CBSE

THERMODYNAMICS WS 8

Class 11 - Physics

Section A

1. A scientist says that the efficiency of his heat engine, which works at source temperature $127^\circ C$ and sink temperature $27^\circ C$, is 26 %. Then **[1]**

   a) it is impossible
   b) it is quite probable
   c) it is possible but less probable
   d) data are incomplete

2. An ideal gas heat engine operates in Carnot cycle between 227° C and 127° C. It absorbs 6×10^4 cal of heat at higher temperature. Amount of heat converted into work is: **[1]**

   a) 1.2×10^4 cal
   b) 2.4×10^4 cal
   c) 4.8×10^4 cal
   d) 6.2×10^4 cal

3. A heat engine is 20% efficient. If the engine does 500 J of work every second, how much heat does the engine exhaust every second? **[1]**

   a) 2500 J
   b) 400 J
   c) 500 J
   d) 2000 J

4. During one cycle of a heat engine 2000 calories of heat is supplied and 1500 calories rejected. The amount of work done equals (assuming J = 4.156 J/cal) **[1]**

   a) 4186 J
   b) 1042 J
   c) 0
   d) 2093 J

5. A power plant that would make use of the temperature gradient in the ocean has been proposed. The system is to operate between 5.00^{o}C (water temperature at a depth of about 1 km) and $20.0^\circ C$ (surface water temperature). If the power output of the plant is 75.0 MW, how much energy is absorbed per hour? **[1]**

   a) 5.27 TJ/hr
   b) 5.07 TJ/hr
   c) 5.57 TJ/hr
   d) 5.37 TJ/hr

6. One of the most efficient engines ever built (actual efficiency 42.0 percent) operates between 430^{o}C and 1 870^{o}C. How much power does the engine deliver if it absorbs1.40×10^5 J of energy each second from the hot reservoir? **[1]**

   a) 52.8 kW
   b) 62.8 kW
   c) 58.1 kW
   d) 58.8 kW

7. A heat engine undergoes a process in which its internal energy decreases by 400 J and it gives out 150 J of heat. During the process: **[1]**

   a) it does 550 J of work and its temperature
   b) it does 250 J of work and its temperature

rises

falls

c) it does 550 J of work and its temperature falls

d) it does 250 J of work and its temperature rises

8. Find the efficiency of a heat engine that absorbs 2000 J of energy from a hot reservoir and exhausts 1500 J to a cold reservoir? **[1]**

a) 25 percent

b) 35 percent

c) 20 percent

d) 30 percent

9. A steam engine has a boiler that operates at 500 K. The energy from the burning fuel changes water to steam, and this steam then drives a piston. The cold reservoir's temperature is that of the outside air, approximately 300 K. What is the maximum thermal efficiency of this steam engine? **[1]**

a) 40 percent

b) 30 percent

c) 25 percent

d) 45 percent

10. An ideal gas heat engine operates in Carnot cycle between 227^{o} C and 127^{o} C. It absorbs 6 kJ of heat at the higher temperature. The amount of heat converted into work is: **[1]**

a) 3.5 kJ

b) 1.6 kJ

c) 1.2 kJ

d) 4.8 kJ

11. A power plant operates at 32.0 percent efficiency during the summer when the seawater for cooling is at 20.0^{o}C. The plant uses 350^{o}C steam to drive turbines. Assuming that the plant's efficiency changes in the same proportion as the ideal efficiency, what would be the plant's efficiency in the winter, when the seawater is at 10.0^{o}C? **[1]**

a) 33 percent

b) 32 percent

c) 31 percent

d) 34 percent

12. One of the most efficient engines ever built (actual efficiency 42.0 percent) operates between 430^{o}C and 1 870^{o}C. What is its maximum theoretical efficiency? **[1]**

a) 99.2 percent

b) 57.2 percent

c) 67.2 percent

d) 87.3 percent

13. A power plant that would make use of the temperature gradient in the ocean has been proposed. The system is to operate between 5.00^{o}C (water temperature at a depth of about 1 km) and 20.0°C (surface water temperature). What is the maximum efficiency of such a system? **[1]**

a) 5.02 percent

b) 5.12 percent

c) 5.45 percent

d) 5.32 percent

14. **Assertion:** For a heat engine, the thermodynamics P-V cyclic curve is always clockwise. **[1]**
Reason: A clockwise cyclic P-V curve does positive work.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

15. **State True or False:** **[1]**

(a) Heat engine can be designed of 100% efficiency. **[1]**

16. Name the hot reservoir in the steam engine and the petrol-engine. **[1]**

17. What is a heat engine? **[1]**

18. Name the working substance in the steam-engine and petrol-engine. **[1]**

19. Is it theoretically possible to device a heat engine which will create no thermal pollution? **[1]**

20. Name the sink in case of a steam-engine. **[1]**

21. State two essential requirements of an ideal heat engine. **[1]**

22. Is the efficiency of a heat engine more in hilly areas than in the plains? **[1]**

Section B

23. What is a heat engine? What is the best way to increase efficiency of a heat engine? Is it possible to design a thermal engine that has 100% efficiency? **[2]**

24. Explain, what do you understand by the efficiency of a heat engine? **[2]**

25. A steam engine delivers $5.4 \times 10^8 \text{J}$ of work per minute and services $3.6 \times 10^9 \text{J}$ of heat per minute from its boiler. What is the efficiency of the engine? How much heat is wasted per minute? **[2]**

26. A steam engine intake steam at 200°C and after doing work exhausts it directly in the air at 100°C. Calculate the percentage of heat used for doing work. Assume the engine to be an ideal engine. **[2]**

Section C

27. **Fill in the blanks:** **[3]**

(a) _____ is a device by which a system is made to undergo a cyclic process, that results in conversions of heat to work. **[1]**

(b) In a steam engine, _____ is the source of heat and _____ is the sink. **[1]**

(c) A heat engine converts _____ into _____ energy. **[1]**

28. Specific heat of Argon at constant Pressure is 0.125 cal/g/K and at constant volume is 0.075 cal/g/ K. Calculate the density of Argon at N.T.P. Given that J = 4.2 Joule/cal? **[3]**

29. What is meant by a reversible heat engine? Explain why a reversible engine is most efficient. **[3]**

Section D

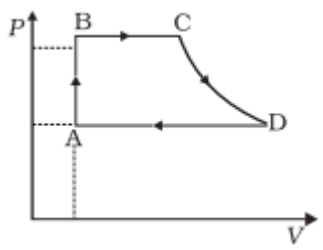
30. A cycle followed by an engine (made of one mole of an ideal gas in a cylinder with a piston) is shown in Fig. Find heat exchanged by the engine, with the surroundings for each section of the cycle. ($C_v = (\frac{3}{2}) R$) **[5]**

AB : constant volume

BC : constant pressure

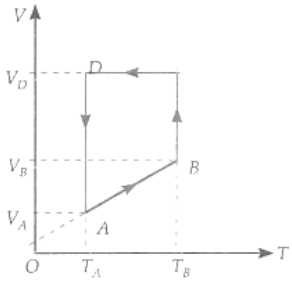
CD : adiabatic

DA : constant pressure



31. A monoatomic ideal gas of two moles is taken through a cyclic process starting from A as shown in Figure. The **[5]**

volume ratios are $\frac{V_B}{V_A}$ = 2 and $\frac{V_D}{V_A}$ = 4. If the temperature T at A is 27°C, calculate,



i. the temperature of the gas at point B,

ii. heat absorbed or released by the gas in each process,

iii. the total work done by the gas during the complete cycle.

Express your answer in terms of the gas constant R.