Max Marks: 300

SR_WEEK-6 (20-07-2026)

Time: 180 mins

Chemistry

1. Given below are two statements: Statement (I): Neopentane forms only one monosubstituted derivative. Statement (II): Melting point of neopentane is higher than n-pentane. In the light of the above statements, choose the most appropriate answer from the options given below:

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

2. The alkane from below having two secondary hydrogens is:

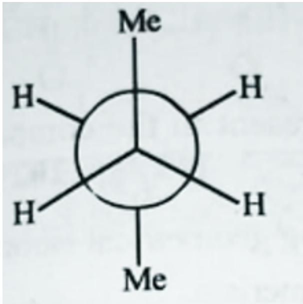
A) 2,2,4,5-Tetramethylheptane
B) 2,2,3,3-Tetramethylpentane
C) 4-Ethyl-3,4-dimethyloctane
D) 2,2,4,4-Tetramethylhexane

3. The incorrect statement regarding conformations of ethane is:

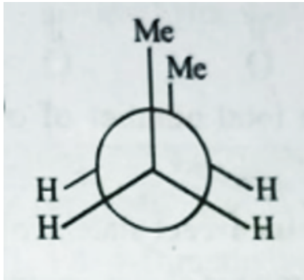
A) Ethane has infinite number of conformations
B) The dihedral angle in staggered conformation is60°
C) Eclipsed conformation is the most stable conformation.
D) The conformations of ethane are interconvertible to one another.

4. Which of the following conformations will be the most stable?

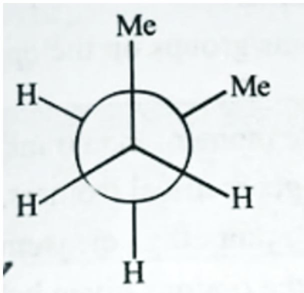
A)



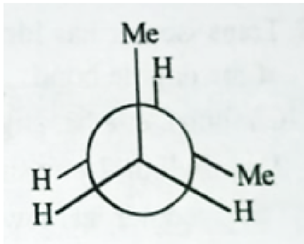
B)



C)



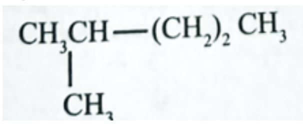
D)



5. In the following reaction, 'X' is:

$CH_3(CH_2)_4CH_3 \xrightarrow[HCl,\Delta]{Anhy.AlCl_3} X$ **major product**

A) $CH_3(CH_2)_4CH_2Cl$
B) $Cl - CH_2 - (CH_2)_4 - CH_2$ -
C)

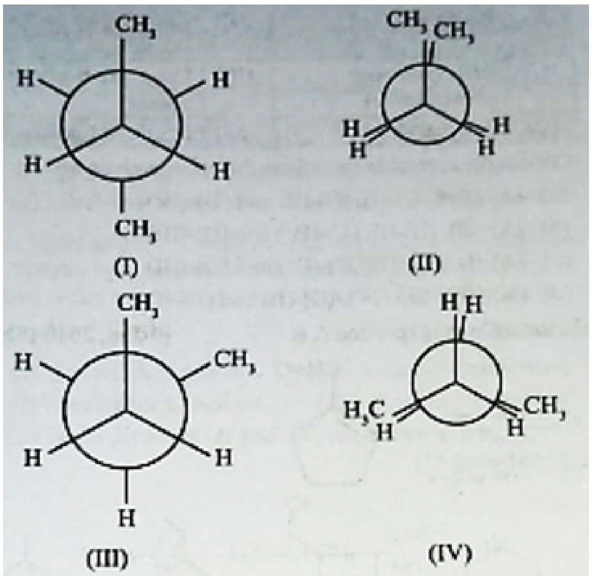


D)

6. Staggered and eclipsed conformers of ethane are:

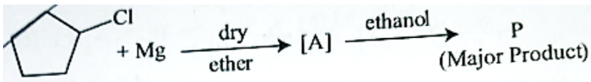
A) Mirror images
B) Polymers
C) Enantiomers
D) Rotamers

7. Arrange the following conformational isomers of n-butane in order of their increasing potential energy:

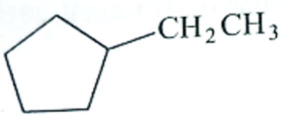


A) I < III < IV < II **B)** I < IV < III < II
C) II < III < IV < I **D)** II < IV < III < I

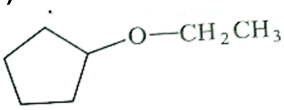
8. In the following sequence of reactions, the P is:



A)

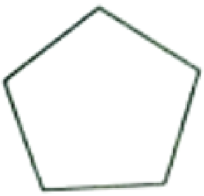


B)

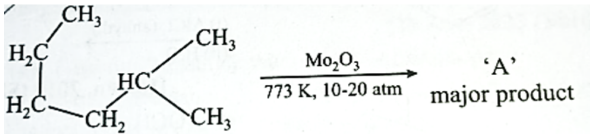


C)

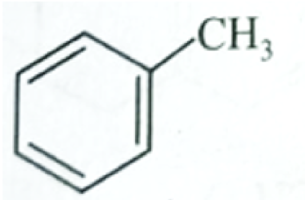
D)



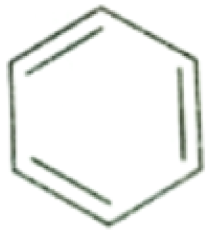
9. Identify A in the given chemical reaction:



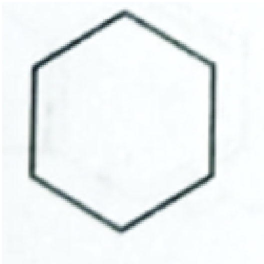
A)



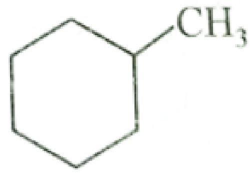
B)



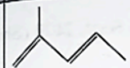
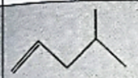
C)



D)



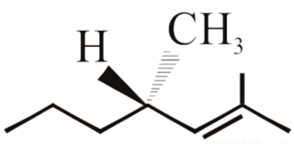
10. Match List-I with List-II:

	List-I (Structure)		List-II (IUPAC Name)
A.	$H_3C{-}CH_2{-}CH(C_2H_5){-}CH_2{-}CH(CH_3){-}C_2H_5$	I.	4-Methylpent-1-ene
B.	$(CH_3)_2C\,(C_3H_7)_2$	II.	3-Ethyl-5-methylheptane
C.		III.	4, 4-Dimethylheptane
D.		IV.	2-Methyl-1, 3-pentadiene

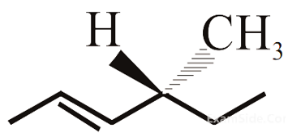
A) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
B) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
C) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
D) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

11. Which of the following compounds produces an optically inactive compound on hydrogenation?

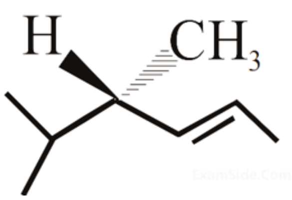
A)



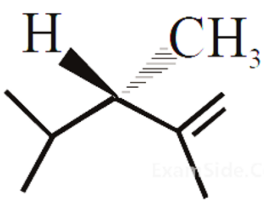
B)



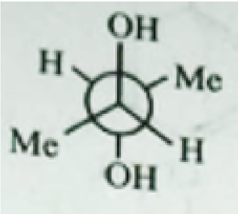
C)

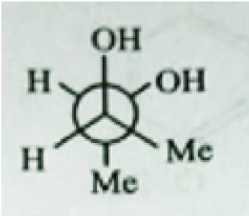


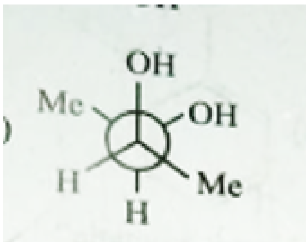
D)

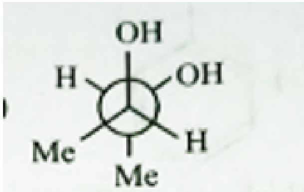


12. **Among the following, the conformation that corresponds to the most stable conformation of meso-butane-2,3-diol is:**

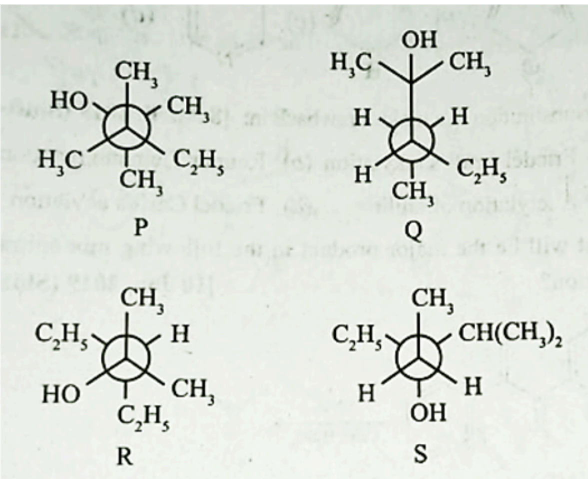
A) 

B) 

C) 

D) 

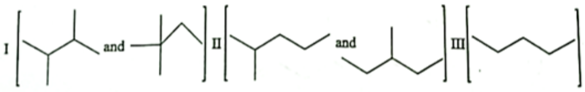
13. **Newman projections P, Q, R and S are shown below.**



Which one of the following options represents identical molecules?

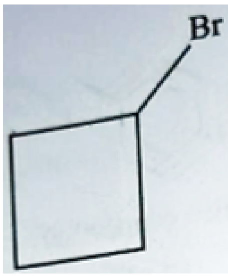
A) P and Q
B) Q and S
C) Q and R
D) R and S

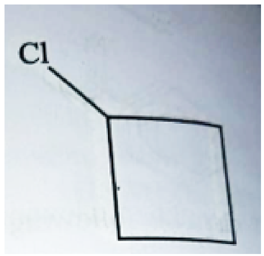
14. **Isomers of hexane, based on their branching can be divided into three distinct classes as shown in the figure. The correct order of their boiling point is:**



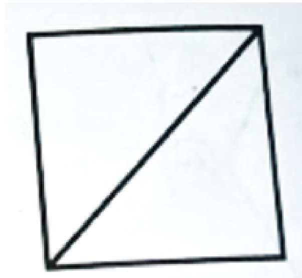
A) I > II > III
B) III > II > I
C) II > III > I
D) III > I > II

15. **1-bromo-3-chlorocyclobutane when treated with two equivalents of Na in the presence of ether which of the following will be formed?**

A) 

B) 

C) 

D) 

16. **How many chiral compounds are possible on mono chlorination of 2-methyl butane?**

A) 2
B) 4
C) 6
D) 8

17. **The highest boiling point is expected for:**

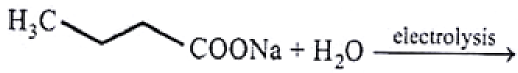
A) iso-octane
B) n-octane
C) 2,2,3,3-tetramethylbutane
D) n-butane

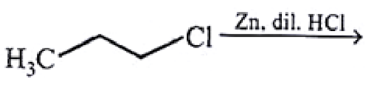
18. **The compound with highest boiling point is:**

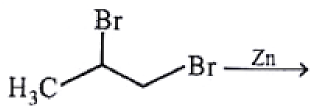
A) 2-methyl butane
B) n-pentane
C) 2,2-dimethylpropane
D) n-hexane

19. **Which of the following reactions product (s) propane as a major product?**

(a) 

(b) 

(c) 

(d) 

A) a and c
B) b and d
C) a and b
D) c and d

20. **For the following reaction**

$$CH_4(g) + Cl_2(g) \xrightarrow{light} CH_3Cl(g) + HCl(g)$$

the correct statement is:

A) Initiation step is exothermic
B) Propagation step involving $^{\bullet}CH_3$ formation is exothermic
C) Propagation step involving CH_3Cl formation is endothermic
D) The reaction is exothermic with $\Delta H^{\circ} = -25\ kcal\ mol^{-1}$

21. **Number of alkanes obtained on electrolysis of a mixture of CH_3COONa and C_2H_5COONa is:**

22. **Number of bromo derivatives obtained on treating ethane with excess of Br_2 in diffused sunlight is:**

23. **The dihedral angle in staggered from the Newman projection of 1,1,1-Trichloro ethane is ______ degree.**

24. **Question: The total number of monohalogenated organic products in the following (including stereoisomers) reaction is ______.**

$$\underset{(Simplest\ optically\ Active\ alkene)}{A} \xrightarrow[(ii)X_2/\Delta]{(i)H_2/Ni\Delta}$$

25. **The maximum number of isomers (including stereoisomers) that are possible on mono-chlorination of the following compound, is $CH_3CH_2CH(CH_3)CH_2CH_3$.**

Maths

26. **For $p > 0$ and $3x^2 + px + 3 = 0$ one root of above equation is square of the other then p is**

A) -6
B) 10
C) 2
D) 3

27. **The quadratic equation $x^2 - 6x + a = 0$ and $x^2 - cx + 6 = 0$ have one root in common, the other roots of the first and second equations are integers in the ratio 4:3 then the common root is**

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

28. **If $p\,(q - r)x^2 + q\,(r - p)x + r\,(p - q) = 0$ has equal roots then $\frac{2}{q} =$:**

A) $\frac{p+r}{p-r}$
B) $\frac{p-r}{pr}$
C) $\frac{p+r}{pr}$
D) $\frac{p+r}{p+r}$

29. **The ratio of the roots of $ax^2 + 2bx + c = 0$ is same as the ratio of the roots of $px^2 + 2qx + r = 0$ then:**

A) $\frac{b^2}{ac} = \frac{p^2}{qr}$
B) $\frac{b}{ac} = \frac{q}{pr}$
C) $\frac{b^2}{ac} = \frac{q^2}{pr}$
D) $\frac{2b}{ac} = \frac{q}{pr}$

30. **The set of values of 'a' for which in-equation $(a-1)x^2 - (a+1)x + (a-1) \geq 0$ is true for all $x \geq 2$ is:**

A) $[\frac{7}{3}, \infty)$
B) $(1, \frac{7}{3}]$
C) $(-\infty, 1)$
D) $(-3, -2)$

31. **Number of rational roots of the equation $|x^2 - 2x - 3| + 4x = 0$ is:**

A) 0
B) 1
C) 2
D) 4

32. **If $p, q, r \in \mathbb{R}$ and the quadratic equation $px^2 + qx + r = 0$ has no real root, then:**

A) $p(p+q+r) > 0$
B) $p(p+q+r) < 0$
C) $q(p+q+r) > 0$
D) $q(p+q+r) < 0$

33. **The condition that the equation $\frac{1}{x} + \frac{1}{x+b} = \frac{1}{m} + \frac{1}{m+b}$ has real roots that are equal in magnitude but opposite in sign is:**

A) $2b = 2m$
B) $b^2 = 2m^2$
C) $b^2 = 22m^2$
D) $b^2 = 3m^2$

34. **If the difference between the roots of equation $x^2 + ax + 1 = 0$ is less than $\sqrt{5}$ then the set of values of a is:**

A) $(3, \infty)$
B) $(3, \infty)$
C) $(-\infty, -3)$
D) $(-3, 3)$

35. **If both roots of the quadratic equation $x^2 - 2kx + k^2 + k - 5 = 0$ are less than 5, then k lies in the interval:**

A) $(5, 6)$
B) $(6, \infty)$
C) $(-\infty, 4)$
D) $[4, 5]$

36. **Let $k \in R$ and the equation $(k-2)\{x - [x]\}^2 + 2\{x - [x]\} + k^2 = 0$ where [ ] stands for the greatest integer function, has exactly one solution in $(3, 4)$, then k lies in the interval:**

A) $(3, 4)$
B) $(1, 3)$
C) $(0, 1)$
D) $(-1, 0)$

37. **If the equation $x^4 - 4x^3 + ax^2 + bx + 1 = 0$ has four positive roots then (a, b) is given by**

A) $(4, 6)$
B) $(6, -4)$
C) $(-4, -6)$
D) $(2, 3)$

38. The value of a, for which one root of the equation $(a-5)x^2-2ax+a-4=0$ is smaller than 1 and the other greater than 2 is:

A) $a \in (5, 24)$ B) $a \in \left(\frac{20}{3}, \infty\right)$

C) $a \in (5, 84)$ D) $a \in (10, 4)$

39. If α, β are the roots of $x^2-3x+\lambda=0$ and $\alpha<1<\beta$, then the true set of values of λ equals:

A) $\pi \in \left(\frac{9}{4}, \infty\right)$ B) $\pi \in \left(-\infty, \frac{9}{4}\right]$

C) $\pi \in (2, \infty)$ D) $\pi \in (-\infty, 2)$

40. The equation $(x^2+6x+7)^2+6(x^2+6x+7)+7=x$ has:

A) no real solutions B) exactly two real and equal solutions

C) exactly two distinct real solutions D) all its solutions are real

41. Let the set of all values of $p \in \mathbb{R}$, for which both the roots of the equation $x^2-(p+2)x+(2p+9)=0$ are negative real numbers, be the interval $(\alpha, \beta]$. Then $\beta-2\alpha$ is equal to

A) 5 B) 0

C) 20 D) 9

42. The equation $e^{4x}+8e^{3x}+13e^{2x}-8e^x+1=0, x \in \mathbb{R}$ has:

A) two solutions and both are negative B) two solutions and only one of them is negative

C) four solutions two of which are negative D) no solution

43. The number of real solutions of the equation, $x^2-|x|-12=0$ is :

A) 2 B) 3

C) 1 D) 4

44. The sum of all real values of x satisfying the equation $(x^2-5x+5)^{x^2+4x-60}=1$ is :

A) 6 B) 5

C) 3 D) -4

45. The number of all possible positive integral values of α for which the roots of the quadratic equation, $6x^2-11x+\alpha=0$ are rational numbers is :

A) 3 B) 2

C) 4 D) 5

46. The number of values of 'a' for which $(a^2-3a+2)x^2+(a^2-5a+6)x+a^2-4=0$ is an identity in x is:

47. Let $P(x)=x^2+bx+c$, where b and c are integers. If $P(x)$ is a factor of both x^4+6x^2+25 and $3x^4+4x^2+28x+5$, find the value of $P(1)$.

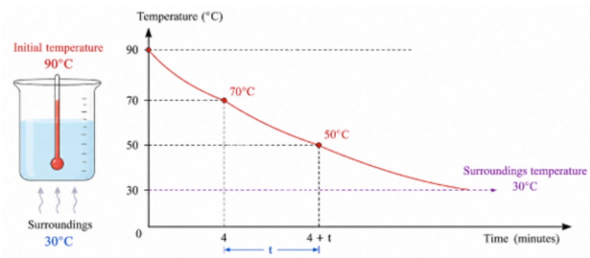
48. Let α, β and γ be the roots of equation $f(x)=0$, where $f(x)=x^3+x^2-5x-1$. Then the value of $|[\alpha]+[\beta]+[\gamma]|$, where $[.]$ denotes the greatest integer function, is equal to

49. The number of real roots of the equation $\sqrt{x^2-4x+3}+\sqrt{x^2-9}=\sqrt{4x^2-14x+6}$, is :

50. If α and β are the roots of the equation $x^2-x+1=0$, then $\alpha^{2009}+\beta^{2009}=$

Physics

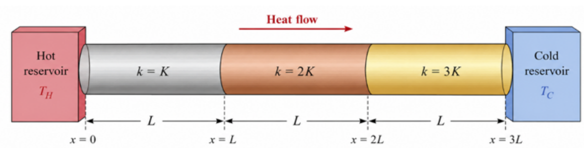
51. A liquid takes 4 minutes to cool from $90^\circ\mathrm{C}$ to $70^\circ\mathrm{C}$. If the temperature of the surroundings is $30^\circ\mathrm{C}$, the time taken by it to cool from $70^\circ\mathrm{C}$ to $50^\circ\mathrm{C}$ is:



A) $\frac{20}{3}$ minutes B) $\frac{10}{3}$ minutes

C) 5 minutes D) 6 minutes

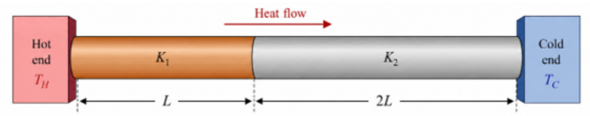
52. A composite rod is made of three rods of equal length L and equal cross-sectional area A connected in series as shown in the figure. The thermal conductivities of the materials of the rods are K, 2K, and 3K respectively. The ends of the composite rod are maintained at constant temperatures. Assuming no heat loss from the sides, the effective thermal conductivity of the bar is:



A) $\frac{18K}{11}$ B) $\frac{11K}{18}$

C) $\frac{6K}{5}$ D) $\frac{5K}{6}$

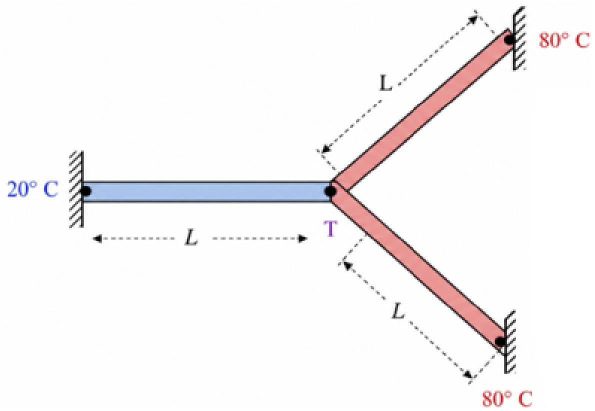
53. Two metal rods of the same cross-sectional area A but different lengths L and 2L having thermal conductivities K_1 and K_2 respectively are connected in series. The effective thermal conductivity K_{eq} of the combination is:



A) A. $\frac{K_1+2K_2}{3}$ B) $\frac{3K_1K_2}{K_1+2K_2}$

C) $\frac{2K_1K_2}{K_1+K_2}$ D) $\frac{3K_1K_2}{2K_1+K_2}$

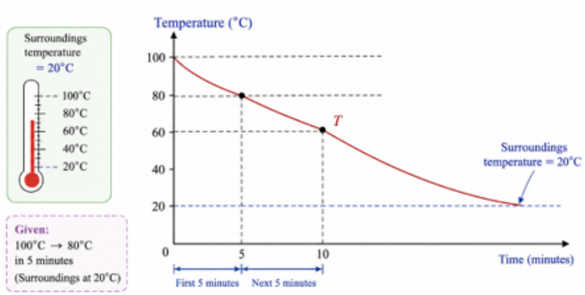
54. Three rods made of the same material and having the same cross-section have been joined as shown in the figure (a Y-shape configuration). Each rod is of the same length. The left end is kept at $20^\circ\mathrm{C}$ and the two right ends are kept at $80^\circ\mathrm{C}$ respectively. The temperature of the junction of the three rods will be:



A) $50^\circ\mathrm{C}$ B) $60^\circ\mathrm{C}$

C) $40^\circ\mathrm{C}$ D) $70^\circ\mathrm{C}$

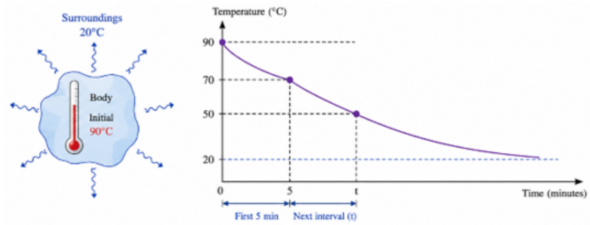
55. A body cools in 5 minutes from $100^\circ\mathrm{C}$ to $80^\circ\mathrm{C}$. The temperature of the surrounding is $20^\circ\mathrm{C}$. The temperature of the body after the next 5 minutes will be:



A) $60^\circ\mathrm{C}$ B) $65^\circ\mathrm{C}$

C) $70^\circ\mathrm{C}$ D) $75^\circ\mathrm{C}$

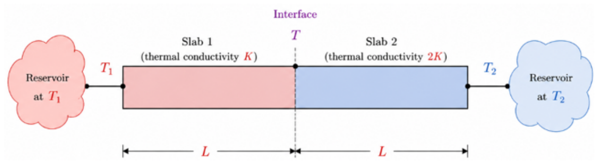
56. A body cools from $90^\circ\mathrm{C}$ to $70^\circ\mathrm{C}$ in 5 minutes. The temperature of the surrounding is $20^\circ\mathrm{C}$. The time it takes to cool from $70^\circ\mathrm{C}$ to $50^\circ\mathrm{C}$ is:



A) $450\ \mathrm{s}$ B) $15/2\ \mathrm{s}$

C) $400\ \mathrm{s}$ D) $500\ \mathrm{s}$

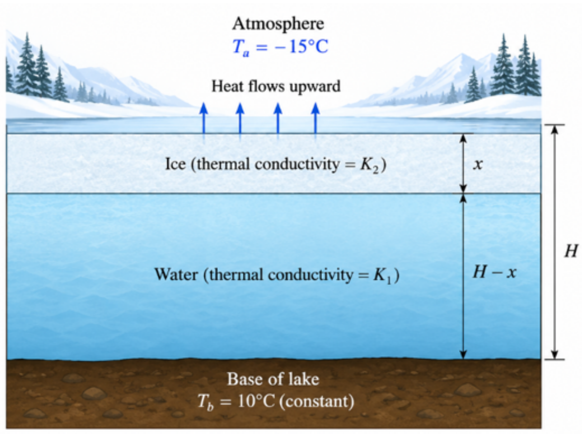
57. Two slabs of equal thickness L and equal cross-sectional area A are joined in series. The first slab has thermal conductivity K and the second has thermal conductivity 2K. If the outer surfaces are maintained at temperatures T_1 and T_2 ($T_1 > T_2$), find the temperature T at the interface. Assume the slab with thermal conductivity K is in contact with the reservoir at T_1.



A) $\frac{T_1+2T_2}{3}$ B) $\frac{2T_1+T_2}{3}$

C) $\frac{T_1+T_2}{2}$ D) $\frac{2T_1+2T_2}{3}$

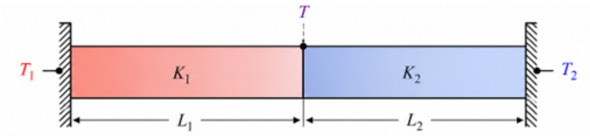
58. Consider a lake of depth H. The temperature of the base is constant at $10^\circ\mathrm{C}$ and the atmosphere temperature is $-15^\circ\mathrm{C}$. Thermal conductivity of water is K_1 and for ice is K_2. Find the expression for the maximum thickness of ice (x) that can be formed theoretically.



A) $\frac{2K_1H}{2K_1+3K_2}$ B) $\frac{3K_2H}{2K_1+3K_2}$

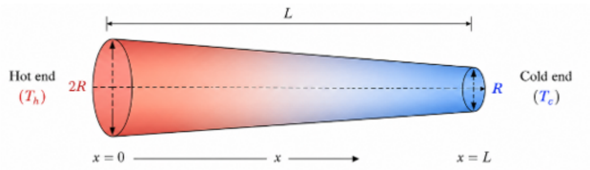
C) $\frac{3K_1H}{3K_1+2K_2}$ D) $\frac{2K_2H}{3K_1+2K_2}$

59. Two slabs of thermal conductivities K_1 and K_2 and thicknesses L_1 and L_2 respectively are joined together in series. The outer surfaces are maintained at temperatures T_1 and T_2 ($T_1 > T_2$). Find the temperature T at the common interface.



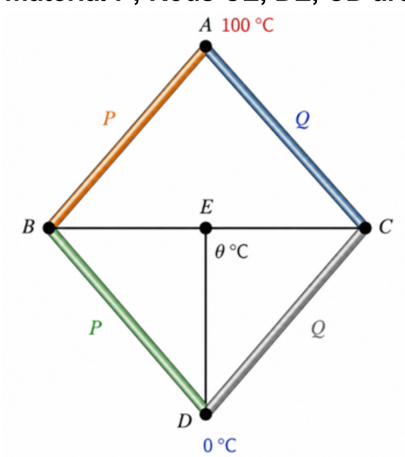
A) $\frac{K_1L_1T_1+K_2L_2T_2}{K_1L_1+K_2L_2}$
B) $\frac{K_1L_2T_1+K_2L_1T_2}{K_1L_2+K_2L_1}$
C) $\frac{K_1L_2T_2+K_2L_1T_1}{K_1L_2+K_2L_1}$
D) $\frac{K_1L_1T_2+K_2L_2T_1}{K_1L_1+K_2L_2}$

60. A rod of length L tapers uniformly from a radius of 2R at the hot end (T_h) to a radius of R at the cold end (T_c). If the thermal conductivity is K, find the rate of heat flow.



A) $\frac{2\pi KR^2(T_h-T_c)}{L}$
B) $\frac{\pi KR^2(T_h-T_c)}{L}$
C) $\frac{3\pi KR^2(T_h-T_c)}{L}$
D) $\frac{4\pi KR^2(T_h-T_c)}{L}$

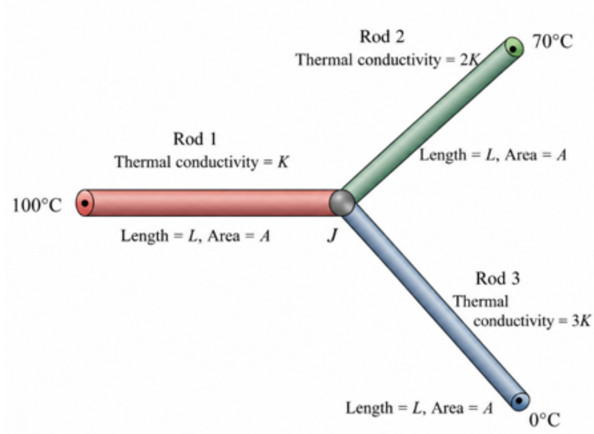
61. Three rods of material P and three rods of material Q are connected in the same network configuration as the figure above (a Wheatstone bridge arrangement with an input rod). All rods are identical in length and cross-sectional area. If the end A is maintained at $100^\circ\mathrm{C}$ and the junction E at $0^\circ\mathrm{C}$, calculate the temperature of the junction B. The thermal conductivity of P is $400\ \mathrm{W\ m^{-1}\ ^\circ C^{-1}}$ and that of Q is $200\ \mathrm{W\ m^{-1}\ ^\circ C^{-1}}$. (Note: Rods AB, BC, BD are material P; Rods CE, DE, CD are material



Q).

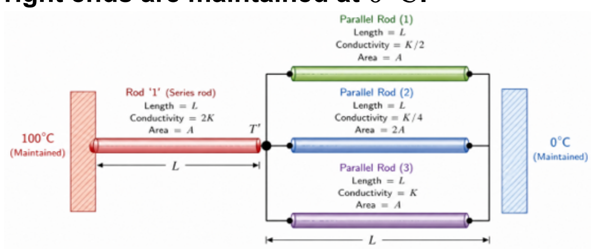
A) $40^\circ\mathrm{C}$
B) $50^\circ\mathrm{C}$
C) $60^\circ\mathrm{C}$
D) $70^\circ\mathrm{C}$

62. Three cylindrical rods of identical length L and cross-sectional area A are joined at a common junction. The first rod has thermal conductivity K and its free end is maintained at $100^\circ\mathrm{C}$. The second rod has thermal conductivity 2K and its free end is maintained at $70^\circ\mathrm{C}$. The third rod has thermal conductivity 3K and its free end is maintained at $0^\circ\mathrm{C}$. Find the steady-state temperature at the junction.



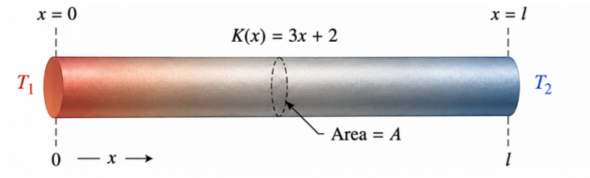
A) $30^\circ\mathrm{C}$
B) $40^\circ\mathrm{C}$
C) $50^\circ\mathrm{C}$
D) $60^\circ\mathrm{C}$

63. Find T' and net rate of flow of heat $\left(\frac{dQ}{dt}\right)$ through rod '1' for the combination of cylindrical rods. The first rod has length L, thermal conductivity 2K, cross-sectional area A, and its left end is maintained at $100^\circ\mathrm{C}$. It is connected to three parallel rods, each of length L and cross-sectional area A, having thermal conductivities $K/2$, $K/4$ (with cross-sectional area 2A), and K respectively, whose right ends are maintained at $0^\circ\mathrm{C}$.



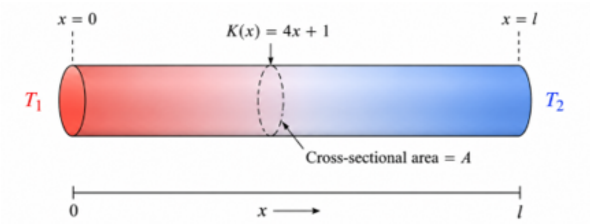
A) $T' = 40^\circ\mathrm{C}, \frac{dQ}{dt} = \frac{120KA}{L}$
B) $T' = 50^\circ\mathrm{C}, \frac{dQ}{dt} = \frac{100KA}{L}$
C) $T' = 60^\circ\mathrm{C}, \frac{dQ}{dt} = \frac{80KA}{L}$
D) $T' = 30^\circ\mathrm{C}, \frac{dQ}{dt} = \frac{140KA}{L}$

64. Find the thermal resistance R_{AB} for a rod of cross-sectional area A and length l where the thermal conductivity varies with length x as $K = 3x + 2$ from $x = 0$ to $x = l$.



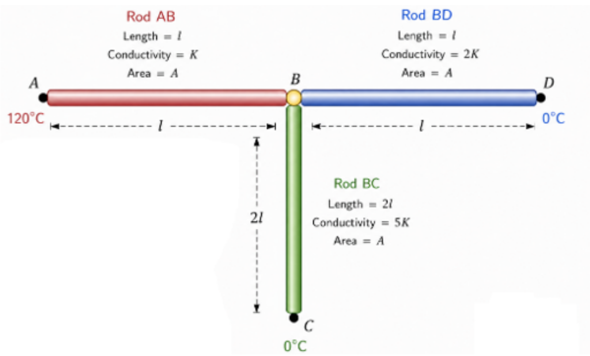
A) $\frac{1}{3A}\ln\left(\frac{3l+2}{2}\right)$ B) $\frac{1}{2A}\ln\left(\frac{3l+2}{3}\right)$
C) $\frac{1}{3A}\ln(3l+2)$ D) $\frac{3}{A}\ln\left(\frac{3l+2}{2}\right)$

65. Find the thermal resistance R_{AB} for a rod of cross-sectional area A and length l where the thermal conductivity varies with length x as $K = 4x + 1$ from $x = 0$ to $x = l$.



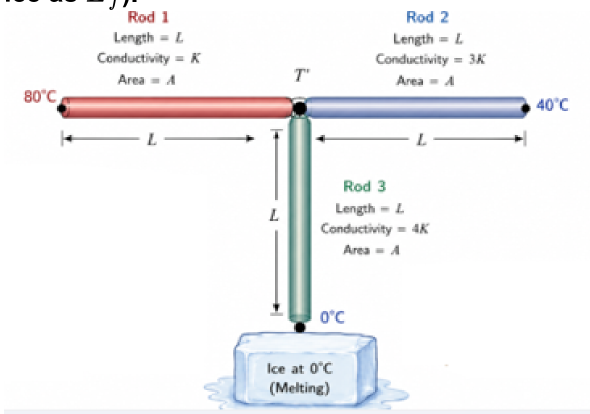
A) $\frac{1}{A}\ln(4l+1)$ B) $\frac{1}{4A}\ln(4l+1)$
C) $\frac{4}{A}\ln(4l+1)$ D) $\frac{1}{4A}\ln\left(\frac{4l+1}{4}\right)$

66. If heat current in rod BC is zero, find T_C (or T_0) given the system of rods connected at junction B. Rod AB has length L, thermal conductivity K, cross-sectional area A, and its end is at $120^\circ\mathrm{C}$. Rod BD has length L, thermal conductivity 2K, cross-sectional area A, and its end is at $0^\circ\mathrm{C}$. Rod BC has length 2L, thermal conductivity 5K, cross-sectional area A.



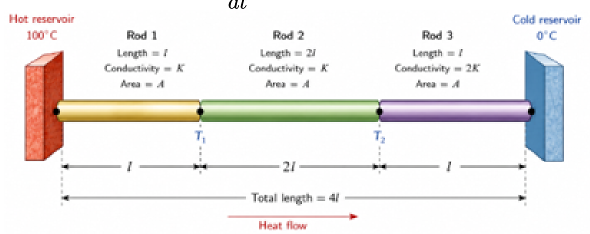
A) $30^\circ\mathrm{C}$ B) $40^\circ\mathrm{C}$
C) $50^\circ\mathrm{C}$ D) $60^\circ\mathrm{C}$

67. Find the temperature at the junction T' and the rate of melting of ice for three cylindrical rods joined at a common junction. The first rod has length L, thermal conductivity K, cross-sectional area A, and its free end is at $80^\circ\mathrm{C}$. The second rod has length L, thermal conductivity 3K, cross-sectional area A, and its free end is at $40^\circ\mathrm{C}$. The third rod has length L, thermal conductivity 4K, cross-sectional area A, and its free end is connected to ice at $0^\circ\mathrm{C}$. (Take the latent heat of fusion of ice as L_f).



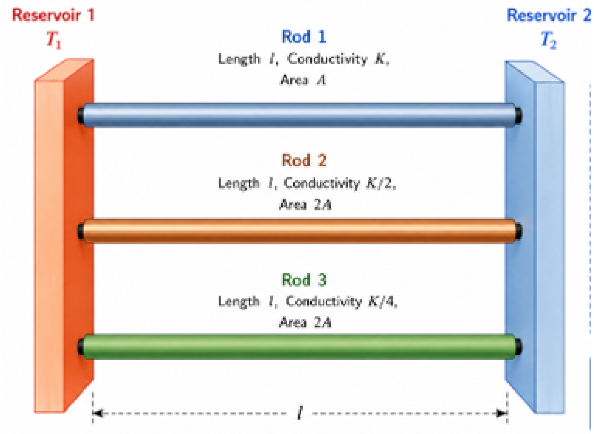
A) B)
$T' = 25^\circ\mathrm{C}, \text{Rate of melting} = \frac{100KA}{LL_f}$ $T' = 20^\circ\mathrm{C}, \text{Rate of melting} =$
C) D)
$T' = 30^\circ\mathrm{C}, \text{Rate of melting} = \frac{100KA}{3LL_f}$ $T' =$, $\text{Rate of melting} =$

68. Three cylindrical rods are joined end-to-end in series. The first rod has length l, thermal conductivity K, and cross-sectional area A. The second rod has length 2l, thermal conductivity K, and cross-sectional area A. The third rod has length l, thermal conductivity 2K, and cross-sectional area A. If the free ends are maintained at $100^\circ\mathrm{C}$ and $0^\circ\mathrm{C}$ respectively, find the steady-state temperatures T_1, T_2 at the junctions and the rate of heat flow $\frac{dQ}{dt}$.



A) B)
$T_1 = \frac{500}{7}{}^\circ\mathrm{C}, T_2 = \frac{100}{7}{}^\circ\mathrm{C}, \frac{dQ}{dt} = \frac{400KA}{7l}$ $T_1 = \frac{200}{7}, T_2 = \frac{200}{7}{}^\circ\mathrm{C}, \frac{dQ}{dt}$
C) D)
$T_1 = \frac{600}{7}{}^\circ\mathrm{C}, T_2 = \frac{300}{7}{}^\circ\mathrm{C}, \frac{dQ}{dt} = \frac{500KA}{7l}$ $T_1 = \frac{100}{7}, T_2 = \frac{200}{7}{}^\circ\mathrm{C}, \frac{dQ}{dt}$

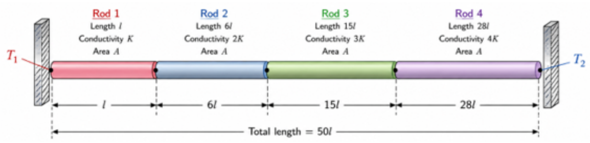
69. Find the net rate of heat flow through a combination of three cylindrical rods connected in parallel between two reservoirs at temperatures T_1 and T_2. The dimensions and thermal conductivities of the rods are: Rod 1: length l, thermal conductivity K, cross-sectional area A Rod 2: length l, thermal conductivity $K/2$, cross-sectional area 2A Rod 3: length l, thermal conductivity $K/4$, cross-sectional area 2A



A) $i_{net} = \frac{2KA(T_1-T_2)}{l}$ B) $i_{net} = \frac{5KA(T_1-T_2)}{2l}$

C) $i_{net} = \frac{3KA(T_1-T_2)}{l}$ D) $i_{net} = \frac{7KA(T_1-T_2)}{2l}$

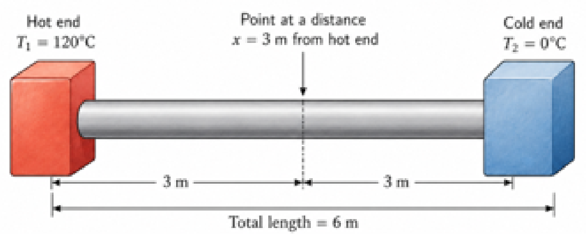
70. Four cylindrical rods are joined end-to-end in series. The first rod has length l, thermal conductivity K, and cross-sectional area A. The second rod has length 6l, thermal conductivity 2K, and cross-sectional area. A. The third rod has length 15l, thermal conductivity 3K, and cross-sectional area A. The fourth rod has length 28l, thermal conductivity 4K, and cross-sectional area A. If the outer ensads are maintained at temperatures T_1 and T_2 respectively, find the steady-state heat current flowing through the system.



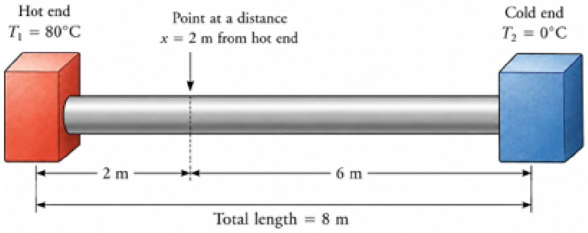
A) $i = \frac{KA(T_1-T_2)}{16l}$ B) $i = \frac{KA(T_1-T_2)}{12l}$

C) $i = \frac{KA(T_1-T_2)}{10l}$ D) $i = \frac{KA(T_1-T_2)}{8l}$

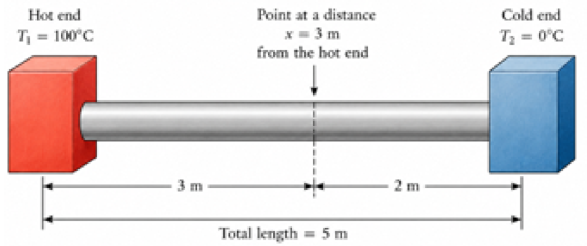
71. Find the temperature at a distance $3\ \mathrm{m}$ from the hot end ($120^\circ\mathrm{C}$) for a rod of total length $6\ \mathrm{m}$ with the other end at $0^\circ\mathrm{C}$.______^0C



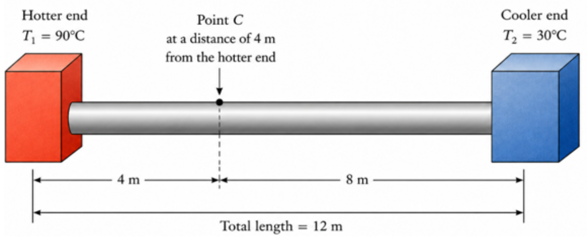
72. Find the temperature at a distance $2\ \mathrm{m}$ from the hot end ($80^\circ\mathrm{C}$) for a rod of total length $8\ \mathrm{m}$ with the other end at $0^\circ\mathrm{C}$.______^0C



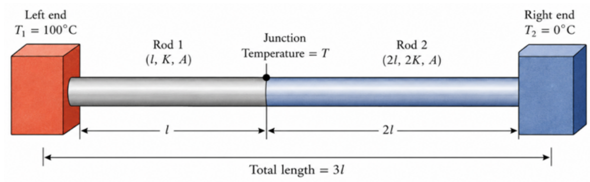
73. Find the temperature at a distance $3\ \mathrm{m}$ from the hot end ($100^\circ\mathrm{C}$) for a uniform rod of total length $5\ \mathrm{m}$ with the other end held at $0^\circ\mathrm{C}$. ______^0C



74. Find the temperature at a point C for a uniform rod of length $12\ \mathrm{m}$ with its ends held at $90^\circ\mathrm{C}$ and $30^\circ\mathrm{C}$, at a distance of $4\ \mathrm{m}$ from the hotter end is ______^0C



75. Two different rods are connected in series as shown in the figure, with the first rod having properties (L, K, A) and the second rod having properties $(2L, 2K, A)$. If the temperatures at the free ends are $100^\circ\mathrm{C}$ and $0^\circ\mathrm{C}$ respectively, find the temperature at the junction is ______^0C



ANSWER KEY

Chemistry

1.	**2**	8.	**4**	15.	**4**	22.	**9**
2.	**4**	9.	**1**	16.	**1**	23.	**60**
3.	**3**	10.	**3**	17.	**2**	24.	**8**
4.	**1**	11.	**2**	18.	**4**	25.	**8**
5.	**3**	12.	**2**	19.	**1**		
6.	**4**	13.	**3**	20.	**4**		
7.	**1**	14.	**2**	21.	**3**		

Maths

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

Physics

51.	**1**	58.	**2**	65.	**2**	72.	**60**
52.	**1**	59.	**2**	66.	**2**	73.	**?**
53.	**4**	60.	**1**	67.	**1**	74.	**70**
54.	**2**	61.	**3**	68.	**1**	75.	**50**
55.	**2**	62.	**2**	69.	**2**		
56.	**1**	63.	**1**	70.	**1**		
57.	**1**	64.	**1**	71.	**60**		

SOLUTIONS

Q1.

Answer: B

Explanation:
Neopentane is highly symmetrical with 12 equivalent hydrogens, and its spherical shape allows for better packing in a solid lattice, raising its melting point.

Q2.

Answer: D

Explanation:
2,2,4,4-Tetramethylhexane contains exactly one CH_2 group (carbon attached to two other carbons), which accounts for the two secondary hydrogens.

Q3.

Answer: C

Explanation:
The eclipsed conformation is the least stable due to maximum torsional strain and electronic repulsion between C-H bonds.

Q4.

Answer: A

Explanation:

Conformation (a) allows for intramolecular hydrogen bonding between the two hydroxyl groups in the gauche position, providing extra stability.

Q5.

Answer: C

Explanation:

Anhydrous $AlCl_3$ and HClact as an isomerization catalyst, converting straight-chain alkanes into branched-chain isomers.

Q6.

Answer: D

Explanation:
Conformations produced by rotation around a single bond are called rotamers or conformational isomers.

Q7.

Answer: A

Explanation:

Stability is inversely proportional to potential energy. Anti (I) is most stable (lowest energy), and Fully Eclipsed (II) is least stable (highest energy).

Q8.

Answer: D

Q9.

Answer: A

Q10.

Answer: C

Explanation:

Matching involves identifying the longest carbon chain and numbering based on substituent priority.

Q11.

Answer: B

Q12.

Answer: B

Explanation:
The gauche conformation is most stable due to intramolecular H-bonding between OHgroups.

Q13.

Answer: C

Explanation:

Molecules are identical if one can be superimposed on the other through simple rotation of the entire molecule or around the C-C bond.

Q14.

Answer: B

Q15.

Answer: D

Q16.

Answer: A

Explanation:
Monochlorination at theC1 or the methyl branch produces a chiral center at C2, creating two enantiomers.

Q17.

Answer: B

Explanation:
Straight-chain n-octane has the highest molecular weight and surface area among theC_8 isomers.

Q18.

Answer: D

Explanation:
Boiling point increases with the number of carbon atoms.

Q19.

Answer: A

Explanation:

Soda-lime decarboxylation (A) and reduction of alkyl halides (C) are standard ways to prepare alkanes.

Q20.

Answer: D

Explanation:
The overall halogenation of methane is an exothermic process.

Q21.

Answer: 3

Explanation:
Kolbe's electrolysis of a mixture of two salts produces a mixture of three alkanes via self-coupling and cross-coupling of methyl and ethyl radicals.

Q22.

Answer: 9

Explanation:
Ethane can have its six hydrogens replaced in various positions, leading to 9 unique structural and positional bromo-derivatives.

Q23.

Answer: 60

Explanation:
In any staggered conformation of an ethane derivative, the dihedral angle between adjacent substituents is 60°.

Q24.

Answer: 8

Explanation:

This typically refers to the chlorination of an alkane like 3-methylpentane, which yields 4 structural isomers, and including chiral centers results in 8 total stereoisomers.

Q25.

Answer: 8

Explanation:
Chlorination at 4 different positions on 3-methylpentane yields various structural and stereoisomers.

Q26.

Answer: D

Explanation:

If the roots are α and α^2, their sum is p and their product is q. Using the relationship between roots and coefficients, the value of p can be determined.

Q27.

Answer: A

Explanation:
Let the common root be α. The other roots are 4k and 3k. Using the sum and product of roots for both equations allows for solving the common root.

Q28.

Answer: C

Explanation:
For equal roots, the discriminant of the quadratic equation must be zero. Applying the condition $b^2 - 4ac = 0$ and simplifying gives a perfect square, from which the required value of $\dfrac{2}{q}$ is obtained directly.

Q29.

Answer: C

Explanation:
If the ratio of roots is k, then $\frac{(1+k)^2}{k} = \frac{b^2}{ac} = \frac{q^2}{pr}$ because both depend only on the ratio of the roots.

Q30.

Answer: B

Explanation:
The quadratic expression must be non-negative for all $x \geq 2$. This involves checking the discriminant and the value at the boundary $x = 2$.

Q31.

Answer: B

Explanation:
By applying the rational root theorem or testing integer factors of the constant term, the number of rational solutions is determined.

Q32.

Answer: A

Explanation:
If there are no real roots, the quadratic $f(x)$ never crosses the x-axis, so $f(x)$ always has the same sign as p. Thus $p \cdot f(1) > 0$.

Q33.

Answer: B

Explanation:
Convert the given equation into a quadratic equation in x. Since the roots are equal in magnitude but opposite in sign, their sum must be zero. Applying this condition gives a relation between b and m, which simplifies to the required answer.

Q34.

Answer: D

Explanation:

The difference of roots $|\alpha - \beta|$ is $\frac{\sqrt{D}}{|a|}$. Setting this less than $\sqrt{5}$ and solving for a gives the interval.

Q35.

Answer: C

Explanation:
To satisfy the condition that roots are less than 5, we must check the discriminant $D \geq 0$, the vertex position $-b/2a < 5$, and the function value $f(5) > 0$.

Q36.

Answer: D

Explanation:
By substituting $x = 3 + \{x\}$ for the interval $(3, 4)$, the equation is solved for k to find the range where a unique solution exists.

Q37.

Answer: B

Explanation:
Since the constant term is 1, the product of the four roots is 1. As all roots are positive, let the roots be $r,\ s,\ \frac{1}{r},\ \frac{1}{s}$. Using Vieta's relations and the identity $(r + \frac{1}{r})(s + \frac{1}{s}) = rs + \frac{r}{s} + \frac{s}{r} + \frac{1}{rs}$, the coefficients are obtained directly.

Q38.

Answer: A

Explanation:

For the roots to straddle the interval $(1, 2)$, the values of $(a - 5)f(1) < 0$ and $(a - 5)f(2) < 0$ must be satisfied.

Q39.

Answer: D

Explanation:
For 1 to lie between the roots, $f(1)$ must be less than 0 (since the parabola opens upwarD).

Q40.

Answer: A

Explanation:
Letting $f(x) = x^2 + 6x + 7$, the equation is $f(f(x)) = x$. Analysis shows that $f(x) = x$ has no real solutions, and neither does the nested form.

Q41.

Answer: A

Explanation:

For both roots of a quadratic equation to be negative real numbers, the discriminant must be non-negative ($D \geq 0$), the sum of the roots must be negative ($S < 0$), and the product of the roots must be positive ($P > 0$).

Q42.

Answer: A

Explanation:
By substituting $t = e^x$, the equation becomes a reciprocal quartic equation. Solving for t and ensuring $t > 0$ allows us to find the number and nature of the solutions for x.

Q43.

Answer: A

Explanation:
Substituting $|x| = t$ converts the equation into a quadratic. Since t represents an absolute value, only non-negative roots for t are valid to determine the real solutions for x.

Q44.

Answer: C

Explanation:
For an equation of the form $a^b = 1$, three cases are evaluated: the exponent $b = 0$ (if the base $a \neq 0$), the base $a = 1$, or the base $a = -1$ (if the exponent b is even).

Q45.

Answer: A

Explanation:
Roots of a quadratic equation with integer coefficients are rational if and only if the discriminant D is a perfect square.

Q46.

Answer: 1

Explanation:
For the equation to be an identity, all coefficients must be simultaneously zero.

Q47.

Answer: 4

Explanation:
Factorize the first expression and check which factor also divides the second expression. $P(x)$ is found to be $x^2 - 2x + 5$.

Q48.

Answer: 3

Explanation:

Locate the roots of the cubic equation in suitable intervals. Then evaluate the greatest integer (floor) of each root. The absolute value of the sum of these floor values gives the required answer.

Q49.

Answer: 1

Explanation:

Factoring the expressions inside the square roots reveals common factors, which helps in identifying potential roots and simplifying the equation to check for others within the valid domain.

Q50.

Answer: 1

Explanation:

The roots of $x^2 - x + 1 = 0$ are related to the cube roots of unity. Specifically, they can be expressed as $-\omega^2$ and $-\omega$, where ω is a complex cube root of unity ($1 + \omega + \omega^2 = 0$ and $\omega^3 = 1$).

Q51.

Answer: A

Explanation:

Using the formula $\frac{T_1 - T_2}{t} = k\left(\frac{T_1+T_2}{2} - T_s\right)$. Case 1: $\frac{90-70}{4} = k(80 - 30) \Rightarrow 5 = 50k \Rightarrow k = \frac{1}{10}$. Case 2: $\frac{70-50}{t} = k(60 - 30) \Rightarrow \frac{20}{t} = 30k$. Substituting k: $\frac{20}{t} = 30\left(\frac{1}{10}\right) = 3$. Therefore, $t = \frac{20}{3}$ minutes.

Q52.

Answer: A

Explanation:

For rods in series with equal lengths, the effective thermal conductivity K_{eff} is given by the harmonic mean formula adapted for length: $\frac{3L}{K_{eff}} = \frac{L}{K_1} + \frac{L}{K_2} + \frac{L}{K_3}$. Simplifying gives $\frac{3}{K_{eff}} = \frac{1}{K} + \frac{1}{2K} + \frac{1}{3K}$. Solving this yields $K_{eff} = \frac{18K}{11}$.

Q53.

Answer: D

Explanation:

For a series combination, thermal resistances add up ($R_{eq} = R_1 + R_2$). Using $R = \frac{L}{KA}$, we have $\frac{3L}{K_{eq}A} = \frac{L}{K_1A} + \frac{2L}{K_2A}$ Canceling common terms gives $\frac{3}{K_{eq}} = \frac{1}{K_1} + \frac{2}{K_2}$. Solving for K_{eq} yields $\frac{3K_1K_2}{2K_1+K_2}$.

Q54.

Answer: B

Explanation:

At the junction, the total heat current entering must equal the total heat current leaving (Kirchhoff's law for heat flow). Heat flows from the two $80^\circ\mathrm{C}$ ends towards the junction and leaves towards the $20^\circ\mathrm{C}$ end. Let T be the junction temperature. Since all rods have identical dimensions and material, their thermal conductance $G = \frac{KA}{L}$ is the same. Equation: $2 \times G(80 - T) = 1 \times G(T - 20)$. Solving this: $160 - 2T = T - 20 \Rightarrow 3T = 180 \Rightarrow T = 60^\circ\mathrm{C}$.

Q55.

Answer: B

Explanation:

According to Newton's Law of Cooling, for equal time intervals, the ratio of the temperature difference between the body and the surroundings remains constant. Ratio $r = \frac{T_{initial} - T_s}{T_{final} - T_s}$. For the first interval: $r = \frac{100-20}{80-20} = \frac{80}{60} = \frac{4}{3}$. For the second interval: $\frac{80-20}{T-20} = \frac{4}{3}$. Solving for T: $60 = \frac{4}{3}(T - 20) \Rightarrow 45 = T - 20 \Rightarrow T = 65^\circ\mathrm{C}$.

Q56.

Answer: A

Explanation:

Using Newton's Law of Cooling approximation $\frac{T_1-T_2}{t} = k(\frac{T_1+T_2}{2} - T_s)$: First interval: $\frac{90-70}{5} = k(\frac{90+70}{2} - 20) \Rightarrow 4 = k(60) \Rightarrow k = \frac{1}{15}$. Second interval: Let time be t. $\frac{70-50}{t} = k(\frac{70+50}{2} - 20) \Rightarrow \frac{20}{t} = k(40)$. Substituting k: $\frac{20}{t} = 40 \times \frac{1}{15} = \frac{8}{3}$. Solving for t: $t = \frac{60}{8} = 7.5$ minutes. Converting to seconds: $7.5 \times 60 = 450$ s.

Q57.

Answer: A

Explanation:

The thermal resistance is given by $R = \frac{L}{KA}$. Thus, $R_1 = \frac{L}{KA}$ and $R_2 = \frac{L}{2KA} = \frac{R_1}{2}$. Equating the heat currents $\frac{T_1-T}{R_1} = \frac{T-T_2}{R_2}$ leads to $\frac{T_1-T}{R_1} = \frac{T-T_2}{R_1/2}$. Simplifying gives $T_1 - T = 2(T - T_2)$, which solves to $T = \frac{T_1+2T_2}{3}$.

Q58.

Answer: B

Explanation:

In steady state, the rate of heat flow through the water layer equals the rate of heat flow through the ice layer. Heat flow through water: $H_w = \frac{K_1A(10-0)}{H-x}$. Heat flow through ice: $H_i = \frac{K_2A(0-(-15))}{x}$. Equating them: $\frac{10K_1}{H-x} = \frac{15K_2}{x} \Rightarrow \frac{2K_1}{H-x} = \frac{3K_2}{x}$. Solving for x: $2K_1x = 3K_2(H - x) \Rightarrow x(2K_1 + 3K_2) = 3K_2H \Rightarrow x = \frac{}{2}$

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Q59.

Answer: B

Explanation:

In steady state, heat current is constant. $\frac{K_1A(T_1-T)}{L_1} = \frac{K_2A(T-T_2)}{L_2}$. Rearranging to solve for T: $\frac{K_1}{L_1}(T_1 - T) = \frac{K_2}{L_2}(T - T_2)$ $\frac{K_1T_1}{L_1} + \frac{K_2T_2}{L_2} = T(\frac{K_1}{L_1} + \frac{K_2}{L_2})$ Multiplying numerator and denominator by L_1L_2: $T = \frac{K_1L_2T_1+K_2L_1T_2}{K_1L_2+K_2L_1}$.

Q60.

Answer: A

Explanation:

Using the formula for heat flow in a tapered rod $H = \frac{K\pi r_1 r_2 \Delta T}{L}$. Here, the radii are $r_1 = 2R$ and $r_2 = R$. Substituting these values gives $H = \frac{K\pi(2R)(R)(T_h - T_c)}{L} = \frac{2\pi KR^2(T_h - T_c)}{L}$.

Q61.

Answer: C

Explanation:

The network forms a balanced Wheatstone bridge because the ratio of thermal resistances in the arms is equal ($R_P/R_Q = R_P/R_Q$). Thus, no heat flows through the central rod CD. The equivalent resistance of the parallel branches (BCE and BDE) is calculated, added to the series rod AB, and the temperature drop across AB is found to determine T_B. Specifically, $R_Q = 2R_P$. The total resistance is $2.5R_P$. The drop across AB is $\frac{R_P}{2.5R_P} \times 100 = 40°\mathrm{C}$, so $T_B = 100 - 40 = 60°\mathrm{C}$.

Q62.

Answer: B

Explanation:

At steady state, the sum of heat currents flowing into the junction equals the sum of currents flowing out. Assuming the junction temperature T is between $0°\mathrm{C}$ and $70°\mathrm{C}$, heat flows from the $100°\mathrm{C}$ and $70°\mathrm{C}$ ends towards the junction, and then out to the $0°\mathrm{C}$ end. The equation is $\frac{KA(100-T)}{L} + \frac{2KA(70-T)}{L} = \frac{3KA(T-0)}{L}$. Solving this yields $T = 40°\mathrm{C}$.

Q63.

Answer: A

Explanation:

At steady state: $\frac{2KA(100-T')}{L} = \frac{(K/2)AT'}{L} + \frac{(K/4)(2A)T'}{L} + \frac{KAT'}{L}$. Simplifying: $2(100 - T') = T'(\frac{1}{2} + \frac{1}{2} + 1) = 2T'$. Therefore $200 - 2T' = 2T'$, giving $4T' = 200$, so $T' = 50°\mathrm{C}$. The heat flow rate is $\frac{dQ}{dt} = \frac{2KA(100-50)}{L} = \frac{100KA}{L}$.

Q64.

Answer: A

Explanation:

The differential resistance is $dR = \frac{dx}{KA}$. Integrating from 0 to l: $R = \int_0^l \frac{dx}{A(3x+2)}$. Using the substitution $u = 3x + 2$, the integral evaluates to $\frac{1}{3A}\ln\left(\frac{3l+2}{2}\right)$.

Q65.

Answer: B

Explanation:

The resistance is given by $R = \int_0^l \frac{dx}{KA} = \int_0^l \frac{dx}{A(4x+1)}$. Integrating this expression yields $\frac{1}{4A}[\ln(4x+1)]_0^l$, which simplifies to $\frac{1}{4A}\ln(4l+1)$ since $\ln(1) = 0$.

Q66.

Answer: B

Explanation:

Zero heat current in rod BC implies the temperature at the junction B is equal to T_0. Thus, heat flow from rod AB equals heat flow into rod BD. The equation is $\frac{KA(120-T_0)}{L} = \frac{2KA(T_0-0)}{L}$. Simplifying gives $120 - T_0 = 2T_0$, which leads to $3T_0 = 120$, so $T_0 = 40°\mathrm{C}$.

Q67.

Answer: A

Explanation:

Heat balance equation: $\frac{KA(80-T')}{L} + \frac{3KA(40-T')}{L} = \frac{4KA(T'-0)}{L}$. Simplifying: $(80 - T') + 3(40 - T') = 4T' \Rightarrow 80 - T' + 120 - 3T' = 4$. Rate of melting = $\frac{4KA(25)}{LL_f} = \frac{100KA}{LL_f}$.

Q68.

Answer: A

Explanation:

The thermal resistances are $R_1 = \frac{l}{KA}$, $R_2 = \frac{2l}{KA} = 2R_1$, and $R_3 = \frac{l}{2KA} = 0.5R_1$. The total resistance is $R_{eq} = (1 + 2 + 0.5)R_1 = 3.5R_1 = \frac{7l}{2KA}$. The heat current is $i = \frac{100}{7l/2KA} = \frac{200KA}{7l}$. The temperature drop across rod 1 is $iR_1 = \frac{200}{7}$, so $T_1 = 100 - \frac{200}{7} = \frac{500}{7}$. The drop across rod 2 is $iR_2 = \frac{400}{7}$, so $T_2 = \frac{500}{7} - \frac{400}{7} = \frac{100}{7}$.

Q69.

Answer: B

Explanation:

The total heat current is $i_{net} = i_1 + i_2 + i_3$. $i_1 = \frac{KA(T_1-T_2)}{l}$. $i_2 = \frac{(K/2)(2A)(T_1-T_2)}{l} = \frac{KA(T_1-T_2)}{l}$. $i_3 = \frac{(K/4)(2A)(T_1-T_2)}{l} = \frac{KA(T_1-T_2)}{2l}$. Summing them: $i_{net} = \frac{KA(T_1-T_2)}{l}(1 + 1 + 0.5) = 2.5\frac{KA(T_1-T_2)}{l} = \frac{5KA(T_1-T_2)}{2l}$.

Q70.

Answer: A

Explanation:

The thermal resistances are $R_1 = \frac{l}{KA}$, $R_2 = \frac{6l}{2KA} = \frac{3l}{KA}$, $R_3 = \frac{15l}{3KA} = \frac{5l}{KA}$, and $R_4 = \frac{28l}{4KA} = \frac{7l}{KA}$. The total resistance is the sum: $R_{eq} = (1+3+5+7)\frac{l}{KA} = \frac{16l}{KA}$. The heat current is $i = \frac{T_1 - T_2}{R_{eq}} = \frac{KA(T_1-T_2)}{16l}$.

Q71.

Answer: 60

Explanation:

The temperature distribution in a uniform rod in steady state is linear. The temperature drop is proportional to the distance. The total temperature difference is $120^\circ\mathrm{C} - 0^\circ\mathrm{C} = 120^\circ\mathrm{C}$ over $6\ \mathrm{m}$. The gradient is $20^\circ\mathrm{C/m}$. At $3\ \mathrm{m}$, the drop is $3 \times 20 = 60^\circ\mathrm{C}$. So, $T = 120 - 60 = 60^\circ\mathrm{C}$.

Q72.

Answer: 60

Explanation:

The total temperature difference is $80^\circ\mathrm{C}$ over a length of $8\ \mathrm{m}$, giving a gradient of $10^\circ\mathrm{C/m}$. At a distance of $2\ \mathrm{m}$, the temperature drops by $2 \times 10 = 20^\circ\mathrm{C}$. Therefore, the temperature is $80^\circ\mathrm{C} - 20^\circ\mathrm{C} = 60^\circ\mathrm{C}$.

Q73.

Answer: ?

Explanation:

The temperature distribution is linear. The total temperature difference is $100^\circ\mathrm{C} - 0^\circ\mathrm{C} = 100^\circ\mathrm{C}$ over a length of $5\ \mathrm{m}$. The temperature gradient is $\frac{100}{5} = 20^\circ\mathrm{C/m}$. At a distance of $3\ \mathrm{m}$, the temperature drops by $3 \times 20 = 60^\circ\mathrm{C}$. Therefore, the temperature is $100^\circ\mathrm{C} - 60^\circ\mathrm{C} = 40^\circ\mathrm{C}$.

Q74.

Answer: 70

Explanation:

The total temperature difference is $90^\circ\mathrm{C} - 30^\circ\mathrm{C} = 60^\circ\mathrm{C}$ over a length of $12\ \mathrm{m}$. The gradient is $\frac{60}{12} = 5^\circ\mathrm{C/m}$. At a distance of $4\ \mathrm{m}$ from the hot end, the temperature drops by $4 \times 5 = 20^\circ\mathrm{C}$. The temperature at point C is $90^\circ\mathrm{C} - 20^\circ\mathrm{C} = 70^\circ\mathrm{C}$.

Q75.

Answer: 50

Explanation:

In steady state, the rate of heat flow is constant. The thermal resistance $R = \frac{L}{KA}$. For the first rod, $R_1 = \frac{L}{KA}$. For the second rod, $R_2 = \frac{2L}{2KA} = \frac{L}{KA}$. Since resistances are equal, the temperature drop is equal across both. Total drop is $100^\circ\mathrm{C}$, so drop is $50^\circ\mathrm{C}$ each. Junction temp = $100 - 50 = 50^\circ\mathrm{C}$.