Astronomy

Define the following:

The Solar System: The eight planets orbiting our Sun, + asteroid belt.

The Milky Way: The galaxy the Solar System is in.

A Galaxy: A collection of billions of stars.

The Universe: A collection of billions of galaxies.

Why do planets orbit the Sun? They are attracted to each other by a gravitational force. They orbit due to a balance between speed and gravity.

How do the orbits of comets differ to the orbits of planets? Comets have more elongated elliptical orbits.

Which two things does the gravitational force between two objects depend on? Mass of the objects and the distance between them.

Write the equation that links orbial speed, orbital radius, and time.

Orbital Speed = 2 × π × Orbital Radius ÷ Orbital Period.

Calculate the speed of a satellite orbiting the Earth (radius 6400 km) at a height of 300 km. The satellite orbits once every 2 hours. Orbital Radius = $(6400 + 300) = 6700$ km. Period = $2 \times 60 \times 60 = 7200$ s

Speed = $\frac{2 \times \pi \times 6700}{7200} = 5.8$ km/s

Forces Revision Booklet

Name: Class:

Forces can change three things. Write these below:

1. Shape of an object.
2. Speed of an object.
3. Direction of motion.

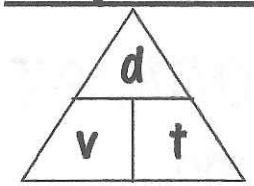
Forces are vectors and are measured in newtons. One newton is defined as:

The force required to accelerate a 1 kg mass by 1 m/s^2.

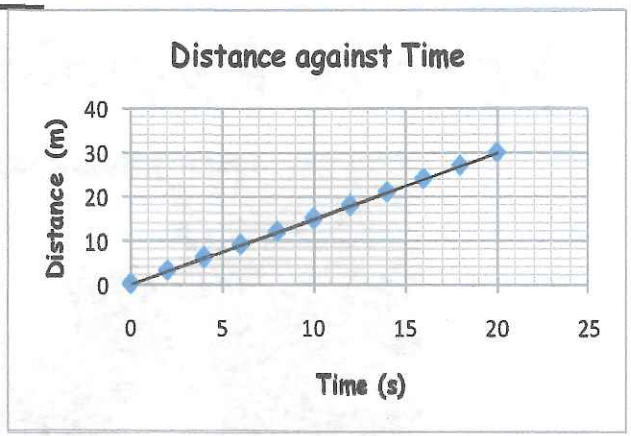
Complete the table showing what different types of forces can do.

Magnetic	Like poles repel, opposite poles attract.
Electrostatic	Like charges repel, opposite charges attract
Friction	Opposes the motion of two surfaces sliding past each other.
Upthrust	Upwards force opposing weight in liquids.
Air Resistance/Drag	Oppose motion of objects moving through fluids.

Graphs of Motion

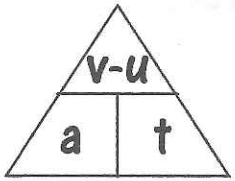


Velocity = displacement / time

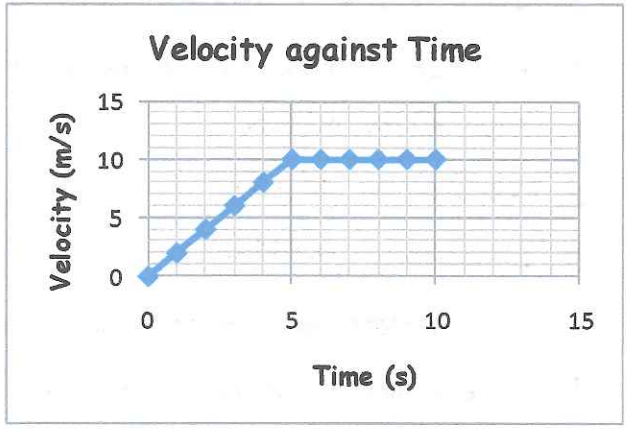


Calculate the velocity shown by the graph.

$v = \frac{\Delta d}{\Delta t} = \frac{30m}{20s} = 1.5 m/s$



Acceleration = change in velocity ÷ time



Calculate the acceleration between 0 - 5 s

$a = \frac{(10-0)}{5} = 2 m/s^2$

Calculate the total distance travelled in 10 seconds. Area = △ + □

$= (\frac{1}{2} \times 5 \times 10) + (5 \times 10)$

$= 25 + 50 = 75 m$

Turning Effect of Forces & Stability

The turning effect of a force is called its moment. The size of the turning effect depends on two things; the force and the distance from the pivot.

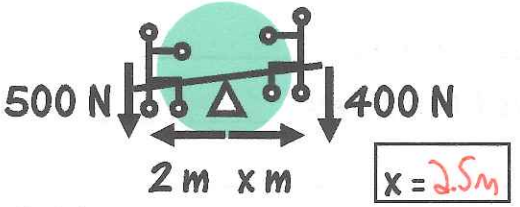
Moment = Force x Distance from Pivot

Write the equation above and use it to calculate the moments of the following:

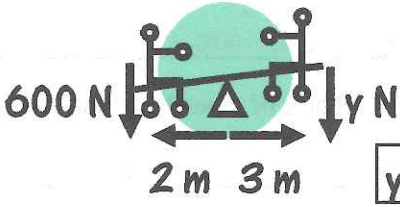
A 300 N weight acting at 2 m from a pivot. 300N × 2m = 600 Nm

A bike pedal 20 cm from the pivot being pushed with 50 N of force. 50 × 0.2 = 10 Nm

Use the principle of moments to balance the two see-saws below.



x = 2.5m



y = 400N

Stability

Define centre of gravity:

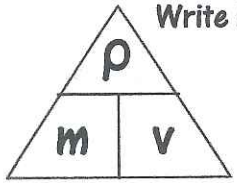
The part of an object where all the weight acts through.

Outline a method of finding the centre of gravity of a 2D piece of card. Explain how your method works.

Hang the shape by a thread - must move freely. Use a plumb line to draw a vertical line. Repeat for two more points and mark where all three lines intersect.

This method works as the weight will always act vertically downwards through the centre of gravity.

Momentum



Write below the equation that links force, mass and acceleration.

Momentum = mass x velocity

Which of the following has more momentum; a 5 000 kg truck moving at 1 m/s, or a 2 kg meteorite moving at 3 000 m/s? Truck = 5000kg x 1m/s = 5000kgm/s

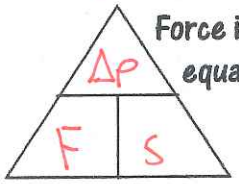
Meteorite = 2kg x 3000 m/s = 6000kgm/s - Meteorite.

Define the term "conservation of momentum:" Momentum in a closed system must remain the same.

A toy train, mass 1 kg, is travelling at 3 m/s when it collides with a second train of equal mass. They stick together due to magnetic catches. How fast do they move away from the point of collision? p = mv = 1 x 3 = 3kgm/s

New mass = 2kg Momentum = 3 Kgm/s

v = p/m = 3/2 = 1.5 m/s



Force is defined as the rate of change of momentum. Write the equation that shows this relationship.

Force = Change in Momentum ÷ time

Frank Lampard takes a penalty and the ball hits the back of the net at 20 m/s. The ball has a mass of 0.5 kg and is in contact with the boot for 0.1 seconds. Calculate the force applied to the ball.

$\Delta p = m \times v = 0.5kg \times 20\ m/s = 10kgm/s$

$F = \frac{\Delta p}{s} = \frac{10}{0.1} = 100\ N$

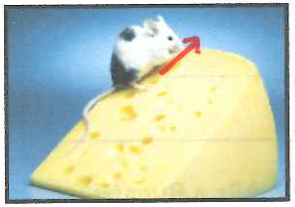
Forces & Shape

Each team has 8 players in a scrum. Each red player pushes with 300 N, each white player pushes with 320N. What is the total force exerted by the red team? 300N x 8 = 2400 N

What is the total force exerted by the white team? 320N x 8 = 2560N

What is the resultant force? 2560 - 2400 = 160N right

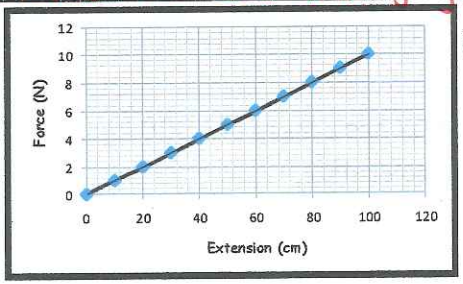
Which team will win? White



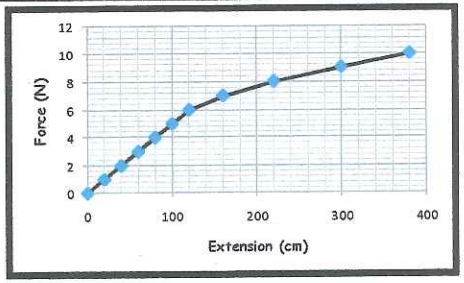
Friction resists the motion of two surfaces sliding against each other. Draw an arrow to show the direction friction is acting on the mouse. Are the forces balanced or unbalanced? Explain your answer.

Balanced. The mouse is staying still (no acceleration)

A



B



The two graphs show two different materials. Which material obeys Hooke's law for the full 10 N range? A

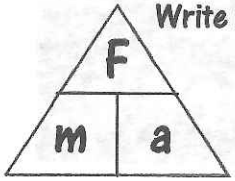
Which material is the stiffest? A: 10/100 = 0.1 B: 6/120 = 0.05

A

Name a material that does not obey Hooke's law: Rubber

A material that returns to its original shape when a load is removed is said to be: elastic. If stretched beyond the elastic limit the sample will deform permanently.

Forces & Movement



Write below the equation that links force, mass and acceleration.

Force = mass x acceleration

An equal force is applied to the two masses below. Which will have the greatest acceleration? Explain your answer.

The 5kg mass.

a = Force ÷ mass.

If forces are equal, the stone with the lowest mass will have the greatest acceleration.

A BMW Z4 accelerates to 27 m/s (≈ 60 mph) in 5.2 s, while a Bugatti Veyron does it in 2.4 s. Calculate the acceleration of each.

BMW - $a = (v-u)/t = 27/5.2s = 5.2 m/s^2$

Veyron - $a = (v-u)/t = 27/2.4s = 11.25 m/s^2$

The Bugatti has a mass of 1 888 kg, the BMW has a mass of 1 500 kg. Calculate the force needed for maximum acceleration.

BMW - $F = ma = 1500 \times 5.2 = 7800N$

Veyron - $F = ma = 1888 \times 11.25 = 21\,240\ N$

Complete the following:

Thinking distance is The distance traveled between seeing the need to stop and applying the break.

Breaking distance is the distance it takes for the car to stop once the brake is applied.

Stopping distance is thinking distance + braking distance.

Two factors that affect stopping distance are road condition, tyre condition, reaction time (alcohol, drugs, etc).

Explain the term "acceleration due to gravity."

The acceleration of free-falling objects due to the gravitational pull of the Earth; $9.81 m/s^2$

Assuming air resistance is negligible, how fast would ball be travelling as it hits the floor after free-falling from rest for 5 seconds?

$v = at = 9.81 \times 5 = 49.05 m/s$

or $= 10 \times 5 = 50 m/s$

Calculate the weight of a 65 kg man on Earth.

$W = mg = 65 \times 10 = 650N$ or $65 \times 9.81 = 637.65\ N$

The gravitational field strength on the moon is a sixth of the Earth's. How much would he weigh on the Moon?

$650N/6 = 108\ N$ or $637.65N/6 = 106.3\ N$

Terminal Velocity

In reality air resistance does affect the acceleration of an object in free-fall. Complete the sentences using the words below.

As an object first starts to fall there is zero drag. The only force acting on the object is weight, causing the object to accelerate downwards. As the object starts to move the drag force starts to increase. The drag force acts upwards against the movement. Resultant Force = Weight - Drag Force. As the object moves faster the drag force continues to increase, reducing the resultant force downwards, until the weight force and the drag force are equal. When the forces are balanced the resultant force is zero and there is no acceleration. The object has reached terminal velocity.

Words: zero terminal velocity equal upwards acceleration weight drag faster accelerate increase reducing

Complete the diagrams showing the acceleration leading to terminal velocity