Flying Start Challenge

Name: _____ Date: _____

Question answers:

1. $Speed = \frac{Distance}{time} \therefore time = \frac{Distance}{Speed}$

$$\frac{8000}{100} = 80\ seconds$$

2.
   a. They could:
      i. Increase the size of the parachute.
      ii. Approach the runway slower.
      iii. Make the Space Shuttle lighter.
      iv. Deploy the parachute earlier.
      v. Design better brakes.
   b. Force diagram should include:
      i. Weight (gravity) [Down]
      ii. Either a combined Drag force arrow or: [Backwards]
         1. Drag of Shuttle &
         2. Drag of parachute as two separate arrows in the same direction.
      iii. Either or both: [Upwards]
         1. A reaction force from the ground acting on the landing gear.
         2. Lift on the wings.
   c. If the parachute was too big:
      i. It could break off.
      ii. The Space Shuttle could stop too quickly and break its wheels.
      iii. It could otherwise damage the Shuttle.

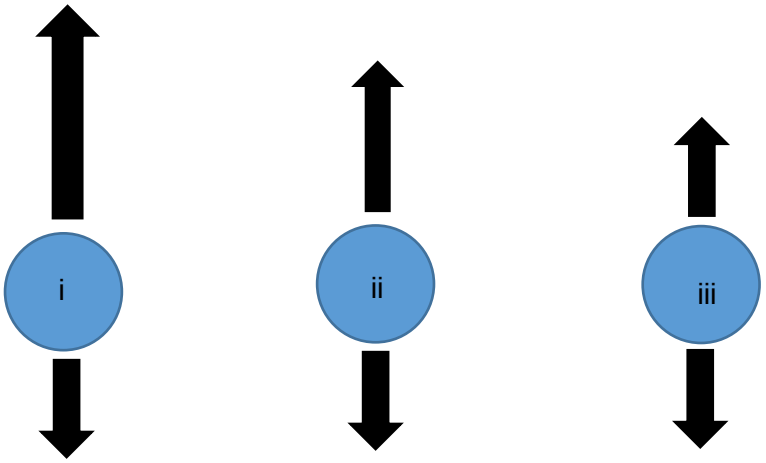
3. Because the can is at terminal velocity, the forces are in equilibrium, and the acceleration force on the can is therefore zero. (Remember Newton's First Law).

$$Distance = Speed \times time$$
$$time = \frac{Distance}{Speed}$$
$$t = \frac{15}{2.5} = \underline{\quad\textbf{6 secs}\quad}$$

NOTE: speed=distance/time can only be used when there is no acceleration

4. The fastest one is ball 1 as the drag force is the largest. Remember from looking at the drag equation that a high velocity results in a high drag force.

5.



When the parachute opens, there is a huge drag force. This drag force is larger than the force from gravity so results in an overall upwards force which acts to slow the ball down. As the ball slows down, the reduced velocity results in a reduced drag force, hence the smaller upwards force shown on ball 2 a few seconds after the parachute opens. Eventually, the velocity reduces enough such that the drag force is once again equal to the force from gravity. The ball has now reached terminal velocity, although this new terminal velocity will be much slower than the previous one without a parachute. Notice that the force from gravity remains the same whether there is a parachute or not due to this only depending on the mass and acceleration due to gravity, both of which remain constant (F=ma).

6. No this is not true. Gravity is everywhere. If we consider the equation $F = \frac{GMm}{r^2}$ it shows that there is always a gravitational force between two objects but it just reduces as they get further away. This means that even at opposite ends of the universe, two objects would still exert a force on each other. It also means that you are attracting everything around you, including the Earth.
If you were sat in space you would slowly drift towards whichever object exerted the biggest force on you. This is why the planets stay in orbit around the sun as the sun exerts the biggest force on them.
Everything appears to be floating because there is nothing to compare your motion to. Think about if you jumped out of a plane with a blindfold on so you couldn't see and there was no wind hitting you, you would feel like you were floating. This is the same as being in space. Everything is so far away, and you're falling so slowly, it appears as you're just floating, when in reality you're falling. Due to the lack of air resistance, everything falls at the same rate, further increasing the illusion of everything just floating together.

Activity mark scheme:

Topic	Mark Scheme	Score
Design changes	0 – No attempt made 1 – Some mention of design changes but no reasoning as to why 2 – Design changes mentioned and a reason given but not backed up using relationships/equations 3 – Design changes mentioned and reasons backed up with references to equations	
Graphs (add up individual scores)	0 – No attempt made 1 – Axes labelled correctly with units 1 – Correct shape of graph 1 – Line of best fit plotted (not dot to dot) 1 – Their points correctly plotted	
Fall height (Don't know what heights they'll get so split the class up. Feel free to change this if you want)	0 – No attempt made 1 – Bottom 1/3 of class 2 – Middle 1/3 of class 3 – Top 1/3 of class	
Creativity of design (Subjective but as long as it's consistent then shouldn't matter)	0 – No attempt to make a design 1 – Standard parachute design, nothing to make it stand out 2 – Elements of being creative and thinking outside the box to make the parachute better 3 – Very creative using ideas not mentioned in the learning material	
Conclusions	0 – No attempt to draw conclusions 1 – Attempt to make a graph with incorrect labelling of graph or plotting 2 – Correct labelling of graph and plotting but no/wrong conclusions 3 – Correct plotting and conclusion	
Overall presentation	0 – No results or design shown 1 – An attempt to show, designs/results/plots but no explanation and/or not clear 2 – The information shown is clear but details such as reasons for design change are missing 3 – All designs, results and plots clearly shown with correct conclusions backed up with equations – A good understanding is clearly shown	
Total score:		