A) A ball is hit with a horizontal speed of 15 m/s and a vertical speed of 18 m/s upward.

Q-A1: What are these speeds 1 second later?
(Consider the gravitational acceleration g=10 m/s² and ignore the air resistance)

A-A1: We can separate the horizontal and vertical motions.

In general \( v(t) = v_{\text{init}} + at \) where \( a \) is the acceleration in the direction of the motion

So

- \( v_{\text{horiz}} = v_{\text{init horiz}} \)
- \( v_{\text{vert}} = v_{\text{init vert}} - gt \)

where \( v_{\text{init horiz}} = 15 \) m/s, \( v_{\text{init vert}} = 18 \) m/s

For \( t=1 \) s one gets

\[
\begin{align*}
\text{horiz} & : v = 15 \text{ m/s} \\
\text{vert} & : v = 18 \text{ m/s} - 10 \text{ m/s}^2 \cdot 1 \text{ s} = 8 \text{ m/s}
\end{align*}
\]

B) A car turns a corner with a radius 25 m at a speed of 15 m/s.

Q-B1: What is the car’s acceleration?
Q-B2: If the car has a mass of 1000 Kg, what is the force that causes the car to turn?

A-B1: The acceleration to which the car is subject when it turns is the centripetal one:

\[
a_c = \frac{v^2}{r} = \frac{(15 \text{ m/s})^2}{25 \text{ m}} = \frac{225}{25} \text{ m/s}^2 = 9 \text{ m/s}^2
\]

A-B2: The force is simply given by Newton’s second law \( F=ma \):

\[
F = ma_c = m \cdot \frac{v^2}{r} = 1000\text{Kg} \cdot 9 \text{ m/s}^2 = 9000 \text{ N}
\]
C) Two children with masses of 27 and 36 Kg are sitting on a balanced seesaw.

Q-C1: If the lighter child is sitting at 4 m from the center, where is the heavier child sitting?

A-C1: If the seesaw is in equilibrium then the torques, $\tau = F \cdot r$, on the two sides are equal.

\[
\tau_1 = W_1 \cdot r_1 = m_1 \cdot g \cdot r_1 = 27 \text{ Kg} \cdot \frac{10 \text{ m}}{s^2} \cdot 4 \text{ m} = 1080 \text{ N} \cdot \text{m}
\]

\[
\tau_2 = W_2 \cdot r_2 = m_2 \cdot g \cdot r_2 = 36 \text{ Kg} \cdot \frac{10 \text{ m}}{s^2} \cdot r_2 = 360 \text{ N} \cdot r_2
\]

At equilibrium: $\tau_1 = \tau_2$ hence \( r_2 = \frac{1080}{360} \text{ m} = 3 \text{ m} \)

Note that it is not necessary to know the exact value of $g$ in order to answer the question (in the above calculations you can leave it unspecified and in the final ratio it will drop out).