PHYSICS

BOOKS - SURA PHYSICS (TAMIL ENGLISH)

HEAT AND THERMODYNAMICS

Exercise Questions Multiple Choice Question

1. In hot summer after a both the body 's

A. internal energy decreases

B. internal energy increase

C. heat decreases

D. no change in internal energy and heat

Answer: A

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2. The graph between volume and temperature in Charles'law is

A. an ellipse

B. a circle

C. a straight line

D. a parabola

Answer: C

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3. For hydrogen gas $C_p - C_v = a$ and for oxygen gas $C_p - C_v = b$. The relation between a and b is

A. a = 4b

B. a = b

C. a = 16b

D. a = 8b

Answer: b

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4. An ideal gas passes from one equllibrium state (P_1, V_1, T_1, N) to anoter equilibrium state $(2P_1, 3V_1, T_2, N)$ Then

A. $T_1 = T$

B. $T_1 = \frac{T_2}{6}$

C. $T_1 = 6T_2$

D. $T_1 = 3T_2$

Answer: B

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5. When a unifrom rod is heated which of the following quantity of the rod will increase

A. mass

B. weight

C. center of mass

D. moment of inertia

Answer: D

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6. The change in internal energy when a gas is cooled from $927^{\circ}C$ to $27^{\circ}C$ is

A. $200\ \%$

B. $100\ \%$

C. $300\ \%$

D. $400\ \%$

Answer: c

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7. When you exercise in the morning by considering your body as thermodynamic system which of following is true ?

A. $\Delta U > 0, W > 0$

B. $\Delta u < 0, W > 0$

C. $\Delta u < 0, W < 0$

D. $\Delta U = 0, W > 0$

Answer: B

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8. A hot cup of coffee is kept on the table , After some time is attains a thernal equilibrium with the surrounding By

considering the air molecules in the room as a thermodynamic system which of the following is true

A. $\Delta U > , Q = 0$

B. $\Delta U > 0, W < 0$

C. $\Delta U > 0, Q > 0$

D. $\Delta = 0, Q > 0$

Answer: C

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9. Each molecule of a gas has f degrees of freedom. The ratio $\left(\frac{C_p}{C_v}\right) = \gamma$ for the gas is

A. $1 + (f/2)$

B. $1 + (1/f)$

C. $1 + (2/f)$

D. $1 + \{(f-1)/3\}$

Answer: c

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10. A distant star emits radiation with maximum intensity at 350 nm. The temperature of the star is

A. 8280 k

B. 5000k

C. 7260 k

D. 9044 k

Answer: A

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11. identify the state variables given here ?

A. Q, T , W

B. P, T , U

C. Q , W

D. P, T ,Q

Answer: B

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12. In an isochoric process we have

A. $W = 0$

B. Q = 0

C. $\Delta U = 0$

D. $\Delta T = 0$

Answer: A

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13. The efficiency of a heat engine working between the freezing point and boiling point of water is

A. 0.0625

B. 0.2

C. 26. 8%

D. 12. 5%

Answer: C

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14. An Ideal refrigerator has a freezer at temperature $-12^{\circ}C$. The coefficient of performance of the engine is 5. The temperature of the air (to which the heat ejected) is

A. $50^{\circ}C$

B. $45.2^{\circ}C$

C. $40.2^{\circ}C$

D. $37.5^{\circ}C$

Answer:

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Ii Short Answer Question S

1. An object contains more heat -Is it a right statement ? If not why ?

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2. The wavelength of maximum intensity of radiation emitted by a star is 289.8nm. The

radiation intensity for the star is

(Stefan's constant = $5.67 \times 10^{-8} Wm^{-2} K^{-4}$,

constant b = $2898 \mu mK$).

A. 5.67×10^{8} W/m^2

B. 5.67×10^{12} W/m^2

C. 10.67×10^{7} W/m^2

D. 10.67×10^{14} W/m^2

Answer: A

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3. Define one mole.

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4. What do you mean by open, closed and isolated systems ? Give an example for each system.

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5. Define molar specific heat capacity .

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6. What is thermal expansion ?

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7. Give the expressions for linear, area and volume thermal expansions.

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8. Define latent heat capacity . Give its unit

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9. State Stefan-Boltzmann law.

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10. What is Wien's law ?

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11. The unit of thermal conductivity is

A. $Wm^{-1}K^{-1}$

B. JmK^{-1}

C. $Jm^{-1}K^{-1}$

D. WmK^{-1}

Answer: A

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12. What is black body ?

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13. What is thermodynamic system ? Give example

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14. Whatere the different types of thermodynamic systems ?

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15. What is meant by thermal equilibrium ?

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16. What is meant by state variable ? Give example

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17. What are intensive and extensive variables ? Give examples.

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18. What is an equation of state ? Give an example

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19. State Zeroth law of thermodynamic .

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20. Define the internal energy of the system

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21. Are internal energy and heat energy the same ? Exaplain .

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22. Define one calorie.

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23. What are the types of Thermodynamic properties?

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24. Define High grade energy. Give some of the examples of High grade energy.

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25. Can we measure the temperature of the object by touching it ?

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26. Give the sign convention for Q and W.

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27. Define Low grade energy. Give some of the examples of Low grade energy.

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28. Give the expression for work done by the gas .

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29. What is PV diagram ?

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30. What are the types of comfort air conditioning ?

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31. Give the equation of state for an isothermal process.

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32. Define thermodynamic efficiency.

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33. Express the change in internal energy in terms of molar specific heat capacity .

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34. A Carnot engine working between 400 K and 800 K has work output of 1000 J per cycle. What is amount of heat energy supplied to the engine from source per cycle.

A. 2800 J/cycle

B. 2350 J/cycle

C. 2000 J/cycle

D. 2950 J/cycle

Answer: C

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35. Give the equation of state for an adiabatic process.

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36. The mass of a helium atom is 6.66×10^{-27} kg. Compute the specific heat at constant volume for helium gas (in J/kg.K) from the molar heat capacity at constant volume.

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37. If the piston of a container is pushed fast inward .Will the ideal gas equation be valid in the intermediate stage ? If not, Why ?

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38. Calculate the total rotational kinetic energy of all the molecules in one mole of air at 25°C.

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39. What is a cyclic process ?

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40. What is meant by reversible and irreversible processes ?

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41. State Clausius form of the second law of thermodynamics.

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42. State Kelvin- Planck statement of second law of thermodynamics.

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43. Define heat engine .

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44. Work done by 0.1 mole of a gas at 27°C to double its volume at constant pressure is

(R = 2 cal/mol/K)

A. 54 cal

B. 600 cal

C. 60 cal

D. 546 cal

Answer: C

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45. Can the given heat energy be completely converted to work in a cyclic process? If not , when can the heat can completely converted to work ?

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46. State the second law of thermodynamics in therms of entropy.

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47. Why does heat flow from a hot object to a cold object?

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48. Calculate the internal energy of 1 mole of an ideal gas at 250 C.

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Iii Long Answer Questions

1. The ratio of $\frac{C_p}{C_v} = \gamma$ for a gas. It's molecular weight is M. It's specific heat capacity at constant pressure is

A. $\frac{R}{\gamma - 1}$

B. $\frac{\gamma R}{\gamma - 1}$

C. $\frac{\gamma R}{M(\gamma - 1)}$

D. $\frac{\gamma R M}{\gamma - 1}$

Answer: c

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2. The ratio of $\frac{C_p}{C_v} = \gamma$ for a gas. It's molecular weight is M. It's specific heat capacity at constant volume is

A. $\frac{R}{M(\gamma - 1)}$

B. $\frac{\gamma R}{\gamma - 1}$

C. $\frac{\gamma R}{M(\gamma - 1)}$

D. $\frac{\gamma R M}{\gamma - 1}$

Answer: a

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3. Differentiate between isothermal and adiabatic process.

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4. A gas expands from 1 liter to 3 liter at atmospheric pressure. The work done by a gas is about

A. 200 J

B. 2 J

C. 300 J

D. 2×10^5 J

Answer: a

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5. A centigrade and a Fahrenheit thermometer are dipped in boiling water. The water temperature is lowered until the Fahrenheit thermometer registered at $140^\circ F$. What is the

fall in temperature as registered by the centigrade thermometer ?

A. 80°

B. 60°

C. 40°

D. 30°

Answer: c

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6. Discuss various modes of heat transfer.

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7. The temperature of a body on Kelvin scale is found to be $x^{\circ}K$. When it is measured by Fahrenheit thermometer, it is found to be $x^{\circ}F$. Then the value of x is

A. 313

B. 301.24

C. 574.25

D. 40

Answer: c

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8. The temperature on Celsius scale is $25^{\circ}C$. What is the corresponding temperature on the Fahrenheit scale ?

A. $40^{\circ}F$

B. $45^{\circ}F$

C. $50^{\circ}F$

D. $77^{\circ}F$

Answer: d

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9. One mole of an ideal gas with $\gamma = 1.4$, is adiabatically compressed so that its temperature rises from $42^{\circ}C$ to $48^{\circ}C$. The

change in the internal energy of the gas is (R= 8.3J/mol/K)

A. $124.65J$

B. $138.46J$

C. $156.32J$

D. $189.65J$

Answer: A

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10. Express a temperature of $60^{\circ}F$ in degree Celsius and in Kelvin scale.

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11. The temperature of an iron piece is heated from $30^{\circ}C$ to $90^{\circ}C$. What is the change in it's temperature on the Fahrenheit scale ?

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12. The temperature of a substance increases by $27^{\circ}C$. What is the value of this increase in Kelvin scale ?

A. $300K$

B. $46K$

C. 7K

D. 27K

Answer: d

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13. A measured temperature on Fahrenheit scale is $200^{\circ}F$. What will this reading be on Celsius scale ?

A. $40^{\circ}C$

B. $94^{\circ}C$

C. $93.3^{\circ}C$

D. $30^{\circ}C$

Answer: c

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14. What is the temperature on Fahrenheit scale corresponding to $30^{\circ}C$?

A. $86^{\circ}F$

B. $52^{\circ}F$

C. $62^{\circ}F$

D. $72^{\circ}F$

Answer: a

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15. The triple point of carbon dioxide is $216.55K$. The corresponding temperature on the Celsius and Fahrenheit scale respectively are

A. $56.45^{\circ}C$, $-69.61^{\circ}F$

B. $-56.45^{\circ}C$, $69.61^{\circ}F$

C. $54.45^{\circ}C$, $69.61^{\circ}F$

D. $-56.45^{\circ}C$, $-69.61^{\circ}F$

Answer: d

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16. The triple point of neon and carbon dioxide are $24.57K$ and $216.55K$ respectively. Express the temperature on the Celsius and Fahrenheit scales respectively.

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17. A diatomic gas initially at 30°C is compressed adiabatically to one- eighth of its original volume. The temperature after compression will be

A. $586K$

B. $646K$

C. $696K$

D. $776K$

Answer: C

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18. Represent freezing and boiling temperature of water in Celsius as well as in Kelvin scales.

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19. A diatomic gas initially at 18°C is compressed adiabatically to one eighth of its original volume. The temperature after compression will be

A. 395.4°C

B. 144°C

C. 18°C

D. 887.4°C

Answer: a

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20. Convert $-40^{\circ}F$ into Celsius and Kelvin scale.

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21. The temperature on Fahrenheit scale corresponding to $200^{\circ}C$ is _____

A. $318^{\circ} F$

B. $336^{\circ} F$

C. $377^{\circ} F$

D. $392^{\circ} F$

Answer: d

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22. A Carnot engine working between 300 K and 600 K has an output of 800 J / cycle. What

is the amount of heat energy supplied to the engine from source per cycle.

A. 1800 J / cycle

B. 1000 J / cycle

C. 2000 J / cycle

D. 1600 J / cycle

Answer: d

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23. The temperature on Celsius scale corresponding to $280^{\circ}F$ is _____

A. $140.85^{\circ}C$

B. $99.38^{\circ}C$

C. $120.65^{\circ}C$

D. $137.78^{\circ}C$

Answer: d

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24. In thermodynamic process, pressure of a fixed mass of a gas is changes in such a manner that the gas molecules gives out $20\ J$ of heat and $10\ J$ of work is done in the gas. If the initial internal energy of the gas was $40\ J$, then the final internal energy will be

A. $30\ J$

B. $20\ J$

C. $60\ J$

D. $40\ J$

Answer: a

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Iv Numerical Problems

1. Calculate the number of moles of air is in the inflated ballon at room temperature as shown in the figure

The radius of the ballon is 10 cm and pressure inside the balloon is 180 k Pa.

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2. In the planet Mars the average temperature is around $-53^{\circ} C$ and atmospheric pressure is 0.7 kPa. Calculate the number of moles of the molecules inunit volume in the planet Mars.

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3. If for a gas $(C_p / C_v) = 1.67$, this gas is made up to molecules which are

A. diatomic

B. polyatomic

C. monoatomic

D. mixture of diatomic and polyatomic

Answer: c

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4. The temperature of uniform rod of length L having a coefficient of linear expansion α_L is changed by ΔT . Calculate the new moment of

inertia of the uniform rod about axis passing through its center and perpendicular to an axis of the rod.

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5. An ideal gas with pressure P, volume V and temperature T is expanded isothermally to a volume $2V$ and a final pressure P_i. If the same gas is expanded adiabatically to a volume $2V$, the final pressure is P_a. The ratio of the

specific heats of the gas is 1.67. The ratio of $\frac{P_a}{P_i}$ is .....

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6. A man starts bicycling in the morning at a temperature around $25^\circ C$ he checked the pressure of tire which is equal to be 500 Kpa. Afternoon he found that the absolute pressure in the tyre is increased to 520 Kpa. By assuming the expansion of tyre is negligible what is the temperature of type at afternoon ?

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7. Normal human body of the temperature is $98.6^{\circ} F$. During high fever if the temperature increases to $104^{\circ} F$ what is the change in peak wavelength that emitted by our body ?

(Assume human body is a black body)

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8. In an adiabatic expansion of the air the volume is increased by 4% what is

pereentage change in pressure ? (For air y = 1.4)

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9. In a petrol engine (internal combustion engine) air at atmospheric pressure and temperature of $20^{\circ}C$ is compressed in the cylinder by the piston to $1/8$ of its original volume . Calculate the termperature of the compressed air .

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10. Consider the following cyclic process consist of isotherm isochoric and isobar which is given in the figure .

Draw the same cyclic process qualitatively in the V-T diagram wherew T is taken along X direction and V is taken along y- direction .

Analyze the nature of heat exchange in each process .

Process 1 to 2= increase in volume . so heat

must be added.

Process 2 to 3 = volume remains constant increase in temperature . The given heat is used to increase the internal energy .

Process 3 to 1 : Pressure remains constant.

volume and Temperature are reduct . Heat flows out of the system . It is an isobaric compression where the work is done on the system .

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11. An ideal gas is taken in a cyclic process as shown in the figure . Calculate

(a) work done by the gas

(b) work done on the gas

(c) Network done in the process

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12. For a given ideal gas 6×10^5 J heat energy is supplied and the volume of gas is increased

from 4 m^3 to $6m^3$ at atmospheric pressure . Calculate (a) the work done by the gas (b) Change in internal energy of the gas

(c) graph this process in PV and TV diagram

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13. Suppose a person wants to increase the efficieny of the reversible heat engine that is operating between $100^\circ C$ and $300^\circ C$

He had two ways to increase the efficiency .

(a) By decreasing the cold reservoir

temperature from $100^{\circ}C$ to $50^{\circ}C$ and keeping the hot reservoir temperature of the hot reservoir from $300^{\circ}C$ to $350^{\circ}C$ by keeping the cold reservoir temperature constnat which is the suitable method ?

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14. A Carnot engine whose efficiency is 45% takes heat from a source maintained at a temperature of $327^{\circ}C$ .To have an engine of efficiency 60% what must be the intake

temperature for the same exhaust (sink) temperature

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15. An ideal refrigerator keeps its content at $0^{\circ}C$ while the room temperature is $27^{\circ}C$ .Calculate its coefficient of performance.

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16. The molar specific heats of an ideal gas at a constant pressure & volume are denoted by $C_P \& C_v$ if $r = \dfrac{C_p}{C_v}$ & R the universal gases constant then C_v is equal

A. $\dfrac{1+r}{1-r}$

B. $\dfrac{R}{(1-r)}$

C. $\dfrac{r-1}{R}$

D. rR

Answer: B

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Additional Questions Multiple Choice Qustion

1. Steam at $100^\circ C$ is passed into 20g of water at 10^C when water acquires temp of $80^\circ C$ the mass of water present will be (take specifies heat of water 1 cal g^1c^{-1} & latent heat of steam =540 cal $g^{-1}c^{-1}$

A. $42.5g$

B. $22.5g$

C. $24g$

D. $31.5g$

Answer: B

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2. The value of coefficient of volume expansion of gycerine is $5 \times 10^{-4}k^{-1}$ fractional change in the density of gycerine for a rise of $40^{\circ}C$ in its temps is

A. 0.020

B. 0.025

C. 0.010

D. 0.015

Answer: A

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3. Two metal wires of identical dimensions are connected in series if σ_1 and σ_2 are the

conductivity of the metal wire respectively the effiective conductivity of the combination is

A. $\frac{\sigma_1 + \sigma_2}{2\sigma_1\sigma_2}$

B. $\frac{\sigma_1 + \sigma_2}{\sigma_1\sigma_2}$

C. $\frac{\sigma_1\sigma_2}{(\sigma_1 + \sigma_2)}$

D. $\frac{2\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$

Answer: B

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4. Coefficient of linear expansion of brass and steel rods are σ_1 and σ_2 length of brass and steel rods are l_1 & l_2 if $(l_2 - l_1)$ is maintained same at all temperature which one of the following relation hold good ?

A. $\alpha_2^1 l_2 = \alpha_2^2 l_1$

B. $\alpha_1 l_1 = \alpha_2 l_2$

C. $\alpha_1 l_2 = \alpha_2 l_1$

D. $\alpha_1 l_2^2 = \alpha_2 l_1^2$

Answer: B

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5. A black body is continously radiating energy at a temperature of 2880 k if U_1, U_2 and U_3 are the amount of radiation measured between the wavelength 599 & 600 nm , 999 & 1000 nm & 1499 & 1500 nm respectively then (wires constant b = 2.88×10^{26} kmk)

A. $U_2 < U_3$

B. $U_1 = U_2 = U_3$

C. $U_1 < U_2 < U_3$

D. $U_2 > U_1 > U_3$

Answer: A

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6. Aluminium has specific heat capacity of

A. $450 Jkg^{-1}.^{\circ} C^{-1}$

B. $900 Jkg^{-1}.^{\circ} C^{-1}$

C. $1350 Jkg^{-1}.^{\circ} C^{-1}$

D. $1800 Jkg^{-1}.^{\circ} C^{-1}$

Answer: B

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7. Internal energy comprises of two types of energies those are

A. mechanical and electrical energy

B. magnetic and electrical energy

C. kinetic and potential energy

D. kinetic and magnetic energy

Answer: C

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8. A sample of $0.1\ g$ of water at $100^{\circ}C$ and normal pressure $\left(1.013 \times 10^{5} Nm^{-2}\right)$ requires $54\ cal$ of heat energy to convert to steam at $100^{\circ}C$. If the volume of the steam produced is 167.1 cc, the change in internal energy of the sample is

A. $104.3\ J$

B. $208.7\ J$

C. $42.2\ J$

D. $84.5\ J$

Answer: b

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9. Amount of energy required to change liquid to gas and vice versa without any change in temperature is termed as

A. Latent Heat and Fusion

B. Latent Heat of Vaporisation

C. Heat capacity

D. Specific heat capacity

Answer: B

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10. The internal energy change in a system that has absorbed $2\ kcal$ of heat and done $500\ J$ of work is

A. $6400\ J$

B. $5400\ J$

C. $7900\ J$

D. $8900\ J$

Answer: c

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11. $110\ J$ of heat is added to a gaseous system whose internal energy is $40\ J$. Then the amount of external work done is

A. $150\ J$

B. $70\ J$

C. $110\ J$

D. $40\ J$

Answer: b

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12. Mercury has boiling point of

A. $157^\circ C$

B. $167^\circ C$

C. $357^\circ C$

D. $457^\circ C$

Answer: C

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13. If c_p and c_v denotes specific heats per unit mass of an ideal gas of molecular weight M, then

A. $c_p - c_v = R / M^2$

B. $c_p - c_v = R$

C. $c_p - c_v = R / M$

D. $c_p - c_v = MR$

Answer: c

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14. One mole of an ideal gas requires $207\ J$ heat to rise the temperature by $10\ K$ when heated at constant pressure. If the same gas is

heated at constant volume to raise the temperature by the same $10\ K$, the heat required is

(Given the gas constant, R = 8.3 J/mol-K).

A. $198.7\ J$

B. $29\ J$

C. $215.3\ J$

D. $124\ J$

Answer: d

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15. Bolye's law states that

A. $P \times V = \text{constant}$

B. $\frac{P}{V} = \text{constant}$

C. $P \times V^2 = \text{constant}$

D. $\frac{P}{V^2} = \text{constant}$

Answer: A

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16. When an ideal diatomic gas is heated at constant pressure the fraction of the heat energy applied which increases the internal energy of gas is

A. $\frac{2}{5}$

B. $\frac{3}{5}$

C. $\frac{3}{7}$

D. $\frac{5}{7}$

Answer: D

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17. A cylinder contains hydrogen gas at pressure of 249 kPa and temperature 27°C. It's density is

$(Given, R = 8.3 Jmol^{-1}K^{-1})$

A. 0.5 kg / m^3

B. 0.2 kg / m^3

C. 0.1 kg / m^3

D. 0.02 kg / m^3

Answer: b

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18. In a thermodynamic process, pressure of a fixed mass of a gas is changed in such a manner that the gas releases $20\ J$ of heat and $8\ J$ of work is done on the gas. If the initial internal energy of the gas was $30\ J$, what will be the final internal energy ?

A. $42\ J$

B. $12\ J$

C. $10\ J$

D. $18\ J$

Answer: d

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19. 1 mole of a gas with $\gamma = \frac{7}{5}$ is mixed with 1 mole of gas with $\gamma = \frac{5}{3}$, then value of γ of the resulting mixture is

A. $\frac{7}{5}$

B. $\frac{2}{5}$

C. $\frac{3}{2}$

D. $\frac{12}{7}$

Answer: C

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20. A gaseous mixture consists of 16g of helium and 16g of oxygen the ratio of two specific heats of the mixture is

A. 1.4

B. 1.54

C. 1.59

D. 1.62

Answer: D

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21. One kg of a diatomic gas is at a pressure of $8 \times 10^4 Nm^{-2}$ the density of the gas if

$4kg/m^g$ .What is the energy of the gas due to its thermal mole

A. $3 \times 10^4 J$

B. $5 \times 10^4 J$

C. $6 \times 10^4 J$

D. $7 \times 10^4 J$

Answer: B

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22. The work fo 146 kJ is performed in order to compress me kilomole of a gas adiabatically and in this process the temperature of gas increases by $7^{\circ} C$ the gases

A. a mixture of monoatomic and diamotomic

B. monoatomic

C. diatomic

D. triatomic

Answer: C

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23. At boyle's temperature

A. Joule effect is positive

B. Vanderwaal's equation is zero

C. gas obeys Boyle's law

D. none of the above

Answer: C

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24. The equation of state for 5g of oxygen at a pressure P and temeprature T, when occupying a volume V, will be

A. $PV = \left(\frac{5}{32}\right)RT$

B. $PV = 5RT$

C. $PV = \left(\frac{5}{2}\right)RT$

D. $PV = \left(\frac{5}{16}\right)RT$

Answer: A

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25. Surface of the lake is at $2^\circ C$ and depth of the lake is 20m find the temperature of the bottom of the lake

A. $2^\circ C$

B. $3^\circ C$

C. $4^\circ C$

D. none of the above

Answer: D

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26. One mole of an ideal monoatomic gas undergoes a process described by the equation PV^3 = constant. The heat capacity of the gas during this process is

A. $\frac{3}{2}R$

B. $\frac{5}{2}R$

C. $2R$

D. R

Answer: d

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27. A mono atomic gas is suddenly compressed to $\left(\frac{1}{8}\right)^{th}$ of its initial volume adiabatically the ratio of its final pressure to the initial pressure is (Given : the ratio of the specific heats of the given gas to be $5/3$)

A. 32

B. $\frac{40}{3}$

C. $\frac{24}{5}$

D. 8

Answer: A

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28. The termeprature of a given is increased from $27^\circ C$ to $327^\circ C$ the rms velocity of the molecules increases

A. $\sqrt{2}$ times

B. 2 times

C. $2\sqrt{2}$ times

D. 4 times

Answer: A

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29. A monatomic gas at a pressure P, having a volume V expands isothermally to a volume 2V and then adiabatically to a volume 16V. The

final pressure of the gas is

(Take $\gamma = \frac{5}{3}$)

A. $64P$

B. $32P$

C. $P/64$

D. $16P$

Answer: c

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30. The mean kinetic energy of one mole of gas per degree of freedom (on basis of kinetic theory of gases) is

A. $\frac{1}{2}KT$

B. $\frac{3}{2}KT$

C. $\frac{3}{2}RT$

D. $\frac{1}{2}RT$

Answer: D

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31. First law of thermodynamics corresponds to

A. conservation of energy

B. heat flow from hotter to cooler body

C. law of conservation of angular momentum

D. Newton's law of cooling

Answer: A

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32. During an adiabatic expansion of 2 moles of a gas, the change in internal energy was found -50 J. The work done during the process is

A. zero

B. 100

C. -50

D. 50

Answer: d

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33. An ideal gas at a pressures of 1 atmosphere and temperature of 27°C is compressed adiabatically until its pressure becomes 8 times the initial pressure. Then, the final temperature is

(Take, $\gamma = 3/2$).

A. 627°C

B. 527°C

C. 427°C

D. 327°C

Answer: d

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34. In an adiabatic process the state of a gas is changed from $P_1, V_1, T_1, \rightarrow P_2, V_2, T_2.$ Which of the following relation is correct ?

A. $T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$

B. $P_1 V_1^{\gamma-1} = P_2 V_2^{\gamma-1}$

C. $T_1 P_1^{\gamma} = T_2 P_2^{\gamma}$

D. $T_1 V_1^{\gamma} = T_2 V_2^{\gamma}$

Answer: A

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35. Universal gas constant is

A. C_p / C_r

B. $C_p - C_v$

C. $C_p + C_r$

D. $\frac{C_v}{C_p}$

Answer: B

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36. A gas is suddenly compressed to 1/4 th of its original volume at normal temperature. The increase in its temperature is

(Take, γ = 1.5).

A. 273 K

B. 573 K

C. 373 K

D. 473 K

Answer: a

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37. In a thermodynamic process, pressure of a fixed mass of a gas is changed in such a manner that the gas releases $30\ J$ of heat and $10\ J$ of work is done on the gas. If the initial

internal energy of the gas was $30\ J$, then the final internal energy will be

A. $2\ J$

B. $-18\ J$

C. $10\ J$

D. $58\ J$

Answer: c

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38. In an isothermal process

A. there is no change in internal energy

B. there is no change in temperature

C. there is no change in enthalpy

D. all the above

Answer: D

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39. A process in which the temperature of working substance reamains constant during its expansion or compression

A. isothermal

B. adiabatic

C. isobaric

D. isochoric

Answer: A

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40. A gas for which $\gamma = 1.5$ is suddenly compressed to 1/4 th of the initial volume. Then the ratio of the final to the initial pressure is

A. 1:16

B. 1:8

C. 1:4

D. 8:1

Answer: d

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41. The specific heat of water is

A. 1.817

B. 2512

C. 4.187

D. none

Answer: C

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42. The sum of internal energy (u) and the product of pressure and volume (P.V) is

A. enthalpy

B. work done

C. entropy

D. none

Answer: A

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43. An ideal gas is expanded adiabatically at an initial temperature of 300 K, so that it's volume is doubled. The final temperature of the hydrogen gas is

(Take, γ = 1.40).

A. 227.36 K

B. 500.30 K

C. 454.76 K

D. -47°C

Answer: a

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44. Helium at 27°C has a volume of 8 litres. It is suddenly compressed to a volume of 1 litre. The temperature of the gas will be

[Take, γ=5/3].

A. 108°C

B. 9327°C

C. 1200°C

D. 927°C

Answer: d

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Ii Match The Following

1. Temperature determine the _____ of flow of heat .

A. direction

B. force

C. velocity

D. line

Answer: A

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Iii Fill In The Blacnks

1. At normal temperature, one mole of diatomic gas is compressed adiabatically to half of its volume. Where, γ = 1.41. The final temperature of the gas will be

A. 983.02 K

B. 678.4 K

C. 363.1 K

D. 767.4 K

Answer: c

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2. A gas is suddenly compressed to 1/4 th of its original volume. What is the rise in the

temperature, if the original temperature of the gas being at $27^{\circ}C$ and $\gamma = 1.5$?

A. 327 K

B. 300 K

C. 400 K

D. 450 K

Answer: B

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3. Water has an _____ behaviour of expansion .

A. ideal

B. normal

C. unique

D. anomalous

Answer: D

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4. The amount of heat energy required to increase the object temperature by $1^{\circ}C$ is called _____ .

A. Specific heat capacity

B. Heat capacity

C. Latent heat capacity

D. Molar specific heat capacity

Answer: B

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5. The temperature on Celsius scale is found to be 400°C. The corresponding temperature on the Fahrenheit scale is

A. 368°F

B. 896°F

C. 752°F

D. 584°F

Answer: c

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6. The measurement of the amount of heat energy released or abosrbed by a thermodynamic system during the heating process is called _____.

A. Heat capacity

B. Enthalpy

C. Entropy

D. Calorimetry

Answer: D

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7. _____ is the sum of kinetic and potential energies of molecules in a thermodynamic system.

A. Potential energy

B. Elastic energy

C. Internal energy

D. External energy

Answer: C

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8. A _____ process is an infinitely slow process in which the system is always at equilibrium with the surrounding .

A. thermal

B. quasi- static

C. quasi- dynamic

D. quadratic

Answer: B

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9. _____ converted mechanical energy in to internal energy of the system.

A. Joule

B. Calorie

C. Kelvin

D. Planck

Answer: A

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10. In an Isochoric process _____ is constant

A. Pressure

B. volume

C. temperature

D. energy

Answer: B

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11. All natural processes are _____

A. Reversible

B. Ideal

C. Irreversible

D. Not Ideal

Answer: C

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12. CHOOSE THE ODD ONE OUT:

A. heat

B. temperature

C. hotness

D. coldness

Answer: A

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Iv Choose The Odd One Out

1. CHOOSE THE ODD ONE OUT:

A. μ

B. σ

C. $\lambda_{\max}$

D. K

Answer: d

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2. CHOOSE THE ODD ONE OUT:

A. Melting point

B. Boiling point

C. Sublimation

D. Oxidation

Answer: d

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3. An engine is supposed to operate between two reservoirs at temperature 727°C and 227°C. The maximum possible efficiency of such an engine is

A. $\frac{3}{4}$

B. $\frac{1}{4}$

C. $\frac{1}{2}$

D. 1

Answer: c

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V Choose The Correct Pair

1. An ideal refrigerator has a freezer at a temperature of -13°C. The coefficient of performance of the engine is 5. The temperature of the air to which heat is rejected will be

A. 325°C

B. 39°C

C. 330°C

D. 320°C

Answer: b

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V I Choose The Incorrect Pair

1. For which combination of working temperatures the efficiency of Carnot's engine is highest.

A. 80 K , 60 K

B. 100 K , 80 K

C. 60 K , 40 K

D. 40 K , 20 K

Answer: d

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2. Choose the incorrect pair :

A. Isobaric process - Cooking

B. Adiabatic process - water droplets forming cloud

C. Open thermodynamic System - Erthern pot system

D. Isothermal process -T $\neq$ constant

Answer: D

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3. Assertion :When camphor is burnt it vapourises during heating .that is solid is converted into gas in this case. This is called sublimation.

Reason.calorimetry means the meansurement of the amount of heat released or absorbed by thhermodynamic system during the heating process : It can be expressed as $Q_{\text{gain}} = Q_{\text{loss}}$

A. Assertion and Reason are correct and Reason is correct explanation of Assertion

B. Assertion and Reason are true but Reason is the false explanation of the assertion

C. Assertionis true gut reason is false

D. Assertion is false but Reason is true .

Answer: B

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V Ii Assertion Reason

1. Assertion : The process in which heat transfer is by actual movement of molecules in fluids such as liquids and gases is called conduction .

Reason : Newton's law of cooling states that rate of loss of heat of a body is directly propositional to the difference in the temperature between that body and its surrounding .

$i.e. \frac{d\theta}{dt} \propto^{-} (T - T_s)$

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2. (i) Heat transfers in three different modes :

(ii) The ideal gas law is PV = RT

which one is correct statement ?

A. 1 only

B. II only

C. both are correct

D. None

Answer: A

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Viii Choose The Correct Or Incorrect Statement

1. (I) Tendency of an object ot change its shape area and volume is called thermal expansion

(ii) All natural process are reversible

which one is incorrect statement ?

A. 1 only

B. II only

C. both are correct

D. None

Answer: B

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2. (I) A Refrigerator is a reverse of carnot engine .

(ii) Carnot engine has the lowest efficiency

Which one is correct statement ?

A. 1 only

B. II only

C. bot

D. None

Answer: A

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3. (I) In a cyclie process change in internal energyy is zero

(ii) $C_V > C_p$

which one is incorrect statement ?

A. 1 only

B. II only

C. both are correct

D. None

Answer: B

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4. What is Thermodynamic ?

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Very Short Answer Question

1. What is meant by heating ?

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2. What is heat ?

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3. What is meaning of temperature ?

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4. Define the avogadro's number :

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5. Define heat capacity .

Watch Video Solution

6. What is Latent heat of fusion ?

Watch Video Solution

7. What is meant by latent heat of vaporization

Watch Video Solution

8. What is latent heat of sublimation?

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9. A Carnot engine takes 3×10^6 cal of heat from a reservoir at 627°C, and gives to a sink at 27°C. The work done by the engine is

A. 4.2×10^6 J

B. 16.8×10^6 J

C. 8.4×10^6 J

D. zero

Answer: c

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10. What is steady state ?

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11. state prevost theory of heat exchnage .

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12. Define Emissivity.

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13. What is Thermodynamics?

Watch Video Solution

14. Write the property of temperature .

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15. Define specific heat capacity at constant prossure .

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16. Define specific heat capacity at constant volume.

Watch Video Solution

17. Define molar specific heat capacities.

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18. What is relegation ?

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19. What is subblimation ?

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20. Is it possible that there is change in temperature of a body without giving / taking heat to from it ?

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21. What is principle of calorimetry ?

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22. Can water be boiled without heating ?

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23. As air is a bad conductor of heat why do we not feel warm without clothes?

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24. Why is hotter at the same distance over the top of a fire than in front of it ?

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25. A gas expands 0.5 L against a constant pressure at 1 atm. Calculate the work done in joule and calorie.

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Short Answer Question

1. An ideal gas heat engine is operating between 227°C and 127°C. It absorbs $10^4 J$ of heat at the higher temperature. The amount of heat converted into work is _____J.

A. 2000

B. 4000

C. 5600

D. 8000

Answer: a

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2. Efficiency of a Carnot engine is 50%, when temperature of outlet is 500 K. In order to increase efficiency upto 60% keeping temperature of intake the same, what is temperature of outlet ?

A. 200 K

B. 400 K

C. 600 K

D. 800 K

Answer: b

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3. An ideal heat engine working between temperature T_1 and T_2 has an efficiency η. The new efficiency if both the source and sink temperature are doubled, will be

A. η

B. 2η

C. 3η

D. $\frac{\eta}{2}$

Answer: a

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4. A Carnot engine converts one-sixth of the heat into work. When the temperature of the sink is reduced by 62°C, the efficiency of the

engine is doubled. The temperature of the source and sink are

A. 80°C, 37°C

B. 95°C, 28°C

C. 90°C, 37°C

D. 99°C, 37°C

Answer: d

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5. What is a cyclic process ?

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6. Write the conditions for reversible process

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7. What is the value of sink temperature, when efficiency of engine is 100%.

A. 300 K

B. 273 K

C. 0 K

D. 400 K

Answer: c

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8. A metal tube & a rod of same distance same material & same outer diameter are given

same amount of heat. Which will show less expansion & why ?

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9. How is skating possible on snow?

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10. State that the coefficient of cubical ecpansion of an ideal gas at constant pressure

is equal to the reciprocal of its absolute temperature .

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11. How does the density of a solid or a liquid vary with temperature ? State that its variation with temperature is given by

$P = P(1 - a\Delta T)$

where γ is coefficient of cubical expansion .

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12. Write the important properties of thermal radiations .

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13. State the factors on which the conduction of heat through a substance depends .

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14. Write any 3 phenomena which are based on thermal convertion.

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15. A Carnot engine having an efficiency of $\eta = \left(\frac{1}{10}\right)$ as a heat engine is used as a refrigerators. If the work done on the system is 10 J, what is the amount of energy absorbed from the reservoir at lowest temperature ?

A. 1 J

B. 90 J

C. 99 J

D. 100 J

Answer: b

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16. Describle an analytical method for a dtermining th work done during the expansion of gas.

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17. The temperature of sink of Carnot engine is 27°C. Efficiency of engine is 25%. Then find the temperature of source.

A. 227°C

B. 327°C

C. 27°C

D. 127°C

Answer: d

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18. The efficiency of Carnot's engine operating between reservoirs, maintained at temperature 27°C and -123°C is

A. 0.5

B. 0.4

C. 0.6

D. 0.25

Answer: a

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19. Derive an expressionfor the work done during the isothermal expansion of an ideal gas.

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20. If a heat engine absorbs 50 KJ heat from a heat source and has an efficiency of 40%, then the heat released by it in heat sink is

A. 40 KJ

B. 30 KJ

C. 20 KJ

D. 20 J

Answer: b

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21. The efficiency of heat engine is 30%. If it gives 30 KJ heat to the heat sink, then it

should have absorbed _____KJ heat from heat source.

A. 42.8

B. 39

C. 29

D. 9

Answer: a

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22. What is meant by coefficient of linear expansion superficial & cubical expansion ?

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Long Answer Question

1. If a heat engine absorbs $2KJ$ heat from a heat source and release $1.5KJ$ heat into cold reservoir, then it's efficiency is

A. $0.5\ \%$

B. $75\ \%$

C. $25\ \%$

D. $50\ \%$

Answer: c

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2. A difference of temperature of $25^\circ C$ is equivalent to a difference of

A. $72^\circ F$

B. $45^{\circ}F$

C. $32^{\circ}F$

D. $25^{\circ}F$

Answer: b

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3. What is the value of absolute temperature on the Celsius scale ?

A. $-273.15^{\circ}C$

B. $100^{\circ}C$

C. $-32^{\circ}C$

D. $0^{\circ}C$

Answer: a

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4. What is latent heat ? Give is units with the help of a suitable graph , explain the terms latent heat of fusion latent heat of vaporisation.

A. `

B.

C.

D.

Answer:

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5. It I is the moment of inertia of a distance about an axis passing through its centre the find the change in moment of inertia due to

small change in its temperature $\Delta t\alpha$ is the Coefficient of linear expeansion of distance .

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Numerical Problems

1. Why burns from steam are more serious than those from boiling water ?

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2. What is specific heat of a gas in an isothermal process ?

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3. What is the specific heat of a gas in an adiabatic process ?

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4. From an equilibrium state A to another equilibrium state A to another equilibrium state B an amount of work equal to 30 J is done on the system .if the gas is taken from state A to B iva a process in which the net heat observe by system is 10 cal , how much is the net work done by the system in the later case.

[Take 1 cal = 4.2 J]

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5. A cylinder with a movable piston contains 3 moles of hydrogen at constant temperature and pressrue. The walls of a cylinder are made up of a heat insulator and the piston is insulated by having a pile of sand on it By what factor does the pressure of a gas increases if the gas is compressed to half its original volume ?

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6. $\frac{1}{2}$ mole of helium is contained in a container at STP . How much heat energy is needed to double the pressure of the gas keeping the volume contant ? Heat capacity of gas is $3Jg^{-1}K^{-1}$

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7. An electric heater supplies heat to a system at a rate or 100 W. If the system performs work

at a rate of 75 joules per second at what rate is the internal energy increasing ?

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8. What is the co- efficient of performance (β) or a carnot refrigerator working between 40° and $0^\circ C$?

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9. A body which absorbs heat of 23,400 J with a temperature change of $14.2^{\circ}C$. The specific heat capacity of the body is 2.46 $J/g^{\circ}C$. What is the required mass of the body in grams ?

A. $6.70 \times 10^2 g$

B. $6.50 \times 10^2 g$

C. $6.20 \times 10^2 g$

D. $5.80 \times 10^2 g$

Answer: a

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10. what amount of heat must be supplied to $2.0 \times 10^{-2} kg$ of nitrogen (at room temperature) to raise its temperature by $45^{\circ} C$ at constant pressure (Molecular mass of $N_2 = 28, R = 8.3 Jmol^{-1} k^{-1}$)

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11. Refrigerator is to maintain eatables kept inside at $9^{\circ} C$. If room temperature is $36^{\circ} C$

Calculate the co- efficient of performance.

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12. The temperature - entropy diagram of a reversible cycle is given in figure. Calculate its efficient .

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13. An deal gas is expanded such that $pT^2 = a$ constant find the coefficient of volume expansion of the gas

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14. A body with mass 2 kg absorbs heat of 100 J, when it's temperature raises from $20^\circ C$ to $70^\circ C$. What is the specific heat of the body ?

A. $10^3\ J/g^\circ C$

B. $10^2\ J/g^\circ C$

C. $10^{-3}\ J/g^{\circ}C$

D. $10^{-2}\ J/g^{\circ}C$

Answer: C

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15. Two rods of equal length and diameter have thermal conductivities 3 & 4 units .it they joined in series . Find the thermal conductivity of the combination.

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16. The specific heat of water is 4180 $J/kg^{\circ}C$.

How much the heat capacity of 2 kg water ?

A. 8360 $J/^{\circ}C$

B. 8000 $J/^{\circ}C$

C. 8200 $J/^{\circ}C$

D. 7800 $J/^{\circ}C$

Answer: a

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Creative Questions Hots

1. The specific heat of aluminium is 900 $J/kg^{\circ}C$. How much the heat capacity of 2 gram aluminium ?

A. $2.8\ J/^{\circ}C$

B. $3.8\ J/^{\circ}C$

C. $1.8\ J/^{\circ}C$

D. $4.8\ J/^{\circ}C$

Answer: c

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2. Calorimeters are made of metals not glass. Why?

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3. A body which absorbs heat of 2,55,000 J with a mass of 10,000 g. The specific heat capacity of the body is 4.18 $J/g^{\circ}C$. What is the change in temperature of the body ?

A. $5.24^{\circ}C$

B. $4.75^{\circ}C$

C. $6.10^{\circ}C$

D. $8.35^{\circ}C$

Answer: C

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4. When 0.45 kg of ice of $0^{\circ}C$ mixed with 0.9 kg of water at $55^{\circ}C$ in a container the

resulting temperature is $10^{\circ} C$. Calculate the heat of fusion of ice .

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5. 2 kg of ice at -20° is mixed with 5 kg of water at $20^{\circ} C$ in an insulating vessel having a negligible heat capacity . Calculate the final mass of water remaining in the container .

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6. Two rods one of aluminium and the other made of steel having initial length l_1 and l_2 are connected together to form a single rod of length $l_1 + l_2$. The co - efficient of linear expansion for aluminium steel are a_a and α_a respectively . If the length of each rod increases by ghe same amount when their temeperature are raised by $+.^\circ C$ then find the ratio $\frac{l_1}{l_1 + l_2}$

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7. A body of mass of $10^6 g$ having a specific heat capacity of $4.18\ J/g^\circ C$ with a temperature change of $6.5^\circ C$. Find out the required heat absorbed by the body ?

A. $3.58 \times 10^4\ kJ$

B. $9.78 \times 10^4\ kJ$

C. $7.79 \times 10^4\ kJ$

D. $2.7 \times 10^4\ kJ$

Answer: d

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Value Based Question

1. Sudeep and Karthideyan were room mates. Sudeep was boiling water in a vessel for bathing purpose. Karthikeyan said Sudeep , you know when you touch the middle part of the vessel containing water you can feel less heat than what you can feel at the top. Sudeep was shocked to hear. Karthikeyan took a thermometer and kept it at the top surface of water. The temepature was rising .Again he

inserted it deep into the vessel containing water , now the temperature has fallen down than in the previous condition .What is teh truth behind it ?

(i) It is good to keep our hand deep into the vessel to check this while the liquid is boiling ?

,

(ii)What are convection current ?

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