Max Marks: 300 **SR_WEEK-7 (27-07-2026)** **Time: 180 mins**

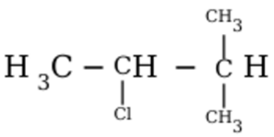
Chemistry

1. The incorrect method for the synthesis of alkenes is:

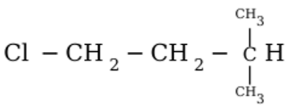
A) treating vicinal dihalides with Zn metal
B) treatment of alkynes with Na in liquid NH_3
C) heating alkyl halides with alcoholic KOH
D) treating alkyl halides in aqueous KOH solution

2. An alkene A on reaction with O_3 and $Zn - H_2O$ gives propanone and ethanal in equimolar ratio. Addition of HCl to alkene A gives B as the major product. The R

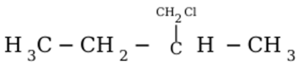
A)



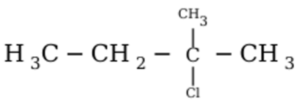
B)



C)



D)

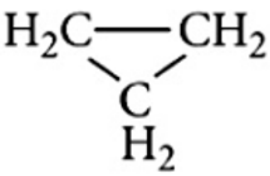


3. Which one is the correct order of acidity?

A) $CH \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2 > CH_3 - CH_3$
B) $CH \equiv CH > CH_2 = CH_2 > CH_3 - C \equiv CH > CH_3 - CH_3$
C) $CH_3 - CH_3 > CH_2 = CH_2 > CH_3 - C \equiv CH > CH \equiv CH$
D) $CH_2 = CH_2 > CH_3 - CH = CH_2 > CH_3 - C \equiv CH > CH \equiv CH$

4. Which of the following compounds shall not produce propene by reaction with HBr followed by elimination or direct only elimination reaction?

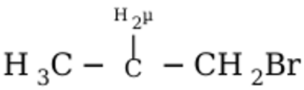
A)



B) $H_3C - C - CH_2 - OH$

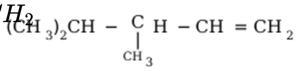
C) $H_2C = C = O$

D)

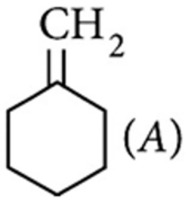


5. 2,3-Dimethyl-2-butene can be prepared by heating which of the following compounds with a strong acid?

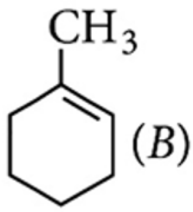
A) $(CH_3)_3C - CH = CH_2$
B) $(CH_3)_2C = CH - CH_2 - CH_3$
C) $(CH_3)_2CH - CH_2 - CH = CH_2$
D)



6. In the reaction with HCl, an alkene reacts in accordance with the Markovnikov's rule to give a product 1-chlorol-methylcyclohexane. The possible alkene is:

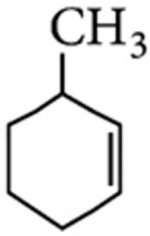


A)



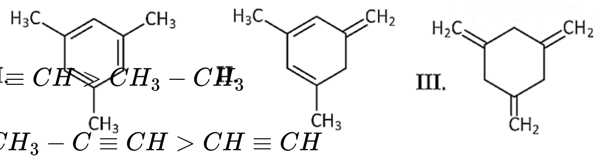
B)

C) (A) and (B)



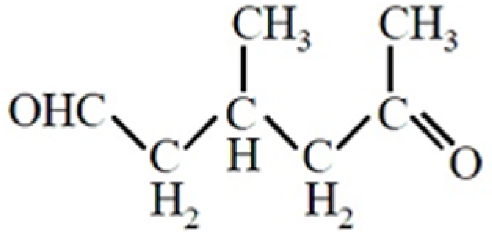
D)

7. Given three cycloalkenes (I: tetrasubstituted, II: disubstituted, III: monosubstituted). The enthalpy of hydrogenation of these compounds will be in the order as:



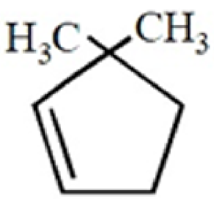
A) II > III > I
B) II > I > III
C) I > II > III
D) III > II > I

8. A single compound of the structure



is obtainable from ozonolysis of which of the following cyclic compounds?

A)



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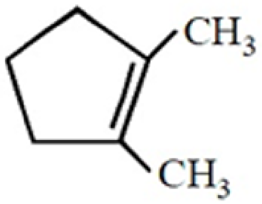
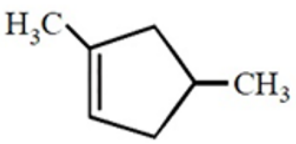
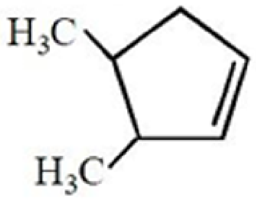


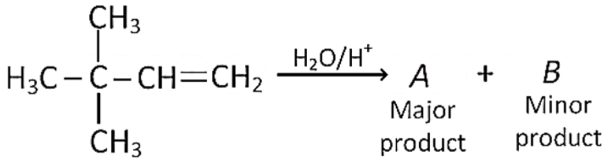
C)



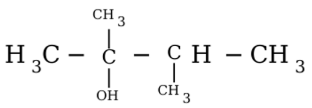
D)



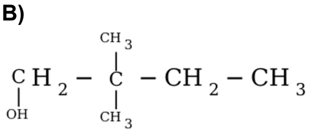
9. In the reaction



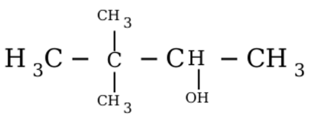
A)



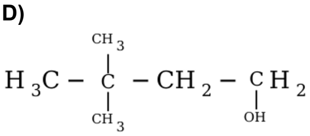
B)



C)

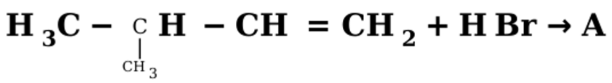


D)



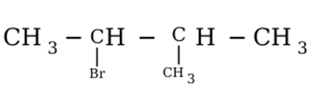
10. Which of the following compounds will exhibit cis-trans (geometrical) isomerism?

A) Butanol
B) 2-Butyne
C) 2-Butenol
D) 2-Butene

11. 

. Product A (predominantly) is:

A)



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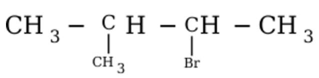
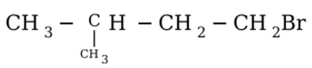
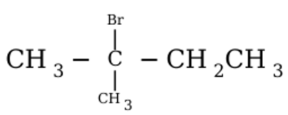


C)



D)



12. Reaction of HBr with propene in the presence of peroxide gives:

A) isopropyl bromide
B) 3-bromopropane
C) allyl bromide
D) n-propyl bromide

13. In preparation of alkene from alcohol using Al_2O_3 which is the effective factor?

A) Porosity of Al_2O_3
B) Temperature
C) Concentration
D) Surface area of Al_2O_3

14. Which is maximum stable?

A) 1-Butene
B) cis-2-Butene
C) trans-2-Butene
D) All have same stability

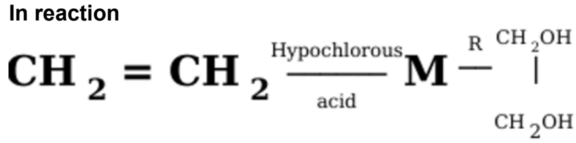
15. 2-Butene shows geometrical isomerism due to:

A) restricted rotation about double bond
B) free rotation about double bond
C) free rotation about single bond
D) chiral carbon

16. 2-Bromopentane is heated with potassium ethoxide in ethanol. The major product obtained is:

A) trans-2-pentene
B) 1-pentene
C) 2-ethoxypentane
D) 2-cis-pentene

17. In reaction



, where, M = Molecule and R = Reagent. M and R are

A) CH_3CH_2OH and HCl
B) $CH_2 = CH_2$and heat
C) CH_3CH_2Cl and NaOH
D) $CH_2Cl - CH_2OH$ and $aq.\ NaHCO_3$

18. The reaction $CH_2 = CH - CH_3 + HBr \rightarrow CH_3CH(Br) - CH_3$ is an example of:

A) electrophilic substitution
B) free radical addition
C) nucleophilic addition
D) electrophilic addition

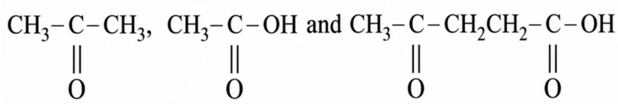
19. Which of the following has zero dipole moment?

A) 1-Butene
B) 2-Methyl-1-propene
C) cis-2-Butene
D) trans-2-Butene

20. One of the following which does not observe the anti-Markownikoff's addition of HBr is:

A) pent-2-ene
B) propene
C) but-2-ene
D) but-1-ene

21. A compound 'X' absorbs 2 moles of hydrogen and 'X' upon oxidation with $KMnO_4/H^+$ gives.



The total number of σ bonds present in the compound 'X' is:

22. The hydrocarbon (X) with molar mass $80\ \mathrm{g\ mol^{-1}}$ and 90% carbon has ________ degree of unsaturation.

23. 3-Methylhex-2-ene on reaction withHBrin presence of peroxide forms an addition product (A). The number of possible stereoisomers for 'A' is ________.

24. Molar mass of the hydrocarbon (X) which on ozonolysis consumes one mole of O_3 per mole of (X) and gives one mole each of ethanal and propanone is ________ $\mathrm{g\ mol^{-1}}$. (Molar ;mass of C:12 g mol^{-1}, H:1 gmol^{-1})

25. The number of possible isomeric products formed when 3-chloro-1-butene reacts with HClthrough carbocation formation is ________.

Maths

26. The number of ways in which 5 boys and 3 girls can be seated on a round table if a particular boy B_1 and a particular girl G_1 never sit adjacent to each other, is :

A) $5 \times 6!$ B) $6 \times 6!$
C) 7! D) $5 \times 7!$

27. If all the words with or without meaning made using all the letters of the word "NAGPUR" are arranged as in a dictionary, then the word at 315^{th} position in this arrangement is :

A) NRAPUG B) NRAGUP
C) NRAPGU D) NRAGPU

28. The number of integers, greater than 7000 that can be formed, using the digits 3, 5, 6, 7, 8 without repetition is :

A) 48 B) 120
C) 168 D) 220

29. The letters of the word OUGHT are written in all possible ways and these words are arranged as in a dictionary, in a series. Then the serial number of the word TOUGH is :

A) 79 B) 84
C) 89 D) 86

30. The number of words, with or without meaning, that can be formed using all the letters of the word ASSASSINATION so that the vowels occur together, is ______.

A) 58950 B) 50400
C) 48593 D) 78145

31. The number of 4-letter words, with or without meaning, each consisting of 2 vowels and 2 consonants, which can be formed from the letters of the word UNIVERSE without repetition is ______.

A) 432 B) 726
C) 149 D) 246

32. The number of arrangements of the letters of the word "INDEPENDENCE" in which all the vowels always occur together is :

A) 16800 B) 14800
C) 18000 D) 33600

33. If the number of words, with or without meaning, which can be made using all the letters of the word MATHEMATICS in which C and S do not come together, is $(6!)k$, then k is equal to :

A) 5670 B) 1890
C) 2835 D) 945

34. In an examination, 5 students have been allotted their seats as per their roll numbers. The number of ways, in which none of the students sits on the allotted seat, is ______.

A) 32 B) 15
C) 27 D) 44

35. The number of 4-letter words, with or without meaning, each consisting of two vowels and two consonants that can be formed from the letters of the word INCONSEQUENTIAL, without repeating any letter, is:

A) 2670 B) 2840
C) 2920 D) 3600

36. The number of ways in which 21 identical apples can be distributed among three children such that each child gets at least 2 apples, is

A) 130 B) 136
C) 142 D) 406

37. The number of triplets (x, y, z), where x, y, z are distinct non negative integers satisfying $x+y+z=15$, is :

A) 136 B) 80
C) 92 D) 114

38. The total number of positive integral solutions (x, y, z) such that $xyz = 24$ is :

A) 36 B) 24
C) 45 D) 30

39. The number of times the digit 3 will be written when listing the integers from 1 to 1000, is

A) 269 B) 300
C) 271 D) 302

40. The number of positive integral solutions of the equation $x_1x_2x_3x_4x_5 = 1050$ is

A) 1800 B) 1600
C) 1400 D) 1875

41. Number of ways in which 25 identical things be distributed among five persons if each gets odd number of things is

A) $^{25}C_4$ B) $^{12}C_8$
C) $^{14}C_{10}$ D) $^{13}C_3$

42. The number of ways in which 15 identical blankets can be distributed among 4 persons so that each of them gets atleast two blankets, is equal to

A) $^{10}C_3$ B) $^{9}C_3$
C) $^{11}C_3$ D) $^{15}C_4$

43. The number of ways of selecting 10 balls out of an unlimited number of white, red, blue and green balls is

A) 270 B) 84
C) 286 D) 86

44. The number of ways to give away 20 apples to 3 boys, each boy receiving atleast 4 apples, is

A) 90 B) $^{22}C_{20}$
C) $^{12}C_4$ D) $^{10}C_8$

45. Ajay writes letters to his five friends and addresses the corresponding envelopes. The number of ways can the letters be placed in the envelopes so that at least two of them are in the wrong envelopes are

A) 120
B) 125
C) 119
D) 118

46. All the letters of the word "GTWENTY" are written in all possible ways with or without meaning and these words are written as in a dictionary. The serial number of the word "GTWENTY" is ______.

47. The total number of words (with or without meaning) that can be formed out of the letters of the word 'DISTRIBUTION' taken four at a time, is equal to ______.

48. The number of 3-digit numbers, formed using the digits 2, 3, 4, 5 and 7, when the repetition of digits is not allowed, and which are not divisible by 3, is equal to ______.

49. The number of 4 letter words (with or without meaning) that can be formed from the eleven letters of the word 'EXAMINATION' is ______.

50. The number of 3 -digit numbers, that are divisible by 2 and 3, but not divisible by 4 and 9, is ______.

Physics

51. A bullet of mass $10 \mathrm{~g}$, traveling with a speed of $225 \mathrm{~m/s}$, strikes a fixed wooden target. One half of its kinetic energy is converted into heat in the bullet while the other half is converted into heat in the wood The rise of temperature of the bullet if the specific heat of its material is $0.030 \mathrm{~cal/g} \cdot{ }^{\circ} \mathrm{C}$ ($1 \mathrm{~cal}=4.2 \times 10^7$ ergs $=4.2$ J) is close to:

A) $100.4^{\circ} \mathrm{C}$
B) $50.2^{\circ} \mathrm{C}$
C) $200.8^{\circ} \mathrm{C}$
D) $75.3^{\circ} \mathrm{C}$

52. M grams of steam at $100^{\circ} \mathrm{C}$ is mixed with $150 \mathrm{~g}$ of ice at its melting point in a thermally insulated container. If it produces liquid water at $40^{\circ} \mathrm{C}$ [heat of vaporization of water is $540 \mathrm{~cal/g}$ and heat of fusion of ice is $80 \mathrm{~cal/g}$], the value of M is:

A) $45 \mathrm{~g}$
B) $30 \mathrm{~g}$
C) $60 \mathrm{~g}$
D) $25 \mathrm{~g}$

53. The specific heat of a metal varies according to $S=a T^2$, where a is a constant and T is the absolute temperature. The heat energy needed to raise unit mass of the metal from $T=1 \mathrm{~K}$ to $T=2 \mathrm{~K}$ is:

A) 3a
B) $\frac{7 a}{3}$
C) $\frac{8 a}{3}$
D) $\frac{2 a}{3}$

54. A block of mass $3.5 \mathrm{~kg}$ is heated to a temperature of $400^{\circ} \mathrm{C}$ and placed on a large ice block. What is the maximum amount of ice that can melt (approx.)? (Given specific heat capacity of the body $c=0.1 \mathrm{~cal/g} \cdot{ }^{\circ} \mathrm{C}$ and latent heat of fusion of ice $L=80 \mathrm{~cal/g}$)

A) $1.25 \mathrm{~kg}$
B) $1.75 \mathrm{~kg}$
C) $2.00 \mathrm{~kg}$
D) $1.50 \mathrm{~kg}$

55. Find the quantity of heat required to convert $40 \mathrm{~g}$ of ice at $-20^{\circ} \mathrm{C}$ into water at $20^{\circ} \mathrm{C}$. Given $L_{\text{ice}}=0.336 \times 10^6 \mathrm{~J/kg}$, specific heat capacity of ice $c_{\text{ice}}=2100 \mathrm{~J/kg} \cdot \mathrm{K}$, and specific heat capacity of water $c_{\text{water}}=4200 \mathrm{~J/kg} \cdot \mathrm{K}$.

A) $15120 \mathrm{~J}$
B) $18480 \mathrm{~J}$
C) $16800 \mathrm{~J}$
D) $20160 \mathrm{~J}$

56. An iron block of mass $3 \mathrm{~kg}$ falls from a height $20 \mathrm{~m}$. After colliding with the ground, it loses 25% energy to surroundings. Then find the temperature rise of the block. (Take specific heat of iron $400 \mathrm{~J/kg} \cdot{ }^{\circ} \mathrm{C}$ and $g=10 \mathrm{~m/s}^2$)

A) $0.375^{\circ} \mathrm{C}$
B) $0.500^{\circ} \mathrm{C}$
C) $0.250^{\circ} \mathrm{C}$
D) $0.125^{\circ} \mathrm{C}$

57. Two bodies A and B have thermal emissivities of 0.04 and 0.64 respectively. The outer surface areas of the two bodies are the same. The two bodies radiate energy at the same rate. The wavelength λ_B, corresponding to the maximum spectral radiancy in the radiation from B, is shifted from the wavelength corresponding to the maximum spectral radiancy in the radiation from A by 2.00 μ. If the temperature of A is $1449 \mathrm{~K}$ (taking Wien's constant $b \approx 2.898 \times 10^{-3} \mathrm{~m} \cdot \mathrm{K}$), calculate the wavelength λ_B.

A) 2.00 μ m
B) 3.00 μm
C) 4.00 μ
D) 6.00 μm

58. The spectra of a black body at temperatures $127^{\circ} \mathrm{C}$ and $527^{\circ} \mathrm{C}$ are shown in the figure. If A_1 and A_2 are the areas under the two curves corresponding to $127^{\circ} \mathrm{C}$ and $527^{\circ} \mathrm{C}$ respectively, the value of $\frac{A_2}{A_1}$ is:

A) 2
B) 4
C) 8
D) 16

59. The spectra of a black body at temperatures $27^{\circ} \mathrm{C}$ and $227^{\circ} \mathrm{C}$ are shown in the figure. If A_1 and A_2 are the areas under the two curves corresponding to $27^{\circ} \mathrm{C}$ and $227^{\circ} \mathrm{C}$ respectively, the value of $\frac{A_2}{A_1}$ is:

A) $\frac{25}{9}$
B) $\frac{125}{27}$
C) $\frac{625}{81}$
D) $\frac{81}{625}$

60. A hot black body emits energy at the rate of $8 \mathrm{~J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$ and its most intense radiation corresponds to $24,000$ Å. When the temperature of this body is further increased such that its most intense radiation corresponds to $12,000$ Å, find the value of energy radiated in $\mathrm{J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$.

A) $32 \mathrm{~J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$
B) $64 \mathrm{~J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$
C) $128 \mathrm{~J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$
D) $256 \mathrm{~J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$

61. A hot black body emits energy at the rate of $5 \mathrm{~J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$ and its most intense radiation corresponds to $15,000$. ÅWhen the temperature of this body is further increased such that its most intense radiation corresponds to $5,000$ Å, find the value of energy radiated in $\mathrm{J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$.

A) $135 \mathrm{~J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$
B) $270 \mathrm{~J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$
C) $405 \mathrm{~J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$
D) $810 \mathrm{~J} \mathrm{~m}^{-2} \mathrm{s}^{-1}$

62. Two spherical stars A and B emit blackbody radiation. The radius of A is 4 times that of B and A emits 256 times the power emitted from B) The ratio of their wavelengths $\frac{\lambda_A}{\lambda_B}$ at which the peaks occur in their respective radiation curves is:

A) $\frac{1}{4}$
B) $\frac{1}{2}$
C) 2
D) 4

63. Two spherical stars A and B emit blackbody radiation. The radius of A is 1600 times that of B and A emits 10^4 times the power emitted from B) The ratio of their wavelengths $\frac{\lambda_A}{\lambda_B}$ at which the peaks occur in their respective radiation curves is:

A) $\frac{1}{4}$ B) 1
C) 2 D) 4

64. The maximum in the energy distribution spectrum of a star is at 5000 Å and its temperature is $6000\ \mathrm{K}$. What will be the temperature of a star whose energy distribution shows a maximum at 2500 Å?

A) $3000\ \mathrm{K}$ B) $12000\ \mathrm{K}$
C) $6000\ \mathrm{K}$ D) $9000\ \mathrm{K}$

65. Light from a star is found to have maximum intensity near a wavelength of $580\ \mathrm{nm}$. Assuming the surface of the star acts as a black body, find the temperature of the star. (Take Wien's constant $b = 2.9 \times 10^{-3}\ \mathrm{m\ K}$)

A) $4500\ \mathrm{K}$ B) $5000\ \mathrm{K}$
C) $5500\ \mathrm{K}$ D) $6000\ \mathrm{K}$

66. Two solid spheres A and B made of the same material are kept at the same temperature and placed in identical surroundings. If the radius of sphere A is R and the radius of sphere B is 2R, the ratios of their rate of heat loss and rate of cooling (A : B) are respectively:

A) $\frac{1}{4}$ and 2 B) $\frac{1}{2}$ and 4
C) 4 and $\frac{1}{2}$ D) 2 and $\frac{1}{4}$

67. A body of emissivity $e = 0.6$, surface area $400\ \mathrm{cm}^2$, and temperature $327^\circ\mathrm{C}$ is kept in a room at a temperature of $27^\circ\mathrm{C}$. Calculate the initial net power emitted by the body.

A) $45.4\ \mathrm{Watt}$ B) $68.0\ \mathrm{Watt}$
C) $90.7\ \mathrm{Watt}$ D) $136.1\ \mathrm{Watt}$

68. A body of emissivity $e = 0.5$, surface area $200\ \mathrm{cm}^2$, and temperature $327^\circ\mathrm{C}$ is kept in a room at a temperature of $27^\circ\mathrm{C}$. Calculate the initial net power emitted by the body.

A) $14.2\ \mathrm{Watt}$ B) $21.5\ \mathrm{Watt}$
C) $28.3\ \mathrm{Watt}$ D) $35.6\ \mathrm{Watt}$

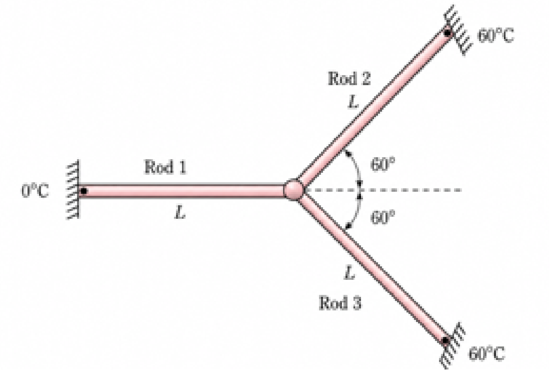
69. If the rate of heat radiation from a body at temperature $127^\circ\mathrm{C}$ is E, find the rate of heat radiation when the body is at $527^\circ\mathrm{C}$.

A) 2E B) 4E
C) 8E D) 16E

70. A body of emissivity $e = 0.8$, surface area $200\ \mathrm{cm}^2$, and temperature $432^\circ\mathrm{C}$ is kept in a room at a temperature of $27^\circ\mathrm{C}$. Calculate the initial net power emitted by the body.

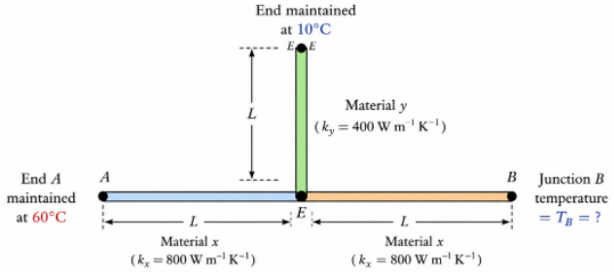
A) $198.5\ \mathrm{Watt}$ B) $217.7\ \mathrm{Watt}$
C) $245.0\ \mathrm{Watt}$ D) $310.2\ \mathrm{Watt}$

71. Three rods made of the same material and having the same cross-section have been joined as shown in the figure. Each rod is of the same length L. The left end is kept at $0^\circ\mathrm{C}$ and the two right ends are kept at $60^\circ\mathrm{C}$ each. The temperature of the junction of the three rods will be_____

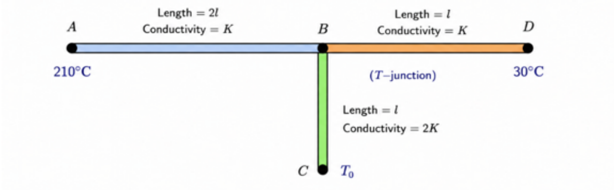


^0C:

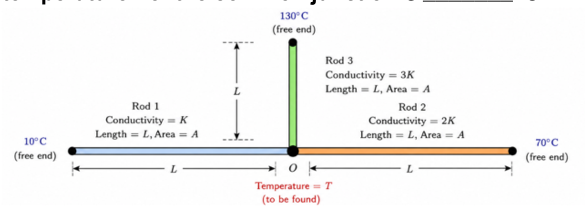
72. Three rods of material x and three of material y are connected as shown in the network. All the rods are identical in length and cross-sectional area. If the end A is maintained at $60^\circ\mathrm{C}$ and the junction E is maintained at $10^\circ\mathrm{C}$, The thermal conductivity of x is $800\ \mathrm{W\ m^{-1}\ K^{-1}}$ and that of y is $400\ \mathrm{W\ m^{-1}\ K^{-1}}$.calculate the temperature of the junction B_____^0C.



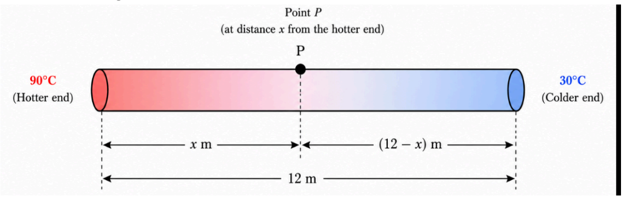
73. Three rods of identical cross-sectional area A are connected to form a T-junction at point B. Rod AB has length 2l and thermal conductivity K, with end A maintained at $210^\circ\mathrm{C}$. Rod BD has length l and thermal conductivity K, with end D maintained at $30^\circ\mathrm{C}$. Rod BC has length l and thermal conductivity 2K, with end C maintained at temperature T_0. If the heat current through rod BC is zero, find the temperature T_0 in^0C.



74. Three cylindrical rods of identical length L and cross-sectional area A are joined at a common junction O. The free end of the first rod is maintained at $10^\circ\mathrm{C}$ and has thermal conductivity K. The free end of the second rod is maintained at $70^\circ\mathrm{C}$ and has thermal conductivity 2K. The free end of the third rod is maintained at $130^\circ\mathrm{C}$ and has thermal conductivity 3K. Find the steady-state temperatureT of the common junction O________^0C.



75. Find the temperature at a point located at a distance of $4\ \mathrm{m}$ from the hotter end for a uniform rod of total length $12\ \mathrm{m}$ with its ends maintained at $90^{\circ}\mathrm{C}$ and $30^{\circ}\mathrm{C}$ respectively____^{0}C.



ANSWER KEY

Chemistry

1.	**4**	8.	**3**	15.	**1**	22.	**3**
2.	**4**	9.	**1**	16.	**1**	23.	**4**
3.	**1**	10.	**4**	17.	**4**	24.	**70**
4.	**3**	11.	**4**	18.	**4**	25.	**4**
5.	**1**	12.	**4**	19.	**4**		
6.	**3**	13.	**2**	20.	**3**		
7.	**4**	14.	**3**	21.	**27**		

Maths

26.	**1**	33.	**1**	40.	**4**	47.	**3734**
27.	**3**	34.	**4**	41.	**3**	48.	**36**
28.	**3**	35.	**4**	42.	**1**	49.	**2454**
29.	**3**	36.	**2**	43.	**3**	50.	**125**
30.	**2**	37.	**4**	44.	**4**		
31.	**1**	38.	**4**	45.	**3**		
32.	**1**	39.	**2**	46.	**553**		

Physics

51.	**1**	58.	**4**	65.	**2**	72.	**40**
52.	**2**	59.	**3**	66.	**1**	73.	**90**
53.	**2**	60.	**3**	67.	**2**	74.	**90**
54.	**2**	61.	**3**	68.	**3**	75.	**70**
55.	**2**	62.	**2**	69.	**4**		
56.	**1**	63.	**4**	70.	**2**		
57.	**3**	64.	**2**	71.	**40**		

SOLUTIONS

Q1.

Answer: D

Explanation:
Treating alkyl halides with aqueous KOH results in nucleophilic substitution to form alcohols, whereas alcoholic KOH is required for the dehydrohalogenation that produces alkenes.

Q2.

Answer: D

Explanation:
Alkene A is reconstructed as 2-methylbut-2-ene. Adding HCl follows Markovnikov's rule, where the chloride ion attacks the most substituted, tertiary carbon to form 2-chloro-2-methylbutane.

Q3.

Answer: A

Explanation:
Acidity is determined by the s-character of the carbon atom. spcarbons (alkynes) are more electronegative and acidic thansp^2(alkenes) orsp^3 (alkanes).

Q4.

Answer: C

Explanation:
Ketene $CH_2 = C = O$ reacts with HBr to form an acyl bromide CH_3COBr, which cannot be converted into the 3-carbon propene molecule.

Q5.

Answer: A

Explanation:
Acid-catalyzed dehydration/rearrangement of 3,3-dimethyl-1-butene involves a secondary-to-tertiary methyl shift to form the most stable tetrasubstituted alkene, 2,3-dimethyl-2-butene.

Q6.

Answer: C

Explanation:

Both methylenecyclohexane and 1-methylcyclohexene form the same 1-methylcyclohexyl tertiary carbocation upon protonation, which then reacts with chloride to yield the same product.

Q7.

Answer: D

Explanation:

Enthalpy of hydrogenation is inversely proportional to the stability of the alkene. More substituted alkenes are more stable and thus have lower enthalpies of hydrogenation.

Q8.

Answer: C

Explanation:
Ozonolysis cleaves the double bond of a ring. Breaking 1,2-dimethylcyclopentene results in an open chain with a ketone at one end and an aldehyde at the other.

Q9.

Answer: A

Explanation:
Hydration of 3,3-dimethyl-1-butene involves a secondary carbocation that undergoes a 1,2-methyl shift to form a more stable tertiary carbocation, leading to 2,3-dimethyl-2-butanol.

Q10.

Answer: D

Explanation:
Geometrical isomerism requires restricted rotation (like a double bond) and two different groups attached to each of the unsaturated carbons. 2-Butene satisfies these conditions.

Q11.

Answer: D

Explanation:

Addition of HBr to 3-methyl-1-butene leads to a secondary carbocation that undergoes a 1,2-hydride shift to form a more stable tertiary carbocation, resulting in 2-bromo-2-methylbutane.

Q12.

Answer: D

Explanation:
In the presence of peroxides, HBr adds to alkenes via a free-radical mechanism, resulting in Anti-Markovnikov addition where the bromine adds to the terminal carbon.

Q13.

Answer: B

Explanation:
Dehydration of alcohols over alumina Al_2O_3 is highly temperature-dependent; higher temperatures $\approx 620 \text{ K}$ favor alkene formation over ethers.

Q14.

Answer: C

Explanation:
Among butene isomers, the internal 2-butenes are more stable than terminal 1-butene. Trans-2-butene is more stable than the cis isomer due to reduced steric repulsion between methyl groups.

Q15.

Answer: A

Explanation:
The π-bond in alkenes prevents the rotation of the two carbon atoms relative to each other, creating fixed spatial arrangements known as geometrical isomers.

Q16.

Answer: A

Explanation:
Dehydrohalogenation of 2-bromopentane follows Saytzeff's rule, favoring the most substituted alkene. The trans-isomer of 2-pentene is the major product due to its higher stability.

Q17.

Answer: D

Explanation:
Ethene reacts with hypochlorous acid to form ethylene chlorohydrin (M). Subsequent hydrolysis with an aqueous base like $NaHCO_3$ replaces the chloride with a hydroxyl group to form glycol.

Q18.

Answer: D

Explanation:
Alkenes undergo addition reactions where the π electrons act as a nucleophile and attack an electrophile (H^+ from HBr), making it an electrophilic addition.

Q19.

Answer: D

Explanation:
In trans-2-butene, the molecule is symmetrical. The bond dipoles of the two methyl groups are oriented in equal and opposite directions, canceling each other out.

Q20.

Answer: C

Explanation:
Anti-Markovnikov addition (peroxide effect) is only observable in unsymmetrical alkenes. Since but-2-ene is perfectly symmetrical, adding HBr in any orientation yields the same product.

Q21.

Answer: 27

Explanation:

Reconstructing the compound from its oxidative cleavage products reveals an acyclic diene with 10 carbons and 18 hydrogens ($C_{10}H_{18}$), resulting in 27 σ bonds.

Q22.

Answer: 3

Explanation:

Calculating the molecular formula from the percentage composition and molar mass gives C_6H_8. Comparing this to the saturated alkane C_6H_{14} yields a degree of unsaturation of 3.

Q23.

Answer: 4

Explanation:
Addition ofHBrin peroxide follows the anti-Markovnikov rule. The resulting product, 2-bromo-3-methylhexane, contains two chiral centers, leading to $2^2 = 4$stereoisomers.

Q24.

Answer: 70

Explanation:
The fragments ethanal (CH_3CHO) and propanone (CH_3COCH_3) combine to form 2-methylbut-2-ene (C_5H_{10}), which has a molar mass of 70 g/mol.

Q25.

Answer: 4

Explanation:
Protonation yields a secondary carbocation that can either be attacked directly or undergo a hydride shift. This results in 2,3-dichlorobutane (3 stereoisomers) and 2,2-dichlorobutane (1 isomer), totaling 4.

Q26.

Answer: A

Explanation:
The total number of circular arrangements is found, and then the arrangements where the two specific individuals are seated together are subtracted.

Q27.

Answer: C

Explanation:
Words are counted alphabetically by their starting letter until the 315^{th} position is reached.

Q28.

Answer: C

Explanation:
The result includes both 4-digit numbers starting with 7 or 8 and all possible 5-digit numbers.

Q29.

Answer: C

Explanation:
The rank is determined by alphabetically ordering the letters (G, H, O, T, U) and counting the words preceding "TOUGH".

Q30.

Answer: B

Explanation:
The vowels are grouped as a single unit, and the permutations of this unit with the consonants are calculated, multiplied by the internal permutations of the vowels.

Q31.

Answer: A

Explanation:
From the unique vowels and consonants in "UNIVERSE", subsets of two each are selected and arranged.

Q32.

Answer: A

Explanation:
Vowels are treated as one unit, and permutations of that unit with remaining consonants are multiplied by internal vowel arrangements.

Q33.

Answer: A

Explanation:
The total permutations are calculated, and the permutations where C and S are together are subtracted.

Q34.

Answer: D

Explanation:
This is a standard derangement problem for $n = 5$.

Q35.

Answer: D

Explanation:
Unique vowels and consonants are identified and used to select subsets that are then arranged into words.

Q36.

Answer: B

Explanation:
By giving each child 2 apples initially, the problem reduces to distributing the remaining apples using the stars and bars method.

Q37.

Answer: D

Explanation:
Total non-negative solutions are calculated, and cases where integers are not distinct (two same or all three same) are subtracted.

Q38.

Answer: D

Explanation:
The prime factorization of 24 is used to distribute the exponents among the three variables using the combination formula.

Q39.

Answer: B

Explanation:
The digit 3 is counted across all possible positions (units, tens, hundreds) for integers from 1 to 999. Since 1000 does not contain the digit 3, the total count is the sum of occurrences in 1-digit, 2-digit, and 3-digit forms.,

Q40.

Answer: D

Explanation:
The number 1050 is prime factored, and the exponents of each prime factor are distributed among the five variables using the "stars and bars" multiset formula.

Q41.

Answer: C

Explanation:
By representing each person's share as $2\lambda_i + 1$, the problem is reduced to finding the number of non-negative integral solutions for a simplified linear equation.

Q42.

Answer: A

Explanation:
First, distribute two blankets to each person to satisfy the minimum requirement. Then, distribute the remaining blankets using the standard distribution formula.

Q43.

Answer: C

Explanation:
This is a problem of finding the number of non-negative integral solutions for a sum of 10 items across 4 categories, which can be solved using the coefficient of a binomial expansion or the "stars and bars" formula.

Q44.

Answer: D

Explanation:
Give 4 apples to each of the 3 boys first ($3 \times 4 = 12$). Distribute the remaining 8 apples among the 3 boys with no further restrictions.

Q45.

Answer: C

Explanation:
Total possible ways to place 5 letters in 5 envelopes is 5!. To find "at least two wrong," subtract the case where all letters are in the correct envelopes (0 wrong). It is impossible to have exactly one letter in the wrong envelope.

Q46.

Answer: 553

Explanation:
The rank is calculated by counting words starting with letters that appear before "GTWENTY" in alphabetical order.

Q47.

Answer: 3734

Explanation:
The word contains 11 letters with repetitions (I appears 3 times, T appears 2 times). Combinations are calculated based on whether letters are distinct or identical.

Q48.

Answer: 36

Explanation:
Total possible numbers are calculated, and the numbers whose digits sum to a multiple of 3 are subtracted.

Q49.

Answer: 2454

Explanation:
Words are counted by considering different cases of distinct and identical letters from the set {E, X, A, M, I, N, T, O} where A, I, and N are repeated.

Q50.

Answer: 125

Explanation:
Numbers divisible by 2 and 3 must be divisible by 6. From these, we subtract numbers divisible by both 4 and 9 (i.e., divisible by 36).

Q51.

Answer: A

Explanation:
First, calculate the total kinetic energy using $KE = \frac{1}{2}mv^2$. Since only half of this energy heats the bullet, $Q = 0.5 \times KE$. Convert the specific heat capacity to SI units ($c = 0.030 \times 4.2 \text{ J/g} \cdot^\circ \text{C}$). Finally, use the heat formula $Q = mc\Delta T$ to solve for the temperature rise ΔT.

Q52.

Answer: B

Explanation:
Apply the principle of calorimetry: Heat Lost by Steam = Heat Gained by Ice. Heat lost by steam involves condensation ($M \cdot L_v$) and cooling from 100°C to 40°C ($M \cdot c \cdot \Delta T$). Heat gained by ice involves melting ($m_{ice} \cdot L_f$) and warming from 0°C to 40°C ($m_{ice} \cdot c \cdot \Delta T$). Equation: $M(540) + M(1)(60) = 150(80) + 150(1)(40)$. Solving for M yields 30 g.

Q53.

Answer: B

Explanation:

Since specific heatS is a function of temperature, we must integrate to find the total heat energy. The differential heat is given by $dQ = mSdT$. For unit mass ($m = 1$) and $S = aT^2$, the total heat Q is the integral of aT^2 with respect to T from 1 to 2.
$Q = \int_1^2 aT^2 dT = a\left[\frac{T^3}{3}\right]_1^2 = \frac{a}{3}(2^3 - 1^3) = \frac{7a}{3}$.

Q54.

Answer: B

Explanation:
The heat lost by the cooling block is used to melt the ice. Heat Lost (Q_{lost}) = $m_{block} \cdot c \cdot \Delta T$. Heat Gained ($Q_{gained}$) = $m_{ice} \cdot L$. Equating them: $3500 \text{ g} \times 0.1 \text{ cal/g}^\circ\text{C} \times 400^\circ\text{C} = m_{ice} \times 80 \text{ cal/g}$.
$140,000 = 80m_{ice} \Rightarrow m_{ice} = 1750 \text{ g} = 1.75 \text{ kg}$.

Q55.

Answer: B

Explanation:
The process involves three stages: 1. Heating ice from -20°C to 0°C: $Q_1 = mc_{\text{ice}}\Delta T$. 2. Melting ice at 0°C: $Q_2 = mL_{\text{ice}}$. 3. Heating water from 0°C to 20°C: $Q_3 = mc_{\text{water}}\Delta T$. Total heat $Q = Q_1 + Q_2 + Q_3 = 18480 \text{ J}$.

Q56.

Answer: A

Explanation:
Potential energy ($PE = mgh$) is converted into heat energy (Q). Since 25% is lost, 75% of PE becomes heat. $PE = 3 \times 10 \times 20 = 600 \text{ J}$. $Q = 0.75 \times 600 = 450 \text{ J}$. Using $Q = mc\Delta T$, we get $450 = 3 \times 400 \times \Delta T$. $\Delta T = \frac{450}{1200} = 0.375^\circ\text{C}$.

Q57.

Answer: C

Explanation:

Since the radiating powers are equal ($P_A = P_B$) and areas are equal, we use Stefan-Boltzmann law: $\epsilon_A T_A^4 = \epsilon_B T_B^4$. Substituting values gives $0.04T_A^4 = 0.64T_B^4$, which simplifies to $T_A = 2T_B$. Using Wien's displacement law ($\lambda T = \text{constant}$), we get $\lambda_A T_A = \lambda_B T_B$, which implies $\lambda_B = 2\lambda_A$. Given the shift $\lambda_B - \lambda_A = 2.00 \text{ \mu m}$, we find $\lambda_A = 2.00 \text{ \mu m}$ and thus $\lambda_B = 4.00 \text{ \mu m}$.

Q58.

Answer: D

Explanation:
The area under the spectral radiance curve represents the total energy radiated per unit area, which is proportional to the fourth power of the absolute temperature ($A \propto T^4$) according to the Stefan-Boltzmann Law. Converting temperatures to Kelvin:$T_1 = 127 + 273 = 400$ K and $T_2 = 527 + 273 = 800$ K. The ratio is $\frac{A_2}{A_1} = \left(\frac{800}{400}\right)^4 = 2^4 = 16$.

Q59.

Answer: C

Explanation:
The area under the curve is proportional to T^4. Converting temperatures to Kelvin gives $T_1 = 27 + 273 = 300$ K and $T_2 = 227 + 273 = 500$ K. The ratio of the areas is $\frac{A_2}{A_1} = \left(\frac{500}{300}\right)^4 = \left(\frac{5}{3}\right)^4 = \frac{625}{81}$.

Q60.

Answer: C

Q61.

Answer: C

Explanation:
Using Wien's Law, the ratio of temperatures is $\frac{T_2}{T_1} = \frac{\lambda_1}{\lambda_2} = \frac{15000}{5000} = 3$. Using the Stefan-Boltzmann Law ($E \propto T^4$), the ratio of energies is $\frac{E_2}{E_1} = 3^4 = 81$. Therefore, $E_2 = 81 \times 5 = 405 \text{ J m}^{-2}\text{s}^{-1}$.

Q62.

Answer: B

Explanation:
Using Stefan-Boltzmann Law, $P \propto R^2T^4$. So, $\frac{P_A}{P_B} = (\frac{R_A}{R_B})^2(\frac{T_A}{T_B})^4$. Substituting values:
$256 = (4)^2(\frac{T_A}{T_B})^4 \Rightarrow 256 = 16(\frac{T_A}{T_B})^4 \Rightarrow (\frac{T_A}{T_B})^4 = 16 \Rightarrow \frac{T_A}{T_B} = 2$.
Using Wien's Law, $\lambda T = \text{constant}$, so $\frac{\lambda_A}{\lambda_B} = \frac{T_B}{T_A} = \frac{1}{2}$.

Q63.

Answer: D

Explanation:
From Stefan-Boltzmann Law, $\frac{P_A}{P_B} = (\frac{R_A}{R_B})^2(\frac{T_A}{T_B})^4$. Substituting values: $10^4 = (1600)^2(\frac{T_A}{T_B})^4$. Since $1600^2 = (16 \times 10^2)^2 = 256 \times 10^4$, we get $10^4 = 256 \times 10^4(\frac{T_A}{T_B})^4$, which simplifies to $(\frac{T_A}{T_B})^4 = \frac{1}{256}$. Thus $\frac{T_A}{T_B} = \frac{1}{4}$. From Wien's Law, $\frac{\lambda_A}{\lambda_B} = \frac{T_B}{T_A} = 4$.

Q64.

Answer: B

Explanation:
According to Wien's displacement law, the product of the wavelength of maximum emission (λ_{max}) and the absolute temperature (T) is constant ($\lambda_{max}T = b$). Therefore, $\lambda_1 T_1 = \lambda_2 T_2$. Substituting the values: $5000 \times 6000 = 2500 \times T_2$. Solving for T_2 gives $T_2 = \frac{5000}{2500} \times 6000 = 2 \times 6000 = 12000$ K.

Q65.

Answer: B

Explanation:
According to Wien's displacement law, $\lambda_{max}T = b$. Rearranging for temperature gives $T = b/\lambda_{max}$. Substituting the values:
$T = (2.9 \times 10^{-3} \text{ m K})/(580 \times 10^{-9} \text{ m}) = (2.9/580) \times 10^6 \text{ K} = 0.005 \times 10^6 \text{ K} = 5000 \text{ K}$
.

Q66.

Answer: A

Explanation:

The rate of heat loss is proportional to surface area ($A \propto r^2$), so the ratio is $(R/2R)^2 = 1/4$. The rate of cooling is proportional to the surface-area-to-mass ratio ($A/m \propto r^2/r^3 \propto 1/r$), so the ratio is $(1/R)/(1/2R) = 2$.

Q67.

Answer: B

Explanation:
The initial net power emitted by a body is calculated using the Stefan-Boltzmann law for net heat radiation: $P = e\sigma A(T^4 - T_0^4)$. Substituting the given absolute temperatures $T = 600$ K, $T_0 = 300$ K, area $A = 0.04 \text{ m}^2$, emissivity $e = 0.6$, and Stefan's constant $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$ gives $P = 68.0$ Watt.

Q68.

Answer: C

Explanation:
The initial net power emitted by a body is calculated using the Stefan-Boltzmann law for net heat radiation: $P = e\sigma A(T^4 - T_0^4)$. Substituting the given absolute temperatures $T = 600$ K, $T_0 = 300$ K, area $A = 0.02 \text{ m}^2$, emissivity $e = 0.5$, and Stefan's constant $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$ gives $P = 28.3$ Watt.

Q69.

Answer: D

Explanation:
According to the Stefan-Boltzmann law, the rate of heat radiation (E) is proportional to the fourth power of the absolute temperature (T). First, convert the temperatures to Kelvin:$T_1 = 127 + 273 = 400$ K and $T_2 = 527 + 273 = 800$ K. The ratio of the new rate E' of the old rate E is $(T_2/T_1)^4 = (800/400)^4 = 2^4 = 16$. Thus, $E' = 16E$.

Q70.

Answer: B

Explanation:

Convert $T_1 = 432 + 273 = 705$ K and $T_2 = 300$ K. Area $A = 0.02 \text{ m}^2$.
$P_{net} = 0.8 \times (5.67 \times 10^{-8}) \times 0.02 \times (705^4 - 300^4)$.
$705^4 \approx 247.2 \times 10^9$, $300^4 = 8.1 \times 10^9$. Diff $\approx 239.1 \times 10^9$.
$P \approx 0.09072 \times 10^{-8} \times 239.1 \times 10^9 \approx 216.9$ (Close enough to 217.7 given rounding differences in constants).

Q71.

Answer: 40

Explanation:

Under steady-state conditions, the rate of heat entering the junction equals the rate of heat leaving the junction. Using the heat current equation $H = \frac{\Delta T}{R}$, the balance equation is $\frac{60-T}{R} + \frac{60-T}{R} = \frac{T-0}{R}$. Solving this gives $2(60 - T) = T$, which yields the junction temperature $T = 40°\text{C}$.

Q72.

Answer: 40

Explanation:
Using the thermal resistance formula $R = \frac{L}{KA}$, since thermal conductivity $K_x = 2K_y$, the resistance of rods made of material y is twice that of material x ($R_y = 2R$). By analyzing the symmetric network of series-parallel combinations between nodes A and E, the equivalent circuit reduces to find the drop across junction B. The heat current conservation yields $T_B = 40°\text{C}$.

Q73.

Answer: 90

Explanation:

Given that the heat current through rod BC is zero, the temperature at junction B (T_1) equals the temperature T_0 at end C. Applying the steady-state condition where the heat current from rod AB equals the heat current into rod BD: $\frac{210-T_1}{2l/(KA)} = \frac{T_1-30}{l/(KA)}$. Simplifying this gives $210 - T_1 = 2(T_1 - 30)$, leading to $3T_1 = 270$, so $T_1 = 90^\circ\mathrm{C}$. Thus, $T_0 = 90^\circ\mathrm{C}$.

Q74.

Answer: 90

Explanation:

By Kirchhoff's junction rule for thermal conduction, the sum of all heat currents meeting at the junction in the steady state is zero ($\sum i = 0$). Writing the heat current equation using thermal resistances $R = \frac{L}{KA}$ for each branch: $\frac{10-T}{L/(KA)} + \frac{70-T}{L/(2KA)} + \frac{130-T}{L/(3KA)} = 0$. Simplifying gives $(10 - T) + 2(70 - T) + 3(130 - T) = 0$, which expands to $6T = 540$, resulting in $T = 90^\circ\mathrm{C}$.

Q75.

Answer: 70

Explanation:

In a uniform rod at steady state, the temperature decreases linearly with distance. 1. Total temperature difference $\Delta T = 90^\circ\mathrm{C} - 30^\circ\mathrm{C} = 60^\circ\mathrm{C}$ over a total length of $12\ \mathrm{m}$. 2. Temperature drop over $4\ \mathrm{m}$ from the hot end: $\mathrm{Drop} = \left(\frac{60^\circ\mathrm{C}}{12\ \mathrm{m}}\right) \times 4\ \mathrm{m} = 20^\circ\mathrm{C}$. 3. Temperature at the point: $T = 90^\circ\mathrm{C} - 20^\circ\mathrm{C} = 70^\circ\mathrm{C}$.