| Upper and Lower Bounds Mark Scheme |  |  |
| :---: | :---: | :---: |
| 1(a) | lower bound $=5.5 \mathrm{~cm}$ | [1] |
|  | upper bound $=6.5 \mathrm{~cm}$ | [1] |
| 1(b) | lower bound $=2.15 \mathrm{~kg}$ | [1] |
|  | upper bound $=2.25 \mathrm{~kg}$ | [1] |
| 1(c) | 55 m | [1] Answer to the nearest meter |
| 2(a) | max. area: $4.15 \mathrm{~m} \times 3.25 \mathrm{~m}=13.4875 \mathrm{~m}^{2}$ | [1] Correct calculation |
|  | min area: $4.05 \mathrm{~m} \times 3.15=12.7575 \mathrm{~m}^{2}$ | [1] Correct calculation |
|  | Max area $=13.5 \mathrm{~m}^{2}, \mathrm{Min}$ area $=12.8 \mathrm{~m}^{2}$ | [1] Both correct to $1 \mathrm{~d} . \mathrm{p}$. |
| 3 | No | [1] Only award with correct explanation |
|  | Min speed $=\frac{225}{4}$, Max Speed $=\frac{235}{4}$ | [1] Correct use of formula and bounds (Accept method using upper and lower bounds of Time to show Sarah is wrong.) |
|  | The average speed is between 56.25 and 58.75 mph | [1] Correct final answer |
| 4(a) | Lower bound $=3.415 \mathrm{~m}$ Upper bound $=3.425 \mathrm{~m}$ | [1] Upper and lower bound of $x$ |
|  | $\begin{aligned} & y \\ & \text { Lower bound }=0.915 \mathrm{~m} \\ & \text { Upper bound }=0.925 \mathrm{~m} \end{aligned}$ | [1] Upper and lower bound of $y$ |
| 4(b) | $z=\frac{1}{\min .} \begin{gathered} \\ 3.425 \\ 0.915=1.207 \text { (to } 3 \mathrm{~d} . \mathrm{p} \text { ) } \end{gathered}$ | [1] Lower bound of $z$ |
|  | max. $z=\frac{1}{3.415}+0.925=1.218$ <br> (to $3 \mathrm{~d} . \mathrm{p}$. ) | [1] Upper bound of $z$ |
| 5(a) | Upper bound $=9.05 \times 8.55 \times 18.25$ | [1] Correct calculation |
|  | $=1412.14 \mathrm{~cm}^{3}$ | [1] Volume to $2 \mathrm{~d} . \mathrm{p}$. |
| 5(b) | Upper bound the water $=1375 \mathrm{~cm}^{3}$ | [1] Upper bound |
|  | Lower bound of the bucket $8.95 \times 8.45 \times 18.15=1372.63 \mathrm{~cm}^{3}$ | [1] Lower bound |
|  | No, the container could overflow. The upper bound of water is greater then the lower bound of the container volume. | [1] Correct conclusion based on workings |
|  |  |  |


| 6(a) | 12.35 m | [1] Lower bound for distance |
| :--- | :---: | :--- |
| $\mathbf{6 ( b )}$ | Correct use of $g=9.85$ | [1] Implicit in question |
|  | $t=\sqrt{\frac{2 \times 12.35}{9.85}}=1.584$ | [1] Correct calculation |
|  | $t=1.58$ seconds | [1] Min. time to 2 d.p. |

END

