

Thermodynamics — NEET Physics PYQ (2005-2019)

Class 11 Physics · 24 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2019 · Q40

1. In which of the following processes, heat is neither absorbed nor released by a system?

- (A) isothermal
- (B) adiabatic
- (C) isobaric
- (D) isochoric

NEET 2018 · Q4

2. The efficiency of an ideal heat engine working between the freezing point and boiling point of water, is

- (A) 6.25%
- (B) 20%
- (C) 26.8%
- (D) 12.5%

NEET 2018 · Q45

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

- (A) 42.2 J
- (B) 208.7 J
- (C) 104.3 J
- (D) 84.5 J

NEET 2017 · Q148

4. A carnot engine having an efficiency of 1/10 as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is:

- (A) 1 J
- (B) 90 J
- (C) 99 J
- (D) 100 J

NEET 2017 (Gujarati paper) · Q163

5. One mole of a gas obeying the equation of state $P(V - b) = RT$ is made to expand from a state with coordinates (P_1, V_1) to a state with (P_2, V_2) along a process that is depicted by a straight line on a P-V diagram. Then, the work done is given by:

- (A) $(1/2)(P_1 + P_2)(V_2 - V_1)$
- (B) $(1/2)(P_2 - P_1)(V_2 - V_1)$
- (C) $(1/2)(P_1 + P_2)(V_2 - V_1 + 2b)$
- (D) $(1/2)(P_2 - P_1)(V_2 + V_1 + 2b)$

NEET 2016 Phase 2 · Q17

6. One mole of an ideal monatomic gas undergoes a process described by the equation $PV^3 = \text{constant}$. The heat capacity of the gas during this process is

- (A) $3R/2$
- (B) $5R/2$
- (C) $2R$
- (D) R

NEET 2016 Phase 2 · Q18

7. The temperature inside a refrigerator is t_2 °C and the room temperature is t_1 °C. The amount of heat delivered to the room for each joule of electrical energy consumed ideally will be

- (A) $t_1/(t_1 - t_2)$
- (B) $(t_1 + 273)/(t_1 - t_2)$
- (C) $(t_2 + 273)/(t_1 - t_2)$
- (D) $(t_1 + t_2)/(t_1 + 273)$

NEET 2016 Phase 1 · Q11

8. A refrigerator works between 4°C and 30°C. It is required to remove 600 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power required is: (Take 1 cal = 4.2 Joules)

- (A) 2.365 W
- (B) 23.65 W
- (C) 236.5 W
- (D) 2365 W

NEET 2016 Phase 1 · Q30

9. A gas is compressed isothermally to half its initial volume. The same gas is compressed separately through an adiabatic process until its volume is again reduced to half. Then:

- (A) Compressing the gas isothermally will require more work to be done.
- (B) Compressing the gas through adiabatic process will require more work to be done.
- (C) Compressing the gas isothermally or adiabatically will require the same amount of work.
- (D) Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas.

AIPMT 2015

10. A Carnot engine, having an efficiency of $\eta = 1/10$ as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is:

- (A) 1 J
- (B) 100 J
- (C) 99 J
- (D) 90 J

AIPMT 2014

11. A monoatomic 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 $\gamma = 5/3$)

- (A) $32P$
- (B) $P/64$
- (C) $16P$
- (D) $64P$

NEET 2013

12. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its temperature. The ratio of C_p/C_v for the gas is

- (A) $4/3$
- (B) 2
- (C) $5/3$
- (D) $3/2$

AIPMT 2011 Mains

13. A mass of diatomic gas ($\gamma = 1.4$) at a pressure of 2 atmospheres is compressed adiabatically so that its temperature rises from 27°C to 927°C . The pressure of the gas in the final state is

- (A) 256 atm
- (B) 8 atm
- (C) 28 atm
- (D) 68.7 atm

AIPMT 2011 Prelims

14. When 1 kg of ice at 0°C melts to water at 0°C , the resulting change in its entropy, taking latent heat of ice to be 80 cal/g, is

- (A) 293 cal/K
- (B) 273 cal/K
- (C) 8×10^4 cal/K
- (D) 80 cal/K

AIPMT 2010 Mains · Q80

15. If c_p and c_v denote the specific heats (per unit mass) of an ideal gas of molecular weight M , then (where R is the molar gas constant)

- (A) $c_p - c_v = R/M^2$
- (B) $c_p - c_v = R$
- (C) $c_p - c_v = R/M$
- (D) $c_p - c_v = MR$

AIPMT 2010 Mains · Q90

16. A monoatomic gas at pressure P_1 and volume V_1 is compressed adiabatically to $1/8$ th of its original volume. What is the final pressure of the gas?

- (A) $64 P_1$
- (B) P_1
- (C) $16 P_1$
- (D) $32 P_1$

AIPMT 2010 Prelims · Q17

17. If ΔU and ΔW represent the increase in internal energy and work done by the system respectively in a thermodynamical process, which of the following is true?

- (A) $\Delta U = -\Delta W$, in an isothermal process
- (B) $\Delta U = -\Delta W$, in an adiabatic process
- (C) $\Delta U = \Delta W$, in an isothermal process
- (D) $\Delta U = \Delta W$, in an adiabatic process

AIPMT 2009 Prelims · Q3

18. In thermodynamic processes which of the following statements is not true?

- (A) In an isochoric process pressure remains constant
- (B) In an isothermal process the temperature remains constant
- (C) In an adiabatic process $PV^\gamma = \text{constant}$
- (D) In an adiabatic process the system is insulated from the surroundings

AIPMT 2009 Prelims · Q37

19. 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

20. If Q , E and W denote respectively the heat added, change in internal energy and the work done in a closed cycle process, then

- (A) $Q = 0$
- (B) $W = 0$
- (C) $Q = W = 0$
- (D) $E = 0$

21. An engine has an efficiency of $1/6$. When the temperature of sink is reduced by 62°C , its efficiency is doubled. Temperature of the source is

- (A) 37°C
- (B) 62°C
- (C) 99°C
- (D) 124°C

22. A Carnot engine whose sink is at 300 K has an efficiency of 40% . By how much should the temperature of source be increased so as to increase its efficiency by 50% of original efficiency ?

- (A) 275 K
- (B) 175 K
- (C) 250 K
- (D) 225 K

23. Which of the following processes is reversible ?

- (A) Transfer of heat by radiation
- (B) Electrical heating of a nichrome wire
- (C) Transfer of heat by conduction
- (D) Isothermal compression

24. An ideal gas heat engine operates in Carnot cycle between 227°C and 127°C . It absorbs $6 \times 10^4\text{ cal}$ of heat at higher temperature. Amount of heat converted to work is :

- (A) $2.4 \times 10^4\text{ cal}$
- (B) $3.6 \times 10^4\text{ cal}$
- (C) $1.2 \times 10^4\text{ cal}$
- (D) $6.4 \times 10^4\text{ cal}$

Answer key and explanations

1. Answer: (B) adiabatic

An adiabatic process is by definition one with no heat exchange ($Q = 0$). In an isothermal process heat does flow, exactly balancing the work done, so that temperature remains constant.

2. Answer: (C) 26.8%

Carnot efficiency $\eta = 1 - T_2/T_1 = 1 - 273/373 = 100/373 \approx 26.8\%$. Temperatures must be in kelvin; using Celsius would wrongly give 100% .

3. Answer: (B) 208.7 J

$Q = 54\text{ cal} \approx 54 \times 4.18 \approx 225.7\text{ J}$. Work by the vapour $W = P\Delta V = 1.013 \times 10^5 \times (167.1 - 0.1) \times 10^{-6} \approx 16.9\text{ J}$. $\Delta U = Q - W \approx 208.8\text{ J} \approx 208.7\text{ J}$.

4. Answer: (B) 90 J

For a Carnot cycle the coefficient of performance as a refrigerator is $\beta = (1 - \eta)/\eta = (9/10)/(1/10) = 9$. Heat drawn from the cold reservoir $Q_2 = \beta W = 9 \times 10 = 90\text{ J}$. 100 J is the heat rejected to the hot reservoir ($Q_2 + W$).

5. Answer: (A) $(1/2)(P_1 + P_2)(V_2 - V_1)$

Work done is the area under the P-V path, whatever the equation of state. For a straight line from (V_1, P_1) to (V_2, P_2) the area is a trapezium: $W = \frac{1}{2}(P_1 + P_2)(V_2 - V_1)$. The constant b does not enter, because the work uses the actual volume change.

6. Answer: (D) R

For a polytropic process $PV^n = \text{constant}$, $C = C_v + R/(1 - n)$. With $C_v = 3R/2$ and $n = 3$, $C = 3R/2 - R/2 = R$. $3R/2$ is just C_v , which applies only at constant volume.

7. Answer: (B) $(t_1 + 273)/(t_1 - t_2)$

For an ideal (Carnot) refrigerator, heat delivered to the hot reservoir per unit work is $Q_1/W = T_1/(T_1 - T_2)$, with $T_1 = t_1 + 273$ K and $T_1 - T_2 = t_1 - t_2$. The expression with $t_2 + 273$ in the numerator is the heat extracted from inside (coefficient of performance), not the heat delivered to the room.

8. Answer: (C) 236.5 W

Coefficient of performance $= T_2/(T_1 - T_2) = 277/26 \approx 10.65$. Heat removed per second $= 600 \times 4.2 = 2520$ W, so power $= 2520/10.65 \approx 236.5$ W. Forgetting to convert calories to joules gives about 56 W, and slips in the powers of ten give the other values.

9. Answer: (B) Compressing the gas through adiabatic process will require more work to be done.

On a P-V diagram the adiabatic curve is steeper, so during adiabatic compression the pressure rises faster and the area under the curve (work done on the gas) is larger for the same volume change. This holds for any $\gamma > 1$, so it does not depend on atomicity.

10. Answer: (D) 90 J

For the Carnot cycle $\eta = W/Q_H = 1/10$, so with $W = 10$ J, $Q_H = 100$ J. The heat taken from the cold reservoir is $Q_L = Q_H - W = 90$ J. 100 J is the heat rejected to the hot reservoir, not that absorbed from the cold one.

11. Answer: (B) P/64

Isothermal doubling halves the pressure to $P/2$. Adiabatic from $2V$ to $16V$: $P_f = (P/2)(2/16)^{(5/3)} = (P/2)(1/32) = P/64$. Pressure must fall on expansion, so the large multiples are impossible.

12. Answer: (D) 3/2

For an adiabatic process $PV^\gamma = \text{constant}$ combined with $PV = nRT$ gives $P \propto T^{\gamma/(\gamma - 1)}$. Setting $\gamma/(\gamma - 1) = 3$ gives $\gamma = 3\gamma - 3$, so $\gamma = 3/2$. $5/3$ is the monatomic value and does not satisfy the given relation.

13. Answer: (A) 256 atm

For an adiabatic process $P^{1-\gamma}T^\gamma$ is constant, so $P \propto T^{\gamma/(\gamma-1)} = T^{3.5}$. T rises from 300 K to 1200 K, a factor of 4, so $P_2 = 2 \times 4^{3.5} = 2 \times 128 = 256$ atm. Using Celsius temperatures or $P \propto T$ (isochoric) gives the wrong values.

14. Answer: (A) 293 cal/K

Heat absorbed $Q = mL = 1000 \text{ g} \times 80 \text{ cal/g} = 8 \times 10^4 \text{ cal}$ at constant $T = 273$ K. $\Delta S = Q/T = 80000/273 \approx 293 \text{ cal/K}$. Giving $8 \times 10^4 \text{ cal/K}$ forgets to divide by the temperature.

15. Answer: (C) $c_p - c_v = R/M$

For one mole, $C_p - C_v = R$ (Mayer's relation). Specific heats per unit mass are molar heats divided by M , so $c_p - c_v = R/M$. ' $c_p - c_v = R$ ' applies to molar specific heats, not per unit mass.

16. Answer: (D) 32 P_1

For an adiabatic process PV^γ is constant with $\gamma = 5/3$ for a monoatomic gas. $P_2 = P_1(V_1/V_2)^\gamma = P_1 \times 8^{(5/3)} = P_1 \times 2^5 = 32P_1$. $64P_1$ would correspond to $\gamma = 2$, and $16P_1$ to $\gamma = 4/3$.

17. Answer: (B) $\Delta U = -\Delta W$, in an adiabatic process

First law: $Q = \Delta U + \Delta W$ with ΔW the work done by the system. In an adiabatic process $Q = 0$, so $\Delta U = -\Delta W$. In an isothermal process of an ideal gas $\Delta U = 0$, so neither isothermal relation holds.

18. Answer: (A) In an isochoric process pressure remains constant

In an isochoric process the volume is held constant; constant pressure describes an isobaric process. The other statements (constant temperature in isothermal, $PV^\gamma = \text{constant}$ and thermal insulation in adiabatic) are all correct.

19. Answer: (C) 7900 J

First law: $\Delta U = Q - W = 2 \times 4200 - 500 = 7900$ J (1 cal = 4.2 J). Adding the work instead of subtracting gives 8900 J.

20. Answer: (D) $E = 0$

Internal energy is a state function, so after a complete cycle its change E is zero. From $Q = E + W$ this gives $Q = W$, but neither heat nor work need be zero: a heat engine running in a cycle does net work.

21. Answer: (C) 99°C

$1/6 = 1 - T_2/T_1$ and $1/3 = 1 - (T_2 - 62)/T_1$. Subtracting, $62/T_1 = 1/6$, so $T_1 = 372\text{ K} = 99^\circ\text{C}$. 62°C confuses the temperature drop with the source temperature.

22. Answer: (C) 250 K

With the sink at 300 K , $0.4 = 1 - 300/T_1$ gives $T_1 = 500\text{ K}$. The new efficiency is $0.4 + 0.5 \times 0.4 = 0.6$, so $300/T_1' = 0.4$ and $T_1' = 750\text{ K}$. The source must be raised by $750 - 500 = 250\text{ K}$; reading '50% more' as an efficiency of 90% gives an impossible value.

23. Answer: (D) Isothermal compression

A quasi-static isothermal compression can be retraced through the same equilibrium states, so it is reversible. Heat flow by conduction or radiation across a finite temperature difference and Joule heating are irreversible.

24. Answer: (C) $1.2 \times 10^4\text{ cal}$

$\eta = 1 - T_2/T_1 = 1 - 400/500 = 0.2$ (temperatures in kelvin). $W = 0.2 \times 6 \times 10^4 = 1.2 \times 10^4\text{ cal}$. Using Celsius temperatures or the rejected heat ($4.8 \times 10^4\text{ cal}$) gives the wrong choices.

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