11th Science Lesson 7 Questions in English

7] Heat And Thermodynamics

1. Which of the following statement is incorrect?

1) Temperature and heat play very important role in everyday life
2) Life on Earth is possible because the Sun maintains its temperature
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Temperature and heat play very **important role in everyday life**. All species can function properly only if its body is maintained at a particular temperature. In fact, **life on Earth is possible** because the **Sun maintains its temperature**.

2. _____ is a branch of physics which explains the phenomena of temperature, heat

a) Kinematics
b) Thermodynamics
c) Acoustics
d) Sonography

Explanation

Understanding the meaning of temperature and heat are very crucial to understand the nature. **Thermodynamics** is a **branch of physics** which explains the **phenomena of temperature, heat** etc.

3. In thermodynamics, heat and temperature are two_____ parameters

a) Same and closely related
b) Different and closely related
c) Different and unrelated
d) Same and unrelated

Explanation

The concepts presented in this chapter will help us to understand the terms 'hot' and 'cold' and also differentiate heat from temperature. In **thermodynamics, heat and temperature** are **two different** but **closely related parameters**.

4. Which of the following statement is correct?

1) Energy flows spontaneously from lower temperature object to higher temperature object
2) This flow of energy is called heat
3) Due to flow of heat sometimes the temperature of the body will increase or sometimes it may not increase.
    a) 1, 2
    b) 1, 3
    c) 2, 3

d) All the above

Explanation

When an object at higher temperature is placed in contact with another object at lower temperature, there will be a **spontaneous flow of energy from the object at higher temperature to the one at lower temperature**. This energy is called heat. This process of energy transfer from higher temperature object to lower temperature object is called heating. Due to flow of heat sometimes the temperature of the body will increase or sometimes it may not increase.

5. Which of the following statement is correct?

1) People often talk 'this water has more heat or less heat'.
2) There is a misconception that heat is a quantity of energy
3) When we use the word 'heat', it is the energy in transit but not energy stored in the body.
   a) 1, 2
   b) 1, 3
   c) 2, 3
   d) All the above

Explanation

There is a **misconception that heat is a quantity of energy**. People often talk 'this water has more heat or less heat'. These words are meaningless. Heat is not a quantity. Heat is an energy in transit which flows from higher temperature object to lower temperature object. Once the heating process is stopped, we cannot use the word heat. When we use the word 'heat', it is the **energy in transit but not energy stored in the body.**

6. Which of the following statement is correct?

1) When you rub your hands against each other the temperature of the hands increases.
2) The temperature of the hands increases due to this work.
   a) 1 alone
   b) 2 alone
   c) 1, 2
   d) None

Explanation

When you rub your hands against each other the temperature of the hands increases. You have done some work on your hands by rubbing. The **temperature of the hands increases due to this work**. Now if you place your hands on the chin, the temperature of the chin increases. This is because the hands are at higher temperature than the chin.

7. Which of the following statement is incorrect?

1) By doing work on the system, the temperature in the system will increase and sometimes may not
2) Work is a quantity
   a) 1 alone
   b) 2 alone

c) 1, 2
d) None

Explanation

By doing work on the system, the temperature in the system will increase and sometimes may not. Like heat, **work is also not a quantity** and through the work energy is transferred to the system. So, we cannot use the word 'the object contains more work' or 'less work'.

8. For the transfer of energy from one body to another body through the process of work, they should be at_____ temperatures

a) Same
b) Different
c) Slightly equal
d) None

Explanation

Either the system can transfer energy to the surrounding by doing work on surrounding or the surrounding may transfer energy to the system by doing work on the system. For the transfer of **energy from one body to another body through the process of work, they need not be at different temperatures.**

9. Which of the following statement is correct?

1) Temperature is the degree of hotness or coolness of a body
2) The temperature will determine the direction of heat flow when two bodies are in thermal contact
   a) 1 alone
   b) 2 alone
   c) 1, 2
   d) None

Explanation

Temperature is the degree of hotness or coolness of a body. Hotter the body higher is its temperature. The temperature will determine the direction of heat flow when two bodies are in thermal contact.

10. The SI unit of temperature is_____

a) K
b) °F
c) ˚C
d) All the above

Explanation

The **SI unit of temperature is kelvin (K).** In our day to day applications, Celsius (˚C) and Fahrenheit (°F) scales are used. Temperature is measured with a thermometer.

11. Which of the following temperature conversion is correct?

1) Celsius to Kelvin K=°C + 273.15

2) Celsius to Fahrenheit °C = (°F − 32) ÷ 1.8
   a) **1 alone**
   b) 2 alone
   c) 1, 2
   d) None

Explanation

Table 8.1 Temperature conversion

Scale	To Kelvin	From Kelvin
Celsius	K=°C + 273.15	°C = K – 273.15
Fahrenheit	K=(°F + 459.67)÷1.8	°F=(K × 1.8)-459.67

Scale	To Fahrenheit	From Fahrenheit
Celsius	°F=(1.8 × °C) + 32	°C = (°F – 32)÷1.8

Scale	To Celsius	From Celsius
Fahrenheit	°C=(°F – 32)÷1.8	°F = (1.8 × °C) + 32

12. According to Boyle's law_____
   a) **Pressure of the gas is inversely proportional to the volume**
   b) Volume of the gas is directly proportional to absolute temperature
   c) Volume of gas is inversely proportional to absolute temperature
   d) Pressure of the gas is directly proportional to the volume

Explanation

When the gas is kept at constant temperature, the **pressure of the gas is inversely proportional to the volume**. P α 1/ V. It was discovered by Robert Boyle (1627-1691) and is known as Boyle's law.

13. According to Charles' law_____
   a) Pressure of the gas is inversely proportional to the volume
   b) Volume of the gas is directly proportional to absolute temperature
   c) Volume of gas is inversely proportional to absolute temperature
   d) Pressure of the gas is directly proportional to the volume

Explanation

When the gas is kept at constant pressure, the v**olume of the gas is directly proportional to absolute temperature**. V α T. It was discovered by Jacques Charles (1743-1823) and is known as Charles' law.

14. Which of the following is ideal gas law?
   a) **PV = N k T**
   b) PV = N T
   c) PV/ T = N k
   d) PV = N k/ T

Explanation

By combining Boyle's law, Charles' law equations we have ideal gas law. So the ideal gas law can be stated as follows:

PV = N k T

15. Boltzmann constant is equal to_____

a) **1.381×10^{-23} JK^{-1}**
b) 1.381×10^{-23} JK
c) 1.608×10^{18} JK
d) 1.608×10^{-18} JK^{-1}

Explanation

Ideal gas equation:

PV = N k T

Here k is the **Boltzmann constant (1.381×10^{-23} JK^{-1})** and it is found to be a universal constant.

16. Which of the following statement is correct?

1) Atom is the practical unit to express the amount of gas
2) One mole of any substance is the amount of that substance which contains Avogadro number (N_A) of particles
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Mole is the practical unit to express the amount of gas. One mole of any substance is the amount of that substance which contains Avogadro number (N_A) of particles (such as atoms or molecules).

17. The Avogadro number is defined as the number of carbon atoms contained in exactly ___g of ^{12}C

a) 13
b) 12
c) 24
d) 18

Explanation

The Avogadro's number NA is defined as the number of carbon atoms contained in **exactly 12 g of ^{12}C**. One mole of any substance is the amount of that substance which contains Avogadro number (NA) of particles (such as atoms or molecules).

18. Avogadro number is equal to_____

a) 6.023×10^{23} mol
b) $6.023 \times 10^{23} mol^{-1}$
c) $5.023 \times 10^{23} mol^{-1}$
d) $4.023 \times 10^{23} mol^{-1}$

Explanation

Suppose if a gas contains μ mole of particles then the total number of particles can be written as

$N = \mu N_A$

where N_A is **Avogadro number ($6.023 \times 10^{23} mol^{-1}$)**

19. Universal gas constant is equal to_____

a) 6.023×10^{23} mol
b) 8.314 J /mol. K
c) 7.314 J /mol. K
d) 6.314 J /mol. K

Explanation

PV = μ N A k T. Here N A k=R called universal gas constant and its value is **8.314 J /mol. K.** So, the ideal gas law can be written for μ mole of gas as

PV = μ R T

20. Which equation relates the pressure, volume and temperature of thermodynamic system at equilibrium?

a) Boyle's equation
b) Charles' equation
c) Ideal gas equation
d) None

Explanation

PV = μ R T

This is called the **equation of state for an ideal gas**. It relates the pressure, volume and temperature of thermodynamic system at equilibrium.

21. A student comes to school by a bicycle whose tire is filled with air at a pressure 240 kPa at 27°C. She travels 8 km to reach the school and the temperature of the bicycle tire increases to 39°C. What is the change in pressure in the tire when the student reaches school?

a) 270 Pa
b) 249.6 Pa
c) 230.6 Pa
d) 210.1 Pa

Explanation

Solution

We can take air molecules in the tire as an ideal gas. The number of molecules and the volume of tire remain constant. So the air molecules at 27°C satisfies the ideal gas equation $P_1V_1 = NkT_1$ and at 39°C it satisfies $P_2V_2 = NkT_2$

But we know

$$V_1 = V_2 = V$$

$$\frac{P_1V}{P_2V} = \frac{NkT_1}{NkT_2}$$

$$\frac{P_1}{P_2} = \frac{T_1}{T_2}$$

$$P_2 = \frac{T_2}{T_1}P_1$$

$$P_2 = \frac{312K}{300K} \times 240 \times 10^3 Pa = 249.6\ kPa$$

22. When a person breathes, his lungs can hold up to 5.5 Litre of air at body temperature 37°C and atmospheric pressure (1 atm =101 kPa). This Air contains 21% oxygen. Calculate the number of oxygen molecules in the lungs.

a) 2.7×10^{22}
b) 3.7×10^{21}
c) 1.7×10^{22}
d) 2.7×10^{21}

Explanation

Solution

We can treat the air inside the lungs as an ideal gas. To find the number of molecules, we can use the ideal gas law.

$$PV = NkT$$

Here volume is given in the Litre. 1 Litre is volume occupied by a cube of side 10 cm.
1Litre = 10cm × 10cm × 10cm = 10^{-3} m^3

$$N = \frac{PV}{kT} = \frac{1.01\times10^{5}\,\text{Pa}\times5.5\times10^{-3}\,\text{m}^3}{1.38\times10^{-23}\,\text{JK}^{-1}\times310\text{K}}$$

$$= 1.29\times10^{23}\,\text{Molecules}$$

Only 21% of N are oxygen. The total number of oxygen molecules

$$= 1.29 \times 10^{23} \times \frac{21}{100}$$

Number of oxygen molecules
$= 2.7 \times 10^{22}$ molecules

23. Calculate the volume of one mole of any gas at STP and at room temperature (300K) with the same pressure 1 atm.
    a) 22.4×10^{-3} m^3
    b) 22.4×10^{-3} m^2
    c) 12.4×10^{-3} m^3
    d) 22.4×10^{-3} m^{-3}

Explanation

Here STP means standard temperature (T=273K or 0°C) and Pressure (P=1 atm or 101.3 kPa)

We can use ideal gas equation $V = \frac{\mu RT}{P}$.

Here μ = 1 mol and R =8.314 J/mol.K.

By substituting the values

$$V = \frac{(1\ \text{mol})(8.314\ \frac{\text{J}}{\text{mol}}\ \text{K})(273\text{K})}{1.013\times10^{5}\ \text{Nm}^{-2}}$$

$=22.4 \times 10^{-3}\ \text{m}^3$

24. 1 Litre (L) =_____

a) $10^{-3}m^3$
b) $10^{3}m^3$
c) $10^{-3}m^{-3}$
d) $10^{3}m^{-3}$

Explanation

We know that 1 Litre (L) = $=10^{-3}m^3$. So we can conclude that 1 mole of any ideal gas has volume 22.4 L.

By multiplying 22.4L by $\frac{300K}{273K}$ we get the volume of one mole of gas at room temperature. It is 24.6 L.

25. _____% of Oxygen present in air

a) 20
b) 21
c) 19
d) 18

Explanation

Air is the mixture of about 20% oxygen, 79% nitrogen and remaining one percent are argon, hydrogen, helium, and xenon. The molar mass of air is 29 g mol^{-1}.

26. _____ is defined as amount of heat energy required to raise the temperature of the given body from T to T + ΔT

a) Heat capacity
b) Radiation
c) Specific heat capacity

d) Sublimation

Explanation

We can define **'heat capacity' as the amount of heat energy required to raise the temperature** of the **given body from T to T + ΔT**. Specific heat capacity of a substance is defined as the amount of heat energy required to raise the temperature of 1kg of a substance by 1 Kelvin or 1°C

27. The SI unit for specific heat capacity is_____

a) J kg $^{-1}$ K^{-1}
b) J kg $^{-1}$ K
c) kg K^{-1}
d) J kg K−1

Explanation

The **SI unit for specific heat capacity is J kg $^{-1}$ K^{-1}**. Heat capacity and specific heat capacity are always positive quantities.

28. Match the specific heat capacity with respective material

I.	Air	1. 130
II.	Lead	2. 4186
III.	Human body	3. 1005
IV.	Water	4. 3470

a) 2, 1, 3, 4
b) 3, 1, 4, 2
c) 3, 4, 1, 2
d) 3, 2, 1, 4

Explanation

Material	Specific heat capacity (Jkg^{-1}K^{-1})
Air	1005
Lead	130
Copper	390
Iron (steel)	450
Glass	840
Aluminium	900
Human body	3470
Water	4186

29. Which of the following statement is correct?

1) The term heat capacity or specific heat capacity does not mean that object contains a certain amount of heat
2) Heat is energy transfer from the object at higher temperature to the object at lower temperature

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

The term **heat capacity or specific heat capacity does not mean that object contains a certain amount of heat.** Heat is energy transfer from the object at higher temperature to the object at lower temperature. The correct usage is 'internal energy capacity'. But for historical reason the term 'heat capacity' or 'specific heat capacity' are retained.

30. The SI unit for molar specific heat capacity is_____

a) J mol
b) J mol^{-1} K^{-1}
c) J mol^{-1}
d) J mol K^{-1}

Explanation

The **SI unit for molar specific heat capacity is J mol^{-1} K^{-1}.** It is also a positive quantity. When we study properties of gases, it is more practical to use molar specific heat capacity.

31. Thermal expansion is the tendency of matter to change in___ due to change in temperature

1) Volume
2) Shape
3) Area

a) 1, 2
b) 2, 3
c) 1, 3
d) All the above

Explanation

Thermal expansion is the **tendency of matter to change in shape, area, and volume due to a change in temperature**.

32. Which of the following will expand when heated?

1) Solid
2) Liquid
3) Gas

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

All three states of matter **(solid, liquid and gas) expand when heated**. When a solid is heated, its atoms vibrate with higher amplitude about their fixed points.

33. Which of the following expands more?

a) Solid
b) Liquid
c) Gas
d) All the above

Explanation

Liquids, have less intermolecular forces than solids and hence they expand more than solids. This is the principle behind the mercury thermometers. In the case of **gas molecules,** the intermolecular forces are almost negligible and hence they expand much more than solids.

34. Which of the following statement is correct?

1) The increase in dimension of a body due to the increase in its temperature is called thermal expansion
2) The expansion in length is called area expansion

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

The increase in dimension of a body due to the increase in its temperature is called thermal expansion. The **expansion in length is called linear expansion**. Similarly, the expansion in area is termed as area expansion.

35. Which of the following statement is incorrect?

1) When the lid of a glass bottle is tight, keep the lid near the hot water which makes it easier to open.
2) When the hot boiled egg is dropped in cold water, the egg shell can be removed easily.

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

When the lid of a glass bottle is tight, keep the lid near the hot water which makes it easier to open. It is because the lid has **higher thermal expansion than glass**. When the hot boiled egg is dropped in cold water, the **egg shell can be removed easil**y. It is because of the different thermal expansions of the shell and egg.

36. Eiffel tower is made up of iron and its height is roughly 300 m. During winter season (January) in France the temperature is 2°C and in hot summer its average temperature 25°C. Calculate the change in height of Eiffel tower between summer and winter.

a) 89 mm
b) 69 mm

c) 39 mm
d) 29 mm

Explanation

The linear thermal expansion coefficient for iron α = 10 ×10−6 per °C

Solution

$$\frac{\Delta L}{L_0} = \alpha_L \Delta T$$

$$\Delta L = \alpha_L L_0 \Delta T$$

$$\Delta L = 10 \times 10^{-6} \times 300 \times 23 = 0.069 \text{ m} = 69 \text{ mm}$$

37. Which of the following statement is correct?

1) Liquids expand on heating and contract on cooling at moderate temperatures.
2) water exhibits an anomalous behaviour

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Liquids expand on heating and contract on cooling at moderate temperatures. But water exhibits an anomalous behaviour.

38. Water contracts on heating between___ °C and __ °C

a) 4, 10
b) 0, 4
c) 2, 5
d) 3, 12

Explanation

Water contracts on heating between 0˚C and 4˚C. The volume of the given amount of water decreases as it is cooled from room temperature, until it reaches 4˚C.

39. Water has maximum density at_____ °C

a) 0

b) 2
c) 10
d) 4

Explanation

Below 4˚C the volume increases and so the density decreases. This means that the water has a **maximum density at 4˚C**. This behaviour of water is called anomalous expansion of water.

40. Match the following

I.	Melting	1. gas to liquid
II.	Sublimation	2. solid to liquid
III.	Condensation	3. solid to gas
IV.	Freezing	4. liquid to solid

a) 2, 1, 3, 4
b) 4, 1, 2, 3
c) 2, 3, 1, 4
d) 1, 2, 3, 4

Explanation

All matter exists normally in three states as solids, liquids or gases. Matter can be changed from one state to another either by heating or cooling.

1. Melting (solid to liquid) 2. Evaporation (liquid to gas) 3. Sublimation (solid to gas) 4. Freezing / Solidification (liquid to solid) 5. Condensation (gas to liquid)

41. Boiling point of water____ ^{0} C

a) 99
b) 100
c) 103
d) 90

Explanation

While boiling a pot of water, the temperature of the water increases until it reaches **100 ˚C which is the boiling point of water**, and then the temperature remains constant until all the water changes from liquid to gas.

42. ____of a substance is defined as the amount of heat energy required to change the state of a unit mass of the material

a) Specific heat capacity
b) Latent heat capacity
c) Thermal resistance
d) Specific heat

Explanation

Latent heat capacity of a substance is defined as the amount of heat energy required to change the state of a unit mass of the material.

43. The SI unit for Latent heat capacity is_____

a) J mol
b) J mol^{-1}
c) J kg^{-1}
d) J K^{-1}

Explanation

The temperature of water does not increase above its boiling point. This is the concept of latent heat capacity. The **SI unit for Latent heat capacity is J kg^{-1}.**

44. Match the following

I.	Latent heat for a solid - liquid state change	1. latent heat of sublimation
II.	Latent heat for a liquid - gas state change	2. latent heat of fusion
III.	Latent heat for a solid - gas state change	3. latent heat of vaporization

a) 2, 1, 3
b) 2, 3, 1
c) 1, 3, 2
d) 3, 1, 2

Explanation

• The latent heat for a solid - liquid state change is called the latent heat of fusion (Lf) • The latent heat for a liquid - gas state change is called the latent heat of vaporization (Lv) • The latent heat for a solid - gas state change is called the latent heat of sublimation (Ls).

45. The triple point of water is at_____ K

a) 273.1
b) 289.2
c) 223.1
d) 289.3

Explanation

Triple point of a substance is the temperature and pressure at which the three phases (gas, liquid and solid) of that substance coexist in thermodynamic equilibrium. The triple point of water is at 273.1 K and a partial vapour pressure of 611.657 Pascal.

46. _____ means the measurement of the amount of heat released or absorbed by thermodynamic system during the heating process.

a) Calorimetry
b) Manometry
c) Nemometry
d) Calsometry

Explanation

Calorimetry means the measurement of the amount of heat released or absorbed by thermodynamic system during the heating process. When a body at higher temperature is brought in contact with another body at lower temperature, the heat lost by the hot body is equal to the heat gained by the cold body.

47. Heat gained or lost is measured with a_____

a) Thermometer
b) Pulse-oximeter
c) Calorimeter
d) Nanometre

Explanation

Heat gained or lost is measured with a calorimeter. Usually, the calorimeter is an insulated container of water.

48. If 5 L of water at 50°C is mixed with 4L of water at 30°C, what will be the final temperature of water? Take the specific heat capacity of water as 4184 J kg^{-1} K^{-1}.

a) 100 ° C
b) 40 °C
c) 30 ° C
d) 70 °C

Explanation

We can use the equation

$$T_f = \frac{m_1 s_1 T_1 + m_2 s_2 T_2}{m_1 s_1 + m_2 s_2}$$

$m_1 = 5L = 5kg$ and $m_2 = 4L = 4kg$, $s_1 = s_2$
and $T_1 = 50°C = 323K$ and $T_2 = 30°C = 303$ K.

So

$$T_f = \frac{m_1 T_1 + m_2 T_2}{m_1 + m_2} = \frac{5 \times 323 + 4 \times 303}{5 + 4} = 314.11 \text{ K}$$

$T_f = 314.11$ K-273K ≈ 41°C.

Suppose if we mix equal amount of water ($m_1 = m_2$) with 50°C and 30°C, then the final temperature is average of two temperatures.

$$T_f = \frac{T_1 + T_2}{2} = \frac{323 + 303}{2} = 313K = 40°C$$

49. Final equilibrium temperature of mixing of gas or liquid depends on_____

1) Mass of the substance
2) Specific heat capacity
3) Temperature

a) 1, 2
b) 1, 3
c) 2, 3

d) All the above

Explanation

It is important to note that the **final equilibrium temperature of mixing of gas or liquid depends on mass of the substances, their specific heat capacities and their temperatures**. Only if we mix the same substances at equal amount, the final temperature will be an average of the individual temperatures.

50. How many modes of heat transfer are there?

a) 2
b) 3
c) 1
d) 4

Explanation

As we have seen already heat is a energy in transit which is transferred from one body to another body due to temperature difference. **There are three modes of heat transfer**: Conduction, Convection and Radiation.

51. ____ is the process of direct transfer of heat through matter due to temperature difference

a) Radiation
b) Conduction
c) Convection
d) All the above

Explanation

Conduction is the process of direct transfer of heat through matter due to temperature difference. When two objects are in direct contact with one another, heat will be transferred from the hotter object to the colder one. The objects which allow heat to travel easily through them are called conductors.

52. Which of the following statement is correct?

1) Thermal conductivity is the ability to conduct heat.
2) The quantity of heat transferred through a unit length of a material in a direction normal to unit surface area due to a unit temperature difference under steady state conditions

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Thermal conductivity is the ability to conduct heat. The **quantity of heat transferred through a unit length of a material in a direction normal to unit surface area due to a unit temperature difference** under steady state conditions is known as **thermal conductivity of a material.**

53. The SI unit of thermal conductivity is_____

a) $J\ s^{-1}\ m^{-1}$

b) J s-1 m K^{-1}
c) J s m K^{-1}
d) J s^{-1} m^{-1} K^{-1}

Explanation

In steady state, the rate of flow of heat Q is proportional to the temperature difference ΔT and the area of cross section A and is inversely proportional to the length L. The SI unit of thermal conductivity is **J s^{-1} m^{-1} K^{-1} or W m^{-1} K^{-1}**.

54. Match the thermal conductivity of the material

I.	Silver	1. 2
II.	Copper	2. 2300
III.	Diamond	3. 380
IV.	Ice	4. 420

a) 3, 1, 2, 4
b) 4, 3, 2, 1
c) 2, 1, 4, 3
d) 4, 2, 3, 1

Explanation

Material	Thermal Conductivity
Diamond	2300
Silver	420
Copper	380
Aluminum	200
Steel	40
Glass	0.84
Brick	0.84
Ice	2

55. Match the following

I.	Water	1. 0.042
II.	Air	2. 0.56
III.	Helium	3. 0.023
IV.	Cork	4. 0.152

a) 2, 1, 3, 4
b) 2, 3, 4, 1
c) 2, 1, 4, 3
d) 3, 2, 1, 4

Explanation

Material	Thermal Conductivity
Water	0.56
Human tissue	0.2
Wood	0.17
Helium	0.152
Cork	0.042
Air	0.023

56. Which of the following have high thermal conductivity?

a) Silver
b) Nickel
c) Aluminium
d) Both a and c

Explanation

Thermal conductivity depends on the nature of the material. For example, **silver and aluminium have high thermal conductivities**. So, they are used to make cooking vessels.

57. Convection is the process in which heat transfer is by actual movement of molecules in___

a) Solid
b) Liquid
c) Gas
d) Fluid

Explanation

Convection is the process in which heat transfer is by actual movement of molecules in fluids such as liquids and gases. In convection, molecules move freely from one place to another. It happens naturally or forcefully.

58. Which of the following statement is correct?

1) During the day, sun rays warm up the land more quickly than sea water
2) It is because water has less specific heat capacity than land

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

During the day, sun rays warm up the land more quickly than sea water. It is because land has less specific heat capacity than water. As a result, the air above the land becomes less dense and rises.

59. The cooler air above the sea flows to land and it is called____

a) Land breeze
b) Sea breeze
c) Both a and b
d) None

Explanation

During the day, sun rays warm up the land more quickly than sea water. It is because land has less specific heat capacity than water. As a result the air above the land becomes less dense and rises. At the same time the **cooler air above the sea flows to land and it is called 'sea breeze'**.

60. Which of the following statement is correct?

1) During the night time the land gets cooled faster than sea due to specific heat.
2) The air molecules above sea are warmer than air molecules above the land

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

During the night time the land gets cooled faster than sea due to the same reason (specific heat). The air molecules above sea are warmer than air molecules above the land. So, air molecules above the sea are replaced by cooler air molecules from the land. It is called 'land breeze'

61. Water at the bottom of the pot receives_____

a) Less heat
b) More heat
c) Medium heat
d) None

Explanation

Boiling water in a cooking pot is an example of convection. Water at the bottom of the pot receives more heat.

62. Due to heating, the water_____ and the density of water increases at the bottom

a) Expands, increases
b) Contracts, increases
c) Expands, decreases
d) Contracts, decreases

Explanation

Boiling water in a cooking pot is an example of convection. Water at the bottom of the pot receives more heat. Due to heating, the **water expands and the density of water decreases at the bottom**. Due to this decrease in density, molecules rise to the top.

63. Which of the following statement is correct?

1) When we keep our hands near the hot stove we feel the heat even though our hands are not touching the hot stove.

2) Heat transferred from the hot stove to our hands is in the form of radiation
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

When we keep our hands near the hot stove we feel the heat even though our hands are not touching the hot stove. Here heat transferred from the hot stove to our hands is in the form of radiation. We receive energy from the sun in the form of radiations.

64. Radiation is a form of energy transfer from one body to another by_____

a) Radio waves
b) Electromagnetic waves
c) Ultrasonic waves
d) Infrasonic waves

Explanation

The conduction or convection requires medium to transfer the heat. Radiation is a form of energy transfer from one body to another by electromagnetic waves.

65. Which of the following statement is correct?

1) The parameter temperature is generally thought to be associated with matter
2) The visible radiation coming from the Sun is at the temperature of 570 K
3) Earth re emits the radiation in the infrared range into space which is at a temperature of around 300K.
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

The parameter temperature is generally thought to be associated with matter (solid, liquid and gas). But radiation is also considered as a thermodynamic system which has well defined temperature and pressure. **The visible radiation coming from the Sun is at the temperature of 5700 K** and the Earth re emits the radiation in the infrared range into space which is at a temperature of around 300K.

66. Which of the following statement is correct?

1) Newton's law of cooling states that the rate of loss of heat of a body is directly proportional to the difference in the temperature between that body and its surroundings
2) Newton's law of cooling states that the rate of loss of heat of a body is indirectly proportional to the difference in the temperature between that body and its surroundings
    a) 1 alone
    b) 2 alone
    c) 1, 2

d) None

Explanation

Newton's law of cooling states that the rate of loss of heat of a body is directly proportional to the difference in the temperature between that body and its surroundings

$$\frac{dQ}{dt} \propto -(T - T_s)$$

67. Which of the following statement is correct?

1) Every object emits heat radiations at all finite temperatures (except 0 K) as well as it absorbs radiations from the surroundings
2) If you touch someone, they might feel your skin as either hot or cold is an example
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Every object emits heat radiations at all finite temperatures (except 0 K) as well as it absorbs radiations from the surroundings. For example, if you touch someone, they might feel your skin as either hot or cold.

68. A body at high temperature_____ to the surroundings

a) Radiates more heat
b) Absorbs more heat
c) Radiates less heat
d) Absorbs less heat

Explanation

A **body at high temperature radiates more heat to the surroundings than it receives** from it. Similarly, a body at a lower temperature receives more heat from the surroundings than it loses to it.

69. Which of the following statement is correct?

1) Prevost applied the idea of 'thermal equilibrium' to radiation
2) He suggested that all bodies radiate energy but hot bodies radiate more heat than the cooler bodies.
3) Only at absolute zero temperature a body will stop emitting
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

Prevost applied the idea of 'thermal equilibrium' to radiation. He suggested that all bodies radiate energy but hot bodies radiate more heat than the cooler bodies. At one point of time the rate of

exchange of heat from both the bodies will become the same. Now the bodies are said to be in 'thermal equilibrium'. Only at absolute zero temperature a body will stop emitting. Therefore, Prevost theory states that all bodies emit thermal radiation at all temperatures above absolute zero irrespective of the nature of the surroundings.

70. Which equation about Stefan Boltzmann law is correct?

a) $E \propto T^4$
b) $E \propto T^3$
c) $E \propto T^6$
d) $E \propto T^2$

Explanation

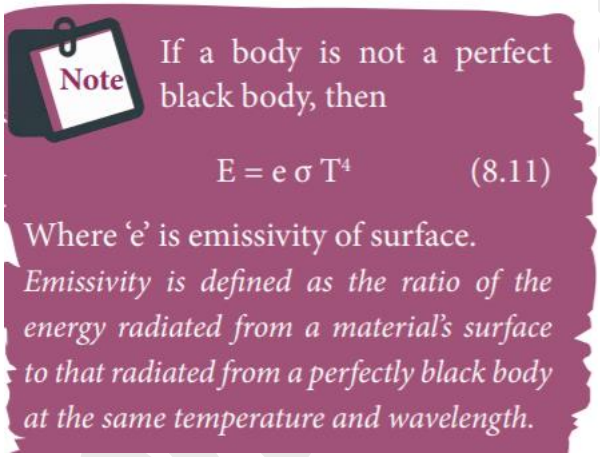
Stefan Boltzmann law states that, the total amount of heat radiated per second per unit area of a black body is directly proportional to the fourth power of its absolute temperature.

$E \propto T^4$ or $E = \sigma T^4$

71. E = e σ T4, e in the equation is_____

a) Emissivity
b) Energy
c) Electron
d) Emergence

Explanation



72. The wavelengths of radiations depend on the object's_____

a) Temperature
b) Absolute temperature
c) Mass
d) Gravitation

Explanation

In the universe every object emits radiation. The **wavelengths of these radiations depend on the object's absolute temperature**. These radiations have different wavelengths and all the emitted wavelengths will not have equal intensity.

73. Which of the following statement is correct?

1) Wien's law states that, the wavelength of maximum intensity of emission of a black body radiation is directly proportional to the absolute temperature of the black body
2) Wien's law states that, the wavelength of maximum intensity of emission of a black body radiation is inversely proportional to the absolute temperature of the black body
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Wien's law states that, the wavelength of maximum intensity of emission of a black body radiation is inversely proportional to the absolute temperature of the black body

$$\lambda_m \propto \frac{1}{T} (or) \lambda_m = \frac{b}{T}$$

74. Wien constant value is____

a) 2.898×10^{-7} m K
b) 2.898×10^{-2} m K
c) 2.898×10^{-5} m K
d) 2.898×10^{-3} m K

Explanation

$$\lambda_m \propto \frac{1}{T} (or) \lambda_m = \frac{b}{T}$$

Where, b is known as Wien's constant. Its value is 2.898×10^{-3} m K It implies that if temperature of the body increases, maximal intensity wavelength (λ m) shifts towards lower wavelength (higher frequency) of electromagnetic spectrum.

75. Which of the following statement is correct?

1) The Sun is approximately taken as a black body.
2) It is the wavelength at which maximum intensity is 508nm
3) Since the Sun's temperature is around 5700K, the spectrum of radiations emitted by Sun lie between 400 nm to 700 nm which is the visible part of the spectrum
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

The Sun is approximately taken as a black body. Since any object above 0 K will emit radiation, Sun also emits radiation. Its surface temperature is about 5700 K. It is the wavelength at which maximum intensity is 508nm. Since the **Sun's temperature is around 5700K**, the spectrum of radiations emitted by Sun lie between 400 nm to 700 nm which is the visible part of the spectrum.

76. Which of the following statement is correct?

1) The humans evolved under the Sun by receiving its radiations.
2) Suppose if humans had evolved in a planet near the star Sirius (9940K), then they would have had the ability to see the Ultraviolet rays
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

The humans evolved under the Sun by receiving its radiations. The human eye is sensitive only in the visible not in infrared or X-ray ranges in the spectrum. Suppose if humans had evolved in a planet near the star Sirius (9940K), then they would have had the ability to see the Ultraviolet rays.

77. _____ branch of physics deals with laws governing the process of conversion of work into heat and conversion of heat into work

a) Kinematics
b) Thermodynamics
c) Sonography
d) Kinetics

Explanation

Thermodynamics is a branch of physics which describes the laws governing the process of conversion of work into heat and conversion of heat into work.

78. Who among the following formulated laws of thermodynamics?

1) Boyle
2) Charles
3) Kelvin
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

The laws of thermodynamics are formulated over three centuries of experimental works of Boyle, Charles, Bernoulli, Joule, Clausius, Kelvin, Carnot and Helmholtz. In our day to day life, the functioning of everything around us and even our body is governed by the laws of thermodynamics.

79. Which of the following parameters can be used to specify thermodynamics?

1) Volume
2) Temperature
3) Pressure
    a) 1, 2
    b) 1, 3

c) 2, 3
d) All the above

Explanation

A thermodynamic system is a finite part of the universe. It is a collection of large number of particles (atoms and molecules) specified by certain parameters called **pressure (P), Volume (V) and Temperature (T)**. The remaining part of the universe is called surrounding. Both are separated by a boundary.

80. Which of the following are thermodynamic system?

1) Bucket of water
2) Sea of water
3) Human body

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

Thermodynamic system	Surrounding
Bucket of water	Open atmosphere
Air molecules in the room	Outside air
Human body	Open atmosphere
Fish in the sea	Sea of water

81. Which of the following statement is correct?

1) Open system can exchange both matter and energy with the environment
2) Isolated system can exchange neither energy nor matter with the environment

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Open system can exchange both matter and energy with the environment. Closed system exchange energy but not matter with the environment. Isolated system can exchange neither energy nor matter with the environment.

82. When a hot cup of coffee is kept in the room, heat flows from_____

a) Coffee to air
b) Air to coffee

c) Wise-versa
d) None

Explanation

When a hot cup of coffee is kept in the room, heat flows from coffee to the surrounding air. After sometime the coffee reaches the same temperature as the surrounding air and there will be no heat flow from coffee to air or air to coffee. It implies that the coffee and surrounding air are in thermal equilibrium with each other.

83. Two systems are said to be in thermal equilibrium with each other if they are at____ temperature

a) Different
b) Same
c) Slightly different
d) None

Explanation

Two systems are said to be in thermal equilibrium with each other if they are at the same temperature, which will not change with time.

84. Which of the following statement is correct?

1) A system is said to be in mechanical equilibrium if no unbalanced force acts on the thermo dynamic system or on the surrounding by thermodynamic system
2) When some mass is placed on the piston where filled with gas, it will move downward due to downward gravitational force and after certain humps and jumps the piston will come to rest at a new position
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Consider a gas container with piston as shown in Figure 8.17. When some mass is placed on the piston, it will move downward due to downward gravitational force and after certain humps and jumps the piston will come to rest at a new position. When the downward gravitational force given by the piston is balanced by the upward force exerted by the gas, the system is said to be in mechanical equilibrium. A system is said to be in mechanical equilibrium if no unbalanced force acts on the thermo dynamic system or on the surrounding by thermodynamic system.

85. If two systems are set to be in thermodynamic equilibrium, then the systems are at____

Equilibrium

a) Thermal
b) Mechanical
c) Chemical
d) All the above

Explanation

If two systems are set to be in thermodynamic equilibrium, then the systems are at thermal, mechanical and chemical equilibrium with each other. In a state of thermo-dynamic equilibrium the macroscopic variables such as pressure, volume and temperature will have fixed values and do not change with time.

86. In mechanics, which of the following are used to explain the state of any moving object?

1) Velocity
2) Mass
3) Momentum
4) Acceleration

a) 1, 2, 3
b) 1, 3, 4
c) 2, 3, 4
d) 1, 2, 4

Explanation

In mechanics velocity, momentum and acceleration are used to explain the state of any moving object. If there is no net chemical reaction between two thermodynamic systems in contact with each other then it is said to be in chemical equilibrium.

87. Which of the following are thermodynamic variables?

a) Pressure
b) Volume
c) Internal energy
d) All the above

Explanation

In thermodynamics, the state of a thermodynamic system is represented by a set of variables called thermodynamic variables. Examples: **Pressure, temperature, volume and internal energy,** etc.

88. Which of the following are process variables in thermodynamics?

1) Work
2) Pressure
3) Heat

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

The values of these variables completely describe the equilibrium state of a thermodynamic system. Heat and work are not state variables rather they are process variables.

89. Which of the following statement is correct?

1) Extensive variable depends on the size or mass of the system
2) Temperature and pressure are examples of extensive variable

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Extensive variable depends on the size or mass of the system. Example: Volume, total mass, entropy, internal energy, heat capacity etc.

90. Which of the following statement is correct?

1) Intensive variables depend on the size or mass of the system.
2) Example are Temperature, pressure, specific heat capacity, density etc.
   a) 1 alone
   b) 2 alone
   c) 1, 2
   d) None

Explanation

Intensive variables do not depend on the size or mass of the system. Example: Temperature, pressure, specific heat capacity, density etc.

91. Which of the following statement is correct?

1) The equation which connects the state variables in a specific manner is called equation of state
2) A thermodynamic equilibrium is completely specified by pressure, volume, temperature state variables by the equation of state
   a) 1 alone
   b) 2 alone
   c) 1, 2
   d) None

Explanation

The equation which connects the state variables in a specific manner is called equation of state. A **thermodynamic equilibrium is completely specified by pressure, volume, temperature state variables by the equation of state**. If the system is not in thermodynamic equilibrium, then these equations cannot specify the state of the system.

92. Which of the following statement is correct?

1) An ideal gas obeys the equation PV = NkT at thermodynamic equilibrium.
2) Since all four macroscopic variables (P, V, T and N) are connected by this equation, we cannot change one variable alone
   a) 1 alone
   b) 2 alone
   c) 1, 2
   d) None

Explanation

An ideal gas obeys the equation PV = NkT at thermodynamic equilibrium. Since all four macroscopic variables (P, V, T and N) are connected by this equation, we cannot change one variable alone. For example, if we push the piston of a gas container, the volume of the gas will decrease but pressure will increase or if heat is supplied to the gas, its temperature will increase, pressure and volume of the gas may also increase.

93. Which of the following statement is correct?

1) There is another example of equation of state called van der Waals equation.
2) The air molecules in the room truly obey van der Waals equation of state.
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

There is another example of equation of state called van der Waals equation. Real gases obey this equation at thermodynamic equilibrium. The air molecules in the room truly obey van der Waals equation of state. But at room temperature with low density we can approximate it into an ideal gas.

94. Which of the following statement is incorrect?

1) The zeroth law of thermodynamics states thermal equilibrium between systems
2) It states that if two systems, A and B, are in thermal equilibrium with a third system, C, then A and B are in thermal equilibrium with each other
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

The zeroth law of thermodynamics states that if two systems, A and B, are in thermal equilibrium with a third system, C, then A and B are in thermal equilibrium with each other.

95.____ is the property which determines whether the system is in thermal equilibrium with other systems or not.

a) Temperature
b) Pressure
c) Volume
d) None

Explanation

Temperature is the **property which determines whether the system is in thermal equilibrium with other systems or not**. Zeroth law enables us to determine the temperature.

96. _____ principle is used in finding the body temperature

a) Zeroth law of thermodynamics
b) Newtons 1st law

c) Newtons 3rd law
d) None

Explanation

Zeroth law enables us to determine the temperature. For example, when a thermometer is kept in contact with a human body, it reaches thermal equilibrium with the body. At this condition, the temperature of the thermometer will be same as the human body. This principle is used in finding the body temperature.

97. The internal energy of a thermodynamic system is_____

a) Kinetic energy alone
b) Potential energy of all the molecules
c) Both a and b
d) None

Explanation

The internal energy of a thermodynamic system is the sum of kinetic and potential energies of all the molecules of the system with respect to the centre of mass of the system.

98. The energy due to molecular interaction is called_____

a) Internal potential energy
b) Internal kinetic energy
c) External potential energy
d) External kinetic energy

Explanation

The energy due to molecular interaction is called **internal potential energy (EP**). Example: Bond energy.

99. Which of the following are included in internal kinetic energy?

1) Rotational motion
2) Translational motion
3) Vibrational motion

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

The energy due to molecular motion including **translational, rotational and vibrational motion is called internal kinetic energy** (E_K).

100. Which of the following statement is correct?

1) Internal energy is a state variable
2) It depends only on the initial state of the thermodynamic system

a) 1 alone
b) 2 alone

c) 1, 2
d) None

Explanation

Internal energy is a state variable. It **depends only on the initial and final states of the thermodynamic** system. For example, if the temperature of water is raised from 30°C to 40°C either by heating or by stirring, the final internal energy depends only on the final temperature 40°C and not the way it is arrived at.

101. Which of the following statement is incorrect?

1) It is very important to note that the internal energy of a thermodynamic system is associated with only the kinetic energy of the individual molecule
2) The bulk kinetic energy of the entire system or gravitational potential energy of the system should not be mistaken as a part of internal energy
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

It is very important to note that the internal energy of a thermodynamic system is associated with only the kinetic energy of the individual molecule due to its random motion and the potential energy of molecules which depends on their chemical nature. The bulk kinetic energy of the entire system or gravitational potential energy of the system should not be mistaken as a part of internal energy.

102. Which of the following statement is correct?

1) It is to be noted that heat does not always increases the internal energy
2) We can see that in ideal gases during isothermal process the internal energy will increase
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

It is to be noted that heat does not always increases the internal energy. Later we shall see that in ideal gases during isothermal process the internal energy will not increase even though heat flows in to the system.

103. Which of the following statement is correct?

1) The temperature of an object can be increased by heating it or by doing some work on it.
2) Due to the turning of wheel inside water, frictional force comes in between the water and the paddle wheel.
3) Friction will increase the heat
    a) 1, 2
    b) 1, 3

c) 2, 3
d) All the above

Explanation

The temperature of an object can be increased by heating it or by doing some work on it. In the eighteenth century, James Prescott Joule showed that mechanical energy can be converted into internal energy and vice versa. In his experiment, two masses were attached with a rope and a paddle wheel as shown in Figure 8.19. When these masses fall through a distance h due to gravity, both the masses lose potential energy equal to 2mgh. When the masses fall, the paddle wheel turns. Due to the turning of wheel inside water, frictional force comes in between the water and the paddle wheel. This causes a rise in temperature of the water.

104. 1 Cal =_____

a) 4.186 J
b) 5.12 J
c) 3.26 J
d) 2.33 J

Explanation

In fact, Joule was able to show that the mechanical work has the same effect as giving heat. He found that to raise 1 g of an object by 1°C, 4.186 J of energy is required. In earlier days the heat was measured in calorie**. 1 Cal = 4.186 J**

105. A student had a breakfast of 200 food calories. He thinks of burning this energy by drawing water from the well and watering the trees in his school. Depth of the well is about 25 m. The pot can hold 25L of water and each tree requires one pot of water. How many trees can he water?

a) 6250 J
b) 6650 J
c) 3350 J
d) 2235 J

Explanation

Solution

To draw 25 L of water from the well, the student has to do work against gravity by burning his energy.

Mass of the water = 25 L = 25 kg (1L=1kg)

The work required to draw 25 kg of water = gravitational potential energy gained by water.

$W = mgh = 25 \times 10 \times 25 = 6250\ J$

106. The first law of thermodynamics is a statement of_____

a) Law of conservation of mass
b) Law of conservation of weight
c) Law of conservation of Energy
d) Law of conservation of pressure

Explanation

The **first law of thermodynamics is a statement of the law of conservation of energy**. In Newtonian mechanics conservation of energy involves kinetic and potential energies of bulk objects.

107. Match the following

I.	Heat flows into the system	1. W is positive
II.	Heat flows out of the system	2. W is negative
III.	Work done on the system	3. Internal energy increases
IV.	Work done by the system	4. Internal energy decreases

a) 2, 1, 4, 3
b) 3, 4, 2, 1
c) 3, 1, 2, 4
d) 2, 1, 3, 4

Explanation

Heat flows into the system	Internal energy increases
Heat flows out of the system	Internal energy decreases
Work is done on the system	Internal energy increases
Work is done by the system	Internal energy decreases

System gains heat	Q is positive
System loses heat	Q is negative
Work done on the system	W is negative
Work done by the system	W is positive

108. 1st law of thermodynamics is applicable to____

a) Solid
b) Liquid
c) Gas
d) Universal

Explanation

Even though we often explain first law of thermodynamics using gases, this law is universal and applies to liquids and solids also.

109. A person does 30 kJ work on 2 kg of water by stirring using a paddle wheel. While stirring, around 5 kcal of heat is released from water through its container to the surface and surroundings by thermal conduction and radiation. What is the change in internal energy of the system?

a) 9080 J
b) 8090 J
c) 1010 J
d) 1000 J

Explanation

Work done on the system (by the person while stirring), W = -30 kJ = −30,000J
Heat flowing out of the system, Q = −5 kcal = −5 × 4184 *J* =−20920 *J*
Using First law of thermodynamics

$$\Delta U = Q - W$$
$$\Delta U = -20{,}920\ J - (-30{,}000)\ J$$
$$\Delta U = -20{,}920\ J + 30{,}000\ J = 9080\ J$$

Here, the heat lost is less than the work done on the system, so the change in internal energy is positive.

110. Jogging every day is good for health. Assume that when you jog a work of 500 kJ is done and 230 kJ of heat is given off. What is the change in internal energy of your body?

a) – 730 kJ
b) – 630 kJ
c) – 530 kJ
d) – 430 kJ

Explanation

Work done by the system (body),
W = +500 kJ
Heat released from the system (body),
Q = –230 kJ
The change in internal energy of a body
= ΔU= – 230 *kJ* – 500 *kJ* = – 730 *kJ*

111. A gas expands from volume 1m^3 to 2m^3 at constant atmospheric pressure. Calculate the work

done by the gas. (kJ)

a) 101
b) 120
c) 230
d) 111

Explanation

Solution

(a) The pressure P = 1 atm = 101 kPa, $V_f = 2\ m^3$ and $V_i = 1 m^3$

From equation (8.17)

$$W = \int_{V_i}^{V_f} PdV = P\int_{V_i}^{V_f} dV$$

Since P is constant. It is taken out of the integral.

$$W = P(V_f - V_i) = 101\times10^3 \times (2-1) = 101\ kJ$$

112. Which of the following has two specific heat capacity?

a) Solid
b) Liquid
c) **Gas**
d) All the above

Explanation

Specific heat capacity of a given system plays a very important role in determining the structure and molecular nature of the system. **Unlike solids and liquids, gases have two specific heats**: specific heat capacity at constant pressure (s_p) and specific heat capacity at constant volume (s_v).

113. Which of the following statement is correct?

1) The amount of heat energy required to raise the temperature of one kg of a substance by 1 K or 1°C by keeping the pressure constant is called specific heat capacity at constant pressure
2) When the heat energy is supplied to the gas, it contracts to keep the pressure constant

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

The amount of heat energy required to raise the temperature of one kg of a substance by 1 K or 1°C by keeping the pressure constant is called specific heat capacity of at constant pressure**. When the heat energy is supplied to the gas, it expands to keep the pressure constant.**

114. What work does the heat energy do when gas is heated under constant pressure?

1) Expansion of gas
2) Increase external energy of gas

3) Increase internal energy of gas
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

In this process of heating gas under constant pressure, a part of the **heat energy is used for doing work (expansion)** and the **remaining part is used to increase the internal energy of the gas**.

115. The amount of heat required to raise the temperature of one mole of a substance by 1K or 1°C at constant volume is called_____ at constant pressure

a) Molar heat capacity
b) Specific heat capacity
c) Molar Specific heat capacity
d) None

Explanation

Sometimes it is useful to calculate the molar heat capacities Cp and C_v. The amount of heat required to raise the temperature of one mole of a substance by 1K or 1°C at constant volume is called **molar specific heat capacity at constant volume** (C_v). If pressure is kept constant, it is called molar specific heat capacity at constant pressure (C_p).

116. Which of the following statement about Meyer's relation is correct?

1) It implies that the molar specific heat capacity of an ideal gas at constant pressure is greater than molar specific heat capacity at constant volume.
2) It implies that the molar specific heat capacity of an ideal gas at constant pressure is lesser than molar specific heat capacity at constant volume.
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

Meyer's relation implies that the molar specific heat capacity of an ideal gas at constant pressure is **greater than molar specific heat capacity at constant volume**.

117. Which of the following is constant is Isothermal process?

a) Temperature
b) Pressure
c) Volume
d) All the above

Explanation

Isothermal process is a process in which the temperature remains constant but the pressure and volume of a thermodynamic system will change.

118. All biological processes occur at constant body temperature of____ °C

a) 30
b) 27
c) 37
d) 35

Explanation

When water is heated, at the boiling point, even when heat flows to water, the temperature will not increase unless the water completely evaporates. Similarly, at the freezing point, when the ice melts to water, the temperature of ice will not increase even when heat is supplied to ice. All biological processes occur at **constant body temperature (37°C).**

119. To calculate the work done in an isothermal process, we assume that the process is_____

a) Dynamic
b) Static
c) Quasi Static
d) None

Explanation

To calculate the work done in an isothermal process, we assume that the process is quasi-static. If it is not quasi-static, we cannot substitute P = μRT/V in equation.

120. A 0.5 mole of gas at temperature 300 K expands isothermally from initial volume of 2 L to 6 L. What is the work done by the gas?

a) 3. 39 kJ
b) 1.369 kJ
c) 1.639 kJ
d) 2.23 kJ

Explanation

We know that work done by the gas in an isothermal expansion

Since $\mu = 0.5$

$$W = 0.5mol \times \frac{8.31J}{mol.K} \times 300\ K \ln\left(\frac{6L}{2L}\right)$$

$$W = 1.369\ kJ$$

121. A 0.5 mole of gas at temperature 300 K expands isothermally from an initial volume of 2 L to 6 L What is the final pressure of the gas? (The value of gas constant, R = 8.31 J mol^{-1} K^{-1})

a) 210 k Pa
b) 207.75 k Pa
c) 220 k Pa
d) 120 k Pa

Explanation

(c) For an isothermal process

$$P_i V_i = P_f V_f = \mu RT$$

$$P_f = \frac{\mu RT}{V_f} = 0.5\text{mol} \times \frac{8.31J}{mol.\text{K}} \times \frac{300K}{6\times10^{-3}m^3}$$

$$=207.75\ k\,Pa$$

122. In which process no heat flows into or out of the system?

a) Adiabatic process
b) Abiastalic process
c) Isothermal process
d) Isomatic process

Explanation

Adiabatic process is a process in which no heat flows into or out of the system (Q=0). Where Q value will be Zero in the system.

123. Which of the following may change in adiabatic process?

1) Volume
2) Pressure
3) Temperature

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

In an Adiabatic process, the gas can expand by spending its internal energy or gas can be compressed through some external work. So, the **pressure, volume and temperature of the** system **may change in an adiabatic process**.

124. For an adiabatic process, the first law becomes_____

a) ΔU = 0
b) ΔU = −W
c) ΔU = W
d) ΔU = ΔV

Explanation

For an adiabatic process, the first law becomes ΔU = −W. This implies that the work is done by the gas at the expense of internal energy or work is done on the system which increases its internal energy.

125. When the warm air rises from the surface of the Earth, it_____

a) Expands
b) Contracts

c) Adiabatically expands
d) Adiabatically Contracts

Explanation

When the warm air rises from the surface of the Earth, it adiabatically expands. As a result, the water vapor cools and condenses into water droplets forming a cloud.

126. Which of the following statement is correct?

1) When the piston is compressed so quickly that there is no time to exchange heat to the surrounding, the temperature of the gas increases rapidly
2) This principle is used in the petrol engine
3) The air-gasoline mixer is compressed so quickly (adiabatic compression) that the temperature increases enormously, which is enough to produce a spark

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

When the piston is compressed so quickly that there is no time to exchange heat to the surrounding, the temperature of the gas increases rapidly. This is shown in the figure. **This principle is used in the diesel engine.** The air-gasoline mixer is compressed so quickly (adiabatic compression) that the temperature increases enormously, which is enough to produce a spark.

127. Which of the following is constant in Isobaric process?

a) Temperature
b) Pressure
c) Internal energy
d) Volume

Explanation

I**sobaric process is a thermodynamic process that occurs at constant pressure**. Even though pressure is constant in this process, temperature, volume and internal energy are not constant.

128. Most of the cooking processes in our kitchen are_____ process

a) Isothermal
b) Isobaric
c) Adiabatic
d) None

Explanation

Most of the cooking processes in our kitchen are isobaric processes. **When the food is cooked in an open vessel, the pressure above the food is always at atmospheric pressure**.

129. Which of the following is constant in Isochoric process?

a) Temperature
b) Pressure

c) Internal energy
d) Volume

Explanation

Isochoric process is a thermodynamic process in which the volume of the system is kept constant. But pressure, temperature and internal energy continue to be variables.

130. How many processes does petrol engine undergo?

a) 3
b) 5
c) 4
d) 2

Explanation

In **automobiles the petrol engine undergoes four processes**. First the piston is adiabatically compressed to some volume as shown. In the second process, the volume of the air-fuel mixture is kept constant and heat is being added. As a result, the temperature and pressure are increased. This is an isochoric process. For a third stroke there will be an adiabatic expansion, and fourth stroke again isochoric process by keeping the piston immoveable.

131. 500 g of water is heated from 30°C to 60°C. Ignoring the slight expansion of water, calculate the change in internal energy of the water? (specific heat of water 4184 J/kg.K).

a) 62.76 kJ
b) 162.76 kJ
c) 262.76 kJ
d) 362.76 kJ

Explanation

When the water is heated from 30°C to 60°C,there is only a slight change in its volume. So we can treat this process as isochoric. In an isochoric process the work done by the system is zero. The given heat supplied is used to increase only the internal energy.

$$\Delta U = Q = ms_v \Delta T$$

The mass of water = 500 g =0.5 kg

The change in temperature = 30K

The heat $Q = 0.5 \times 4184 \times 30 = 62.76\ kJ$

132. Which of the following statement is correct?

1) When a hot object is in contact with a cold object, heat always flows from the hot object to cold object
2) Heat does not flow in reverse direction
3) In nature the direction of heat flow is always from higher temperature to lower temperature.
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

When a hot object is in contact with a cold object, heat always flows from the hot object to cold object but not in the reverse direction. According to first law, it is possible for the energy to flow from hot object to cold object or from cold object to hot object. But in nature the direction of heat flow is always from higher temperature to lower temperature.

133. When brakes are applied, work done against friction is converted into_____

a) Motion
b) Heat
c) Pressure
d) Cold

Explanation

When brakes are applied, a car stops due to friction and the work done against friction is converted into heat. But this heat is not reconverted to the kinetic energy of the car. So the first law is not sufficient to explain many of natural phenomena.

134. Which of the following are the conditions for reversible process?

1) The process should proceed at an extremely slow rate
2) The system should remain in mechanical, thermal and chemical equilibrium state at all the times with the surroundings, during the process.
3) No dissipative forces such as friction, viscosity, electrical resistance should be present
    a) 1, 2
    b) 1, 3
    c) 2, 3
    d) All the above

Explanation

A quasi–static isothermal expansion of gas, slow compression and expansion of a spring.

Conditions for reversible process:

1. The **process should proceed at an extremely slow rate**.

2. The system should remain in mechanical, thermal and chemical equilibrium state at all the times with the surroundings, during the process.

3. No dissipative forces such as friction, viscosity, electrical resistance should be present.

135. Which of the following statement is correct?

1) All-natural processes are irreversible.
2) Irreversible process can be plotted in a PV diagram
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

All-natural processes are irreversible. Irreversible process cannot be plotted in a PV diagram, because these processes cannot have unique values of pressure, temperature at every stage of the process.

136. Which of the following statement is correct?

1) In the modern technological world, the role of automobile engines plays a vital role in for transportation.
2) In motor bikes and cars there are engines which take in petrol or diesel as input, and do work by rotating wheels
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation

In the modern technological world, the role of automobile engines plays a vital role in for transportation. In motor bikes and cars there are engines which take in petrol or diesel as input, and do work by rotating wheels.

137. Most of these automobile engines have efficiency not greater than____ %

a) 30
b) 50
c) 40
d) 90

Explanation

Most of these automobile engines have efficiency not greater than 40%. The second law of thermodynamics puts a fundamental restriction on efficiency of engines. Therefore, understanding heat engines is very important.

138. _____ is defined as a thermodynamic system which has very large heat capacity

a) Water tank
b) Reservoir
c) Hot water in tumbler
d) All the above

Explanation

Reservoir is defined as a thermodynamic system which has very large heat capacity. By taking in heat from reservoir or giving heat to reservoir, the reservoir's temperature does not change.

139. How many parts are there in heat engine?

a) 3
b) 4
c) 2
d) 5

Explanation

Heat engine is a device which takes heat as input and converts this heat in to work by undergoing a cyclic process. A heat engine has three parts: (a) Hot reservoir (b) Working substance (c) Cold reservoir.

140. Which of the following statement is correct?

1) The heat engine works in a cyclic process.
2) After a cyclic process it returns to the same state
3) The change in the internal energy of the heat engine is infinity

a) 1, 2
b) 1, 3
c) 2, 3
d) All the above

Explanation

The heat engine works in a cyclic process. After a cyclic process it returns to the same state. Since the **heat engine returns to the same state after it ejects heat, the change in the internal energy of the heat engine is zero**

141. Which of the following statement about Kelvin Planck statement is correct?

1) It is impossible to construct a heat engine that operates in a cycle, whose sole effect is to convert the heat completely into work
2) This implies that no heat engine in the universe can have 100% efficiency.

a) 1 alone
b) 2 alone
c) 1, 2
d) None

Explanation

Kelvin-Planck statement:

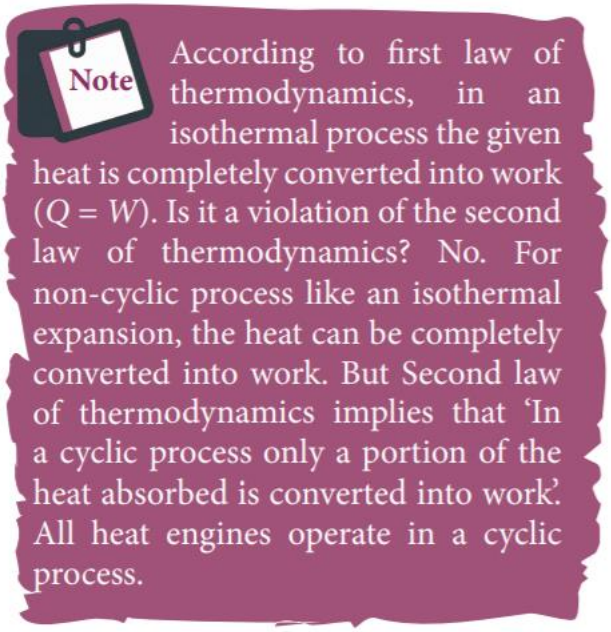
It is impossible to construct a heat engine that operates in a cycle, whose sole effect is to convert the heat completely into work. This implies that no heat engine in the universe can have 100% efficiency.

142. Which of the following statement is correct?

1) According to first law of thermodynamics, in an isothermal process the given heat is completely converted into work

2) For non-cyclic process like an isothermal expansion, the heat can be completely converted into work.
    a) 1 alone
    b) 2 alone
    c) 1, 2
    d) None

Explanation



143. During a cyclic process, a heat engine absorbs 500 J of heat from a hot reservoir, does work and ejects an amount of heat 300 J into the surroundings (cold reservoir). Calculate the efficiency of the heat engine?

a) 0.4
b) 0.6
c) 0.9
d) 0.7

Explanation

Solution

The efficiency of heat engine is given by

$$\eta = 1 - \frac{Q_L}{Q_H}$$

$$\eta = 1 - \frac{300}{500} = 1 - \frac{3}{5}$$

$$\eta = 1 - 0.6 = 0.4$$

The heat engine has 40% efficiency, implying that this heat engine converts only 40% of the input heat into work.

144. Who proved that a certain reversible engine operated in cycle between hot and cold reservoir can have maximum efficiency?

a) **James Carnot**
b) James Princep
c) James Krikup
d) James Cameron

Explanation

In the year 1824 a young French engineer Sadi Carnot proved that a certain reversible engine operated in cycle between hot and cold reservoir can have maximum efficiency. This engine is called Carnot engine.

145. A steam engine boiler is maintained at 250°C and water is converted into steam. This steam is used to do work and heat is ejected to the surrounding air at temperature 300K. Calculate the maximum efficiency it can have?

a) 0.3
b) 0.23
c) **0.43**
d) 0.65

Explanation

Solution

The steam engine is not a Carnot engine, because all the process involved in the steam engine are not perfectly reversible. But we can calculate the maximum possible efficiency of the steam engine by considering it as a Carnot engine.

$$\eta = 1 - \frac{T_L}{T_H} = 1 - \frac{300\,K}{523\,K} = 0.43$$

The steam engine can have maximum possible 43% of efficiency, implying this steam engine can convert 43% of input heat into useful work and remaining 57% is ejected as heat. In practice the efficiency is even less than 43%.

146. There are two Carnot engines A and B operating in two different temperature regions. For Engine A the temperatures of the two reservoirs are 150°C and 100°C. For engine B the temperatures of the reservoirs are 350°C and 300°C. What is engine A efficiency?

a) 0.11
b) 0.43
c) 0.23
d) 0.34

Explanation

Solution

The efficiency for engine A = $1 - \frac{373}{423}$ = 0.11. Engine A has 11% efficiency

The efficiency for engine B = $1 - \frac{573}{623} = 0.08$

Engine B has only 8% efficiency.

147. Which of the following statement is correct?

1) Diesel engines used in cars and petrol engines used in our motor bikes are all real heat engines
2) The efficiency of diesel engines has maximum up to 44% and the efficiency of petrol engines are maximum up to 30%.
    a) 1 alone
    b) 2 alone
    c) 1, 2

d) None

Explanation

Diesel engines used in cars and petrol engines used in our motor bikes are all real heat engines. The efficiency of diesel engines has maximum up to 44% and the efficiency of petrol engines are maximum up to 30%. Since these engines are not ideal heat engines (Carnot engine), their efficiency is limited by the second law of thermodynamics.

148. _____ is also called 'measure of disorder'.

a) Entropy
b) Enthalpy
c) Endom
d) None

Explanation

Entropy is also called **'measure of disorder'**. All- natural process occurs such that the disorder should always increases.

149. A refrigerator has COP of 3. How much work must be supplied to the refrigerator in order to remove 200 J of heat from its interion?

a) 66.67 J
b) 66.67 kJ
c) 56.67 J
d) 56. 67 kJ

Explanation

A refrigerator has COP of 3. How much work must be supplied to the refrigerator in order to remove 200 J of heat from its interion?

$$\text{COP} = \beta = \frac{Q_L}{W}$$

$$W = \frac{Q_L}{COP} = \frac{200}{3} = 66.67J$$

150. Top of the atmosphere is at___ °C and bottom of the atmosphere is at__ °C

a) -19, 14
b) 19, 14
c) 19, -14
d) -19, -14

Explanation

The presence of atmosphere in the earth plays very important role in human lives. **Top of the atmosphere is at -19°C and bottom of the atmosphere is at +14°C.** The increase in 33°C from top to

bottom is due to some gases present in the atmosphere. These gases are called Greenhouse gases and this effect is called Greenhouse effect.

151. Which of the following are green-house gases?

a) Ne
b) He
c) CO_2
d) All the above

Explanation

The greenhouse gases are mainly CO_2, water vapour, Ne, He, NO_2, CH4, Xe, Kr, ozone and NH_3. Except CO_2 and water vapor, all others are present only in very small amount in the atmosphere.

152. CO2 and other gases in the atmosphere trap____ radiation, keeping the earth warm.

a) UV
b) IR
c) X- ray
d) All the above

Explanation