



THE SCIENCE OF ROLLERCOASTERS

PRE-VISIT



ANSWERS: STARTER ACTIVITY

1. Speed = Distance $\div$ Time
2. Other units – kilometres per hour, miles per hour or any other
3. $s = d \div t$, $s = 200 \div 20 = 10$ m/s ANS
4. Sound energy, light energy, electrical energy gravitational (potential) energy, strain or elastic (potential) energy, chemical (potential energy), heat energy, nuclear energy
5. Friction is the force that opposes motion. It is not a form of energy but it does make the following energy transfer happen:

Kinetic energy $\rightarrow$ Heat energy



Speed = Distance ÷ Time can be re-arranged to make two other formulae:

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Time} = \text{Distance} \div \text{Speed}$$

Use any of the above to answer the following questions.

Give your answers to 1 decimal place where appropriate.

I) **SAW – The Ride** is an extreme rollercoaster experience.



Calculate the speed of a carriage travelling on SAW – The Ride for 200 m in 10 s.

2) As people board **Logger's Leap** log flume, it travels 30 m in 36 s.
Calculate the speed....



3) How far does a carriage move on **Nemesis Inferno** when it is travelling at the following speeds?:

- a) 20 m/s for 10 s
- b) 23 m/s for 5 s



SCREAM

4) A rollercoaster moves 10 m at 15 m/s instantly followed by 50 m at 25 m/s.

How much time in total does it take for a rollercoaster to move the above distances (assuming there is no time interval between changing speeds)?



THE SWARM: Ride Data



SCREEN

The following questions are based around **THE SWARM**.

Click the image to watch THE SWARM in action.



5) **THE SWARM** Ride data

Maximum height

- 39 meters

Ride duration

- 125 seconds

Maximum speed

- 92 km/h

Track length (approx.)

- 775 meters

Capacity

- 28 guests

Number of inversions

- 4

5) **THE SWARM** Questions

- a) What is the average speed for the whole ride?
- b) Convert the maximum speed in km/h into m/s
- c) If THE SWARM moved at maximum speed for 2 s then how far (in metres) would it travel?
- d) A student says that THE SWARM can move at 40 m/s. Explain why this is a mistake (use calculations in your answer)

(Hint $1 \text{ m/s} = 3.6 \text{ km/h}$)

TIDAL WAVE: Ride Data



Tidal Wave Ride data

Maximum height

- 26 meters

Ride duration

- 120 seconds

Maximum speed

- 72 km/h

Track length (approx.)

- 886 meters

Capacity

- 20 guests

TIDAL WAVE

- **Tidal Wave** is one of the UK's tallest log flumes
- Thrill seekers are taken 26 metres high before experiencing a heart-stopping plunge into the blue



DISTANCE TIME GRAPH: TIDAL WAVE

- The following slide shows a distance time graph for **Tidal Wave**.
- The gradient slope shows the speed. The first section of the graph has a smaller gradient than the second section.
- The speed of the object is shown by the gradient. This means that the speed in the first section is slower than the speed in the second section.
- If the line were straight and horizontal this would indicate a speed of 0 m/s – the object being stationary.



DISTANCE TIME GRAPH: TIDAL WAVE



DETONATOR:BOMBS AWAY: Ride Data

SCREEN



Detonator: Bombs Away Ride data

Maximum height • 35 meters

Ride duration • 60 seconds

Maximum speed • 75 km/h

Capacity • 12 guests

6) Detonator: Bombs Away: Ride Data

Detonator: Bombs Away is an extreme thrill ride that takes riders to the top of a 35 m tower, leaves them hanging for a while and then drops at 20.85 m/s. The experience is described below:



6) **Detonator: Bombs Away** Questions

- a) Sketch a distance-time graph for Detonator: Bombs Away. Your graph should show distance from the ground, not total distance travelled.
- b) State the energy transfer that occurs from the Detonator: Bombs Away carriage as it moves from the bottom to the top of the tower.
- c) State the main energy transfer that occurs from the Detonator: Bombs Away carriage as it moves from the top to the bottom of the tower.
- d) What force is used when the rides are braking or slowing down? What energy transfer is associated with this force?



7) Look at the examples below (10 N means 10 Newtons)



The forces are unbalanced on the object.
The resultant force is 3 N to the right.



The forces are balanced on the object.
The resultant force is 0 N.

Now answer these questions....



a) The forces are _____ on the object.
The resultant force is _____.

Now answer these questions....



a) The forces are _____ on the object.
The resultant force is _____.

SCREAM

c) Now draw a similar diagram with labels for THE SWARM'S carriages. The force to the right is 700 N and the force to the left is 300 N.



SCREAM
LOUDER

ANSWERS

LAUGH
HARDER



SO HOW DID YOU DO?

Answers

1) 20 m/s

2) 0.83 m/s

3) a) 200m b) 115m

4) $0.7 \text{ s} + 2 \text{ s} = 2.7 \text{ s}$

5) a) Average speed for the whole ride = $775\text{m} \div 125\text{s} = 6.2\text{m/s}$ ANS

b) Maximum speed is 92 km/h. $92 \times (1000 \div 3600) = 25.6 \text{ m/s}$ ANS

c) $25.6 \times 2 = 51.2 \text{ m}$ ANS

d) $40 \times 3.6 = 144 \text{ km/h}$ which is bigger than the maximum speed of 92 km/h



Answers

6) a) Your Detonator: Bombs Away graph should look like this...



Answers continued...

- 6) b) Electrical energy $\rightarrow$ Gravitational (potential) energy
- c) Gravitational (potential) energy $\rightarrow$ Kinetic energy
- d) Name of the force is Friction and the energy transfer associated is:

Kinetic energy $\rightarrow$ Heat energy

Answers continued...

- 7) a) Unbalanced, 5 N to the left
b) Balanced 0 N
c) 400 N to the right