SUBJECT: Science

UNIT: P5: Forces

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Lesson 1: Vector and Scalar

1. What is a scalar quantity?
2. What is a vector quantity?

Lesson 2: Contact and Non-Contact Forces

1. What is a contact force including an example?
2. What is a non-contact force including an example?

Lesson 3: Gravity and weight

1. What two factors affect gravity?
2. What is the equation for calculating weight?

Lesson 4: Resultant Forces

1. What is a resultant force?
2. What is the motion of an object with a resultant force of 0N?
   What is the motion of an object with a resultant force that is **not** 0N?

Lesson 5: Resolving Forces HT ONLY

1. How can a force be resolved?

Lesson 6: Forces and Elasticity

1. What is the equation for calculating Hooke's law?

Lesson 7 & 8: Hooke's Law Practical

1. What are the three variables for the Hooke's law practical?
2. What is the conclusion from the practical?

Lesson 9: Work Done and Energy Transfer

1. What is work done?
2. How are work done and energy transferred related?

Lesson 10: Moments, Levers, and Gears SEP ONLY

3. What is a moment?
4. How do levers affect moments?
5. How does the size of the gear affect the moment?

Lesson 11: Pressure in a fluid SEP ONLY

6. What is a fluid?
7. What is the equation for calculating pressure?

Lesson 12: Pressure in a fluid 2 SEP ONLY

8. What is the equation for calculating pressure in a fluid?
9. How does depth affect pressure in a fluid?

Lesson 13: Atmospheric Pressure SEP ONLY

10. What happens to pressure as altitude increases?
11. Why does this happen?

Lesson 14: Distance, Displacement, Speed, Velocity

12. Which is vector and which is scalar: distance or displacement?
13. Which is vector and which is scalar: speed or velocity?

Lesson 15: Distance-Time Graphs

14. What does a horizontal line represent?
15. What does a straight diagonal line represent?
16. What does a curved line represent?

Lesson 16: Acceleration

17. How is acceleration calculated? (There are three equations)

Lesson 17: Velocity-Time Graphs

18. What does a horizontal line represent?
19. What does a straight diagonal line represent?
20. What does a curved line represent?

Lesson 18: Terminal Velocity

21. What is terminal velocity?

Lesson 19: Newton's 1st Law

22. What is Newton's 1st law?

Lesson 20: Newton's 2nd Law

23. What is Newton's 2nd law?

Lesson 21: Acceleration Required Practical

24. What are the three variables for the acceleration practical?
25. What is the conclusion from the practical?

Lesson 22: Newton's 3rd Law

26. What is Newton's 3rd law?

Lesson 23: Factors Affecting Braking Distance

27. What are two factors that affect breaking distance?

Lesson 24: Momentum HT ONLY

28. What is momentum?
29. How is momentum conserved?

Lesson 25: Change of Momentum

30. What is the equation for calculating the rate of change of momentum?
31. What are some safety features that increase the rate of change of momentum?

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Key Equations

Weight

$$W = m \; x \; g$$

Acceleration

$$F = m \; x \; a$$

$$a = \frac{v - u}{t}$$

$$v^2 - u^2 = 2as$$

Work Done

$$W = F \; x \; s$$

Hooke's Law

$$F = k \; x \; e$$

Momentum

$$p = m \; x \; v$$

Quantities and units

W = Weight (Newtons, N)
m = Mass (kg)
g = gravitational field strength (N/kg)
t = Time (Seconds, s)
a = Acceleration (m/s^2)
W = Work done (N/m or J)
p = Momentum (kgm/s)
v = Velocity (m/s)
k = Spring Constant (N/m)
e = Extension (m)

Converting units

100cm = 1m
1000mm = 1m
1000m = 1km

Ambitious Vocabulary

Scalar Vector Resultant
Velocity Displacement

Scalar and Vector

Scalar – a quantity that has only magnitude e.g. temperature, mass
Vector – a quantity that has magnitude and direction e.g. velocity, displacement, force

Gravity

Gravity is affected by mass and weight. In the equation we can see that mass and weight are directly proportional. An objects centre of mass is the point where weight is acting.

Contact and Non-contact Forces

Contact forces occur when objects are touching; friction, air resistance, tension, contact force.
Non-contact forces occur when objects are not touching; gravitational, electrostatic, magnetism.

Work Done and Energy Transferred

When a force acts on an object and makes it move, work is done. Energy transferred and work done are the same thing.

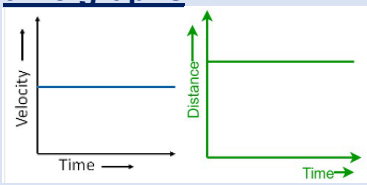
Terminal Velocity

When weight and air resistance are equal and balanced an object has reached terminal velocity and can no longer accelerate.

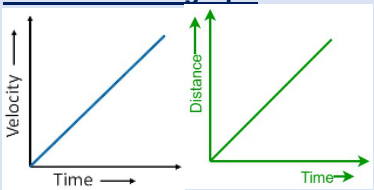
Resultant Force

A single force that describes all forces acting on an object. If the resultant force is 0N then the object could be stationary or moving at a constant velocity. If the resultant force is any other number the object is accelerating/decelerating.

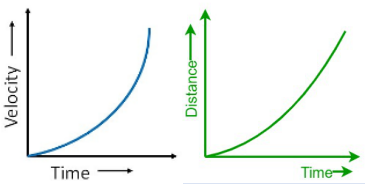
Distance-time and Velocity-time graphs



Velocity time graph – constant speed
Distance time graph - stationary



Velocity time graph – constant acceleration
Distance time graph – constant velocity



Velocity time graph – changing acceleration
Distance time graph - acceleration

Typical Speeds

Walking – 1.5m/s.
Running – 3m/s
Cycling – 6m/s

Braking Distance

Braking distance is the distance travelled by a vehicle once the brakes are applied. Factors that may affect this are: adverse weather, poor vehicle condition.

Stopping Distance

The total of the braking and thinking distances. Thinking distance is affected by tiredness, drugs, alcohol.

Required Practical: Hooke's Law

Independent variable- force (N)
Dependent variable- extension (m)
Control variables- type of spring
Conclusion- Increasing the force on the spring increases the extension at a rate that is directly proportional until it's elastic limit. The gradient of the line is the spring constant of the spring.

Required Practical: Acceleration

Independent variable- force (N)
Dependent variable- acceleration (m/s^2)
Control variables- same total mass, surface area
Conclusion- increasing the force on an object increases acceleration at a rate that is directly proportional.

Newton's Laws

1st law – if the resultant force on an object is 0N the object is either stationary or moving at a constant speed.
2nd law – F = m x a
3rd law – when two objects interact the forces acting on one another are always equal and opposite.

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Velocity Displacement

Pressure in a fluid 1 (SEP ONLY)

A fluid can be either a liquid or a gas. The pressure in fluids causes a force at right angles to any surface.

Pressure in a fluid 2 (SEP ONLY)

Pressure in fluids depends on the weight of the fluid on top of the object. The higher the column of water on top of an object the higher the pressure. A partially submerged object experiences a greater force on the bottom surface compared to the top surface.

Atmospheric Pressure (SEP ONLY)

The atmosphere is a thin layer of air around the Earth. The atmosphere gets less dense with increasing altitude. Air molecules colliding with the surface create atmospheric pressure. The number of air molecules (weight of air) above a surface decreases with altitude.

Momentum (HT ONLY)

Momentum is calculated using Momentum = mass x velocity
In a closed system, the total momentum before an event is equal to the total momentum after the event.
This is called conservation of momentum.
In a collision two objects have initial momentums that are separate and after the collision these two momentums combine to generate an equal final momentum.

Changes in Momentum (SEP ONLY)

When a force acts on an object that is moving or able to move, a change in momentum occurs.
Safety features are added to cars such as air bags and seatbelts to increase the time of collisions and therefore reduce the rate of change of momentum.
This is also true for gymnasium crash mats, cycle helmets and cushioned surfaces.

Resolving Forces (HT ONLY)

When multiple forces act on an object they can be combined into one singular force. One singular force acting at an angle on an object can also be separated into its component forces.

Moments, Levers, and Gears (SEP ONLY)

A force or a system of forces may cause an object to rotate. The turning effect of a force is called the moment of a force.
If an object is balanced, the total clockwise moment about a pivot equals the total anticlockwise moment about the same pivot.
A simple lever and gear system can be both used to transmit the rotational effects of forces.
Longer levers can increase the moment and therefore the turning force about a pivot without increasing the force on the lever.
The larger a gear the slower it turns but the larger the moment.
The smaller a gear, the faster is turns but the smaller the moment.