Engineering Daily 19 [Home Practice] EV

Thermodynamics

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

MCQ 50 marks

1. An iron nail of 20 gm is heated in a burner flame for some time. The hot nail is dipped into 200 gm of water at 15°C, raising the water temperature to 25°C. Find the temperature of the nail before dipping. (Specific heat of iron = 0.11 kcal $kg^{-1}°C^{-1}$)

(A) 959.1°C (B) 934.1°C (C) 909.1°C (D) 467.0°C

2. In an adiabatic process the pressure and temperature of an ideal gas are related by $P \propto T^4$. What is the value of $\frac{C_P}{C_V}$ for the gas?

(A) $\frac{5}{3}$ (B) $\frac{4}{3}$ (C) $\frac{3}{2}$ (D) $\frac{5}{4}$

3. 1 kg of water at 80°C is poured into a huge lake at 20°C. What is the total change in entropy of the universe (water + lake) when equilibrium is reached? (The lake temperature remains unchanged)

(A) 860.1 $J K^{-1}$ (B) 0 $J K^{-1}$

(C) 77.6 $J K^{-1}$ (D) −782.4 $J K^{-1}$

4. An ideal gas at initial temperature T_1 has an initial volume of 3 m^3. Due to adiabatic expansion its volume becomes 6 m^3; then it expands isothermally to 15 m^3; in the next step an adiabatic compression brings its temperature back to T_1. What is its final volume?

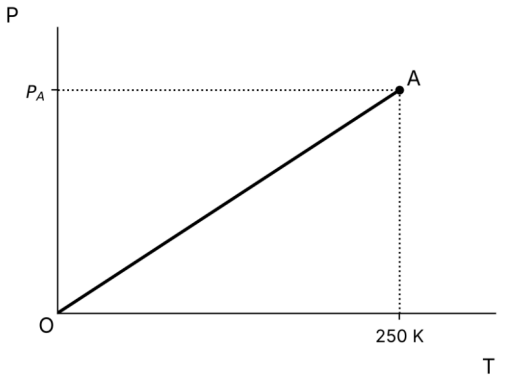
(A) 7.5 m^3 (B) 6 m^3

(C) 5 m^3 (D) 3 m^3

5. Determine the change in entropy to convert 2 kg of ice at −10°C into steam at 100°C. (Specific heat of ice 2100 $Jkg^{-1}K^{-1}$, latent heat of fusion 336000 Jkg^{-1}, latent heat of vaporization 2268000 Jkg^{-1})

(A) 1.22×10^4 $J K^{-1}$ (B) 8.70×10^3 $J K^{-1}$

(C) 1.48×10^4 $J K^{-1}$ (D) 1.74×10^4 $J K^{-1}$



6. The graph shows the variation of pressure with temperature of 3 moles of a gas. The volume of the gas remains constant along OA. The molar specific heat at constant volume is 20.8 $J mol^{-1}K^{-1}$. Find the change in internal energy along OA.

(A) 5200 J (B) 21835 J

(C) 31200 J (D) 15600 J

7. By how much will the mass of 50 kg of copper increase if its temperature is raised by 200°C? (Specific heat of copper = 389 $J kg^{-1}K^{-1}$)

(A) 2.16×10^{-11} kg (B) 4.32×10^{-11} kg

(C) 4.32×10^{-13} kg (D) 1.30×10^{-2} kg

8. A monatomic ideal gas is heated at constant volume until its pressure doubles. It is again heated at constant pressure until its volume doubles. Find the molar heat capacity for the whole process.

(A) 2.07R (B) 2.17R (C) 2.00R (D) 4.00R

9. When heat is supplied to an ideal diatomic gas, one-third of the supplied heat is used by the gas to do external work. What is the molar heat capacity of the gas in this process?

(A) 3.50R (B) 2.50R (C) 1.67R (D) 3.75R

10. Which thermometer is used to measure temperatures above 3000°C without contact?

(A) Pyrometer

(B) Constant volume gas thermometer

(C) Platinum resistance thermometer

(D) Thermocouple thermometer

11. On which does the internal energy of an ideal gas depend?

(A) Only temperature (B) Path of the process

(C) Only pressure (D) Only volume

12. At the same point on a P-V diagram, how many times is the slope of the adiabatic curve the slope of the isothermal curve?

(A) γ (B) $\frac{1}{\gamma}$ (C) 1 (D) $\gamma - 1$

13. What must be the sink temperature for the efficiency of a Carnot engine to be 100%?

(A) 273 K (B) 0°C

(C) Half of source temperature (D) 0 K

14. Some gas is enclosed in a cylinder with a piston. Keeping the pressure constant at 500 Pa, 900 J of heat is slowly supplied and 1500 J of work is done. What are the changes in volume and internal energy of the gas?

(A) −3 m^3, −600 J (B) 3 m^3, −600 J

(C) 1.8 m^3, +2400 J (D) 3 m^3, +600 J

15. A thermometer is made using a carbon resistor having a temperature coefficient of resistivity of $-0.0005°C^{-1}$. On a winter day at 10°C the resistance is 200 Ω. What is the temperature on a summer day when the resistance is 196.2 Ω?

(A) 47.81°C (B) 28.00°C

(C) 38.00°C (D) 48.00°C

16. In a mercury thermometer the length of the mercury column is 4 cm at the ice point and 24 cm at the steam point. When dipped in a liquid the length becomes 9.6 cm. What is the temperature of the liquid on the Fahrenheit scale?

(A) 50.4°F (B) 104.0°F

(C) 82.4°F (D) 28.0°F

17. A 20 g lead bullet at 30°C moving at 400 ms^{-1} strikes a large block of ice at 0°C and stops. If the ice receives all the heat, how many grams of ice will melt? (Specific heat of lead 130 $Jkg^{-1}K^{-1}$, latent heat of fusion 336000 Jkg^{-1})

(A) 9.52 g (B) 0.23 g (C) 4.76 g (D) 4.99 g

18. A sample of ideal gas is expanded from 1 m^3 to 3 m^3 in a quasi-static process for which $P = \alpha V^2$, with $\alpha = 2\ atm\ m^{-6}$. How much work is done by the expanding gas?

(A) 5.27 MJ (B) 1.76 MJ

(C) 0.53 MJ (D) 0.81 MJ

19. Suppose there is friction between the piston and the cylinder wall of a Carnot engine. What will happen to the efficiency of the engine and to the area enclosed by the P-V diagram?

(A) Efficiency unchanged, area decreases

(B) Efficiency decreases, area unchanged

(C) Both will decrease

(D) Both will increase

20. 700 g of water at 80°C is mixed with 300 g of water at 30°C. Assume no heat loss to the surroundings. What is the final temperature of this mixture?

(A) 55°C (B) 70°C (C) 65°C (D) 50°C

21. A cylinder contains 8 L of oxygen at 1 atm and 27°C. If the pressure is suddenly made four times, what will be the volume and temperature of the oxygen?

(A) 2.00 L, 300.0 K (B) 2.97 L, 445.8 K

(C) 2.97 L, 300.0 K (D) 2.00 L, 445.8 K

22. A large balloon filled with 1.00×10^3 m^3 of helium at 1.00 atm and 27.0°C rises rapidly from the ground to an altitude where the atmospheric pressure is only 0.800 atm. Assume helium behaves as an ideal gas and the balloon ascends so fast that there is no chance of heat exchange with the surrounding air. What is the change in internal energy of the helium?

(A) -1.30×10^7 J (B) $+1.30 \times 10^7$ J

(C) -2.16×10^7 J (D) -7.92×10^6 J

23. A closed system receives 120 kJ of heat at constant volume. Then at constant pressure it rejects 40 kJ of heat while 25 kJ of work is done on it. The system is then restored to its initial state by an adiabatic process. How much work is done by the system in the adiabatic process?

(A) 80 kJ (B) 55 kJ

(C) 135 kJ (D) 105 kJ

24. $\frac{C_P}{C_V} = \frac{5}{3}$] [When an atomic bomb explodes, the fireball formed has a radius of 50 m and a temperature of 8×10^4 K. If the fireball expands adiabatically to a radius of 400 m, what will be its probable temperature? ($\frac{C_P}{C_V} = \frac{5}{3}$)

(A) 156.25 K (B) 1250 K

(C) 10000 K (D) 5000 K

25. J = 4.2 J cal^{-1}] [The speed of a 25 kg meteor decreases from 30 km min^{-1} to 6 km min^{-1} while passing through the earth's atmosphere. Find the heat produced in calories. (J = 4.2 J cal^{-1})

(A) 7.14×10^5 cal (B) 2.57×10^3 cal

(C) 3.0×10^6 cal (D) 2.57×10^9 cal

26. A power station contains a heat engine operating between two heat reservoirs, one containing steam at 150°C and the other containing water at 30°C. What is the maximum amount of electrical energy which can be generated for each joule of heat extracted from the steam?

(A) 0.800 J (B) 0.716 J

(C) 0.284 J (D) 0.200 J

27. Water is more suitable for cooling hot bodies because water has—

(A) High boiling point

(B) High thermal conductivity

(C) High specific heat

(D) High density

28. $\gamma = 1.4$] [Some air at 27°C and 76 cm of mercury pressure is doubled in volume adiabatically. Then, keeping the volume constant, its temperature is raised by 30 K. What will be the final pressure? ($\gamma = 1.4$)

(A) 41.38 cm-Hg (B) 32.60 cm-Hg

(C) 38.00 cm-Hg (D) 28.80 cm-Hg

29. $\gamma = 1.4$] [A diatomic gas of density 1.2 kgm^{-3} is compressed adiabatically so that its pressure becomes 128 times. What is the change in density of the gas? ($\gamma = 1.4$)

(A) 38.4 kgm^{-3} (B) 152.4 kgm^{-3}

(C) 37.2 kgm^{-3} (D) 18.0 kgm^{-3}

30. J = 4.2 J cal^{-1}, g = 9.8 ms^{-2}] [To what height can a 10 kg body be raised by the work equivalent to 1 kcal of heat? (J = 4.2 J cal^{-1}, g = 9.8 ms^{-2})

(A) 10.20 m (B) 42.86 m

(C) 0.043 m (D) 428.6 m

31. The work done in the isothermal expansion of 2 moles of a gas at 27°C is 3458 J. If the initial volume of the gas is 500 cm^3, what will be the volume after expansion?

(A) 1500 cm^3 (B) 1000 cm^3

(C) 750 cm^3 (D) 2000 cm^3

32. Mr. Rafiq kept 255 gm of ice at 0°C in a container, 10% of which has already melted. What will be the change in entropy to convert the entire ice-water mixture in the container into steam at 100°C? (Latent heat of fusion 336000 Jkg^{-1}, latent heat of vaporization 2268000 Jkg^{-1})

Ⓐ 1550.5 JK^{-1} Ⓑ 2198.6 JK^{-1}

Ⓒ 2167.2 JK^{-1} Ⓓ 1884.8 JK^{-1}

33. An ideal gas is kept in a closed, rigid and thermally insulated container. A coil of 50 Ω resistance carries a current of 3 A for 5 minutes. What will be the change in internal energy of the gas?

Ⓐ 135 kJ Ⓑ 45 kJ

Ⓒ 2.25 kJ Ⓓ 0 kJ

34. A sealed beaker contains 100 g of water initially at 25°C. How much heat is required to bring the water to its boiling point? (Specific heat of water 4.186 kJ $kg^{-1}°C^{-1}$, boiling point 100°C, and heat of vaporization 2260 kJ kg^{-1})

Ⓐ 257.4 kJ Ⓑ 41.9 kJ

Ⓒ 226.0 kJ Ⓓ 31.4 kJ

35. Which processes make up a Carnot cycle?

Ⓐ Two adiabatic and two isobaric

Ⓑ Two isothermal and two adiabatic

Ⓒ Two isobaric and two isochoric

Ⓓ Two isothermal and two isochoric

36. According to the second law of thermodynamics, which of the following is impossible?

Ⓐ Converting all heat absorbed in isothermal expansion into work

Ⓑ Converting work completely into heat

Ⓒ Transferring heat from cold to hot body using external work

Ⓓ Converting all heat from a single source into work by a cyclic engine

37. R = 8.314 $Jmol^{-1}K^{-1}$] [If the temperature of 4 moles of an ideal gas is raised from 300 K to 350 K at constant pressure, what is the work done by the gas? (R = 8.314 $Jmol^{-1}K^{-1}$)

Ⓐ 2494.2 J Ⓑ 4157.0 J

Ⓒ 11639.6 J Ⓓ 1662.8 J

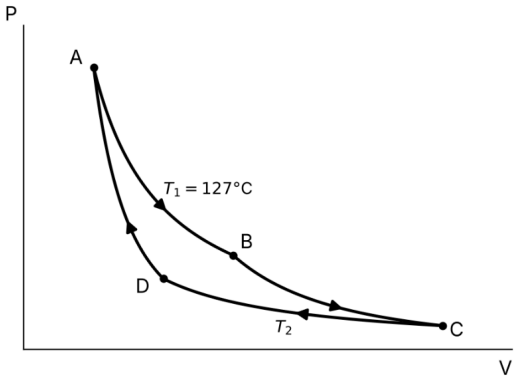
38. γ = 1.4] [The pressure in a car tyre is 3 times the atmospheric pressure at 27°C. If the tyre suddenly bursts, what will be the temperature of the air inside? (γ = 1.4)

Ⓐ −173.0°C Ⓑ 27.0°C

Ⓒ −53.8°C Ⓓ −80.3°C

39. A thermometer with a uniform bore is divided into equal degrees. It reads 10 in melting ice and 90 at 60°C. What reading will it give at 104°F?

Ⓐ 76.67 Ⓑ 53.33 Ⓒ 60.00 Ⓓ 63.33



40. In each stage of a Carnot engine the compression or expansion ratio is 1:3. 2 mol of diatomic gas is used as the working substance. From the graph of the Carnot cycle, calculate the work done from A to B.

Ⓐ 7307.1 J Ⓑ 2320.0 J

Ⓒ 3173.4 J Ⓓ 6650.9 J

41. Which one is the unit of entropy?

Ⓐ $Jkg^{-1}K^{-1}$ Ⓑ JK

Ⓒ $Jmol^{-1}$ Ⓓ JK^{-1}

42. Ice at 0°C is continually added to 500 gm of water at 100°C until no more ice melts. What is the maximum amount of ice that will melt?

Ⓐ 625 g Ⓑ 500 g

Ⓒ 312.5 g Ⓓ 1250 g

43. An inventor claims that his engine, working between 127°C and 27°C, takes 1000 J of heat from the source and does 300 J of work per cycle. How much heat will the engine reject to the sink per cycle?

Ⓐ 750 J

Ⓑ 700 J

Ⓒ Such an engine is not possible

Ⓓ 250 J

44. Two Carnot engines are built, the first to work between 227°C and 27°C and the second between 27°C and −73°C. What is the ratio of the efficiencies of the two Carnot engines?

Ⓐ 1 : 1 Ⓑ 2 : 1

Ⓒ 1 : 1.2 Ⓓ 1.2 : 1

45. In an ideal refrigerator, heat from inside at 260 K is transferred to a room at 300 K. How many joules of heat will be delivered to the room for each joule of work done?

Ⓐ 7.5 J Ⓑ 0.87 J

Ⓒ 6.5 J Ⓓ 1.15 J

46. An ideal gas has initial volume V and pressure P. In doubling its volume, in which of the following processes will the work done by the gas be minimum?

Ⓐ Isothermal Ⓑ Adiabatic

Ⓒ Equal in all processes Ⓓ Isobaric

47. How many values can the specific heat of a gas have?

(A) **Two** (B) **One**

(C) **Infinite** (D) **Three**

48. A 2 kg block of aluminium is heated from 27°C to 227°C using an electric heater. If the specific heat capacity of aluminium is 0.9 J $g^{-1}°C^{-1}$, what will be the change in entropy of the block?

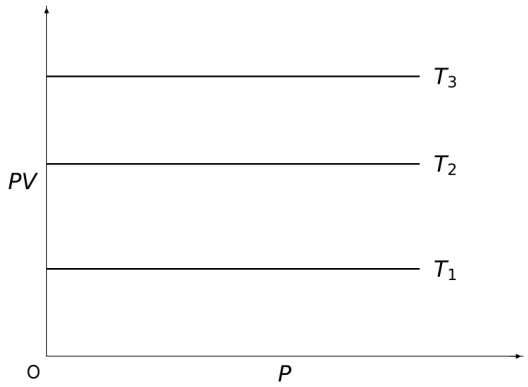
(A) **919.5 J K^{-1}** (B) **4086.6 J K^{-1}**

(C) **1200.0 J K^{-1}** (D) **15.24 J K^{-1}**

49. A Carnot engine working between ice and steam does 746 J of work per cycle. How much heat does the engine reject to the sink per cycle?

(A) **2036.6 J** (B) **746.0 J**

(C) **1490.0 J** (D) **2782.6 J**



50. Which one is correct?

(A) $T_3 > T_2 > T_1$ (B) $T_1 > T_2 > T_3$

(C) $T_1 = T_2 = T_3$ (D) $T_2 > T_3 > T_1$