy_1 + g(x + x_1) + f(y + y_1) + c$ and S_{11} represents the value of the power of the point (x_1, y_1) with respect to the circle.

Q30.

Answer: A

Explanation:

(derived from principles in the sources): According to the properties of circles, the angle subtended by a chord at the centre is double the angle it subtends at any point on the remaining part of the circumference. Given the angle at the circumference is 30°, the angle at the centre is 60°. The perpendicular distance d from the centre of a circle with radius r to a chord that subtends an angle θ at the centre is given by the formula $d = r\cos(\theta/2)$. In the given line equation $x\cos\alpha + y\sin\alpha = p$, the value p represents the perpendicular distance from the origin $(0, 0)$ to the line.

Q31.

Answer: C

Explanation:
(derived from principles on page 42 and 5-6): According to the properties of circles, the equation of a chord with a given mid-point (x_1, y_1) is $S_1 = S_{11}$. Furthermore, the line joining the center of the circle to the mid-point of a chord is always perpendicular to that chord. By identifying the center of the circle and finding the line perpendicular to the chord that passes through the center, the intersection of these two lines will yield the mid-point.

Q32.

Answer: A

Explanation:

According to the synopsis regarding different forms of the equation of a circle, if a circle touches the y-axis, the radius r of the circle is equal to the absolute value of the x-coordinate of its centre (α, β). The equation for such a circle is given by the standard form $(x - \alpha)^2 + (y - \beta)^2 = r^2$, where $r = |\alpha|$.

Q33.

Answer: C

Explanation:

The distance of point$P$ from chord AB is found by calculating the distance from the intersection of tangents to the chord of contact. By using the properties of the right triangle formed by the center, the point of tangency, and the intersection point P, we can determine the length of the segment from P to the chord.

Q34.

Answer: B

Explanation:

Since $x - y + 1 = 0$ is the perpendicular bisector of PQ, Q is the reflection of P about this line. By finding the coordinates of Q in terms of P and substituting into the line equation, we find the possible coordinates for P.

Q35.

Answer: D

Explanation:

For the line $x + y = 0$ to bisect chords from point P, the midpoint of such chords must lie on the line. This condition leads to a quadratic equation in terms of the midpoint's coordinates, where the existence of two distinct chords requires the discriminant to be positive.

Q36.

Answer: C

Explanation:

If a diameter of circle C_1 is a chord of circle C_2, then the center of C_1 lies on the chord of C_2. The distance from the center of C_2 to the center of C_1, combined with the radius of C_1, allows us to find r^2 using the Pythagorean theorem.

Q37.

Answer: B

Explanation:

This is similar to Q.4. We find the radius and center of the first circle, calculate the distance to the center of circle 'C', and use the property that the diameter is a chord.

Q38.

Answer: C

Explanation:

A chord of length r in a circle of radius r forms an equilateral triangle with the center only if the distance from the center is $\frac{\sqrt{3}}{2}r$. Here, we relate the chord length to the distance from the center $(0, 0)$ to the line.

Q39.

Answer: C

Explanation:

For orthogonal circles, the triangle formed by the centers and a point of intersection is a right-angled triangle. The common chord is twice the altitude to the hypotenuse of this triangle.

Q40.

Answer: B

Explanation:

By the power of a point theorem, for a point P and a circle S, $PA \cdot PB = S_1$, where S_1 is the value obtained by substituting P's coordinates into the circle's power equation.

Q41.

Answer: D

Explanation:

Similar logic to previous diameter-as-chord problems. We calculate the radius of the first circle and the distance between the two centers.

Q42.

Answer: D

Explanation:

The locus of midpoints of chords subtending a constant angle at the center is a concentric circle. The radius of this locus is the distance from the center to the chord.

Q43.

Answer: B

Explanation:

The area of a triangle formed by tangents and the chord of contact is given by $\frac{RL^3}{R^2+L^2}$, where R is radius and L is tangent length.

Q44.

Answer: C

Explanation:

The circumcircle of the triangle formed by the origin and the points of contact of tangents from the origin to a circle passes through the center of that circle. The diameter of this circumcircle is the segment joining the origin to the center of the given circle.

Q45.

Answer: B

Explanation:

Use the formula for the area of triangle OAB: $\frac{RL^3}{R^2+L^2}$.

Q46.

Answer: 2

Explanation:

The equation of a circle passing through the origin $(0,0)$ and having intercepts α and β on the x-axis and y-axis respectively is given by the formula $x^2+y^2-\alpha x-\beta y=0$. In this case, the points $(2,0)$ and $(0,-2)$ represent the intercepts on the x and y axes, so $\alpha=2$ and $\beta=-2$. Substituting these values into the formula gives the equation of the circle: $x^2+y^2-2x+2y=0$. For the four points to be concyclic, the point $(k,-2)$ must also lie on this circle and satisfy its equation.

Q47.

Answer: 5

Explanation:

The center A of the circle is $(1,2)$ and the radius r is 5. The equations of the tangents at $B(1,7)$ and $D(4,-2)$ are determined to be $y=7$ and $4y-3x+20=0$ respectively. Their intersection point C is found to be $(16,7)$. The area of the quadrilateral $ABCD$ is calculated as twice the area of the right-angled triangle ABC, which equals $15\times5=75$. Therefore, $\lambda=75$ and $\lambda/15=5$.

Q48.

Answer: 8

Explanation:

According to the source, for a point P outside a circle where tangents PA and PB are drawn with an angle $\angle APB=120^\circ$ and the distance from the point to the centre $CP=16$, the length of the chord AB is determined by the geometry of the triangles formed. The source identifies the correct value as 8.

Q49.

Answer: 2

Explanation:

The centre of similitude is given as $\left(0,\frac{5}{2}\right)$. Using the properties of the common tangent drawn through the centre of similitude for the given pair of circles, the length of the required common tangent is found to be 2.

Q50.

Answer: C

Explanation:

For the circles to have exactly two common tangents, they must intersect at two distinct points. The first circle has: • Centre: $(0,0)$ • Radius: 3 The second circle has: • Centre: $(4,3)$ • Radius: $\sqrt{25-n^2}$ Distance between the centres is $d=\sqrt{4^2+3^2}=5$. For two circles to intersect, $|r_1-r_2|2\ 25-n^2>4\ n^2<21$. As n is an integer, $n=-4,-3,-2,-1,0,1,2,3,4$, which gives 9 possible values. Hence, the required answer is $\boxed{9}$.

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:

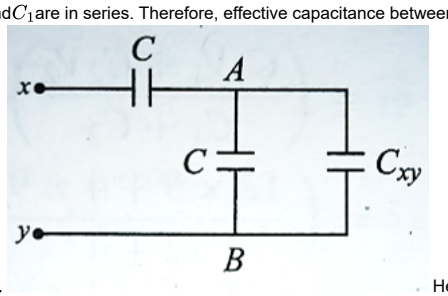
The four plates are alternately connected. They form three capacitors in parallel. Capacity of each capacitor is $\frac{\varepsilon_0 A}{d}$. So, the net capacity is $\frac{3\varepsilon_0 A}{d}$.

Q55.

Answer: B

Explanation:

As $\infty\pm1=\infty$ 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 $C'=\frac{\varepsilon_0 A}{\frac{d/2}{2}+\frac{d/2}{3}}=\frac{\varepsilon_0 A}{d}\left[\frac{1}{\frac{1}{4}+\frac{1}{6}}\right]$

$C'=C\times2.4=1.2\mu\text{F}$

Q61.

Answer: B

Explanation:

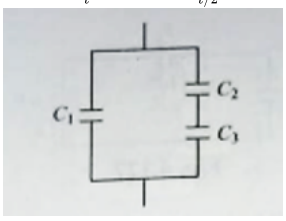
$C'=\frac{2\varepsilon_0 A/2}{d}+\frac{3\varepsilon_0 A/2}{d}=C\left[1+\frac{3}{2}\right]=\frac{5}{2}\times0.5=1.25\mu\text{F}$

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, $C_{\text{eq}} = C_1 + \frac{C_2 C_3}{C_2 + C_3}$.

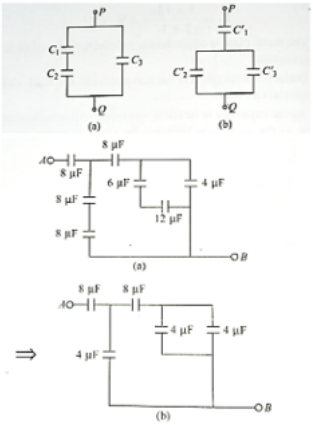


Q63.

Answer: A

Explanation:

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

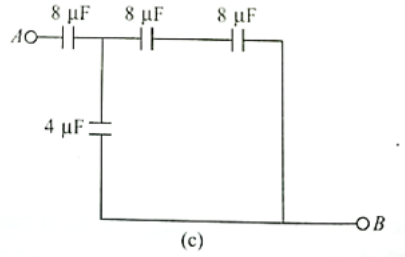


Q64.

Answer: C

Explanation:

Using the method of successive reduction (see Fig).

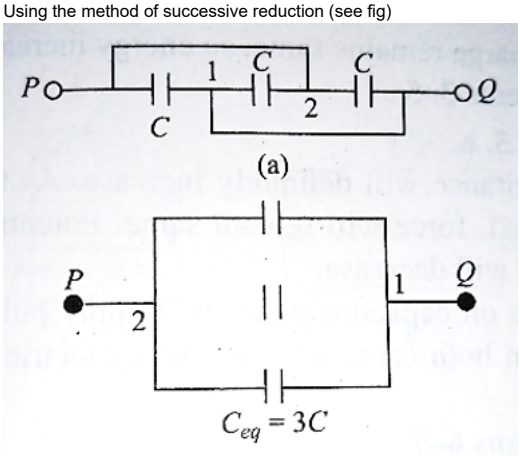


Q65.

Answer: B

Explanation:

Using the method of successive reduction (see fig)

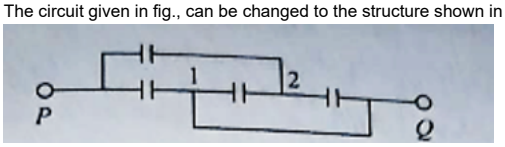


Q66.

Answer: B

Explanation:

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

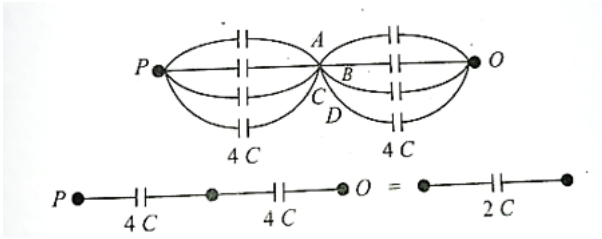


Q67.

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.

$C_{23} = C_2 + C_3 \Rightarrow C_{23} = 3C + 5C = 8C$

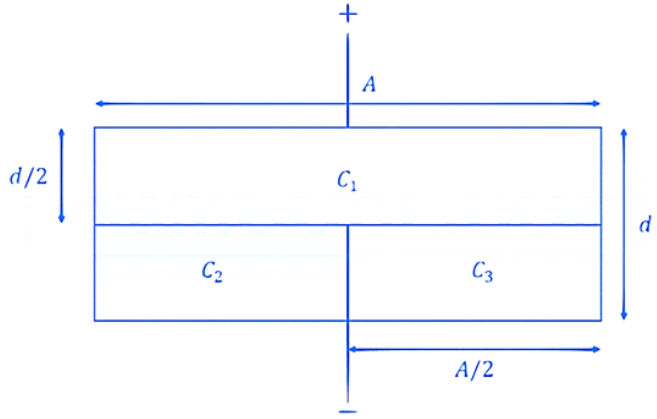
This combined section $((C_{23}))$ is in series with the first capacitor $((C_1)).\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_{23}}$

$\Rightarrow \frac{1}{C_{eq}} = \frac{1}{4C} + \frac{1}{8C} \Rightarrow \frac{1}{C_{eq}} = \frac{2+1}{8C} = \frac{3}{8C}$

$\Rightarrow C_{eq} = \frac{8C}{3} = \frac{n}{3}C \therefore n = 8$

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, ρ 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 $C = 1, \mu\text{F} = 1 \times 10^{-6}\ \text{F}$ The resistivity is $\rho = 1 \times 10^{13}\ \Omega\text{m}$ And the permittivity of free space is $\varepsilon_0 = 8.85 \times 10^{-12}\ \text{F/m}$ 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 α is 2.

Q73.

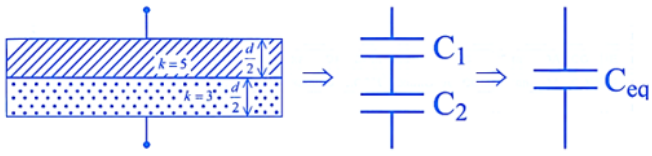
Answer: 15

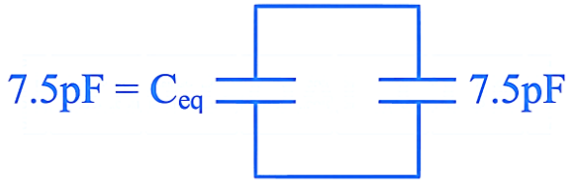
Explanation:

$C_1 = \frac{5\times4\times10^{-4}\times8.85\times10^{-12}}{\frac{1.77}{2}\times10^{-3}} = 20\text{pF}$ $C_2 = \frac{3\times4\times10^{-4}\times8.85\times10^{-12}}{\frac{1.77}{2}\times10^{-3}} = 12\text{pF}$

$C_{eq} = \frac{C_1 C_2}{C_1 + C_2} = \frac{12\times20}{12+20} = 7.5\text{pF}$ Finally equivalent capacitance

$(C_{eq})_{\text{final}} = 7.5 + 7.5 = 15\text{pF}$





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Q74.

Answer: 80

Explanation:

$C_1 = 10, \mu\text{F}, \quad C_2 = 15, \mu\text{F}\ F = F_1 + F_2\ \frac{(10\times10^{-6})V^2}{2\cdot\frac{d}{2}\cdot\varepsilon_0} + \frac{(15\times10^{-6})V^2}{2\cdot\frac{d}{2}\cdot\varepsilon_0} = 8$

$V^2 = 0.9 \times 10^{-4}\ V = 0.95 \times 10^{-2}\ \text{V}$

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 (τ) $(inseconds)$ of a capacitor-resistor (CR) .circuit to the capacitance (C) (in Farads) and resistance (R) $(inOhms)$. The time constant (τ) 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 $(\frac{1}{3}V_0)$ 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 $(4, \Omega)$.