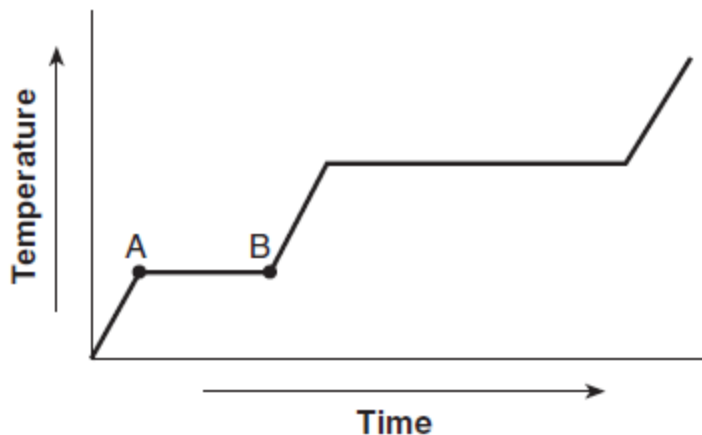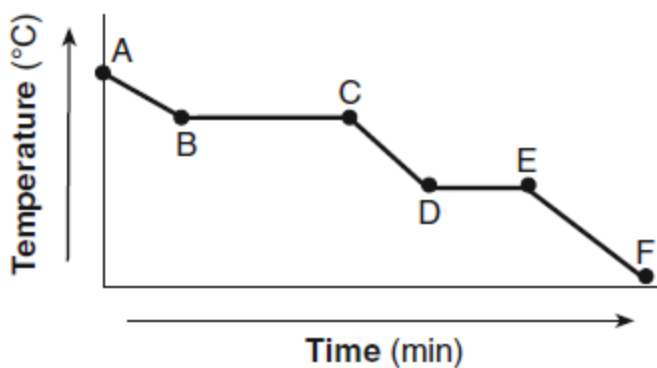1. The graph below represents the relationship between time and temperature as heat is added at a constant rate to a sample of a substance.

During interval AB which energy change occurs for the particles in this sample?

A) The potential energy of the particles increases.
B) The potential energy of the particles decreases.
C) The average kinetic energy of the particles increases.
D) The average kinetic energy of the particles decreases.

2. Given the cooling curve of a substance:

During which intervals is potential energy decreasing and average kinetic energy remaining constant?
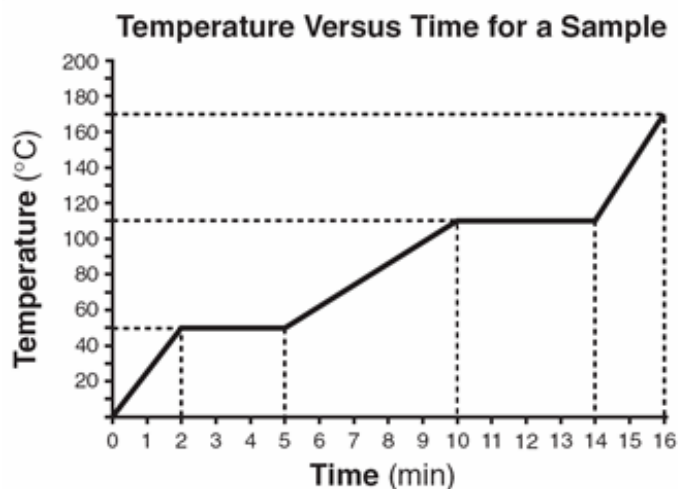
A) AB and BC B) AB and CD
C) DE and BC D) DE and EF

3. The graph below represents the uniform heating of a sample of a substance starting as a solid below its melting point.
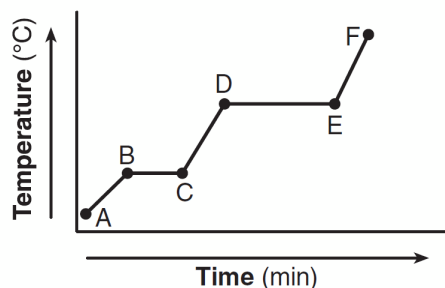
Which statement describes what happens to the energy of the particles of the sample during time interval *DE*?

A) Average kinetic energy increases, and potential energy remains the same.
B) Average kinetic energy decreases, and potential energy remains the same.
C) Average kinetic energy remains the same, and potential energy increases.
D) Average kinetic energy remains the same, and potential energy decreases

4. Starting as a solid, a sample of a substance is heated at a constant rate. The graph below shows the changes in temperature of this sample.

Temperature Versus Time for a Sample

What is the melting point of the sample and the total time required to completely melt the sample after it has reached its melting point?

A) 50°C and 3 min   B) 50°C and 5 min
C) 110°C and 4 min   D) 110°C and 14 min

5. The graph below represents the uniform heating of a substance, starting below its melting point, when the substance is solid.
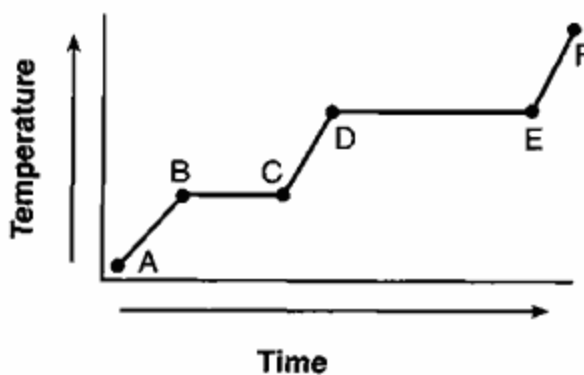
Which line segments represent an increase in average kinetic energy?

A) $\overline{AB}$ and $\overline{BC}$ B) $\overline{AB}$ and $\overline{CD}$
C) $\overline{BC}$ and $\overline{DE}$ D) $\overline{DE}$ and $\overline{EF}$

6. Which physical changes are endothermic?

A) melting and freezing
B) melting and evaporating
C) condensation and sublimation
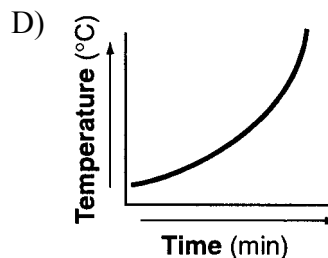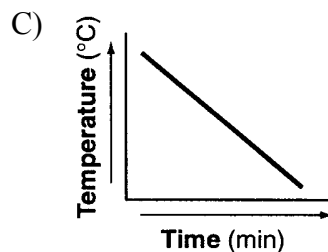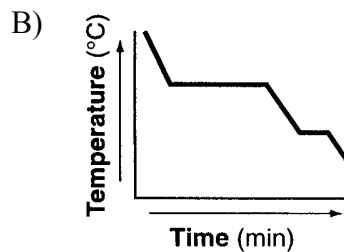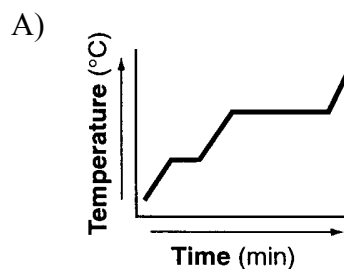D) condensation and deposition

7. The graph below represents the heating curve of a substance that starts as a solid below its freezing point.
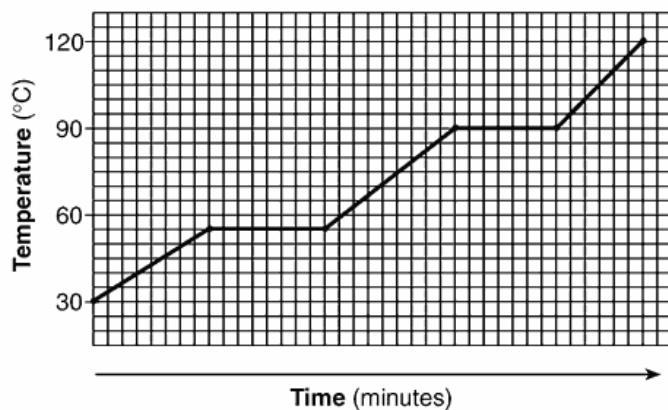
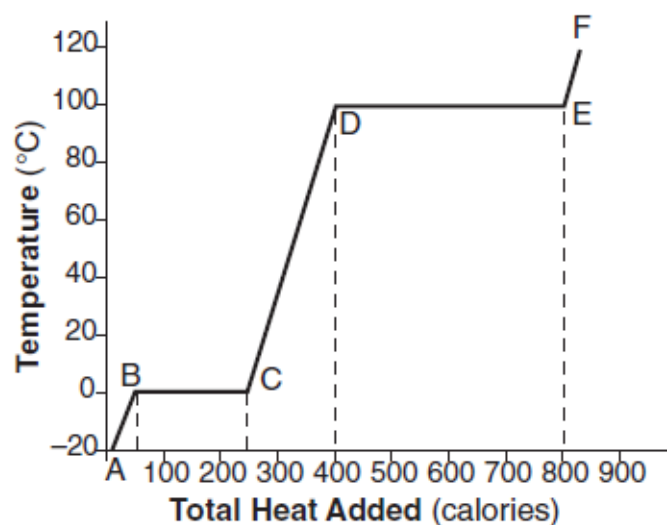What is the melting point of this substance?

A) 30°C   B) 55°C
C) 90°C   D) 120°C

8. Which graph could represent the uniform cooling of a substance, starting with the gaseous phase and ending with the solid phase?

A)

B)

C)

D)

9. The graph below shows the heating curve of 1.0 gram of a solid as it is heated at a constant rate, starting at a temperature below its melting point.

Based on this graph, what is the heat of vaporization?

A) 200 calories, as measured along line *BC*
B) 250 calories, as measured along line *BC*
C) 400 calories, as measured along line *DE*
D) 800 calories, as measured along line *DE*

10. The table below shows the data collected by a student as heat was applied at a constant rate to a solid below its freezing point.

Time (min)	Temperature (°C)	Time (min)	Temperature (°C)
0	20	18	44
2	24	20	47
4	28	22	51
6	32	24	54
8	32	26	54
10	32	28	54
12	35	30	54
14	38	32	58
16	41	34	62

What is the boiling point of this substance?

A) 32°C   B) 54°C   C) 62°C   D) 100°C

11. The graph below represents the uniform cooling of a substance, starting with the substance as a gas above its boiling point.
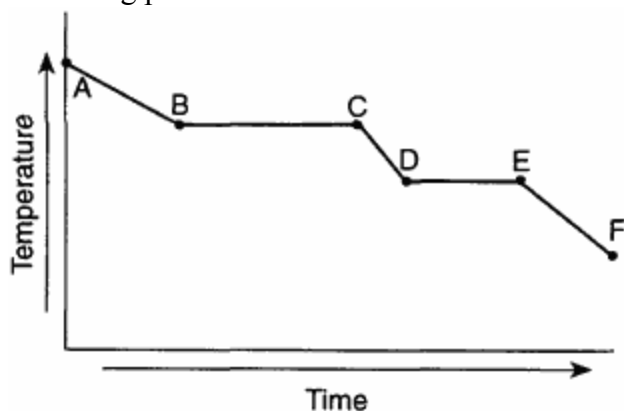
During which interval is the substance completely in the liquid phase?

A) *AB*   B) *BC*   C) *CD*   D) *DE*

12. A student obtained the following data while cooling a substance. The substance was originally in the liquid phase at a temperature below its boiling point.

Time (minutes)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
Temperature (°C)	70.	63	57	54	53	53	53	53	53	52	51	48

What is the freezing point of the substance?

A) 70.°C   B) 59°C   C) 53°C   D) 48°C

Base your answers to questions **13** and **14** on the graph below, which represents uniform cooling of a sample of a pure substance, starting as a gas.
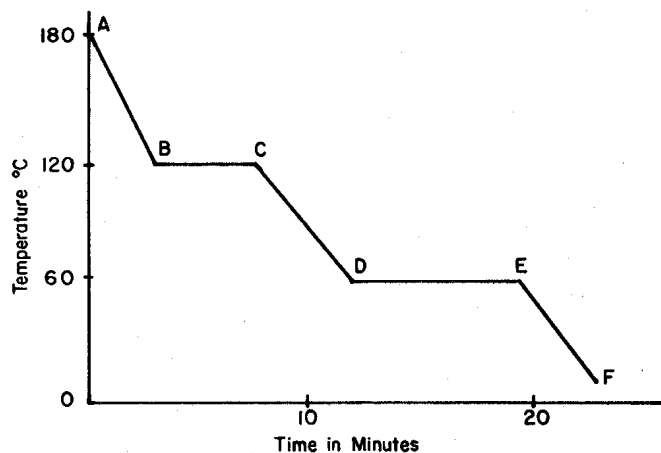
13. Solid and liquid phases can exist in equilibrium between points

A) *E* and *F*   B) *B* and *C*
C) *C* and *D*   D) *D* and *E*

14. The boiling point of the substance is

A) 10°C   B) 60°C
C) 120°C   D) 180°C

15. As a solid is heated, its temperature increases from 10°C to 25°C, remains at 25°C for 5 minutes, and then increases to beyond 45°C. Based on this information, what conclusion can be drawn about the substance?

A) Its melting point is 45°C.
B) Its boiling point is 45°C.
C) Its melting point is 25°C.
D) Its boiling point is 25°C.

16. The graph below represents the relationship between temperature and time as heat is added uniformly to a substance, starting when the substance is a solid below its melting point.
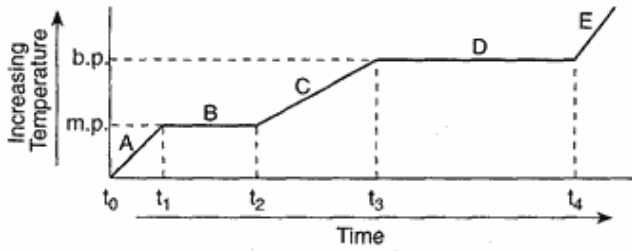
Which portions of the graph represent times when heat is absorbed and potential energy increases while kinetic energy remains constant?
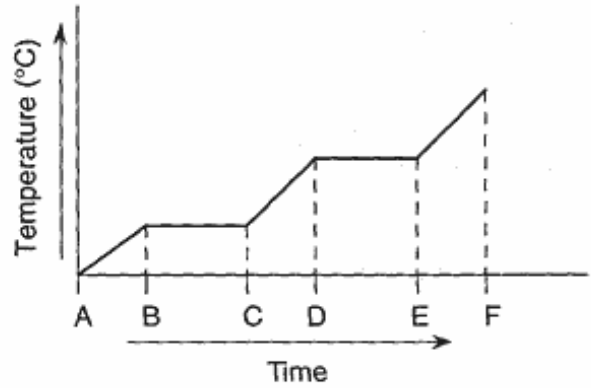
A) *A* and *B* B) *B* and *D*
C) *A* and *C* D) *C* and *D*

17. The graph below was constructed by a student to show the relationship between temperature and time as heat was uniformly added to a solid below its melting point.
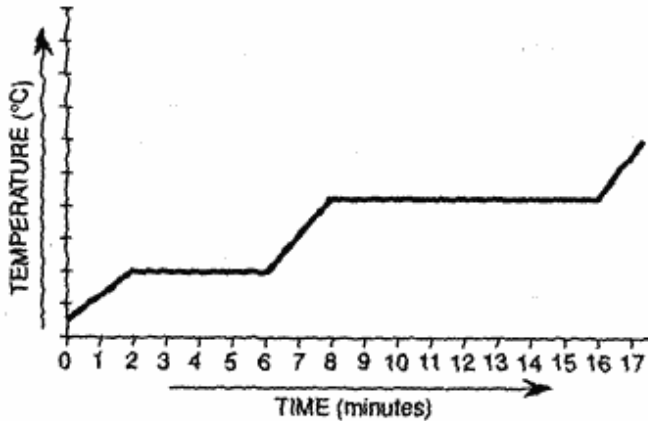
What is the total length of time that the solid phase existed with the liquid phase?

A) 6 min B) 10 min
C) 8 min D) 4 min

18. The diagram below represents the uniform heating of a substance that is a solid at Time *A*.

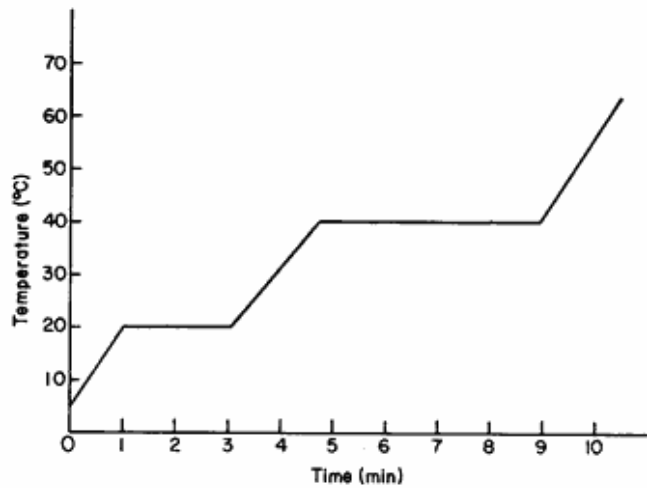Between which times could the heat of fusion be determined?

A) *A* and *B* B) *B* and *C*
C) *C* and *D* D) *E* and *F*

19. The graph below represents the uniform cooling of a substance, starting as a gas at 160°C. At which temperature does a phase change occur for this substance?
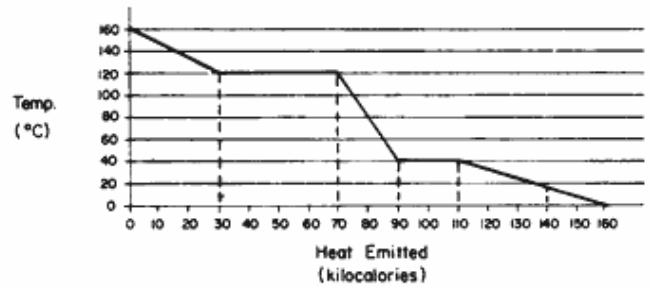
A) 0°C B) 40°C
C) 80°C D) 140°C

20. The graph below represents changes of state for an unknown substance.

What is the boiling temperature of the substance?

A) 0°C   B) 20°C   C) 70°C   D) 40°C