Seat Number

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शक - 009

PHYSICS PAPER-I : PHY-121
Heat and Thermodynamics
(112201)

P. Pages : 4

Time : Two Hours **Max. Marks : 60**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Graph or diagram should be drawn with the black ink pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory and carry equal marks.
5. Figures to the right indicating full marks.
6. Draw neat and labelled diagram wherever necessary.
7. Use logarithmic table or standard electronic calculator is allowed.

1. a) Attempt **any six** of the following Select correct option. **6**

i) According to kinetic theory of gases the intermolecular forces between the gas molecules are ----------.

a) Zero b) Small
c) Large d) Depends on intermolecular forces

ii) Efficiency of Carnot's ideal heat engine is always ----------.

a) Zero b) Equal to one
c) Greater than one d) Less than one

iii) The coefficient of performance of refrigerator is ----------.

a) $\frac{Q_2}{Q_2 - Q_1}$ b) $\frac{Q_1}{Q_2 - Q_1}$

c) $1 - \frac{Q_2}{Q_1}$ d) $\frac{Q_1}{Q_1 - Q_2}$

iv) A graph of ---------- is called an indicator diagram.

a) P versus V b) PV versus V
c) T versus P d) PV versus P

v) The net change in entropy for reversible process is ----------

a) Constant b) Zero
c) Positive d) Negative

vi) A system which exchanges both mass and energy with its surroundings then it is called ---------
a) Closed system b) Open system
c) Isolated system d) Equillibrium system

vii) The highest temperature at which a gas can be liquefied by the application of pressure alone is called ----------
a) Boyle temperature b) Room temperature
c) Absolute zero temperature d) Critical temperature

viii) The first law of thermodynamics expresses ---------
a) Law of conservation of momentum
b) Law of conservation of energy
c) Law of conservation of mass
d) All of these

b) Attempt **any six** of the following. **6**

i) Mention the names of working substance used in Diesel engine.

ii) What do you mean by an adiabatic change?

iii) State the reduced equation of state for the gas.

iv) State the purpose of refrigeration.

v) State zeroth law of thermodynamics.

vi) Define entropy.

vii) Define critical pressure.

viii) What is an indicator diagram?

2. Attempt **any six** of the following. **12**

i) List the names of four strokes of diesel engine.

ii) The temperature of a perfect gas undergoing an adiabatic expansion falls from 27°C to -73°C. Calculate the work done by the gas (R = 8.3J/mole°K)

iii) What do you understand by throttling of a gas?

iv) What do you understand by critical point and critical isothermal?

v) Carnot's heat engine has an efficiency of 60% with its sink at 27°C. Calculate temperature of the source.

vi) What is an internal energy of a system? Give one example.

vii) Mention any two methods of refrigeration.

viii) State first law of thermodynamics.

ix) What is the advantage of the reduced equation of state over Vander Waal's equation of state.

3. Attempt **any four** of the following. **12**

i) Distinguish between refrigerator and heat pump.

ii) Find the critical temperature for helium from following data:
Critical pressure = 2.26 atmosphere,
Critical density = 0.069 gm cm^{-3}
R = 8.31 J/ kmole °K.

iii) A refrigerator absorbs 1000 calories of heat and rejects 1200 calories to the atmosphere. Calculate its coefficient of performance.

iv) Assuming the relation PV^{γ} = constant for an adiabatic change, obtain the relation between temperature (T) and pressure (P)

v) One mole of Vander Waal's gas expands isothermally from V_1 to V_2. Show that the work done by the gas is expanded by

$$W = RT \ell n \left(\frac{V_2 - b}{V_1 - b}\right) + a\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$$

vi) Explain the temperature entropy diagram.

4. Attempt **any three** of the following. **12**

i) A motor car tyre has a pressure of 2 atmospheres at temperature 27°C. If tyre suddenly bursts, find the resulting temperature.

ii) Carnot's heat engine has an efficiency of 30% with its sink at 27°C. What should be the change in temperature of its source if the engine is to have an efficiency of 50%?

iii) Show that $V_C = 3b$, $T_C = \frac{8a}{27Rb}$ and $P_C = \frac{a}{27b^2}$ where symbols have their usual meanings.

iv) State the basic components of vapour compression refrigerator system. Explain the function of each component.

v) Derive the first latent heat equation.

5. Attempt **any two** of the following. **12**

i) Explain the Diesel cycle with a neat diagram and hence obtain its efficiency.

ii) Describe Amagat's experiment on hydrogen, nitrogen and carbon di-oxide and discuss his results.

iii) Draw the PV diagram for Carnot's cycle and explain the four operations and hence obtain an expression for its efficiency.

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