PREVIOUS YEAR QUESTIONS
(Chapterwise)

CHAPTER NAME: CALORIMETRY

SUMMARY POINTS

Key Concept	Details	Formula	SI Unit
Heat Transfer	Heat flows from a higher temperature to a lower temperature.	$Q = mc\Delta T$	Joules (J)
Latent Heat	Heat absorbed or released during a phase change without temperature change.	$Q = mL$	J/kg
Specific Heat Capacity (c)	Heat required to raise the temperature of 1 kg of a substance by 1°C or 1 K.	$c = \frac{Q}{m\Delta T}$	J/kg·K
Thermal Capacity (C)	Total heat required to raise the temperature of a substance by 1°C or 1 K.	$C = mc$	J/°C or J/K
Principle of Calorimetry	Heat lost by a hotter body equals heat gained by a colder body, assuming no heat loss to surroundings.	$Q_{lost} + Q_{gained} = 0$	—
Phase Change	During phase changes, temperature remains constant despite heat absorption or release.	$Q = mL$	J

Additional Notes

- **Heat Transfer:**
  Heat flows due to a temperature difference.
- **Latent Heat Types:**
  - **Latent heat of fusion**: Solid ↔ Liquid.
  - **Latent heat of vaporization**: Liquid ↔ Gas.
- **Specific Heat Capacity Relation:**
  Higher c values mean the substance requires more heat to change temperature.
- **Thermal Capacity:**
  Proportional to mass and specific heat.

Q.NO.: 1	During melting of ice at 0°C (a) energy is released and temperature remains constant. (b) energy is absorbed and temperature remains constant. (c) energy is released and temperature decreases. (d) energy is absorbed and temperature increases.	YEAR [2024]
ANS.:	energy is absorbed and the temperature remains constant	
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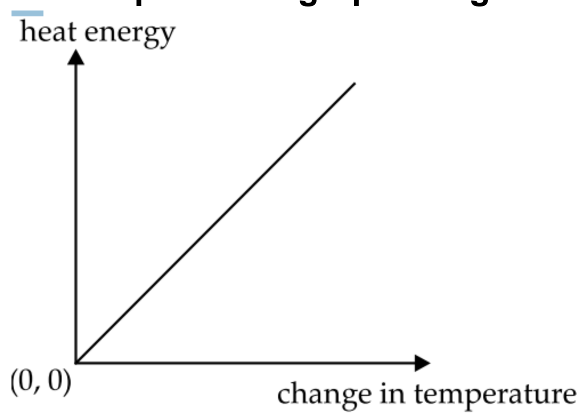
Q.NO.: 2	The graph given below shows heat energy supplied against change in temperature when no energy is lost to the surrounding. The slope of this graph will give  (a) Specific heat capacity (b) Latent heat of fusion (c) Latent heat of vaporization (d) Heat capacity	YEAR [2024]
ANS.:	heat capacity	
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Q.NO.: 3	How much heat is required to convert 500 g of ice at 0°C to water at 0°C? The latent heat of fusion of ice is 330 Jg^{-1}.	YEAR [2024]
ANS.:	Identify the given values: Mass of ice (***m***) = 500 g	

	Latent heat of fusion of ice **(*L*)** = 330 J/g **Use the formula for heat during a phase change:** The formula is ***Q = mL***, where *Q* is the heat required, *m* is the mass, and *L* is the latent heat of fusion. **Calculate the heat required:** *Q* = 500 g * 330 J/g ***Q* = 165000 J** Therefore, **165,000 J of heat is required** to convert 500 g of ice at 0°C to water at 0°C.	
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Q.NO.: 4	**(a) Why does it become pleasantly warm when the lakes start freezing?** **(b) Water freezes to form ice.** **(c) What change would you expect in the average kinetic energy of the molecules?Which will contain more heat energy 1 g of ice at 0°C or 1 g water at 0°C?**	**YEAR** **[2024]**
ANS.:	**(a) Why does it become pleasantly warm when the lakes start freezing?** When water in a lake freezes, it releases a significant amount of heat into its surroundings. This is because water must lose heat to change its state from liquid to solid, and this heat is transferred to the environment1. This heat release can make the surrounding area feel warmer. The process of freezing involves a phase change, and during this phase change, **the latent heat of fusion is released**. The latent heat of fusion of ice is quite high, meaning a large amount of heat is released as water freezes. **(b) Water freezes to form ice.** Water freezes by releasing heat to the surroundings. The molecules in liquid water lose kinetic energy and slow down. As the temperature decreases, the molecules reach a point where the attractive forces between them become strong enough to form a solid structure. This process happens at the freezing point (0°C), but the water will continue to release energy as it changes state to ice. **The heat energy released during freezing is called latent heat of fusion**. **(c) What change would you expect in the average kinetic energy of the molecules?** During the phase change from water to ice, the average kinetic energy of the molecules **decreases**.	

	Even though the temperature may remain constant at 0°C during the phase change, the molecules lose kinetic energy as they transition from a more mobile liquid state to a more fixed solid state. **Which will contain more heat energy, 1 g of ice at 0°C or 1 g of water at 0°C?** **1 g of water at 0°C contains more heat energy than 1 g of ice at 0°C**. This is because to change ice at 0°C to water at 0°C requires an input of energy called the latent heat of fusion. The heat energy is absorbed by the ice during the melting process and becomes stored within the water. This energy is released when water freezes into ice.	
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Q.NO.: 5	**85 g of water at 30°C is cooled to 5°C by adding certain mass of ice. Find the mass of ice required.** **[Specific heat capacity of water = 4.2 $Jg^{-1}°C^{-1}$, Specific latent heat of fusion = 336 Jg^{-1}]**	**YEAR** **[2024]**
ANS.:	**Calculate the heat lost by the water:** The formula for heat loss is **($Q = mc\Delta T$)**, where (m) is the mass, (c) is the specific heat capacity, and (ΔT) is the change in temperature. Mass of water **(*m*)** = 85 g Specific heat capacity of water **(*c*)** = 4.2 J/g°C Change in temperature **(*ΔT*)** = 30°C - 5°C = 25°C Heat lost by the water **(*Q*)** = 85 g * 4.2 J/g°C * 25°C = **8925 J** **Calculate the heat gained by the ice as it melts and warms to the final temperature:** Assume the ice is initially at 0°C. First, the ice will melt, and then the melted ice (now water) will warm up to the final temperature of 5°C. Let the mass of ice be *m*. Heat gained by ice during melting ((Q_1)) = (mL), where (L) is the specific latent heat of fusion. **(Q_1)** = *m* * 336 J/g Heat gained by the melted ice (now water) as its temperature rises to 5°C (Q_2) = ($mc\Delta T$)	

	$(Q_2) = m * 4.2$ J/g°C * (5°C - 0°C) = **21*m* J** Total heat gained by the ice (*Q*) = 336*m* + 21*m* = **357*m* J** **Apply the principle of calorimetry**: Heat lost = Heat gained 8925 J = 357*m* J **Solve for the mass of ice (*m*):** *m* = 8925 J / 357 J/g ***m* = 25 g**	
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Q.NO.: 6	**Specific latent heat of a substance:** **a. is directly proportional to the mass** **b. is directly proportional to the change in the temperature** **c. depends on the material** **d. is inversely proportional to the mass**	**YEAR** **[2023]**
ANS.:	c. depends on the material	
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Q.NO.: 7	**Specific heat capacity of a substance X is 1900 Jkg-1°C-1 means:** **a. Substance X absorbs 1900 J for 1°C rise in temperature** **b. 1 kg of substance X absorbs 1900 J heat for 1°C rise in temperature** **c. 1 kg of substance X absorbs 1900 J heat to increase the temperature** **d. 1 kg of substance X absorbs 1900 J heat to cool down by 1°C**	**YEAR** **[2023]**
ANS.:	It means that **1 kg of substance X absorbs 1900 J of heat** for a 1°C rise in temperature.	
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Q.NO.: 8	**Thermal capacities of substances A and B are same. If mass of A is more than mass of B then:** **(a) Which substance will have more specific heat capacity?** **(b) Which substance will show greater rise in temperature if the same amount of**	**YEAR** **[2023]**
ANS.:	(a) Substance **B** will have a greater specific heat capacity. (b) Both substances will show the **same rise in temperature.**	
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Q.NO.: 9	**Calculate the total amount of heat energy required to melt 200 g of ice at** **0°C to water at 100°C. (Specific latent heat of ice = 336 Jg^{-1}, specific heat** **capacity of water = 4.2 Jg^{-1} $°C^{-1}$)**	**YEAR** **[2023]**
ANS.:	The total heat energy required is the sum of the heat needed to melt the ice and the heat needed to raise the temperature of the water to 100°C. This is calculated as follows: Heat to melt the ice: m * L = 200g * 336 J/g Heat to raise water temperature: m * c * ΔT = 200g * 4.2 J/g/°C * 100°C Total heat energy = **151200 J**	
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Q.NO.: 10	**(a) State the principle of calorimetry.** **(b) Name the material used for making a calorimeter.** **(c) Write one characteristic property of the material chosen for making a calorimeter.**	**YEAR** **[2023]**
ANS.:	(a) When a hot body is in contact with a cold body, the **heat lost by the hot body equals the heat gained by the cold body**, provided there is no heat loss to the environment. (b) Copper (c) Low specific heat capacity, and it is a good conductor of heat.	
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Q.NO.: 11	**If water absorbs 4000 joule heat to increase the temperature of 1 kg water through 1°C then the specific heat capacity of water is** **a. 4 Jkg^{-1} $°C^{-1}$** **b. 400 Jg^{-1} $°C^{-1}$** **c- 4Jg^{-1} $°C^{-1}$** **d. 4.2 Jg^{-1} $°C^{-1}$**	YEAR [2022]
ANS.:	The specific heat capacity of water is **4 J/g/°C**.	
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Q.NO.: 12	**Water is used in car radiators because:** **a. it is a good conductor of heat.** **b. it conducts heat faster as compared to the other substances and cools the engine quickly.** **c. its specific heat capacity is very low.** **d. its specific heat capacity is very high so it can cool the engine without a greater increase in its own temperature**	YEAR [2022]
ANS.:	Because of its **high specific heat capacity**, which allows it to cool the engine without a large increase in its own temperature.	
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Q.NO.: 13	**(a) Give an important reason for copper to be used as a material for a calorimeter.** **(b) Calculate the thermal capacity of 40 g of water.** **[Specific heat capacity of water = 4200 $JKg^{-1}°C-^{1}$]**	YEAR [2022]
ANS.:	(a) Copper has **low specific heat capacity** and is a good conductor of heat. (b) Thermal capacity = mass * specific heat capacity = 40g * 4.2 J/g/°C = **168 J/°C.**	
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Q.NO.: 14	**(a) Why does it become colder after a hailstorm than during or before the hailstorm?** **(b) 'If two bodies have the same specific heat capacities, then they will always absorb the same amount of heat if their temperature increases by the same amount.' State whether the given statement is true or false.**	**YEAR** **[2022]**
ANS.:	(a) Because the ice absorbs heat from the surroundings to melt, due to the **high latent heat of fusion of ice**. (b) **False**. The amount of heat absorbed also depends on the mass of the body.	
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Q.NO.: 15	**A metal piece of mass 420 g present at 80°C is dropped in 80 g of water present at 20°C in a calorimeter of mass 84 g. If the final temperature of the mixture is 30°C, then calculate the specific heat capacity of the metal piece.** **[Specific heat capacity of water = 4.2 Jg^{-1} $°C^{-1}$, Specific heat capacity of the calorimeter = 200 Jkg^{-1} $°C^{-1}$]**	**YEAR** **[2022]**
ANS.:	Heat lost by the metal = Heat gained by the calorimeter and water. **Calculations:** Heat lost by metal = m * c * deltaT = 420g * c * (80 - 30) Heat gained by water = m * c * deltaT = 80g * 4.2 * (30 - 20) = 3360J Heat gained by calorimeter = m * c * deltaT = 84g * 0.2 * (30 - 20) = 168J Specific heat capacity of the metal = **0.16 J/g/°C**	
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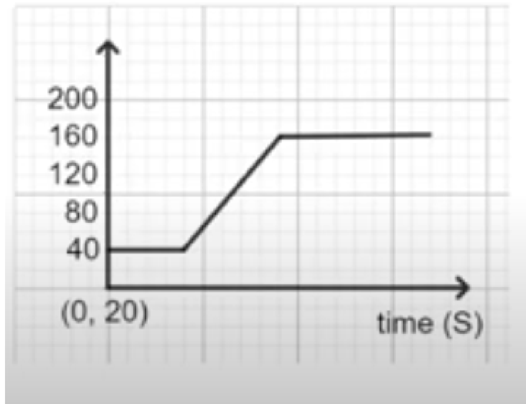
Q.NO.: 16	**From the graph of heating curve given below state the melting point and boiling point of the substance.**	**YEAR** **[2022]**



ANS.:	The melting point is 40°C and the boiling point is 160°C, as indicated on the graph.	
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Q.NO.: 17	**Two metallic blocks P and Q having masses in ratio 2: 1 are supplied with the same amount of heat. If their temperatures rise by same degree, compare their specific heat capacities.**	**YEAR** **[2020]**
ANS.:	The specific heat capacities are in the ratio of **1:2** (P:Q).	
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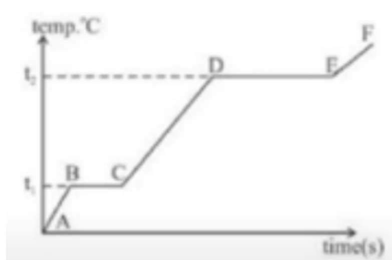
Q.NO.: 18	**The diagram below shows the change of phases of a substance on a temperature vs time graph on heating the substance at a constant rate.**  **(i) Define heat capacity of a substance.** **(ii) Write the SI unit of heat capacity.** **(iii) What is the relationship between heat capacity and specific heat capacity of a substance?**	**YEAR** **[2020]**

ANS.:	(i) The amount of heat energy required to change the temperature of a body by 1°C. (ii) J/K (iii) Specific heat capacity = heat capacity / mass	
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Q.NO.: 19	**A piece of ice of mass 60 g is dropped into 140 g of water at 50°C** **Calculate the final temperature of water when all the ice has melted. (Assume no heat is lost to the surrounding)** **[Specific heat capacity of water - 4.2 $Jg^{-1}k^{-1}$ Specific latent heat of fusion of ice- 336 Jg^{-1}]**	**YEAR** **[2020]**
ANS.:	Heat gained by ice = heat lost by water Heat gained by ice = Heat to melt ice + Heat to raise temperature of ice water to final temperature. Heat lost by water = m * c * deltaT = 140 * 4.2 * (50 - T) * The final temperature **11°C.**	
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Q.NO.: 20	**(i)Name the physical quantity which is measured in calories.** **(ii)How is the calorie related to the S.I unit of that quantity.**	**YEAR** **[2019]**
ANS.:	(i) Heat energy (ii) 1 calorie = 4.2 joules	
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Q.NO.:21	**The specific heat capacity of a substance A is 3,800 $Jkg^{-1}K^{-1}$ and that of a substance B is 400 Jkg^{-1} K^{-1}.** **Which of the two substances is a good conductor of heat? Give a reason for your answer.**	**YEAR** **[2019]**
ANS.:	Substance **B** Because it has a **lower specific heat capacity**	

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Q.NO.: 22	**(i) State whether the specific heat capacity of a substance remains the same when its state changes from solid to liquid. (ii) Give one example to support your answer.**	YEAR [2019]
ANS.:	(i) No, it changes. (ii) The specific heat capacity of water is 4.2 J/g/°C, while for ice it is 2.1 J/g/°C.	
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Q.NO.: 23	**(i) Define Calorimetry. (ii) Name the material used for making a Calorimeter. (iii) Why is a Calorimeter made up of thin sheets of the above material answered in (ii)?**	YEAR [2019]
ANS.:	(i) The science of measuring the amount of heat exchanged by a system with its surroundings. (ii) Copper (iii) Because copper is a good conductor of heat, and it has low specific heat capacity. Thin sheets reduce the mass and heat capacity of the calorimeter.	
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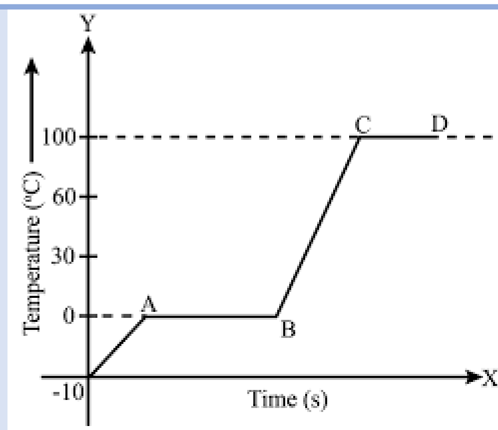
Q.NO.: 24	**The melting of naphthalene is 80°C and the room temperature is 30°C. A sample of liquid naphthalene at 100°C is cooled down to the room temperature. Draw a temperature-time graph to represent this cooling. In the graph. Mark the region which corresponds to the freezing process.**	YEAR [2019]

ANS.:		
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Q.NO.: 25	**104 g of water at 30°C is taken in a calorimeter made of copper of mass 42 g. When a certain mass of ice at O°C is added to it, the final steady temperature of the mixture when the ice has melted, was found to be 10°C. Find the mass of ice added.** **[Specific heat capacity of water = 4.2 $Jg^{-1}°C^{-1}$, latent heat of fusion of ice 336 Jg^{-1} Specific heat capacity of copper = 0.4 $Jg^{-1}°C^{-1}$]**	**YEAR** **[2019]**
ANS.:	Heat lost by the water and calorimeter is equal to the heat gained by the ice. Calculations for the heat lost and gained are done using the formulas **mcdeltaT** and **m*L** for phase changes. The mass of ice added is **24 grams.**	
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Q.NO.: 26	**(i) How can a temperature in degree Celsius be converted into S.I. unit of temperature.** **(ii) A liquid X has the maximum specific heat capacity and is used as a coolant in Car radiators. Name the liquid X.**	**YEAR** **[2018]**
ANS.:	(i) By adding 273 (ii) Water	
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Q.NO.: 27	**A solid metal weighing 150 g melts at its melting point of 800°C by providing heat at the rate of 100 W. The time taken for it to completely melt at the same temperature is 4 min. What is the specific latent heat of fusion of the**	YEAR [2018]
ANS.:	The specific latent heat of fusion of the metal is **160000 J/kg.**	
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Q.NO.: 28	**(i) Heat supplied to a solid change it into liquid. What is this change in phase called?** **(ii) During the phase change does the average kinetic energy of the molecules of the substance increase?** **(iii) What is the energy absorbed during the phase change called?**	YEAR [2018]
ANS.:	(i) Fusion or melting (ii) No (iii) Latent heat	
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Q.NO.: 29	**The temperature of 170g of water at 50°C is lowered to 5°C by adding a certain amount of ice to it. Find the mass of ice added.** **[Given: Specific heat capacity of water = 4200 J kg^{-1}°C^{-1} and Specific latent of heat of ice = 3360000 J kg^{-1}]**	YEAR [2018]
ANS.:	Heat lost by the water = heat gained by the ice.	
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Q.NO.: 30	**(i) State two differences between "Heat Capacity" and "Specific Heat Capacity".** **(ii) Give a mathematical relation between Heat Capacity and Specific Heat Capacity.**	YEAR [2018]

ANS.:	(i) The first difference is in their definitions and the second is in their SI units. **Heat capacity:** The amount of heat required to raise the temperature of a body by 1°C, unit is J/K. **Specific heat capacity:** The amount of heat required to raise the temperature of a unit mass of a substance by 1°C, unit is J/kg/K. (ii) Heat capacity = mass * specific heat capacity	
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Q.NO.: 31	**Define heat capacity and its S.I unit.**	**YEAR** **[2017]**
ANS.:	Heat capacity is the amount of heat energy required to raise the temperature of a body by 1°C, and its SI unit is J/K.	
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Q.NO.: 32	**Why is the base of a cooking pan generally made thick?**	**YEAR** **[2017]**
ANS.:	To increase its heat capacity so that it can impart sufficient heat to the food at a low temperature, and keep it warm for a longer time.	
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Q.NO.: 33	**A solid of mass 50 g at 150°C is placed in 100 g of water at 11°C, when the final temperature recorded is 20°C. Find the specific heat capacity of the solid. (Specific heat capacity of water = 4.2 J/g °C)**	**YEAR** **[2017]**
ANS.:	**Identify the given values:** Mass of the solid **(m_s)** = 50 g Initial temperature of the solid **(T_{si})** = 150°C Mass of the water **(m_w)** = 100 g Initial temperature of the water **(T_{wi})** = 11°C Final temperature of the mixture **(T_f)** = 20°C Specific heat capacity of water **(c_w)** = 4.2 J/g°C	

	Calculate the heat lost by the solid: The formula for heat loss is **($Q = mc\Delta T$)**, where (Q) is the heat, (m) is the mass, (c) is the specific heat capacity, and (ΔT) is the change in temperature. Let **(c_s)** be the specific heat capacity of the solid. Change in temperature of the solid **(ΔT_s)** = **(T_{si})** - **(T_f)** = 150°C - 20°C = **130°C** Heat lost by the solid **(Q_s)** = **(m_s)** * (c_s) * (ΔT_s) = 50 g * (c_s) * 130°C = 6500 (c_s) J7 **Calculate the heat gained by the water:** ◦ Change in temperature of the water ((ΔT_w)) = (T_f) - (T_{wi}) = 20°C - 11°C = 9°C ◦ Heat gained by the water ((Q_w)) = (m_w) * (c_w) * (ΔT_w) = 100 g * 4.2 J/g°C * 9°C = 3780 J7 **Apply the principle of calorimetry:** ◦ Heat lost by the solid = Heat gained by the water. ◦ (Q_s) = (Q_w) ◦ 6500 (c_s) = 3780 J9 5. **Solve for the specific heat capacity of the solid ((c_s)):** ◦ (c_s) = 3780 J / 6500 = 0.582 J/g°C9 Therefore, the **specific heat capacity of the solid is 0.582 J/g°C**	
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Q.NO.: 34	**How is the transference of heat energy by radiation prevented in a calorimeter?**	**YEAR** **[2017]**
ANS.:	By polishing the inner and outer surfaces of the calorimeter.	
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Q.NO.: 35	**Calculate the mass of ice needed to 150g of water contained in a calorimeter of mass 50g at 32°C such that the final temperature is 5°C.**	**YEAR** **[2017]**

[Sp heat capacity of calorimeter = 0.4 J/g°C, Sp heat capacity of water=4.2 J/g°C, Latent heat capacity of ice=330 J/g]

ANS.:

Calculate the heat lost by the calorimeter[8]:

- The formula for heat loss is $Q = mc\Delta T$, where m is the mass, c is the specific heat capacity, and ΔT is the change in temperature.
- Mass of calorimeter (m) = 50 g
- Specific heat capacity of calorimeter (c) = 0.4 J/g°C
- Change in temperature (ΔT) = 32°C - 5°C = 27°C
- Heat lost by calorimeter (Q) = 50 g * 0.4 J/g°C * 27°C = 540 J[9]

2\.
Calculate the heat lost by the water[8]:

- Mass of water (m) = 150 g
- Specific heat capacity of water (c) = 4.2 J/g°C
- Change in temperature (ΔT) = 32°C - 5°C = 27°C
- Heat lost by water (Q) = 150 g * 4.2 J/g°C * 27°C = 17010 J[9]

3\.
Calculate the total heat lost[9]:

- Total heat lost = Heat lost by calorimeter + Heat lost by water
- Total heat lost = 540 J + 17010 J = 17550 J

4\.
Calculate the heat gained by the ice as it melts and warms to the final temperature[9...]:

- Assume the ice is initially at 0°C. First, the ice will melt, and then the melted ice (now water) will warm up to the final temperature of 5°C[10...].
- Let the mass of ice be m.
- Heat gained by ice during melting ($Q1$) = mL, where L is the latent heat of fusion.
  - $Q1 = m$ * 330 J/g
- Heat gained by melted ice (now water) as its temperature rises to 5°C ($Q2$) = $mc\Delta T$
  - $Q2 = m$ * 4.2 J/g°C * (5°C - 0°C) = 21m J
- Total heat gained by the ice (Q) = 330m + 21m = 351m J[14]

5\.
Apply the principle of calorimetry[3...]:

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	Heat lost = Heat gained ◦ 17550 J = 351*m* J 6. **Solve for the mass of ice (*m*)**14: ◦ *m* = 17550 J / 351 J/g ◦ *m* = 50 g Therefore, **50 grams of ice is needed** to cool the water and calorimeter to a final temperature of 5°C	
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Q.NO.: 36	**You have a choice of three metals A, B and C, of specific heat capacities** **900 Jkg-1 °C-1 380 Jkg-1 °C-1 and 460 Jkg-1 °C-1 respectively, to make a calorimeter. Which material will you select? Justify answer.**	**YEAR** **[2017]**
ANS.:	The metal with the lowest specific heat capacity i.e. 380 J/kg/°C is chosen for a calorimeter, because it takes the least heat from the contents to acquire their temperature.	
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Q.NO.: 37	**Calculate the mass of ice required to lower the temperature of 300 g of water at 40°C to water at 0°C.** **(Specific latent heat of ice=336 J/g, Specific heat capacity of water= 4.2 J/g°C)**	**YEAR** **[2016]**
ANS.:	**Heat Loss by Water:** The heat lost by the water as it cools from 40°C to 0°C can be calculated using the formula **Q = m * c * ΔT**, where m is the mass, c is the specific heat capacity of water, and ΔT is the change in temperature. Given the mass of the water is 300 g, its specific heat capacity is 4.2 J/g/°C, and the change in temperature is from 40°C to 0°C (a difference of 40°C), the heat lost by the water is: Q = 300 g * 4.2 J/g/°C * 40°C = **50400 J**. **Heat Gain by Ice:** It is assumed that the ice is initially at 0°C. The heat gained by the ice is due to the phase change as it melts to become water. This can be calculated using the formula **Q = m * L**, where m is the mass of the ice and L is the specific latent heat of fusion of ice.	

	Let's denote the mass of the ice as 'm'. The heat required for melting is therefore: Q = m * 336 J/g = **336m J**. **Applying the Principle of Calorimetry:** According to the principle of calorimetry, the total heat lost by the water is equal to the total heat gained by the ice, provided there is no heat lost to the surroundings. Therefore, 50400 J = **336m J**. **Solving for m:** Solving for m: m = 50400 J / 336 J/g = **150 g**. Therefore, **150 grams** of ice is required to lower the temperature of 300 grams of water from 40°C to 0°C.	
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Q.NO.: 38	**What do you understand by the follow in statements: (i) The heat capacity of the body is 60 JK^{-1}. (ii) The specific heat capacity of lead is 130 $JKg^{-1}K^{-1}$**	**YEAR** **[2016]**
ANS.:	(i) The heat energy required to raise the temperature of the entire body by 1K is 60 J. (ii) The heat energy required to raise the temperature of 1 kg of lead by 1K is 130 J.	
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Q.NO.: 39	**State two factors upon which the heat absorbed by a body depends.**	**YEAR** **[2016]**
ANS.:	The mass of the body and the increase in temperature of the body.	
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Q.NO.: 40	**(i) What is the principle of method of mixtures? (ii) What is the other name given to it? (iii) Name the law on which the principle is based.**	**YEAR** **[2016]**
ANS.:	(i) Heat lost by a hot body equals heat gained by a cold body, if no heat is lost to the surroundings.	

(ii) Principle of calorimetry

(iii) The law of conservation of energy

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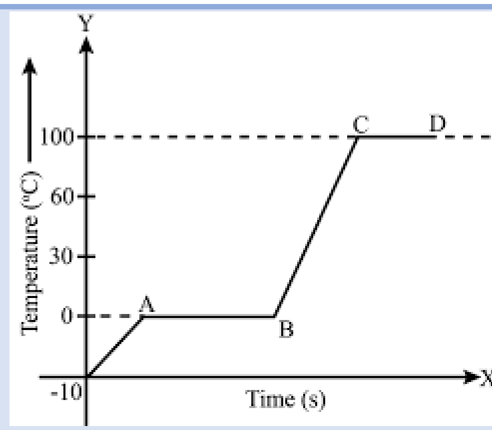
Q.NO.: 41 **Some ice is heated al a constant rate, and its temperature is recorded after every few seconds, till steam is formed at 100°C. Draw a temperature time graph to represent the change. Label the two phase changes in your graph.**

YEAR [2016]

ANS.:



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Q.NO.: 42 **A copper vessel of mass 100 g contains 150 g of water at 50°C. How much ice is needed to cool it to 5°C?**

Given :
Specific heat capacity of copper= 0.4 Jg^{-1} $°C^{-1}$
Specific heat capacity of water =4.2 Jg^{-1} $°C^{-1}$
Specific latent heat of fusion of ice = 336 Jg^{-1}

YEAR [2016]

ANS.:

Heat Loss by the Copper Vessel:

The heat lost by the copper vessel can be calculated using the formula Q = m * c * ΔT, where m is the mass, c is the specific heat capacity, and ΔT is the change in temperature.
Given the mass of the copper vessel is 100 g, its specific heat capacity is 0.4 J/g/°C, and the change in temperature is from 50°C to 5°C (a difference of 45°C), the heat lost by the copper vessel is: Q = 100 g * 0.4 J/g/°C * 45°C = **1800 J**.

Heat Loss by the Water:
Similarly, the heat lost by the water can be calculated using Q = m * c * ΔT.

	Given the mass of the water is 150 g, its specific heat capacity is 4.2 J/g/°C, and the change in temperature is 45°C, the heat lost by the water is: Q = 150 g * 4.2 J/g/°C * 45°C = **28350 J**. **Total Heat Loss:** The total heat lost by the copper vessel and the water is the sum of the individual heat losses: 1800 J + 28350 J = **30150 J**. **Heat Gain by the Ice:** The heat gained by the ice involves two stages: the ice melting and then the melted ice (water) warming up to the final temperature of 5°C. Assume the ice is initially at 0°C. The heat required to melt the ice is calculated using Q = m * L, where m is the mass of the ice and L is the specific latent heat of fusion of ice. Let's denote the mass of the ice as 'm'. The heat required for melting is therefore: Q = m * 336 J/g = **336m J**. The heat gained by the melted ice (now water) to reach 5°C can be calculated using Q = m * c * ΔT. Here, c is the specific heat capacity of water, which is 4.2 J/g/°C, and ΔT is 5°C. Thus, heat required for warming is: Q = m * 4.2 J/g/°C * 5°C = **21m J**. **Total Heat Gain:** The total heat gained by the ice is the sum of heat for melting and warming: 336m J + 21m J = **357m J**. **Applying the Principle of Calorimetry:** According to the principle of calorimetry, the total heat lost by the copper and water is equal to the total heat gained by the ice, provided there is no heat lost to the surroundings. Therefore, 30150 J = 357m J. Solving for m: m = 30150 J / 357 J/g = **84.5 g**. Therefore, **84.5 grams** of ice is needed to cool the copper vessel and water to 5°C.	
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Q.NO.: 43	**(a) Which property of water makes it an effective coolant?** **(b) A refrigerator converts 100g of water at 20°C to ice at -10°C in 35 minutes.** **Calculate the average rate of heat extraction in terms of watts.** **Given: Specific heat capacity of ice = 2.1 Jg^{-1} $°C^{-1}$** **Specific heat capacity of water = 4.2 Jg^{-1} $°C^{-1}$** **Specific Latent heat of fusion of ice = 336 Jg^{-1}**	**YEAR** **[2015]**

	(c) **(i) Water in lakes and ponds do not freeze at once in cold countries. Give a reason in support of your answer.** **(ii) What is the principle of Calorimetry?** **(iii) Name the law on which this principle is based.** **(iv) State the effect of an increase of impurities on the melting point of ice.**	
ANS.:	(a) High specific heat capacity (b) **Cooling Water to 0°C:** First, calculate the heat energy lost when the water cools from 20°C to 0°C using the formula Q = m * c * ΔT, where m is mass, c is specific heat capacity, and ΔT is the change in temperature. Q = 100 g * 4.2 J/g/°C * (20°C - 0°C) = 8400 J. **Freezing Water at 0°C:** Next, calculate the heat energy lost when the water at 0°C freezes into ice at 0°C using the formula Q = m * L, where L is the specific latent heat of fusion. Q = 100 g * 336 J/g = 33600 J. **Cooling Ice to -10°C:** Then, calculate the heat energy lost when the ice cools from 0°C to -10°C, using Q = m * c * ΔT, and the specific heat capacity of ice. Q = 100 g * 2.1 J/g/°C * (0°C - (-10°C)) = 2100 J. **Total Heat Loss:** Add the heat lost in each of the three steps to find the total heat energy removed by the refrigerator: Total Q = 8400 J + 33600 J + 2100 J = **44100 J**. **Calculating Average Rate of Heat Extraction (Power):** The average rate of heat extraction (power) is the total heat energy removed divided by the time taken. The time is 35 minutes, which is equal to 35 * 60 = 2100 seconds. Power (P) = Total Q / time = 44100 J / 2100 s = **21 W**. Therefore, the average rate of heat extraction by the refrigerator is **21 watts.** (c) (i) Because the specific latent heat of fusion of ice is high. (ii) Heat lost = Heat gained (iii) The law of conservation of energy (iv) The melting point decreases	
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Q.NO.: 44	**50g of metal piece at 27 °C requires 2400 J of heat energy so as to attain a temperature of 327 °C. Calculate the specific heat capacity of the metal.**	YEAR [2014]
ANS.:	To calculate the specific heat capacity of the metal, the formula **Q = m * c * ΔT** can be used, where: Q is the heat energy supplied. m is the mass of the substance. c is the specific heat capacity. ΔT is the change in temperature1. In this case: Q = 2400 J m = 50 g ΔT = 327°C - 27°C = 300°C We need to find 'c', the specific heat capacity. By rearranging the formula to solve for c: **c = Q / (m * ΔT)** Plugging in the values: c = 2400 J / (50 g * 300°C) c = 2400 J / 15000 g°C c = 4/25 J/g°C c = 0.16 J/g°C Therefore, the specific heat capacity of the metal is **0.16 J/g/°C.**	
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Q.NO.: 45	**(a) Heat energy is supplied at a constant rate to 100g of ice at 0°C. The ice is converted into water at 0°C in 2 minutes. How much time will be required to raise the temperature of water from 0°C to 20°C?** **[Given: sp. heat capacity of water = 4.2 J g^{-1} $°C^{-1}$, sp. latent heat of ice = 336 J g^{-1}].** **(b) Specific heat capacity of substance A is 3.8 Jg^{-1} K^{-1} whereas the Specific heat capacity of substance B is 0.4 Jg^{-1} K^{-1}.** **(i) Which of the two is a good conductor of heat?** **(i) How is one led to the above conclusion?**	YEAR

	(iii) If substances A and B are liquids then which one would be more useful in car radiators?	
ANS.:	**(a)** **Melting Ice:** The heat energy required to convert 100 grams of ice at 0°C to water at 0°C can be calculated using the formula **Q = m * L**, where m is the mass and L is the specific latent heat of fusion1. Given the mass of ice is 100 grams and the latent heat of fusion of ice is 336 J/g, the total heat energy is 100 g * 336 J/g = **33600 J**. This amount of heat is supplied in 2 minutes (120 seconds), allowing us to calculate the power of the heat source using the formula **P = Q / t**, where t is time. The power is therefore, 33600 J / 120 s = **280 W**. **Heating Water:** The heat energy required to raise the temperature of 100 grams of water from 0°C to 20°C can be calculated using the formula **Q = m * c * ΔT**, where m is the mass, c is the specific heat capacity of water, and ΔT is the change in temperature. Given the mass is 100 g, the specific heat capacity of water is 4.2 J/g/°C, and the change in temperature is 20°C, the heat energy is 100 g * 4.2 J/g/°C * 20°C = **8400 J**. To find the time required, we can use the power calculated earlier which is 280 W and rearrange the equation **P = Q/t** to find **t = Q/P**, giving t = 8400 J / 280 W which is **30 seconds.** **(b)** (i) Substance B is a better conductor of heat. (ii) The conclusion that substance B is a better conductor is reached because it has a lower specific heat capacity1. A substance with a lower specific heat capacity requires less heat energy to raise its temperature, meaning it can transfer heat more readily and is therefore a better conductor of heat. (iii) Substance A would be more useful in car radiators. Car radiators require a coolant with a high specific heat capacity3.... A higher specific heat capacity means that the substance can absorb more heat without a significant increase in its own temperature, allowing it to cool the engine more effectively.	
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