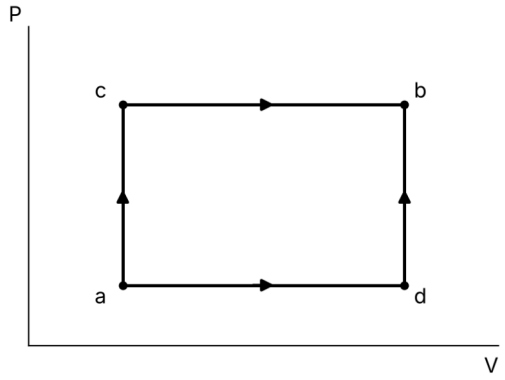
Engineering Daily 19 [Set 04] EV

Thermodynamics

Total Marks: 50 **Negative Marks:** 0.25 **Time:** 1 Hour

MCQ 50 marks



1. In the figure, when a system is taken from a to b along path acb, 250 J of heat is absorbed and the system does 90 J of work. If the work done along adb is 40 J, how much heat is absorbed along adb?

(A) 160 J (B) 200 J (C) 290 J (D) 120 J

2. What is the maximum possible efficiency of an engine working between 177°C and 627°C?

(A) 66.7% (B) 71.8% (C) 28.2% (D) 50.0%

3. The coefficient of performance of a refrigerator is 5. If 300 J is removed from the cold compartment per cycle, what is the work done per cycle?

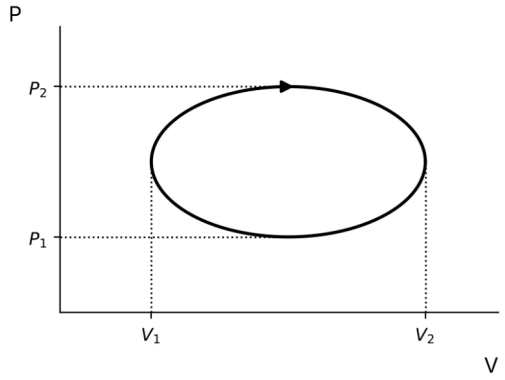
(A) 60 J (B) 240 J

(C) 360 J (D) 1500 J

4. The melting point of lead is 327°C and its latent heat of fusion is 5.86 cal g^{-1}. What will be the change in entropy to melt 2 gm-mol of lead? (Atomic weight of lead 207)

(A) 2.02 calK^{-1} (B) 8.09 calK^{-1}

(C) 7.42 calK^{-1} (D) 4.04 calK^{-1}



5. What is the work done in the process shown in the figure?

(A) 1256.6 J (B) 628.3 J (C) 800.0 J (D) 2513.3 J

6. The efficiency of an engine is 35%. If it rejects 3250 J of heat per cycle, how much heat does it absorb per cycle?

(A) 5000 J (B) 4388 J (C) 1750 J (D) 9286 J

7. The electrical power of a refrigerator is 500 W, its electrical efficiency is 80% and its coefficient of performance is 4. If 5 kg of water at 0°C is kept inside, how long will it take to turn completely into ice?

(A) 8 min 45 s (B) 14 min 0 s

(C) 21 min 53 s (D) 17 min 30 s

8. The specific heat of helium at constant volume is 0.75 cal $g^{-1}°C^{-1}$. What is its molar specific heat at constant pressure? (R = 2 cal $mol^{-1}°C^{-1}$, molecular weight of helium M = 4)

(A) 2.75 cal $mol^{-1}°C^{-1}$ (B) 1.25 cal $mol^{-1}°C^{-1}$

(C) 3 cal $mol^{-1}°C^{-1}$ (D) 5 cal $mol^{-1}°C^{-1}$

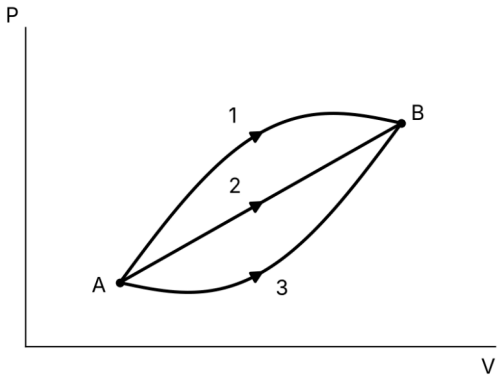
9. In which of the following cases does the entropy of the system decrease?

(A) Water turns into steam

(B) Gas expands isothermally

(C) Water freezes into ice

(D) Ice melts into water



10. A gas goes from state A to state B through three different paths 1, 2 and 3 as shown in the figure. If the work done by the gas is W_1, W_2 and W_3 respectively, which one is correct?

(A) $W_2 > W_1 > W_3$ (B) $W_1 < W_2 < W_3$

(C) $W_1 = W_2 = W_3$ (D) $W_1 > W_2 > W_3$

11. Liquid helium has a very low boiling point 4.2 K as well as a low latent heat of vaporization equal to 2.09×10^4 J kg^{-1}. What is the boiling time for 3 kg of liquid helium by a 150 W heater?

(A) 13.93 min (B) 4.18 min

(C) 6.97 min (D) 10.45 min

12. For a gas C_P = 29.1 J $mol^{-1}K^{-1}$ and C_V = 20.8 J $mol^{-1}K^{-1}$. If the gas at 300 K is suddenly compressed adiabatically to half its volume, what will be the final temperature?

(A) 227.5 K (B) 791.5 K

(C) 395.6 K (D) 600.0 K

13. What is the relation between pressure and temperature in an adiabatic process?

(A) $PT^{\gamma-1} = K$ (B) $P^{\gamma-1}T = K$

(C) $P^{\gamma}T^{1-\gamma} = K$ (D) $P^{1-\gamma}T^{\gamma} = K$

14. A faulty thermometer indicates 5°C at the ice point and 115°C at the steam point. If the actual temperature of a body is 60°C, what will the faulty thermometer indicate?

(A) 60°C (B) 71°C (C) 66°C (D) 76°C

15. When an ideal monatomic gas is heated at constant pressure, what fraction of the heat energy supplied is spent in doing external work?

(A) $\frac{5}{7}$ (B) $\frac{2}{5}$ (C) $\frac{3}{5}$ (D) $\frac{2}{7}$

16. A Carnot engine operates between absolute temperatures T_H and T_C with efficiency η. If the absolute temperatures of both reservoirs are doubled, what will the new efficiency?

(A) η (B) $1 - 2\eta$ (C) 2η (D) $\frac{\eta}{2}$

17. A 4 kg iron cylinder contains 3 mol of an ideal diatomic gas. The whole system is heated at constant pressure from 300 K to 450 K. What is the total change in entropy of this system? (Specific heat of iron 450 J $kg^{-1}K^{-1}$)

(A) 754.8 JK^{-1} (B) 35.4 JK^{-1}

(C) 729.8 JK^{-1} (D) 765.2 JK^{-1}

18. The initial pressure and volume of a gas are 3 atm and 5×10^{-2} m^3. The gas undergoes a process obeying PV = constant. If the final volume is three times the initial volume, how much heat does the gas absorb?

(A) 7251.7 J (B) 30393.0 J

(C) 0 J (D) 16697.5 J

19. 0.5 kg of ice at 0°C is converted into water at 50°C. Determine the change in entropy.

(A) 968.6 JK^{-1} (B) 353.2 JK^{-1}

(C) 615.4 JK^{-1} (D) 1937.1 JK^{-1}

20. Three 10 cm long copper rods and two 15 cm long steel rods at 10°C are joined to form a 60 cm long rod. What is the increase in length of the joined rod when the temperature is raised to 110°C? (Coefficient of linear expansion of copper = 1.7×10^{-5} K^{-1} and steel = 1.2×10^{-5} K^{-1})

(A) 1.02 mm (B) 1.74 mm

(C) 0.87 mm (D) 0.51 mm

21. A stirrer rotates in 3 L of water along a circular path of radius 5 cm with an angular speed of 400 rev s^{-1} against a retarding force of 0.3 N. Neglecting heat loss by radiation, find the rise in temperature of the water per second.

(A) 2.99×10^{-3} K (B) 4.76×10^{-4} K

(C) 1.50×10^{-3} K (D) 1.88×10^{-2} K

22. 1 kg of ice at −10°C is mixed with 0.2 kg of steam at 100°C. What is the final temperature of the mixture? (Specific heat of ice 2100 $Jkg^{-1}K^{-1}$, latent heat of fusion 336000 Jkg^{-1}, latent heat of vaporization 2268000 Jkg^{-1}; no heat loss)

(A) 35.83°C (B) 40.83°C

(C) 0°C (D) 100°C

23. How much heat must be released to condense 0.03 kg of steam at 100°C and turn it into ice at −10°C? (Latent heat of condensation of steam = 2268000 Jkg^{-1}, specific heat of ice = 2100 $Jkg^{-1}K^{-1}$ and latent heat of fusion of ice = 336000 Jkg^{-1})

(A) 12600 J (B) 80430 J

(C) 90720 J (D) 91350 J

24. Three different liquids A, B and C of equal mass are at 10°C, 20°C and 30°C respectively. When A is mixed with B the temperature becomes 16°C. When B is mixed with C the temperature becomes 26°C. What will be the temperature if A is mixed with C?

(A) 25.38°C (B) 20.00°C

(C) 23.85°C (D) 21.00°C

25. The motor of a fridge has a power of 250 W. If the temperature of the cold compartment is 268 K and the outside temperature is 298 K, what is the maximum amount of heat that can be extracted from the cold compartment in 30 min?

(A) 4.50×10^5 J (B) 2.24×10^6 J

(C) 4.02×10^6 J (D) 4.47×10^6 J

26. 3 g of water is boiled into steam at 1 atm, each gram becoming 1671 cm^3 of steam. If the heat of vaporization at this pressure is 2256 Jg^{-1}, what is the change in internal energy?

(A) 507.6 J (B) 6260.4 J

(C) 7275.6 J (D) 6768.0 J

27. How long will a 2000 W immersion heater take to heat a vessel full of 15 L water from 25°C to 45°C?

(A) 315 s (B) 630 s

(C) 1260 s (D) 150 s

28. The volume of a certain mass of oxygen at 2×10^5 Pa and 300 K is 2×10^{-3} m^3. If its volume is suddenly doubled adiabatically, what will be the change in its internal energy? The molar heat capacities of oxygen at constant pressure and constant volume are 29.2 J $mol^{-1}K^{-1}$ and 20.9 J $mol^{-1}K^{-1}$.

(A) −242.1 J (B) −96.9 J

(C) −277.3 J (D) +242.1 J

29. A platinum resistance thermometer reads 2.60 Ω at 0°C and 3.56 Ω at 100°C. What will it read at 40°C?

(A) 2.888 Ω (B) 3.176 Ω

(C) 2.984 Ω (D) 3.024 Ω

30. R = 8.314 $Jmol^{-1}K^{-1}$] [How much heat is required to raise the temperature of 3 mol of helium gas by 40 K at constant volume? (R = 8.314 $Jmol^{-1}K^{-1}$)

(A) 498.8 J (B) 997.7 J

(C) 1496.5 J (D) 2494.2 J

31. In which process is all the heat supplied to a gas used only to increase its internal energy?

(A) Isochoric (B) Adiabatic

(C) Isothermal (D) Isobaric

32. If some water at 4°C is slowly cooled to 0°C (before freezing), its volume—

(A) Increases

(B) Remains unchanged

(C) Decreases

(D) First decreases then increases

33. In an adiabatic process $\gamma = 1.4$. If the pressure of a diatomic gas is increased by 1.4%, the volume will decrease by—

(A) 1.93% (B) 0.99% (C) 1.40% (D) 0.40%

34. The temperature of a cup of tea is lowered from 90°C to 40°C. What is this change on the Fahrenheit scale?

(A) 50°F (B) 27.8°F

(C) 122°F (D) 90°F

35. Two Carnot engines A and B. The source temperature of A is 400 K and its expansion or compression ratio is 1:2. The source temperature of B is 450 K and its ratio is 1:3. 1 mole of diatomic gas is used as the working substance in both engines. Which engine is more efficient and what is its efficiency?

(A) B; 24.2% (B) B; 35.6%

(C) A; 35.6% (D) A; 24.2%

36. A heat engine takes 1600 J per cycle from a source at 227°C and rejects 1120 J to a sink at 47°C. Find the efficiency of the engine.

(A) 30% (B) 36% (C) 79.3% (D) 70%

37. A gas in a cylinder is held at a constant pressure of 1.2×10^5 Pa and is cooled and compressed from 3.0 m^3 to 2.0 m^3. The internal energy of the gas decreases by 2.5×10^5 J. How much heat is removed from the gas?

(A) 2.5×10^5 J (B) 3.7×10^5 J

(C) 1.2×10^5 J (D) 1.3×10^5 J

38. The heat source of a Carnot engine contains 100 mol of gas at 5 atm in 200 L. The sink contains 200 mol of gas at 2 atm in 300 L. What is the efficiency of the engine? (These two gases are not the working substance)

(A) 40% (B) 75%

(C) 70% (D) 30%

39. What is the difference in entropy between 10 gm of water at 100°C and 10 gm of steam at 100°C at 1 atmospheric pressure? (Latent heat of steam at 100°C = 540 cal g^{-1})

(A) 14.48 cal K^{-1} (B) 1.45 cal K^{-1}

(C) 54.0 cal K^{-1} (D) 5400 cal K^{-1}

40. How much heat is required to raise the temperature of 1.5 kg of ice from −15°C to −5°C?

(A) 15750 J (B) 535500 J

(C) 63000 J (D) 31500 J

41. How many joules of heat are needed to raise the temperature of 25 gm of water from 12°C to 30°C?

(A) 450 J (B) 3150 J

(C) 107.1 J (D) 1890 J

42. The equation of state of a gas is $P(V - b) = RT$. 1 mol of the gas is expanded isothermally at 300 K from 3×10^{-4} m^3 to 9×10^{-4} m^3. If $b = 1 \times 10^{-4}$ m^3, what is the work done?

(A) 1729.0 J (B) 3457.7 J

(C) 2740.2 J (D) 4048.3 J

43. The temperature of 8 g of nitrogen is raised by 15°C (i) at constant pressure and (ii) at constant volume. What is the change in internal energy in each case respectively? (For nitrogen $C_V = 0.177$ cal $g^{-1}°C^{-1}$, J = 4.2 J cal^{-1})

(A) 89.2 J, 89.2 J (B) 89.2 J, 0 J

(C) 124.9 J, 89.2 J (D) 124.9 J, 124.9 J

44. 4 kg of water is heated from 10°C to 20°C at atmospheric pressure (10^5 Pa). If the density of water at 10°C and 20°C is 999.7 kgm^{-3} and 998.2 kgm^{-3} respectively, what is the change in internal energy?

(A) 168000.0 J (B) 167999.4 J

(C) 167940.0 J (D) 168000.6 J

45. Dry air at normal temperature and pressure enclosed in a piston-cylinder is compressed to $\frac{2}{5}$ of its volume. If the temperature remains unchanged, what will be the final pressure?

(A) 1.01×10^5 Nm^{-2} (B) 4.05×10^5 Nm^{-2}

(C) 2.53×10^5 Nm^{-2} (D) 0.41×10^5 Nm^{-2}

46. A developed country generates about 6.0×10^{16} J of electrical energy a day. If this energy is generated by a power plant with an average efficiency of 40%, how much heat is dumped into the environment each day?

(A) 1.5×10^{17} J (B) 9.0×10^{16} J

(C) 4.0×10^{16} J (D) 3.6×10^{16} J

47. What is the change in entropy if 1 kg of water at 10°C is mixed with 2 kg of water at 70°C?

(A) 50.61 JK^{-1} (B) −50.61 JK^{-1}

(C) 555.2 JK^{-1} (D) 0 JK^{-1}

48. 2 mol of an ideal diatomic gas is heated at constant volume from 300 K to 600 K. What is the change in entropy of the gas?

(A) $0\ \mathrm{J\,K^{-1}}$ (B) $11.53\ \mathrm{J\,K^{-1}}$

(C) $28.81\ \mathrm{J\,K^{-1}}$ (D) $40.34\ \mathrm{J\,K^{-1}}$

49. In an adiabatic process, when the temperature of a body is raised from 25°C to 125°C, the pressure becomes double. What is the absolute value of the slope in the $\ln P$ versus $\ln V$ graph?

(A) 1.72 (B) 0.58 (C) 1.40 (D) 1.67

50. Two separate vessels contain 2 mol and 3 mol of the same ideal gas at the same temperature and pressure. If they are allowed to mix, what is the total change in entropy?

(A) $5R \ln 3$ (B) 0

(C) $5R \ln 2$ (D) $R\left(2 \ln \frac{5}{2} + 3 \ln \frac{5}{3}\right)$