P1.2 Summary questions

1. Particle arrangement for a material in a solid state: C
   Particle arrangement for a material in a liquid state: A
   Particle arrangement for a material in a gas state: B

2. a. joules, speed
   b. kelvin/K, degrees Celsius/°C, hot, cold

3. a. melting
   b. They are very close together, moving.
   c. In a hot solid the particles are vibrating faster.

4. a. Given:
   mass = 0.5 kg
   specific heat capacity = 2100 J/kg K
   change in temperature = 50 K
   change in thermal energy (J) = mass (kg) \times \text{specific heat capacity (J/kg K)} \times \text{change in temperature (K)}
   = 0.5 \text{ kg} \times 2100 \text{ J/kg K} \times 50 \text{ K}
   = 52500 \text{ J}
   = 53 \text{ kJ (2 sig. fig.)}
   
   b. Given:
   mass = 0.03 kg
   specific latent heat of melting = 334000 J/kg
   thermal energy for a change in state (J) = mass \times \text{specific latent heat of melting}
   = 0.03 \text{ kg} \times 334000 \text{ J/kg}
   = 10020 \text{ J}
   = 10000 \text{ J (2 sig. fig.)}

5. a. The particles of a material in a liquid state are very close together, almost as close together as the particles of a material in a solid state. The particles of a material in a gas state are much further apart than the particles of a material in a liquid state.
   The density depends on mass and volume, so if the volume is bigger the density will be smaller.
   
   b. density = mass \div volume
   
   c. mass of a person = 70 kg
   volume of a person = 1.5 \text{ m} \times 0.3 \text{ m} \times 0.2 \text{ m}
   = 0.09 \text{ m}^3
   density = 70 \text{ kg} \div 0.09 \text{ m}^3
   = 780 \text{ kg/m}^3 \text{ (2 sig. fig.)}
   
   d. Given:
   mass of person = 70 kg
   density of gold = 19.3 \times 10^3 \text{ kg/m}^3
   volume = mass \div \text{density}
   = 70 \text{ kg} \div 19.3 \times 10^3 \text{ kg/m}^3
   = 0.0036 \text{ m}^3
   
   e. Measure the mass of the ring using scales/digital balance.
   Pour water into a measuring cylinder so the level is about half-way.
   Note the level. Put the ring into the measuring cylinder and note the new level. Subtract the initial level from the final level to find the volume of the ring.
Use the equation to calculate density.

6  a  Measure the temperature of each liquid after a period of time. The liquid with the lower temperature has the higher specific heat capacity.

   b  Given:
   change in thermal energy = 80 kJ = 80 000 J
   mass = 500 g = 0.5 kg
   change in temperature = 50 °C = 50 K

   specific heat capacity = change in thermal energy ÷ mass × change in temperature
   = 80 000 J ÷ 0.5 kg × 50 K
   = 3200 J/kg K

   c  When you heat an object energy is always transferred to the surroundings, so you need to use more energy to raise the temperature.

7  a  Ethanol vapour is cooling down, and condensing.

   b  The density is very low and then increases.

   c  Given:
   change in energy = 18 kJ = 18 × 10³ J
   mass = 20 g = 20 × 10⁻³ kg

   thermal energy for a change in state = mass × specific latent heat of fusion
   specific latent heat of fusion = thermal energy for a change in state ÷ mass
   = 18 × 10³ J ÷ 20 × 10⁻³ kg
   = 900 000 J/kg

   d  The density of liquids is about 1000 times larger than the density of gases, so the density of ethanol liquid is about 1.4 g/cm³.