

Assess Quizzes from the o-book – Explanations for the answers.

Chapter 1 Review – Support

Q	Reason
1	Internal energy is defined as the sum of micro KE and micro PE. Sometimes people say that is the same as thermal energy but thermal energy does not include the potential energy or chemical and nuclear bond energy. See Table 1 page 66. The reason people do this is because a ‘change’ in thermal energy and a ‘change’ in internal energy is the same value, as the PE of chemical and nuclear bonds doesn’t change when things are heated or cooled.
2	Water normally boils at 100°C. Using the formula $T_K = T_C + 273$, we get $T_K = 100 + 273 = 373$ K.
3	50°C in K is: $T_K = 50 + 273 = 323$ K.
4	See page 70. The formula $E_K = 3/2 kT$ is not in the QCAA Formula and Data Book so would not be required for the EA but maybe required for your school’s internal assessment. Check with the teacher.
5	If the temperature is constant the average KE of the molecules is also constant. The formula $E_K = 3/2 kT$ shows this. However, when gas particles collide, they do so elastically which means no mechanical energy is lost in the collision. They just change speeds and so there is a rearrangement of the KE of the colliding particles, but no KE is lost. See page 69.
6	They don’t attract or repel. Remember we are talking about an ‘ideal’ gas where the particles just collide but don’t attract otherwise they might just stick to each other and not bounce off. See page 63.
7	The temperature at which water can exist in all three state (s, l, g) is said to be the triple point of water and is 0 °C (273 K). Actually, it is 0.01 °C but for laboratory investigations in senior physics we just say 0°C is the freezing point of water. See page 73.
8	We can assume it has a zero error of 5°C so reads 5°C instead of 0°C. It must also have a calibration error of some sort so that its boiling point for water is 95°C instead of 100°C. It seems most likely that it is equally in error by the same amount at either end of the scale, so the true reading would still be 59°C.
9	Internal energy is the sum of microscopic KE and microscopic PE. This could be just generalised to the total microscopic energy. It is not ‘thermal’ energy as that doesn’t include the microscopic PE due to chemical and nuclear bonds. See page 66.
10	The motion of a gas particle is random and when it collides with other particles (as it must) it scatters off in random directions.

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Chapter 1 Review – Consolidate

Q	Reason
1	The formula $E_K = 3/2 kT$ makes it clear that E_K and T (in kelvin) are directly proportional.
2	Copper expands more than steel for the same length and temperature rise. They bend into a circular arc with the one that expands most (copper) on the outside (where a longer length can be accommodated).
3	$T_H = T_{He}$ $\frac{1}{2} m_H v_H^2 = \frac{1}{2} m_{He} v_{He}^2$ $m_H v_H^2 = m_{He} v_{He}^2$ $m_H v_H^2 = 2m_H v_{He}^2$ $v_H^2 = 2v_{He}^2$ $= 2 \times 100^2$ $v_H = \sqrt{20000}$ $= 141 m s^{-1}$
4	It will be linear as $Q = mc\Delta T$, that is, $Q \propto \Delta T$. So as Q increases, ΔT follows in a directly linear fashion (when T is in K).
5	The relationship $Q = mc\Delta T$ says that $\Delta T \propto 1/m$ when Q and c are constant. So, the shape will be the familiar $y \propto 1/x$ or inversely proportional.

Chapter 1 Review – Extend

Q	Reason
1	For two substances of the same mass, the one that has a greater temperature change when the same amount of heat energy is added, is the one with lower specific heat. This is shown by $Q = mc\Delta T$ which says that $\Delta T \propto 1/c$, when Q and m are constant.
2	$-Q_{lost} = Q_{gained}$ $-m_{iron} c_{iron} (T_f - T_i)_{iron} = m_w c_w (T_f - T_i)_w$ $-\frac{40}{1000} \times 444 (T_f - 120) = \frac{600}{1000} \times 4180 (T_f - 30)$ $-17760 T_f + 2.131 \times 10^6 = 2.508 \times 10^6 T_f - 7.524 \times 10^7$ $7.737 \times 10^7 = 2.5257 \times 10^6 T_f$ $T_f = 30.63^\circ C$ <p>Check – is this reasonable? Yes, the temperature is somewhere between the two initial temperatures.</p>

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3	$-Q_{lost} = Q_{gained}$ $-m_w c_w (T_f - T_i)_w = m_e c_e (T_f - T_i)_e$ $-\frac{120}{1000} \times 4180 (T_f - 70) = \frac{40}{1000} \times 2450 (T_f - 23)$ $-5.016 \times 10^5 T_f + 3.511 \times 10^7 = 9.8 \times 10^4 T_f - 2.254 \times 10^6$ $3.7364 \times 10^7 = 5.996 \times 10^5 T_f$ $T_f = 62.3^\circ C$ <p>Check – is this reasonable? Yes, the temperature is somewhere between the two initial temperatures.</p>
4	$-Q_{lost} = Q_{gained}$ $-m_m c_m (T_f - T_i)_m = m_w c_w (T_f - T_i)_w$ $-\frac{100}{1000} \times c_m (28.6 - 99.5) = \frac{50}{1000} \times 4180 (28.6 - 15.5)$ $7090 c_m = 2.7379 \times 10^6$ $c_m = \frac{2.7379 \times 10^6}{7090}$ $= 386$ <p>Check – is this reasonable? Yes, the temperature is somewhere between the two initial temperatures.</p>
5	<p>Total thermal energy = thermal energy to heat solid to melting point + thermal energy to just melt solid</p> $Q = Q_{temp\ increase} + Q_{melt}$ $Q = mc\Delta T + mL_f$