1. Heat (thermal energy) naturally flows from:

   ☐ lighter to heavier object

   ☐ higher to lower temperature

   ☐ lower to higher temperature

   ☐ bigger to smaller object

2. Select **all** the properties that can be used to measure temperature.

   ☐ e.m.f. of a thermocouple

   ☐ the colour of the glass case

   ☐ resistance of a metal

   ☐ expansion of a liquid

   Tick every correct option.

3. How much energy raises 2.0 kg of water by 10 K? (Use $c = 4200\ \frac{\text{J}}{\text{kg} \cdot \text{K}}$.)

   _____ J

4. At thermal equilibrium there is no net flow of energy between two bodies.

   ☐ True ☐ False

5. Absolute zero (0 K) is:

   ☐ room temperature

   ☐ the lowest possible temperature

   ☐ the boiling point of water

   ☐ the freezing point of water

6. Water has a high specific heat capacity compared with most metals.

   ☐ True ☐ False

7. Two objects in thermal equilibrium are at the same _____.

   _____

8. What is 27 °C in kelvin?

   _____ K

9. While a solid is melting, its temperature:

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   ☐ stays constant

   ☐ doubles

   ☐ rises steadily

10. Temperature tells you:

    ☐ which way heat will flow

    ☐ the mass of the object

    ☐ the volume of the object

    ☐ the total thermal energy stored

1. **higher to lower temperature**

   Energy always flows down the temperature difference, from hot to cold, until they are equal.

2. **e.m.f. of a thermocouple; resistance of a metal; expansion of a liquid**

   Any property that changes repeatably with temperature works. The fixed colour of the case does not.

3. **84000 J**

   $Q = mc\Delta T = 2.0 \times 4200 \times 10 = 84000$ J.

4. **True**

   Equal temperatures mean no net flow – particles still exchange energy, but with no overall transfer.

5. **the lowest possible temperature**

   At 0 K a system has its least possible internal energy; nothing can be made colder.

6. **True**

   Water ~4200 vs aluminium ~900, copper ~385 J/(kg · K) – water needs much more energy per kelvin.

7. **temperature**

   Same temperature is exactly the condition for thermal equilibrium.

8. **300 K**

   $T/\mathrm{K} = \theta/^{\circ}\mathrm{C} + 273 = 27 + 273 = 300$ K.

9. **stays constant**

   During a state change the energy breaks bonds rather than raising temperature, so it stays constant.

10. **which way heat will flow**

    Temperature decides the direction of heat flow; the amount of energy also depends on mass and material.

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