

TEACHER NOTES

Newton's Laws

Isaac Newton 1642-1727 ([see Encarta](#))

Quiz Answers (NEWTON'S FIRST LAW)

No.	Answer	Description
1	2(B)	<i>For equilibrium lift = weight</i>
2	3(C)	<i>To lose height resultant force must be weight</i>
3	4(D)	<i>For looping, resultant force is centripetal i.e. towards the centre of the circle. Hint available. NB Actually more complicated than this as aircraft also accelerates downwards and decelerates upwards in the loop..</i>
4	1(A)	<i>If the engine cuts out its thrust is zero</i>
5	1(A)	<i>Velocity constant so line horizontal</i>
6	3(C)	<i>Veloc vertical, time horizontal, so area = distance travelled</i>
7	3(C)	<i>Veloc increasing with time, so accelerating</i>
8	4(D)	<i>Acceleration is veloc/time from gradient of graph</i>
9	2(B)	<i>Distance increasing linearly in uniform flight</i>
10	4(D)	<i>Veloc = dist/time from gradient of graph</i>

Notes

The quiz works well if you go round the class asking students individually. If they all find a question difficult, they can vote. A good internet program on Newton's Laws is available at:

www.bbc.co.uk/schools/gcsebitesize/physics/forces/index.shtml

Experiments *Newton's Laws are usually investigated by using ticker-timers and/or an air track.*

As such these definitions may not be in your particular syllabus, so you may need to check. Letts Revise GCSE Study Guide gives an overview. www.letts-education.com

1. **Define Newton's First Law**

An object continues in its state of rest, or motion, unless acted on by a resultant force.

Discussion

This would be a good place to have a discussion about vehicles/objects that obey or do not obey Newton's First Law. (See question 5 on the worksheet for suggestions).

Quiz Answers (NEWTON'S SECOND and THIRD LAWS)

No.	Answer	Comments
1	2(B)	<i>Unbalanced forces produce acceleration</i>
2	3(C)	<i>Spring</i>
3	1(A)Yes	<i>Hooke's Law obeyed</i>
4	2(B)	<i>Load/Extension would be a linear graph</i>
5	2(B)	<i>Forces exist in pairs</i>
6	4(D)	<i>1N opposed by 5 N gives 4 N and maximum acceleration</i>
7	3(C)	<i>$a = F / m$ Use the magic triangle.</i>
8	1(A)	<i>300 g ($W = mg = 0.3 \times 10 = 3 \text{ N}$)</i>
9	2(B)No	<i>Unbalanced forces on the same body produce acceleration</i>
10	4(D)	<i>Chrome or bronze</i>

2. Define Newton's Second Law

A resultant force produces acceleration.

OR acceleration is proportional to the resultant force ($F = ma$)

and acceleration is inversely proportional to mass.

Discussion What is the difference between mass and weight?

This would be a good place to have a discussion about

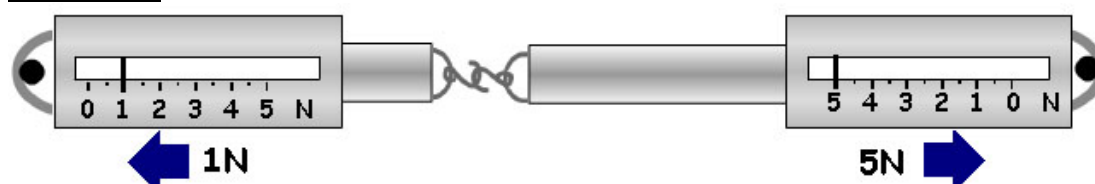
Mass, the amount of matter in an object

Weight, the force of gravity on an object

and the equation $W=mg$.

(See Questions 1 and 2 on the worksheet)

Exercise



In the above arrangement, if the mass of each spring-balance is 200 g, what will be the resultant acceleration?

Using $a = F/m = (5 - 1)/(0.2 + 0.2) = 4/0.4 = 10 \text{ m/s}^2$ i.e. the value of g

3. Define Newton's Third Law

Forces exist in pairs,

OR to every action there is an equal and opposite reaction.

Discussion Is Newton's Third Law always true? **YES**

(NB equal and opposite forces do not act on the same body; if they did, there could never be any resultant forces. i.e. acceleration would not be possible.)

Newton's Laws Problems/Homework/Test

Take $g = 10 \text{ m/s}^2$ and use $F = ma$ and $W = mg$

1. What is the weight of an 18 kg solar power supply on Earth?

Using $W = mg$, $W = 18 \times 10 = \underline{180 \text{ N}}$

A good time to discuss weight (the force on a body towards the centre of the Earth.)

2. If the gravitational acceleration on the Moon is $1/6$ that on the Earth, how much will the power supply weigh on the Moon?

Using $W = mg$, $W = 18 \times 10/6 = \underline{30 \text{ N}}$

3. Two spring-balances/newton-meters are hooked together on a smooth horizontal surface. One of them reads 25 N, and if the both of them read accurately, what should the other one read?

Applying Newton's Third Law, the other spring-balance will read 25 N

4. A small satellite orbiting the Earth has a mass of 300 kg fires its rocket to go to a higher orbit. If the thrust from the rocket is 150 N, what will be the acceleration of the satellite?

Using $F = ma$,

So $a = F/m = 150/300 = \underline{0.5 \text{ m/s}^2}$

5. What vehicles or objects can you think of that demonstrate Newton's First Law?

Examples include the plane in level flight in the program, and any vehicle/object not accelerating or decelerating, an ice-hockey puck, the trolley on an air-track, an object in space, a hovercraft. This might be a good place to introduce the concepts of friction opposing motion and centripetal force (i.e. gravitation causing satellites to stay in orbit.)