For timing events the most important quality in the coincidence setup was to ensure the events were aligned. Look at the change from 24 hour intervals since the first reading for each clock.

<table>
<thead>
<tr>
<th>Clock</th>
<th>Error from 24 hour interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>±16</td>
</tr>
<tr>
<td>B</td>
<td>+3</td>
</tr>
<tr>
<td>C</td>
<td>+58</td>
</tr>
<tr>
<td>D</td>
<td>-67</td>
</tr>
<tr>
<td>E</td>
<td>-70</td>
</tr>
</tbody>
</table>

Std dev: 0.8 sec 13.1 sec 0 sec 0 sec 27 sec.

C and D are therefore equivalent, but let's give the nod to C since it's consistent closer to the accepted rate of time passage.

\[ C, D, A, B, E \]

(is the ranked order by way of increasing std. dev.)

1-40

Insert at 1.661 \times 10^{-24} kg (see back inside cover)

1 H_2O molecule thus a mole of \sim 18 v or

\[ M_{mol} = 2.99 \times 10^{-26} \text{kg} \]

\[ N_{H_2O} = \frac{M_{molec}}{M_{mol}} = \frac{1.4 \times 10^{22} \text{kg}}{2.99 \times 10^{-26} \text{kg}} = 4.7 \times 10^{46} \]

\[ \sim 5 \times 10^{46} \text{ molecules} \]

(suggested precision here is roughly 20%, which is closer to the scientific value of \sim 7% than would be \sim 4.7 \times 10^{46}.
5-69 a) The crew thought that they had

\[
7682 \text{ l} \times 1.77 \text{ kg/l} = 13597 \text{ kg}
\]

(b) They asked for 4917 liters to be added

\[
\text{Given that they needed } 22300 \text{ kg} - 13597 \text{ kg} = 8703 \text{ kg} \\
\frac{1 \text{ kg}}{1.77 \text{ kg/l}} = 4917 \text{ liters}
\]

(They actually may have added for 4900 or maybe 5000)

(c) In fact there was only 13597 lb of fuel on board

\[
13597 \text{ lb} \times \frac{1 \text{ kg}}{2.265} = 6166 \text{ kg}
\]

(d) So they needed to add 16134 kg or

\[
35575 \text{ lb} \text{ or } 20099 \text{ l}
\]

(To a total of 27781 l)

20100 l should have been added

(d) In fact, they had on board 7682 + 4917 = 12600 lb

But they needed 27781, so they only had

\[
-45\% \text{ of the required fuel}
\]

on board.
Initially consider B + C as one block and consider the following:

\[ m_A \frac{d^2 \vec{a}_1}{d t^2} = T \]

\[ T = m_A \vec{a}_1 \]

\[ T - m_{BC} g = -m_{BC} \vec{a}_2 \]

(Note: The sign in the above equation has the same direction as \( m_{BC} g \)!

As drawn, the magnitudes of \( \vec{a}_1 \) and \( \vec{a}_2 \) must be equal sine the string stays taut.

\[ 0 - T \rightarrow m_{BC} g = m_A \vec{a} + m_{BC} \vec{a} \]

\[ \Rightarrow \vec{a} = \frac{m_{BC}}{m_A + m_{BC}} \cdot g = \frac{50 \text{ kg}}{30 \text{ kg} + 50 \text{ kg}} \cdot 9.8 \text{ m/s}^2 \]

\[ = 6.125 \text{ m/s}^2 \] (Intermediate result)

To answer question a), look at the FBD for Block B.

\[ \vec{T}_2 \]

\[ m_{BC} \quad \vec{a} = 6.125 \text{ m/s}^2 \]

\[ m_{BC} g \]

\[ \vec{T}_2 = 10.0 \text{ kg} \cdot 9.8 \text{ m/s}^2 = -10 \text{ kg} \cdot 61.25 \text{ m/s}^2 \]

\[ \vec{T}_2 = 36.8 \text{ N} \]

b) To figure out how far a merry, we know \( t_1 \) (0.25 sec) \( a \) (6.125 m/s^2) \( \vec{v}_0 \) (0 m/s) so use H.2

\[ x - x_0 = \vec{v}_0 t + \frac{1}{2} a t^2 = 0 + \vec{v}_0 \cdot 6.125 \text{ m/s}^2 \cdot (0.25 \text{ sec})^2 \]

\[ (x - x_0) = 0.191 \text{ m} \]
Consider a Free Body diagram for the lower cab (B)

\[ m_a = 1700 \text{ kg} \]
\[ m_c = 12 \text{ kg} \]
\[ F = 19100 \text{ N} \]
\[ m_b = 1300 \text{ kg} \]

\[ \sum F = m_a a \]

\[ a = \frac{F}{m_a} = \frac{19100}{1700} = 11.23 \text{ m/s}^2 \]

\[ mg = 1300 \text{ kg} \cdot 9.8 \text{ m/s}^2 = 12,740 \text{ N} \]

\[ \Rightarrow \text{ There is a Net upward force of } 6360 \text{ N on the 1300 kg cab. The magnitude of its acceleration must be } a = 4.89 \text{ m/s}^2 \]

Now look at the F.B. diagram for the box

\[ \sum F = m_a a \]

\[ N = (12.0 \text{ kg} \cdot 9.8 \text{ m/s}^2) = 12 \text{ kg} \cdot 9.8 \text{ m/s}^2 \]

\[ N = 12.0 \text{ kg} \cdot (4.98 \text{ m/s}^2 + 9.8 \text{ m/s}^2) \]

\[ N = 176 \text{ N} \]
5-50 Considering all 4 people as one mass we find that

\[ T_4 = M_{\text{tot}} \cdot a \]

\[ 222N = (15kg + 20kg + 12kg + m_2) \cdot a \]

Similarly \[ 111N = (12kg + m_2) \cdot a \]

Taking 1 away from 0 we find that

\[ (222N - 111N) = (15kg + 20kg) \cdot a \]

\[ \Rightarrow a = 3.17 \text{ m/s}^2 \]

Putting this back into 0 we find

\[ 111N = (12kg + m_2) \cdot 3.17 \text{ m/s}^2 \]

\[ \Rightarrow m_2 = 23.0 \text{ kg} \]

(Note if you plug \( a + m_2 \) back into 0 this confirms that the two values are correctly not affected as also solved)