CBSE

THERMAL PROPERTIES OF MATTER WS 4

Class 11 - Physics

Section A

1. A child running a temperature of 101^{o}F is given an antipyrin (i.e. medicine that lowers fever) which causes an increase in the rate of evaporation of sweat from his body. If the fever is brought down to 98 ^{o}F in 20 min, what is the average rate of extra evaporation caused, by the drug? Assume the evaporation mechanism to be the only way by which heat is lost. The mass of the child is 30 kg. The specific heat of human body is approximately the same as that of water, and the latent heat of evaporation of water at that temperature is about 580 cal g^{-1}. **[1]**

   a) 4.9 g/min
   b) 5.2 g/min
   c) 4.6 g/min
   d) 4.3 g/min

2. A copper block of mass 2.5 kg is heated in a furnace to a temperature of 500 ^{o}C and then placed on a large ice block. What is the maximum amount of ice that can melt? (Specific heat of copper = 0.39 J $g^{-1}K^{-1}$; the heat of fusion of water = 335 J g^{-1}). **[1]**

   a) 1.7 kg
   b) 1.6 kg
   c) 1.5 kg
   d) 1.8 kg

3. A 0.0500-kg ingot of metal is heated to 200.0^{o}C and then dropped into a beaker containing 0.400 kg of water initially at 20.0^{o}C. If the final equilibrium temperature of the mixed system is 22.4^{o}C, find the specific heat of the metal. **[1]**

   a) 4.53 J/kg. ^{o}C
   b) 4.83 J/kg^{o}C
   c) 4.73 J/kg. ^{o}C
   d) 4.63 J/kg. ^{o}C

4. In an insulated vessel, 250 g of ice at 0^{o}C is added to 600 g of water at 18.0^{o}C. What is the final temperature of the system? **[1]**

   a) -2^{o}C
   b) 0^{o}C
   c) 4^{o}C
   d) 2^{o}C

5. A 3.00-g copper penny at 25.0° C drops from a height of 50.0 m to the ground. (a) If 60.0% of the change in potential energy goes into increasing the internal energy, what is its final temperature? **[1]**

   a) 21.8^{o}C
   b) 25.8^{o}C
   c) 27.8^{o}C
   d) 23.8^{o}C

6. A body A of mass 0.5 kg and specific heat 0.85 is at a temperature of 60 °C. Another body B of mass 0.3 kg and specific heat 0.9 is at a temperature of 90°C. When they are connected to a conducting rod, heat will flow from **[1]**

   a) B to A
   b) A to B

c) first A to B then B to A

d) heat can't flow

7. Molar Specific Heat capacity has units of: **[1]**

a) W/m.K

b) J/mol.K

c) J.ohm/sec. K^2

d) J/kg.K

8. Find the wrong statement about the specific heat of a material: **[1]**

a) Has units as J/kg-K.

b) Is extensive property

c) Heat capacity per unit mass

d) Constant for a material

9. A brass boiler has a base area of 0.15 m^2 and thickness 1.0 cm. It boils water at a rate of 6.0 kg/min when placed on a gas stove. Estimate the temperature of the part of the flame in contact with the boiler. Thermal conductivity of brass = 109 J $s^{-1}m^{-1}K^{-1}$; Heat of vaporization of water = 2256 $\times$ $10^3 Jkg^{-1}$. **[1]**

a) 237 ^oC

b) 238 ^oC

c) 240 ^oC

d) 239 ^oC

10. If 90.0 g of molten lead at 327.3^oC is poured into a 300-g casting form made of iron and initially at 20.0^oC, what is the final temperature of the system? (Assume that no energy loss to the environment occurs.) Latent heat of fusion of lead = 2.45 $\times$ 10^4 J/kg, specific heat of lead = 128J/Kg^oC **[1]**

specific heat of iron = 448J/Kg^oC.

a) 55.4^oC

b) 59.4^oC

c) 62.4^oC

d) 51.4^oC

11. The thermal capacity of 40 g of aluminium (specific heat = 0.2 cal $g^{-1}{}^oC^{-1}$) is **[1]**

a) 200 cal $^oC^{-1}$

b) 160 cal $^oC^{-1}$

c) 8 cal $^oC^{-1}$

d) 40 cal $^oC^{-1}$

12. Amount of heat required to raise the temperature of a body through 1K is called its **[1]**

a) Thermal capacity

b) specific heat

c) entropy

d) water equivalent

13. A 10 kW drilling machine is used to drill a bore in a small aluminum block of mass 8.0 kg. How much is the rise in temperature of the block in 2.5 minutes, assuming 50 percent of power is used up in heating the machine itself or lost to the surroundings. Specific heat of aluminum = 0.91 J $g^{-1}K^{-1}$. **[1]**

a) 103 ^oC

b) 93 ^oC

c) 113 ^oC

d) 123 ^oC

14. In an insulated vessel, 250 g of ice at 0°C is added to 600 g of water at 18.0°C. How much ice remains when the system reaches equilibrium? **[1]**

given that latent heat of fusion of ice = 79.5 cal/gm, the specific heat of water = 1cal/gm^oC.

a) 94 g

b) 87 g

c) 134 g

d) 114 g

15. **Assertion (A):** Water is taken for heating purpose in hot water bottle. **[1]**

Reason (R): Specific heat of water is less than that of other liquids.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

16. **Assertion (A):** Water expands both when heated or cooled from 4^oC. **[1]**

Reason (R): The volume of water at 4^oC is minimum.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

17. An aluminium sphere is dipped into water. Which of the following is true? **[1]**

a) Buoyancy in water at 0°C will be same as that in water at 4°C.

b) Buoyancy will be more in water at 0°C than that in water at 4°C.

c) Buoyancy may be more or less in water at 4°C depending on the radius of the sphere.

d) Buoyancy will be less in water at 0°C than that in water at 4°C.

18. Why juice bottles are placed underwater in cold countries? **[1]**

19. What is the difference between the specific heat and the molar specific heat? **[1]**

20. Which substance has the highest specific heat? **[1]**

21. Write the values of the specific heats of water at 20°C and ice. **[1]**

22. What is the specific heat of water in the SI units? **[1]**

23. Fill in the blank: Specific heat of water at 20^oC is and that of ice is _____. **[1]**

24. What is the relation between heat capacity and water equivalent of a body? **[1]**

25. Fill in the blank: The amount of heat required tc raise the temperature of one mole of any substance through one degree is called its _____. The SI unit of it is _____. **[1]**

26. Write the SI unit of specific heat. **[1]**

27. Why, water is used as an coolant in the radiator of cars? **[1]**

28. The Coolant used in a nuclear plant should have high specific heat. Why? **[1]**

29. Which has the maximum and which has the minimum specific heat amongst the following: **[1]**
Carbon, Silver, Aluminium, Tungsten?

Section B

30. A metal piece of 50 g having specific heat 0.6 cal $g^{-1}°C^{-1}$ initially at 120°C is dropped in 1.6 kg of water at 25°C. Find the final temperature or mixture. **[2]**

31. The heat of combustion of ethane gas is 373 kcal per mole. Assuming that 60 % of the heat is useful, how many litres of ethane measured at S.T.P. must be burnt to convert 50 kg of water at 10^o C to steam at 100^o C? One mole of a gas occupies 22.4 litre at S.T.P. **[2]**

32. A filament type electric lamp contains a small quantity of some inert gas too. Explain why. **[2]**

33. Why water is preferred to any other liquid in the hot water bottles? **[2]**

34. There is a slight temperature difference between the water fall at the top and the bottom. Why? **[2]**

35. A pan filled with hot food cools from 94 °C to 86 °C in 2 minutes when the room temperature is at 20 °C. How long will it take to cool from 71°C to 69°C? **[2]**

36. What are the basic requirements of a cooking utensil in respect of **[2]**

i. specific heat,

ii. thermal conductivity?

37. Calculate the difference between two principal specific heats of 1g of helium gas at N. T. P. Given Molecular weight of Helium = 4 and J = 4.186 J/cal and Universal Gas constant, R = 8.314J / mole / K. **[2]**

38. Two bodies of specific heats C_1 and C_2 having same heat capacities are combined to form a single composite body. What is the specific heat of the composite body? **[2]**

39. A sphere, a cube and a thin circular plate, all made of the same material and having the same mass are initially heated to a temperature of 200°C. Which of these objects will cool fastest and which one slowest when left in air at room temperature? Give reasons. **[2]**

40. Calculate the heat of combustion of coil when 10 g of coal on burning raises the temperature of 2 litres of water from 20^o C to 55^o C. **[2]**

41. What are the basic requirements of a cooking utensil in respect of specific heat, thermal conductivity and coefficient of expansion? **[2]**

42. What do you mean by molar specific heat of a substance? What is its SI unit? **[2]**

43. What kind of thermal conductivity and specific heat requirements would you specify for cooking utensils? **[2]**

44. Water is a very efficient coolant. Why? **[2]**

Section C

45. When 0.45 kg of ice at 0^oC is mixed with 0.9 kg of water at 55^oC in a container, the resulting temperature is 10^oC. Calculate the heat of fusion of ice. Specific heat capacity of water = 4186 J kg^{-1} K^{-1}. **[3]**

46. Explain why: **[3]**

a. the earth without its atmosphere would be inhospitably cold

b. heating systems based on the circulation of steam are more efficient in warming a building than those based on the circulation of hot water.

47. A certain substance has a mass of 50 g/mole. When 300 J of heat is added to 25g of sample of this material, its temperature rises from 25^oC to 45^oC. Calculate **[3]**

i. the thermal capacity,

ii. specific heat capacity, and

iii. molar heat capacity of the sample.

48. A 10 kW drilling machine is used to drill a bore in a small aluminium block of mass 8.0 kg. How much is the rise in temperature of the block in 2.5 minutes, assuming 50% of power is used up in heating the machine itself or lost to the surroundings. Specific heat of aluminium = 0.91 J g^{-1} K^{-1}. **[3]**

49. A 20 cm thick layer of ice has been formed on the surface of a freshwater lake during extreme winter. The temperature of the air is -10^oC. Find how long will it take for another 1mm layer of water to freeze? Thermal conductivity of ice = 2.1 W m^{-1} K^{-1}, latent heat of fusion of water = 3.36×10^5 J kg^{-1} and density of ice = 10^3 kg m^{-3}. **[3]**

50. Define the terms specific heat and molar specific heat. Give their SI units. **[3]**

Section D

51. Given below are observations on molar specific heats at room temperature of some common gases. **[5]**

Gas	**Molar specific heat (C_v)**

	(cal mol^{-1} K^{-1})
Hydrogen	4.87
Nitrogen	4.97
Oxygen	5.02
Nitric oxide	4.99
Carbon monoxide	5.01
Chlorine	6.17

The measured molar specific heats of these gases are markedly different from those for monatomic gases. Typically, the molar specific heat of a monatomic gas is 2.92 cal/mol K. Explain this difference. What can you infer from the somewhat larger (than the rest) value for chlorine?

52. A sphere of 0.047 kg aluminum is placed for sufficient time in a vessel containing boiling water so that the sphere is at 100 °C. It is then immediately transferred to a 0.14 kg copper calorimeter containing 0.25 kg water at 20 °C. The temperature of water rises and attains a steady-state at 23°C. Calculate the specific heat capacity of aluminum. **[5]**

53. Calculate the heat required to convert 3 kg of ice at -12°C kept in a calorimeter to steam at 100 °C at atmospheric pressure. Given specific heat capacity of ice = 2100 J $kg^{-1}K^{-1}$, specific heat capacity of water = 4186 J kg^{-1} K^{-1}, latent heat of fusion of ice = 3.35×10^5 J kg^{-1} and latent heat of steam = 2.256×10^6 J kg^{-1} **[5]**

54. Calculate the force required to prevent! of 1 mm^2 a steel wire cross-section from contracting when it cools from 60°C to 15°C, if Young's modulus for steel is 2×10^{11} Nm^{-2} and its coefficient of linear expansion is 0.000011°C^{-1}. **[5]**

Section E

55. **Fill in the blanks:** **[6]**

(a) The unit of water equivalent W is _____. **[1]**

(b) Thermal capacity of a body is ecual to the product of its _____ and _____. **[1]**

(c) The amount of heat needed to raise the temperature of unit mass of a substance by unity is known as the _____. **[1]**

(d) The specific heat of a substance depends on its _____ and _____. **[1]**

(e) Thermal capacity and water equivalent of a body have _____ numerical values and _____ units. **[1]**

(f) The amount of heat energy required to raise the temperature of 1 gram of water from 14.5^o C to 15.5^o C is called one _____. **[1]**