(a) Ideal gas expands from volume *V*1 to volume *V*2 in three different regimes: isothermal, isobaric and adiabatic, Fig.Q1.

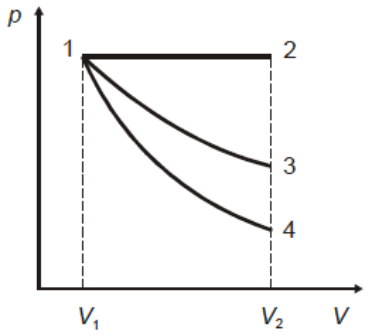

Figure **Q1**

(i) Identify the regimes (isothermal, isobaric, adiabatic) with the curves (1-2, 1-3, 1-4).

(ii) In which of three expansion regimes the gas will perform the larger work?

(iii) In which of three expansion regimes the larger heat will be transferred to the gas?

(i) In this case the gas is expanding therefore its volume will increase and the pressure will drop. As volume gets bigger particles have more space to move around.

Isobaric is curve (1-2). It's a horizontal line because here the pressure is constant.
Isothermal is curve (1-3) temp is constant here, energy added to the system through work, the is no change in internal energy. From perfect gas equation $PV = mRT$, m, R and temperature are constant therefore PV = constant, $P = \frac{constants}{V}$ and that's similar to rectangular hyperbola $y = \frac{1}{x}$

Adiabatic curve is (1-4) there is no heat transfer into or out of the system. The internal energy of gas will decrease. As the gas expands it will cool down and lose its kinetic energy therefore temperature will decrease. The internal energy equal the work done on the gas as there is no heat supply to the gas. The gas is doing work on the environment to expand. Here the gas will end up on a lower pressure. That's why the curve is steeper.

(ii) The area under the curve gives the work done in a system. If expansion is occurring, isothermal will perform the larger work.
In isobaric from the first law of thermodynamics $\Delta U = Q + (-P\Delta V)$

In isothermal process the internal energy $(\Delta U) = 0$
From the first law of thermodynamics $\Delta U = Q + W$ as $\Delta U = 0$, heat flow into the gas (Q) and work done on the gas (W) add up to zero. $Q = W$. The work here is done more on the surrounding. Because the temperature is constant the internal energy didn't change energy had to be added to the system to make up the work done. The heat get transferred from the

surroundings to do the work *therefore isothermal* process does more work than the *adiabatic. The heat transferred to the gas keeps its temperature constant higher pressure and more work done*

whereas for adiabatic heat flow (Q) = 0, From the first law of thermodynamics $\Delta U = Q + W$ as $Q = 0$, internal energy $\Delta U = W$ there it means that the system's used its internal energy to perform its work

(iii) Adiabatic curve (1-4) there is no heat transfer into or out of the system, therefore its excluded. Isobaric curve (1-2) heat is transferred to the system to keep the pressure constant where Isothermal curve (1-3) temperature is constant and the internal energy is equal to zero because the temperature is constant the internal energy didn't change energy had to be added to the system to make up the work done. Therefore, Isobaric has the largest heat transfer.