PHYSICS

BOOKS - BHARATI BHAWAN PHYSICS (HINGLISH)

CALORIMETRY

Others

1. A platinum balls of mas $100g$ is remoived from a furnace and immersed in a copper vessel of mass $100g$ containing water of mass $390g$ at $30^{\circ}C$. The temperature of water rises to $40^{\circ}C$. Caltulate the temperature of the furnace. (Given that the specific heat of platinum $= 168kg^{-1}K^{-1}$, specific heat capacity of copper $= 420Jkg^{-1}K^{-1}$ and specific heat capacity of water $= 4200Jkg^{-1}K^{-1}$)

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2. Equal masses of three liquids are thoroughly mixed. The specific heat capacities of the liquids ar s_1, s_2 and s_3 and their temperatures t_1, t_2 and t_3 respectively. Find the temperature of the mixture.

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3. How should $1kg$ of water at $50^\circ C$ be divided in two parts such that if one part is turned into ice at $0^\circ C$. It would release sufficient amount of heat to vapourize the other part. Given that latent heat of fusion of ice is $3.36 \times 10^5 J / Kg$. Latent heat of vapurization of water is $22.5 \times 10^5 J / kg$ and specific heat of water is $4200 J / kgK$.

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4. A spherical iron ball is placed on a large block of dry ice at $0^\circ C$. The ball sinks into the ice until it is half subsmurged. What was the temperature of the iron?

(Density of iron $= 7.7 \times 10^3 kgm^3$, Density of ice $= 920 kgm^{-3}$ specific heat capacity of iron $= 504 Jkg^{-1} K^{-1}$, specific latent heat of fusion of ice $= 336 \times 10^3 Jkg^{-1}$)

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5. A body cools from $50^\circ C$ to $40^\circ C$ in 5 minutes. The surrounding temperature is $20^\circ C$. What will be its temperature 5 minutes after reading $40^\circ C$? Use approximate method.

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6. $200g$ of water and a equal volume of another liquid of mass $250g$ are placed in turn in the same calorimeter of mass $100g$ and specific heat capacity $420Jkg^{-1}K^{-1}$. The liquids which are constantly stirred are found to cool from $60^\circ C$ and $20^\circ C$ in $180s$ and $140s$ respectively. Find the specific heat capacity of the liquid. The temperature of the surroundings $= 20^\circ C$

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7. In the constant flow moethof of callendar and Barnes it was found that when the rate of flow water was $11g$ per minute the heating current was 2 amperes and the difference in potential between the ends of the heating wire was 1 volt, the rise in temperature was $2.5^{\circ} C$. On increasing the rate of flow to $25.4g$ per minute, the heating current to 3 amperes and the p.d.to 1.51 volts, the rise of temperature of water was still $2.5^{\circ} C$.Calculate the value of J.

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8. Find the result of mixing 0.5 kg ice at $0^{\circ} C$ with 2 kg water at $30^{\circ} C$. Given that latent heat of ice is $L = 3.36 \times 10^{5} J / kg$ and specific heat of water is $4200 J / kg / K$.

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9. What will be the result of mixing $2 kg$ of cooper at $100^{\circ} C$ with 0.75 kg of ice at $0^{\circ} C$ (Specific heat capacity of cooper

$= 378 J kg^{-1} K^{-1}$ specific heat capacity of water $= 4200 J kg^{-1} K^{-1}$ and specific latent heat of fusion of ice $= 336 \times 10^3 J kg^{-1}$)

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10. When $45g$ of a metal at $100^\circ C$ is dropped into an ice calorimeter, the contraction in the volume of the ice is observed ot be $0.4596 \times 10^{-6} m^3$. What is the specific heat capacity of the metal? $\left(L = 336 \times 10^3 J kg^{-1}\right.$ and relative density of ice $= 0.917$)

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11. An alloy consists of n metals of mases m_1, m_2, m_3 ....m_m and specific heat capacitors s_1, s_2, s_n. What is the specific heat capacity of the alloy?

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12. A copper vessel weighting $190g$ contains $300g$ of water at $0^\circ C$ and $50g$ of ice at $0^\circ C$. Find the quantity of steam at $100^\circ C$ that

must be passed into the vessel to raise its temperature and that of its content by $10^{\circ}C$ [Specific heat capacity of copper $= 420 Jkg^{-1}K^{-1} L$ (of steam) $= 2250 \times 10^3 Jkg^{-1}$ and L (of ice) $= 336 \times 10^3 Jkg^{-1}$]

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13. Find the result of mixing $1kg$ of ice at $0^{\circ}C$ with $1.5kg$ of water at $45^{\circ}C$. (Specific latent heat of fusioin of ice $= 336 \times 10^3 Jkg^{-1}$)

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14. What would be the final temperature of the mixture when $1kg$ of ice at $-10^{\circ}C$ is mixed with $4.4kg$ of water of $30^{\circ}C$? (Specific heat capacity of ice $= 2100Jkg^{-1}K^{-1}$)

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15. An alloy consists 40% copper and 60% nickel. A piece of the alloy of mass $0.1kg$ is palced in a calorimeter of water equivalent is

$10 \times 10^{-3} kg$ which contains 90×10^{-3} kg of water at $10^{\circ} C$. If the final temperature is $20^{\circ} C$, calculate the original temperature of the alloy. (Specific heat capacity of copper $= 339 J kg^{-1} K^{-1}$ and that of nickel $= 462 J kg^{-1} K^{-1}$)

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16. $4g$ of steam is added to a mixture of $35g$ of ice and $35g$ of water in a copper calorimeter weighing $50g$. What is the final temperature?

Specific heat capacity of copper $= 420 Jkg^{-1}K^{-1}L$ (of ice) $= 336 \times 10^3 Jkg^{-1}$ and L (of steam) $= 2268 \times 10^3 Jkg^1$)

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17. How should $2kg$ of water at $60^\circ C$ be divided so that when one part of it is turned into ice at $0^\circ C$ it would give out sufficient heat to vaporize the other part? (Specific latent heat of fusionof ice

$= 336 \times 10^3 Jkg^{-1}$ and specific latent heat of vaporization of steam $= 2250 \times 10^3 Jkg^{-1}$)

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18. The specific heat capacities of n liquid are s_1, s_2, s_3,.........s_n respectively and their respective temperatures $t_1, t_2, t_3, \ldots\ldots\ldots t_n$. Equal masses of the liquids are mixed together. Find the temperature of the mixture.

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19. $1kg$ of ice at $0^\circ C$ contracts by $91x10^{-6}m^3$ on melting. A solid weighitn $40g$ and at $60^\circ C$ dropped into an ice calorimeter cause a change in volume of $0273 \times 10^{-6}m^3$.

(Specific latent heat of fusion of ice $= 336 \times 10^3 Jkg^{-1}$. Calculate the specific heat capacity of the solid.

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20. The volume of a mixture of ice and water is found to decrease by $0.125 \times 10^{-6} m^3$ without change in temperature when $10 \times 10^{-3} kg$ of a metal at $100^\circ C$ is immersed into it. The relative density of ice is 0.917. Find the specific heat capacity of the metal.

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21. When 20×10^{-3} kg of water at $15^\circ C$ is placed in the tube of an ice calorimeer, it si found that the mercury thread mvoes through $29cm$. If a metal of mass $12g$ and $100^\circ C$ is placed in the tube, the mercury thread contracts by $12cm$. Find the specific heat capacity of metal. (Specific heat capacity of water $= 4200Jkg^{-1}K^{-1}$)

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22. A calorimeter whose water equivalent is $5 \times 10^{-3}kg$ is filled with 50×10^{-3} kg of water at $80^\circ C$. The temperature falls to $75^\circ C$

in 4 minutes. When it is filled with $40 \times 10^{-3} kg$ of another liquid, the time to fall through same range of temperature (from $80^{\circ} C$ to $75^{\circ} C$) is 130 seconds. Find the specific heat capacity of the liquid.

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23. A body cools from $50^{\circ} C$ to $40^{\circ} C$ is 5 minutes when its surrounding are at a constant temperature of $20^{\circ} C$. How long will it take for it to cool by another $10^{\circ} C$?

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24. A copper calorimeter, blackened outside, is filled with some hot liquid and placed on a table. It is found to cool from $60^{\circ} C$ to $50^{\circ} C$ in 4 minutes and $40^{\circ} C$ to $30^{\circ} C$ in 8 minutes. What is the temperature of the surroundings? Why is blackened?

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25. The temperature of a body falls from $30^\circ C$ to $20^\circ C$ in 5 minutes. The temperature of the air is $13^\circ C$. Find the temperature of the body after another 5 minutes.

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26. A body initially at $80^\circ C$ cools to $64^\circ C$ in 5 minutes and to $52^\circ C$ in 10 minutes. What will be its temperature in 15 minutes and what is the temperature of its surroundings?

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27. A calorimeter of water equivalent $10 \times 10^{-3} kg$ is filled with $70 \times 10^{-3} kg$ of a substance at its melting point. The substance is found to solidify completely in 21 minutes. A similar calorimeter containing $80 \times 10^{-3} kg$ of water at the same temperature cools at the rate of $1.5^{\circ} C$ per minute, the room temperature being the same in both cases. What is the latent heat of fusioin of the substance? (Specific heat capacity of water $= 4200 J kg^{-1} K^{-1}$)

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28. In the continuous flow method of Callender and Barnes the the potential difference across the wire was 3 volts and the current 2 amperes. The temperature of in flowing water was $20^{\circ} C$ and that of out flowing water $22.7^{\circ} C$ and $300 g$ of water were collected in 10 minutes. When the p.d. was increased to 3.75

volts and the current to 2.5 amperes, the flow was adjusted to maintain the same temperature difference and $240 g$ of water were collected in 5 minutes. Calculate the mean specific heat capacity of water at the mean temperature $21.35^\circ C$.

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29. The resistance of the wire of a Callendar and Barnes apparatus is 10 ohms at $20^\circ C$. A cell of steady volate 2.2 volts and internal resistance 1 ohm was connected to it. A liquid was slowly and steadily forced through it and the temperatures of the incoing and outgoing flow of liquid were found to b$18^\circ C$ and $22^\circ C$, respectively in the steady state. The liquid collected in 40 minutes was $120g$. Find the specific heat capacity of the liquid. Neglect loss of heat by radiation.

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30. In an first experiment using the Callendar and Barnes method the voltage across the heating wire was 2.01 volts the current 7.81 amperes and 501.2g of water was passed through the tube of the apparatus is 22 minutes. The rise in temperature was $9.37^\circ C$. In the second experiment (to eliminate radiation on effect) the voltage was 2.21 volts andthe current 8.52 amperes. The flow of water was adjusted to maintain the same temperature differences and $6.7g$ of water was passed through the tube in the same time as before. Calculate the specific heat capacity of water.

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31. A liquid of denisty $850 kgm^{-3}$ flows through a calorimeter at the rate of 8×10^{-6} cubic metre per second. Heat is supplied by mean of a 250- watts electric heating coil and a temperature difference of $15^{\circ} C$ is established in steady state conditioins betweenthe inflow adn outflow. Find the specific heat capacity of the liquid.

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32. The temperature of three different liquids A, B and C are $14^\circ C, 24^\circ C$ and $34^\circ C$ respectively. When equal masses of A and B are mixed, the temperature of the mixture is $20^\circ C$. When equal masses of B and C are mixed, the temperature of the mixture is $31^\circ C$. Supposing equal masses of A and C

were mixed, what would be the temperature of the mixture?

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33. A copper calorimeter of negligible thermal capacity is filled with a liquid. The mass of the liquid is $250g$. A heating element of negligible thermal capacity is immersed in the liquid. It is found that the temperature of the calorimeter and its contents rise form $25^{\circ}C$ to $30^{\circ}C$ in 5 minutes when a current of 2.05 amperes is passed through it at a potential difference of 5 volts. The liquid is throuwn off and the heater is switched on again. It is now found that the temperature of the calorimeter alone remains constant at $32^\circ C$ when the current through the heater is $0.7A$ at the potential differfnce 6 volts. Calculate the specific heat capacity of the liquid. The temperature of the surroundings is $25^\circ C$.

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34. A calorimeter contains ice. Determine the heat capacitiy of the calorimeter if $2.1kJ$ of heat is required to heat it togheter with its contents from $270^\circ K$ to $270^\circ K$, and $69.72kJ$ of heat of required to raise its temperature of $272K$ to $274^\circ K$.

(L of ice $= 336 \times 10^3 Jkg^{-1}$, specific heat capacity of ice $= 2100kg^{-1}K^{-1}$)

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35. A heat -proof envelope contains $100g$ of ice at $1^{\circ}C$. It is compressed to $1200atm$. Find the mass of the melted ice if the melting point of ice is lowered by $1^{\circ}C$ when the pressure is increased by 138 atm.

(L of ice $= 336 \times 10^{3} Jkg^{-1}$ and specific heat capacity of ice $= 2100 Jkg^{-1}K^{-1}$)

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36. Assume that the a planet radiates heat at a rate proportiona to the fourth power of its surface temperature T and that the planet assumes such a steady temperature that this loss of heat is exactly compensated by the heat gained from the sun. Show that other thing remaining the same, a planet's surface temperature varies inversely as the square root of its distance from the sun.

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37. A vessel containing $100g$ watera at $0^\circ C$ is suspended in the middle of a room. In 15 minutes the temperature of the water rises by $2^\circ C$. When an equal amount of ice is placed in the vessel, it melts in 10 hours. Calculate the specific latent heat of fusion of ice.

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38. In an industrial process 10 kg of water per hour is to be heated from $20^\circ C$ to $80^\circ C$. To do this steam at $150^\circ C$ is passed from a boiler into a copper coil immersed in water. The steam condenses in the coil and is returned to the boiler as water at $90^{\circ} C$. How many kilograms of steam is required per hour (specific heat of steam $= 1cal/g^{\circ} C$, Latent heat of vapourization $= 540cal/g$)?

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39. About $5g$ of water at $30^{\circ} C$ and $5g$ of ice at $-20^{\circ} C$ are mixed together in a calorimeter. Calculate final temperature of the mixture.

Water equivalent of the calorimeter is negligible. Specific heat of ice $= 0.5 \text{cal} g^{-1} C^{\circ} - 1)$ and latent heat of ice $= 80 \text{cal} g^{-1}$

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40. A vessel is completely filled with $500g$ of water and $1000g$ of mercury. When 21,200 calories of heat are given to it $3.52g$ of water overflows. Calculate the volume expansion of mercury. Expansion of the vessel may be neglected. Given that coefficient of volume expansion of water $= 1.5 \times 10^{-4} / C^{\circ}$, density of mercury $= 13.6 g / cm^{3}$, density of water $e = 1 g / cm^{3}$, and specific heat of mercury $= 0.03 \text{cal} / g C^{\circ}$

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41. Ice with mass $m_1 = 600 g$ and at temperature $t_1 = -10^{\circ} C$ is placed into a copper vessel heated to $t_2 = 350^{\circ} C$. As a result, the vessel now contains $m_2 = 550 g$ of ice mixed with water. Find the mass of the vessel. The specific heat of copper $= 0.1 \text{cal} / C^{\circ} g$ and sp. heat of ice $= 0.5 \text{cal} / g C^{\circ}$. Latent heat of ice $= 80 \text{cal} / g$

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