**Science Home learning**

We hope you are all doing well at home, well done for doing your science work :-). Below are the email addresses for all Science staff. Do not hesitate to contact any of us with any questions. We even have twitter!

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**L07 Newton’s Second Law.**

**Year: 10**

Topic: **Physics** Unit: **Forces 2**

Date Set:

Information to read / watch:

<https://classroom.thenational.academy/units/forces-ft-9dee>

(Foundation: Lesson 12 Newton’s Laws)

<https://classroom.thenational.academy/units/forces-ht-573f>

(Higher: Lesson 12 Newton’s Laws)

<https://www.youtube.com/watch?v=SqdCCxv9YzI>

Objectives:

Be able to estimate the speed, accelerations and forces involved in large accelerations for everyday road transport.

Recognise and be able to use the symbol that indicates an approximate value or approximate answer ̴

(HT only) Students should be able to explain that:

• inertial mass is a measure of how difficult it is to change the velocity of an object

• inertial mass is defined as the ratio of force over acceleration.

Additional Websites:

<https://www.bbc.co.uk/bitesize/guides/z8crsrd/revision/2>

**ME Task Lesson 7: Newtons 2nd Law**

1. A bus accelerates away from the bus stop at 2.5 m/s2.

The total mass of the bus and passengers is 14 000 kg.

Calculate the resultant force needed to accelerate the bus and passengers.

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Resultant force = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ N

2. A stone dropped off a cliff has a mass of 2kg and accelerates at 9m/s².

Calculate the force on the stone?

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Force = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ N

3. A car of mass 750kg is travelling along a straight road, assuming there are no other forces acting on the car calculate the force that is being produced by the engine if the car is accelerating at 20m/s2

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4. A person of mass 55kg is riding a bike of mass 35kg down a hill, they are accelerating at 1.25m/s2. Assuming friction and air resistance are negligible calculate the force of the bike travelling.

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5. A bus of mass 1200kg has eight passengers who each have a mean mass of 69kg, it is accelerating at 8.23m/s2. Calculate the force, assuming no other forces are acting on the bus.

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What is the symbol for an approximate value? Use it to provide an answer to the question above.

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HT Only:

Why are seatbelts needed?

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What happens to your takeaway coffee in its cup when travelling and the car speeds up, slows down, or changes direction?

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Why do we have head restraints in cars?

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What is the inertial mass of a car that needs a force of 2000N to accelerate it by 1m/s2

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What is the inertial mass of a bus that accelerates at a rate of 0.5m/s2 when 5 people push it, each with a force of 750N?

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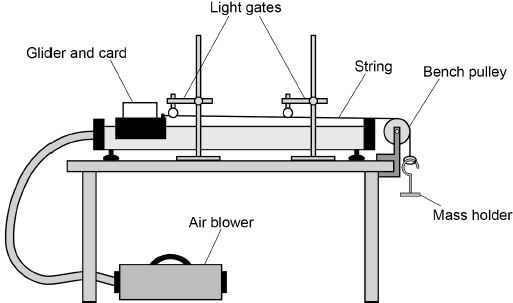
**ME Task Lesson 7: Newtons 2nd Law Challenge**

A student investigated acceleration using gliders, an air track and light gates.

The air track reduces friction between the glider and the track to zero.

**Figure 1** shows the apparatus.

**Figure 1**

****

The glider was released from rest and moved along the track.

The mass holder hit the ground before the card passed through the second light gate.

(a)  Which **two** statements describe the effect this would have on the glider?

Tick **two** boxes.

|  |  |
| --- | --- |
| Its acceleration would decrease to zero. |  |
| Its acceleration would increase. |  |
| The resultant force on it would decrease to zero. |  |
| The resultant force on it would increase. |  |
| Its speed would increase. |  |

**(2)**

(b)  The mass holder should **not** hit the ground before the card passes through the second light gate.

Suggest **one** way that the student could stop this happening.

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**(1)**

The student increased the resultant force acting on the glider by adding more masses to the mass holder.

She calculated the acceleration of the glider for each resultant force.

Each test was done three times.

**Table 1** shows the results. **Table 1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Resultant force in N** | **Acceleration in m/s2** | | | **Mean acceleration in m/s2** |
| **Test 1** | **Test 2** | **Test 3** |
| 0.20 | 1.3 | 1.2 | 1.3 | 1.26667 |
| 0.39 | 2.6 | 2.5 | 2.6 | 2.6 |
| 0.59 | 3.8 | 3.8 | 3.9 | 3.8 |
| 0.78 | 5.1 | 5.1 | 5.1 | 5.1 |
| 0.98 | 6.4 | 7.2 | 6.4 | 6.7 |

(c)  The student made **two** mistakes in the mean acceleration column.

Identify the mistakes the student made.

Suggest how each mistake can be corrected.

Mistake \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Correction \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(4)**

(d)  Write a conclusion for this investigation.

Use the data in **Table 1**

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**(1)**

**Mark Scheme**

1. 35 000 (F= ma)

*allow****1****mark for correct substitution, ie 14 000 × 2.5 provided no subsequent step*

*an answer of 87 500 indicates acceleration (2.5) has been squared and so scores zero*

2. 18 (F= ma)

3. 15000N

4. 112.5N

5. 14418.96N ̴

* To increase the time it takes to slow the body down. This reduces the impact forces on the body.

It also prevents the body being thrown out of the vehicle.

* It will spill because the coffee tries to move in the same direction and speed it was travelling.
* To stop the head being forced backwards and damaging the neck.

6. 2000kg

7. 7500kg

**Challenge**

(a)  its acceleration would decrease to zero

**1**

the resultant force on it would decrease to zero

**1**

(b)  any **one** from:

•   move the second light gate closer to the first

•   shorten the string length

*allow use a taller table*

**1**

(c)  1.26667 (m/s2) (is wrong)

*allow (mean value calculated at) 0.20 (N)*

**1**

give value to 2 significant figures

*allow give value to 1 decimal place allow 1.3 (m/s2)*

**1**

6.7 (m/s2) (is wrong)

*allow (mean value calculated at) 0.98 (N)*

*allow test 2 for 0.98 (N) or 7.2 is an anomaly*

**1**

discard the anomalous result and recalculate the mean

*allow repeat the anomalous test result and re-calculate the mean allow 6.4 (m/s2)*

**1**

*each mistake and its correction may be given in any order*

(d)  (resultant) force is directly proportional to acceleration

*allow the larger the (resultant) force, the greater the acceleration*

*allow positive correlation between (resultant) force and acceleration*

*allow mass / weight (of the holder) for (resultant) force*

**1**