2 **(a)** A student performs an experiment to determine the specific latent heat of fusion of ice. The student has two sets of apparatus next to each other on the laboratory bench, as shown in Fig. 2.1 and Fig. 2.2.

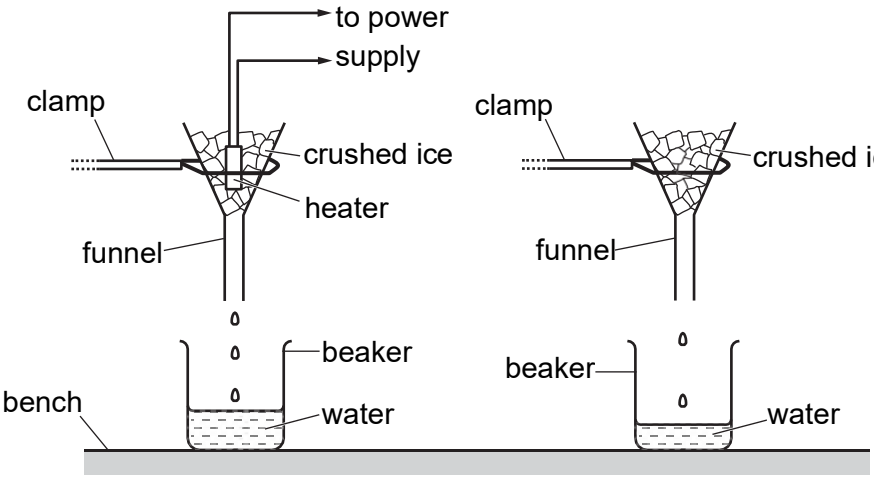

Fig. 2.1

Fig. 2.2

Both funnels are identical and have the same mass of crushed ice at 0 °C.

The current in the heater is 5.0 A and the potential difference across it is 12 V.

Fig. 2.3 shows the variation of mass of water m collected in each beaker with time t.

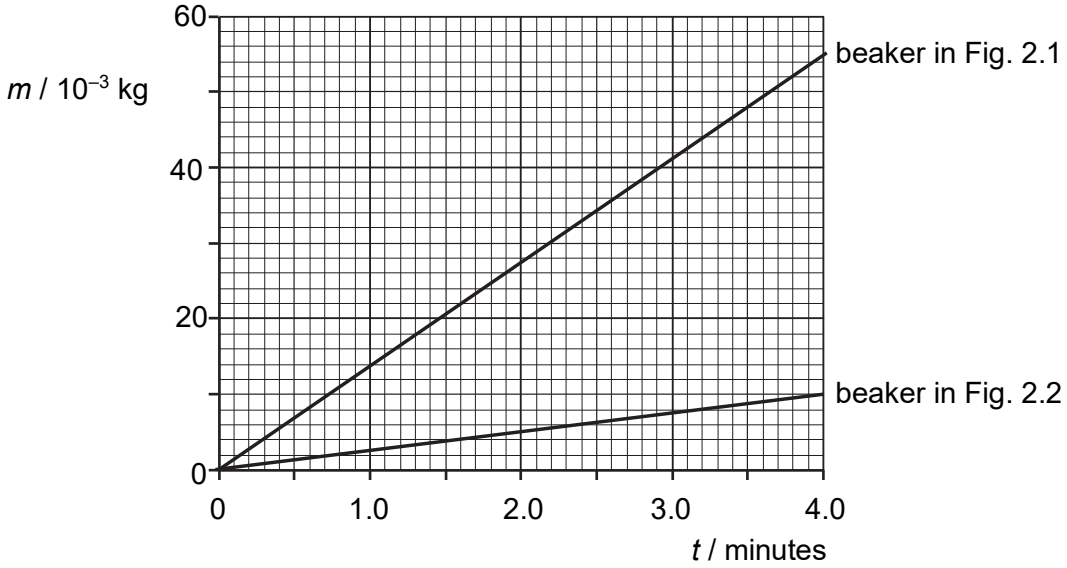

Fig. 2.3

(i) Explain why the gradients of the two graphs are different.

.....

.....[1]

(ii) Use Fig. 2.3 to show that the specific latent heat of fusion of ice is about 3×10^5 J kg^{-1}.

specific latent heat of fusion = ... J kg^{-1} [2]

(b) A heat engine, such as a car engine, is a device that converts thermal energy into mechanical work.

When the heat engine operates, a fixed amount of gas expands and contracts repeatedly in a cylinder with a piston.

The cycle of expansion and contraction for a fixed quantity of an ideal gas is illustrated graphically in Fig. 2.4.

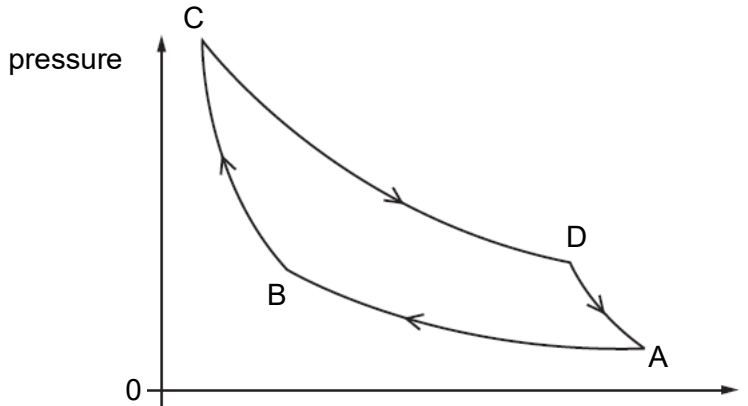

Fig. 2.4

There are four stages in the cycle.

Stage	Description
A to B	a slow compression of the gas at constant temperature
B to C	a sudden compression of the gas causing an increase in temperature
C to D	a slow expansion of the gas at constant temperature
D to A	a sudden expansion back to its original pressure, volume, and temperature

(i) Explain each of the following facts about the cycle:

1 During stage B to C, the piston causes a sudden compression of the gas, causing an increase in temperature, with reference to the kinetic theory of gases.

.....

.....[1]

2 At the end of all four stages, the change in internal energy of the gas is zero.

.....

.....[1]

(ii) Complete the table in Fig. 2.5 for the cycle.

stage	thermal energy supplied to gas / J	work done on gas / J	increase in internal energy of gas / J
A to B	–702	702	0
B to C	0	844	844
C to D	936	–936	0

D to A	0		

Fig. 2.5

[1]

(iii) Determine the efficiency of the heat engine.

Show your working clearly.

efficiency = ... % [2]

[Total: 8]