cause air pollution. In effect, all forms of energy production have some undesirable effects.

The imperative from thermodynamics is that whenever you do anything, be sure to take into account its present and possible future impact on your environment.

QUESTIONS :

The answers to the questions at the end of the chapter are given below:

Q. 11.1 :- The no. of molecules in a gas is large and their motion is random. The no. of molecules moving in any direction with certain velocity is equal to the no. of molecules moving in opposite direction with the same velocity. The avg. velocity of the molecules is, therefore, zero. Let 'v_x' be the velocity of a molecule along +x-axis. Then after collision its velocity will be '$-v_x$'. So

$$\langle v \rangle = \frac{(v_x) + (-v_x)}{2} = 0$$

Hence motion of molecules is not justified. In such cases, avg. of squared velocities is taken which will not be zero. So

$$\langle v^2 \rangle = \frac{(v_x)^2 + (-v_x)^2}{2} \neq 0.$$

Q. 11.2 :- When a car is driven on the road through some distance, its tyre has to overcome the frictional force of the road. The work done against the friction heats up the tyre and hence, the gas in the tyre. This results in the increase in molecular velocities of the air contained in the tyre. This increases the rate of molecular collisions against the walls of the tyre and hence the pressure of air in the tyre increases.

Q. 11.3 :- The given graph and temp. constt. shows that the system undergoes the isothermal expansion. We already know that temp. of a system is directly proportional to internal energy. As temp. remains constt., so internal energy also remains constant. Hence there will be no change in the internal energy of the system.

Q. 11.4 :- In all these cases, the system returns to the initial state i.e. all these are cyclic processes. Hence, there is no change in internal energy.

Q. 11.5 : When a gas is heated under constant volume, no work is done. The entire heat supplied is utilized in raising the internal energy of the system. On the other hand, when a gas is heated under constt. pressure, heat is required not only to increase the internal energy of the

system but also to do work as gas expands against constant pressure. This shows that more heat is required to heat a gas at constt. pressure than at constant volume for the same rise of temperature. Hence, specific heat of a gas at constt. pressure is greater than the specific heat at constt. volume.

Q. 11·6 :- An adiabatic process is a process in which no heat is transferred to or from the system, but its temp. changes.

(i) In an adiabatic expansion of gas, the temp. decreases as the work in expanding the gas is done at the cost of internal energy of the gas.

(ii) In an adiabatic compression, the work done on the gas increases the temp. of the gas.

For example, the passage of sound through air.

Q. 11·7 :- Yes, it is possible to convert internal energy into mechanical energy or work. When a system under an adiabatic process is allowed to expand, volume increases by decreasing pressure and work is

done by the system using its internal energy. Hence, we can say that internal energy of a system is being converted into mechanical energy.

Q. 11.8 :- No, it is not possible to construct a heat engine that will not expel heat into the atmosphere. A heat engine works only when some of the total heat absorbed from the source is expelled to a sink or atmosphere.

Q. 11.9 :- When milk is shaken rapidly in a thermos flask, work is done on the molecules of the system, their velocities increases and its temp., although very small, rises.

Q. 11.10 :- The temp. of the room will not reduce rather it will rise as the heat absorbed from the room is expelled in the same room plus the work done by the compressor is changed into heat and expelled in the same room.

Q. 11.11 :- Yes, mechanical energy can be completely converted into heat energy. When work (mechanical energy) is done in compressing the gas by adiabatic process, the increase in internal energy of the gas is equal to the work done on it.

Q.11.12 :- The entropy of a system increases due to friction as work done against friction is changed into heat and heat added to a system increases its entropy.

Q.11.13 :- Melting of ice into water is such an example. When ice melts due to high temp. of its surroundings, the heat 'ΔQ' transferred to ice from the surroundings at absolute temp. 'T' is '+ve' and is given by:

$$\Delta S = \frac{\Delta Q}{T}.$$

Hence entropy of melted ice i.e. water increases.

Q.11.14 :- An adiabatic change is the one in which no heat enters or leaves the system. Hence correct statement is (a).

Q.11.15 :- An explosion is a rapid process. Such processes are usually irreversible. Hence, the correct answer is (d).

Q.11.16 :- According to second law of thermodynamics, the efficiency of heat engine cannot be 100%. Hence an ideal heat engine has highest efficiency but not equal to 100%. Thus correct answer is (b).