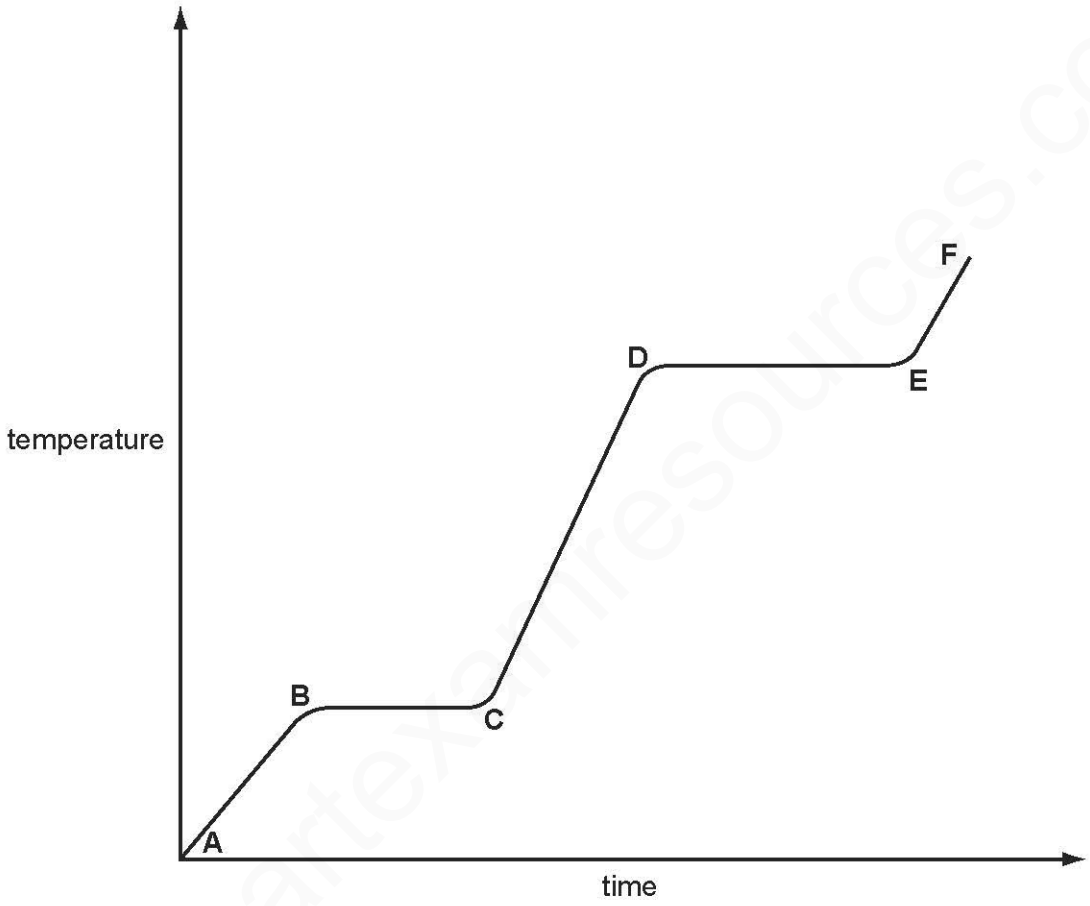
HEATING-COOLING CURVE

1.3.1

Ethanoic acid is a colourless liquid at room temperature. It has the typical acid properties and forms compounds called ethanoates.

(a) A pure sample of ethanoic acid is slowly heated from 0°C to 150°C and its temperature is measured every minute. The results are represented on the graph below.



(i) Name the change that occurs in the region **D** to **E**.

..... [1]

(ii) What would be the difference in the region **B** to **C** if an impure sample had been used?

..... [1]

(iii) Sketch on the graph how the line would continue if the acid was heated to a higher temperature. [1]

(iv) Complete the following table that compares the separation and movement of the molecules in regions **C** to **D** with those in **E** to **F**.

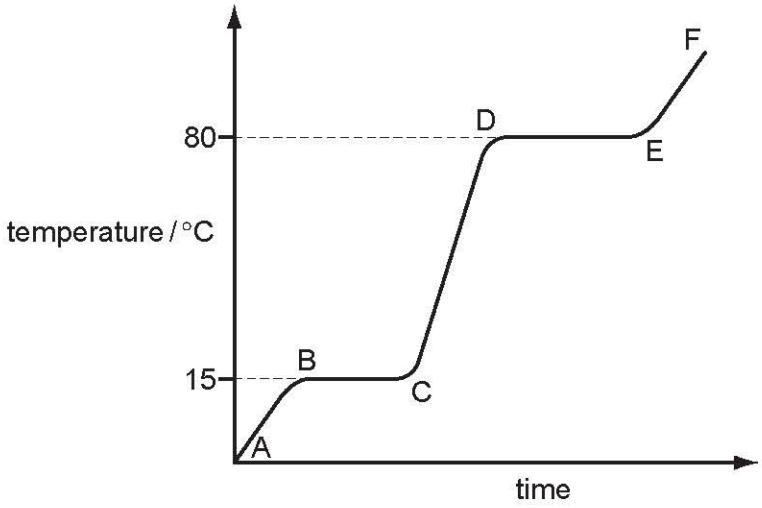
	C to **D**	**E** to **F**
separation (distance between particles)	.....	.....
movement of particles	random and slow	....
Can particles move apart to fill any volume?	.....	.....

[5]

(a)(i)	boiling		**[1]**
(ii)	lower temperature **or** over temperature range or no plateau		**[1]**
(iii)	direct continuation of E to F		**[1]**
(iv)	close **or** touching	far apart	**[2]**
		fast and random	**[1]**
	cannot move apart	can move apart	**[2]**

1.3.2

The diagram shows a heating curve for a sample of compound X.



(a) Is X a solid, a liquid or a gas at room temperature, 20 °C?

..... [1]

(b) Write an equation for the equilibrium which exists in region BC.

..... [2]

(c) Name the change of state which occurs in region DE.

..... [1]

(d) Explain how the curve shows that a pure sample of compound X was used.

.....

..... [2]

(a) liquid; [1]

(b) (l) and (s); [1]
reversible sign; [1]
accept: X in equation
ignore: any compounds just look for state symbols
must be the same compound on both sides of equation

(c) boiling / condensation; [1]
accept: evaporation or vaporisation

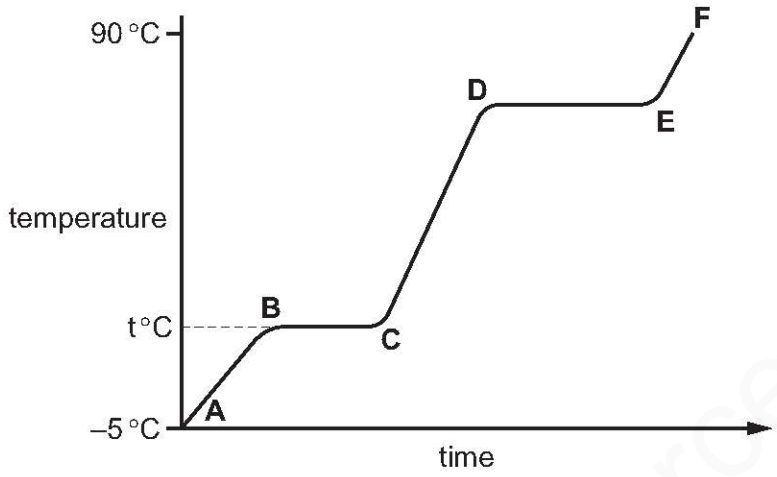
(d) (in region BC) solid melts / liquid boils (in region DE); [1]
at one / fixed / sharp / single / specific temperature; [1]

[Total: 6]

1.3.3

Compound X is a colourless liquid at room temperature.

(a) A sample of pure X was slowly heated from –5.0 °C, which is below its melting point, to 90 °C, which is above its boiling point. Its temperature is measured every minute and the results are represented on the graph.



(i) Complete the equation for the equilibrium present in the region **BC**.

X(s) ⇌ ..... [1]

(ii) What is the significance of temperature t °C?

..... [1]

(iii) What is the physical state of compound X in the region **EF**?

..... [1]

(iv) What would be the difference in the region **BC** if an impure sample of X had been used?

..... [1]

(a) (i) (X(s) ↔) X(l) [1]

(ii) melting point/freezing point (of X) [1]

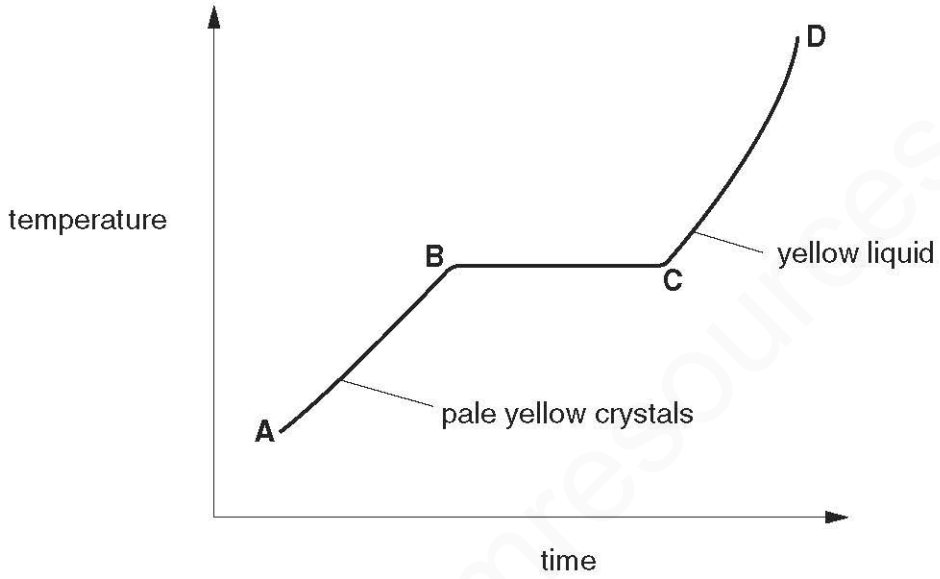
(iii) gas/gaseous or vapour [1]

(iv) not horizontal **or** line slopes **or** line is lower [1]

1.3.4

Nitrogen dioxide, NO_2, is a dark brown gas.

(b) When nitrogen dioxide is cooled, it forms a yellow liquid and then pale yellow crystals. These crystals are heated and the temperature is measured every minute. The following graph can be drawn.



(i) Describe the arrangement and movement of the molecules in the region **A**–**B**.

.....

.....

(ii) Name the change that occurs in the region **B–C**

.....[4]

(c) Nitrogen dioxide and other oxides of nitrogen are formed in car engines.

(i) Explain how these oxides are formed.

.....

.....

(ii) How are they removed from the exhaust gases?

.....

.....[4]

(b) **(i)** close **or** tightly packed [1]
ordered **or** lattice [1]
vibrational [1]
NOT forces

(ii) melting **or** freezing **or** fusion **or** solidification [1]

(c) **(i)** oxygen and nitrogen (in air) [1]
react at high temperatures (and high pressure) [1]
If nitrogen in fuel [0] out of [2]

(ii) catalytic converter
react with carbon monoxide **or** hydrocarbons
form nitrogen
ANY TWO [2]