CBSE

THERMAL PROPERTIES OF MATTER WS 6

Class 11 - Physics

Section A

1. A 3.00-g lead bullet at 30.0^{o}C is fired at a speed of 240 m/s into a large block of ice at 0^{o}C, in which it becomes embedded. What quantity of ice melts? Latent heat of ice = 3.33 $\times$ 10^{-5} J/Kg, the specific heat of lead = 128J/Kg^{o}C? **[1]**

   a) 3.04 g
   b) 2.54 g
   c) 2.94 g
   d) 2.74 g

2. A slab of stone of area 0.36 m^2 and thicknes 0.1 m is exposed on the lower surface to steam at 100°C. A block of ice at 0°C rests on the upper surface of the slab. In one hour 4.8 kg of ice is melted. The thermal conductivity of slab is **[1]**

   (Given latent heat of fusion of ice = 3.36 $\times$ 10^5 Jkg^{-1})

   a) 1.02 J/m/s/°C
   b) 1.29 J/m/s/°C
   c) 1.24 J/m/s/°C
   d) 2.05 J/m/s/°C

3. In an energy recycling process, X g of steam at 100°C becomes water at 100°C which converts Y g of ice at 0°C into water at 100°C. The ratio of X and Y will be **[1]**

   a) $\frac{1}{3}$
   b) 3
   c) $\frac{2}{3}$
   d) 2

4. When water boils or freezes, during these processes its temperature **[1]**

   a) does not change
   b) decreases
   c) increases
   d) Sometimes increase and sometimes deceases

5. When a solid is converted into a gas, directly by heating, then this process is known as **[1]**

   a) sublimation
   b) vaporization
   c) boiling
   d) condensation

6. The latent heat of vaporisation of a substance is always **[1]**

   a) greater than its latent heat of sublimation
   b) greater than its latent heat of fusion
   c) equal to its latent heat of sublimation
   d) less than its latent heat of fusion

7. A liquid boils when its vapour pressure is equal to **[1]**

   a) atmospheric pressure
   b) double of atmospheric pressure
   c) 6.0 cm of Hg column
   d) 1000 pa or more

8. Liquid helium has a very low boiling point, 4.2 K, and a very low latent heat of vaporization, 2.09 $\times$ 10^4 J/kg. If **[1]**

energy is transferred to a container of boiling liquid helium from an immersed electric heater at a rate of 10.0 W, how long does it take to boil away 1.00 kg of the liquid?

a) 31 min
b) 33 min
c) 35 min
d) 37 min

9. Hailstone of 0°C falls from a height of 1 km on an insulating surface converting whole of its kinetic energy into heat. What part of it will melt? (g = 10 ms^{-2}) **[1]**

a) $(\frac{1}{33}) \times 10^{-4}$
b) All of these
c) $\frac{1}{8}$
d) $\frac{1}{33}$

10. How do the freezing point and boiling point of ocean water compare to those of distilled water? **[1]**

A. Ocean water freezes at a lower temperature and boils at a lower temperature.
B. Ocean water freezes at a lower temperature and boils at a higher temperature.
C. Ocean water freezes at a higher temperature and boils at a lower temperature.
D. Ocean water freezes at a higher temperature and boils at a higher temperature.

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

11. A quantity of heat required to change the unit mass of a solid substance, from solid state to liquid state, while the temperature remains constant, is known as **[1]**

a) hoar frost
b) sublimation
c) latent heat of fusion
d) latent heat

12. The triple point of water is **[1]**

a) 273.16^oC
b) 273.16 K
c) 273.16^oF
d) 0.15 K

13. **Assertion (A):** Water kept in an open vessel will quickly evaporate on the surface of the moon. **[1]**
Reason (R): The temperature at the surface of the moon is much higher than the boiling point of water.

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.

14. **Assertion (A):** The triple point of water is a standard fixed point in modern thermometry. **[1]**
Reason (R): Melting point of ice and the boiling point of water change due to change in atmospheric pressure but triple-point of water does not change.

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.

15. **Assertion (A):** Water kept in an open vessel will quickly evaporate on the surface of the moon. **[1]**
Reason (R): The temperature at the surface of the moon is much higher than the boiling point of water.

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:** Liquid molecules have greater potential energy at the melting point. **[1]**

Reason: Intermolecular spacing between molecules increases at melting point.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

17. **Assertion:** A piece of ice, with a stone frozen inside it, floats on water in a beaker. When the ice melts, the level of water in the beaker decreases. **[1]**

Reason: Density of stone is more than that of water.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

18. **Assertion:** At room temperature water does not sublimate from ice to steam. **[1]**

Reason: The critical point of water is much above the room temperature.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

19. What is the effect of pressure on the melting point of a solid? **[1]**

20. At what temperature and pressure, can the solid, liquid and vapour phases of water co-exist in equilibrium? **[1]**

21. Why do the fusion line, vaporisation line and sublimation line of a substance, meet necessarily at a single point? **[1]**

22. Ice of 0° C is converted into steam at 100° C. State the isothermal changes in the process. **[1]**

23. What is sublimation? **[1]**

24. What happens if water vapour at a pressure of 0.004 atm is cooled to 0°C? **[1]**

25. Can gas be liquified at any temperature by the increase of pressure alone? **[1]**

26. Is CO_2 solid, liquid or gas at **[1]**

i. - 70°C under 1 atm

ii. - 60°C under 10 atm

iii. - 15°C under 56 atm?

27. What physical changes may be observed, if an object is heated? **[1]**

28. How much is the critical temperature of the water? **[1]**

29. Fill in the blank: The amount of heat required to change the state of unit mass of a substance at constant temperature and pressure is called _____ of the substance. Its SI unit is _____. **[1]**

30. What are the values of the triple point of water on the Centigrade, Fahrenheit and absolute scales of temperature? **[1]**

31. The triple-point of water is a standard fixed point in modern thermometry. Why? What is wrong in taking the melting point of ice and the boiling point of water as standard fixed points (as was originally done in the Celsius scale)? **[1]**

32. At what temperature and pressure, can the solid, liquid and vapour phases of CO_2 co-exist in equilibrium? **[1]**

33. What happens when CO_2 at 4 atm pressure is cooled from room temperature at constant pressure? **[1]**

34. CO_2 at 1 atm pressure and temperature - 60°C is compressed isothermally. Does it go through liquid phase? **[1]**

35. What is the effect of decrease of pressure on the fusion and boiling points of CO_2? **[1]**

36. Are the relative amounts of ice, water and vapour fixed at the triple point of water? **[1]**

37. What is the significance of negative slope of ice line of water? **[1]**

38. What are the critical temperature and pressure for CO_2? What is their significance? **[1]**

Section B

39. Steam at 100°C is passed into a copper cylinder 10 mm thick and of 200 cm^2 area. Water at 100°C collects at the rate of 150 g min^{-1}. Find the temperature of the outer surface, if the conductivity of copper is 0.8 cal s^{-1} cm^{-1}° C^{-1} and the latent heat of steam is 540 cal g^{-1}. **[2]**

40. When 0.15 kg of ice at 0 °C is mixed with 0.30 kg of water at 50°C in a container, the resulting temperature is 6.7°C. Calculate the heat of fusion of ice. (s_{water} = 4186 J kg^{-1} K^{-1}) **[2]**

41. 100g of ice at 0°C is mixed with 100g of water at 80°C. The resulting temperature of the mixture is 6°C. Calculate the latent heat of fusion of ice. **[2]**

42. Define latent heat of fusion of ice and latent heat of vaporisation of steam. **[2]**

43. Estimate the rate at which ice would melt in a wooden box 2.0 cm thick and of inside measurements 200 cm × 120 cm × 120 cm assuming that the external temperature is 30°C and coefficient of thermal conductivity of wood is 0.0004 cal $s^{-1}cm^{-1}{}^{o}C$. **[2]**

44. Is it possible to convert water into vapour form without increasing its temperature, if temperature and pressure of water are 30 °C and 1 atm respectively? **[2]**

45. An iron boiler is 1 cm thick and has a heating area of 2 m^2. The two surfaces of the boiler are at 234°C and 100°C respectively. If the latent heat of steam is 536 kcal kg^{-1} and thermal conductivity of iron is 1.6 × 10^{-2} kcal s^{-1} m^{-1} $°C^{-1}$, then how much water will be evaporated into steam per minute? **[2]**

46. What do you mean by the term 'latent heat'? What are three types of latent heat? **[2]**

47. A thermally isolated vessel contains 100 g of water at 0°C when the air above the water is pumped out, some of the water freezes and some evaporates at 0°C itself. Calculate the mass of ice formed, if no water is left in the vessel. Latent heat of vaporisation of water at 0^{o} C = 2.10 × 10^6 J kg^{-1} and latent heat of fusion of ice = 3.36 × 10^5 J kg^{-1}. **[2]**

Section C

48. A clock with an iron pendulum keeps the correct time at 20^{o} C. How much will it lose or gain if the temperature changes to 40^{o}C? Coefficient of cubical expansion of iron = 36 × 10^{-6} $^{o}C^{-1}$. **[3]**

49. A brass boiler has a base area of 0.15 m^2 and thickness 1.0 cm. It boils water at the 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 vaporisation of water = 2256×10^3 J kg^{-1}. **[3]**

Section D

50. **State True or False:** **[4]**

(a) When certain amount of water is heated from 0°C its volume increases continuously. **[1]**

(b) The melting point of a substance at atmospheric pressure is called normal melting point. **[1]**

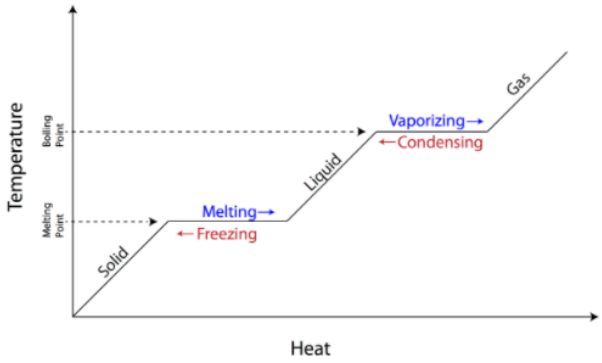
(c) Every type of motion provides some kinetic energy to the molecules of the body. **[1]**

(d) Boiling point increases with increase in temperature and its vice-versa. **[1]**

Section E

Question No. 51 to 55 are based on the given text. Read the text carefully and answer the questions: **[5]**

A **phase change** is when matter changes from one state (solid, liquid, gas, plasma) to another. These changes occur when sufficient energy is supplied to the system (or a sufficient amount is lost), and also occur when the pressure on the system is changed. The temperatures and pressures under which these changes happen differ depending on the chemical and physical properties of the system.



51. The latent heat of vaporization of a substance is always

a) lower than the heat of sublimation
b) greater than the heat of sublimation
c) less than the heat of fusion
d) greater than the heat of fusion

52. Specific heat of a substance at the melting point becomes

a) remains unchanged
b) low
c) high
d) infinite

53. Specific heat of gas in an isothermal process is

a) zero
b) infinite
c) One
d) finite

54. A quantity of heat required to change the unit mass of a substance, from solid to liquid state, while the temperature remains constant, is known as

a) sublimation
b) latent heat
c) latent heat of fusion
d) suppression

55. The sprinkling of water reduces the temperature of the closed room because

a) Specific heat of water is low
b) Water is a bad conductor of heat
c) The water has a large latent heat of vaporization
d) Specific heat of water is high

56. Answer the following questions based on the P-T phase diagram of carbon dioxide: **[5]**

a. At what temperature and pressure can the solid, liquid, and vapor phases of CO_2 co-exist in equilibrium?

b. What is the effect of the decrease of pressure on the fusion and boiling point of CO_2?

c. What are the critical temperature and pressure for CO_2? What is its significance?

d. Is CO_2 solid, liquid or gas at

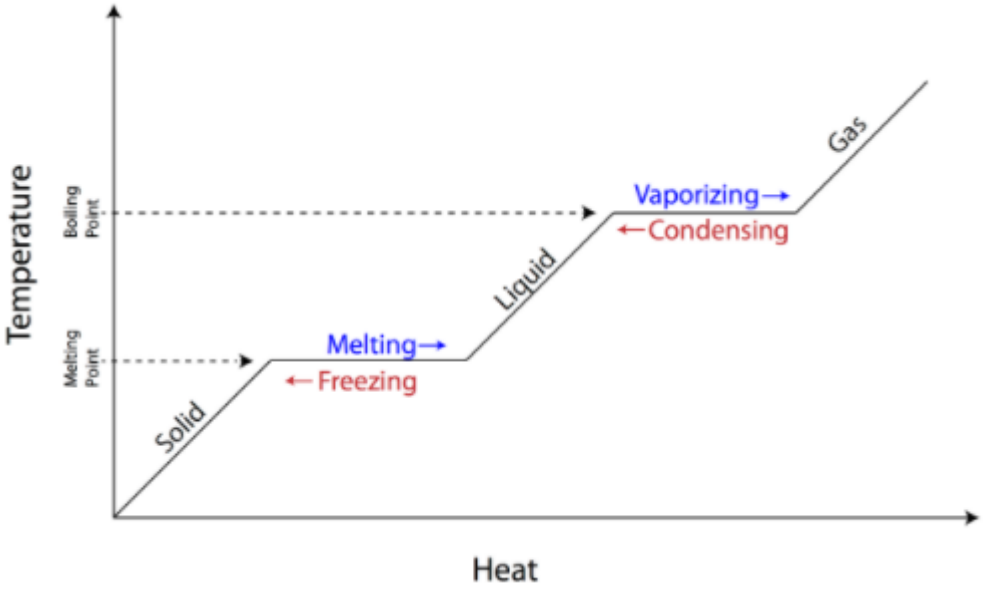
i. -70°C under 1 atm,

ii. -60°C under 10 atm,

iii. 15°C under 56 atm?

57. **Read the case study given below and answer any four subparts:** **[5]**

A **phase change** is when matter changes from one state (solid, liquid, gas, plasma) to another. These changes occur when sufficient energy is supplied to the system (or a sufficient amount is lost), and also occur when the pressure on the system is changed. The temperatures and pressures under which these changes happen differ depending on the chemical and physical properties of the system.



i. The latent heat of vaporization of a substance is always

a. greater than the heat of fusion

b. less than the heat of fusion

c. greater than the heat of sublimation

d. lower than the heat of sublimation.

ii. Specific heat of a substance at the melting point becomes

a. low

b. high

c. remains unchanged

d. infinite

iii. Specific heat of gas in an isothermal process is

a. zero

b. finite

c. infinite

d. none of these

iv. A quantity of heat required to change the unit mass of a substance, from solid to liquid state, while the temperature remains constant, is known as

a. sublimation

b. latent heat of fusion

c. latent heat

d. none of these

v. The sprinkling of water reduces the temperature of the closed room because

a. The water has a large latent heat of vaporization

b. Water is a bad conductor of heat

c. Specific heat of water is high

d. none of these

Section F

58. **Fill in the blanks:** **[8]**

(a) The process in which ice melts when pressure is increased and again freezes when] pressure is removed is called _____. **[1]**

(b) The temperature at which the liquid starts to evaporate is called the _____ of the liquid. **[1]**

(c) The process of change of state from liquid to vapour (or gas) is called _____. **[1]**

(d) The process of transition of a substance from solid-state to vapour state without passing through the liquid state is called _____. **[1]**

(e) The temperature at which solid starts to liquify is known as the _____ point of that solid. **[1]**

(f) The temperature at which liquid starts to freeze is known as the _____ point of the liquid. **[1]**

(g) The process of change of state directly from solid to vapour (or gas) in known as _____. **[1]**

(h) The process of converting one state of a substance into another state is known as _____ of a substance or matter. **[1]**