2021 ASSESSMENT MATERIALS

GCSE
PHYSICS

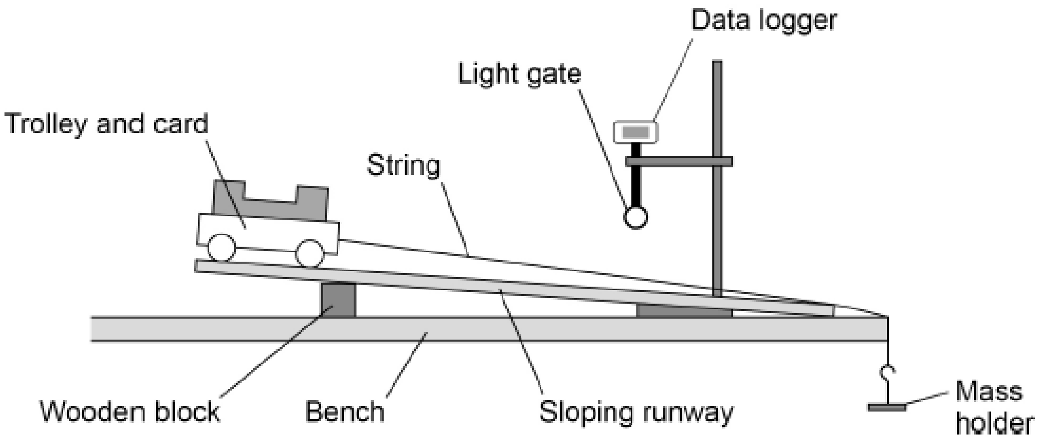
Physics Test 4: Forces (Higher)

Total number of marks: 37

0 8 A student investigated the acceleration of a trolley.

Figure 13 shows how the student set up the apparatus.

Figure 13



The light gate and data logger were used to determine the acceleration of the trolley.

The student increased the resultant force on the trolley and recorded the acceleration of the trolley.

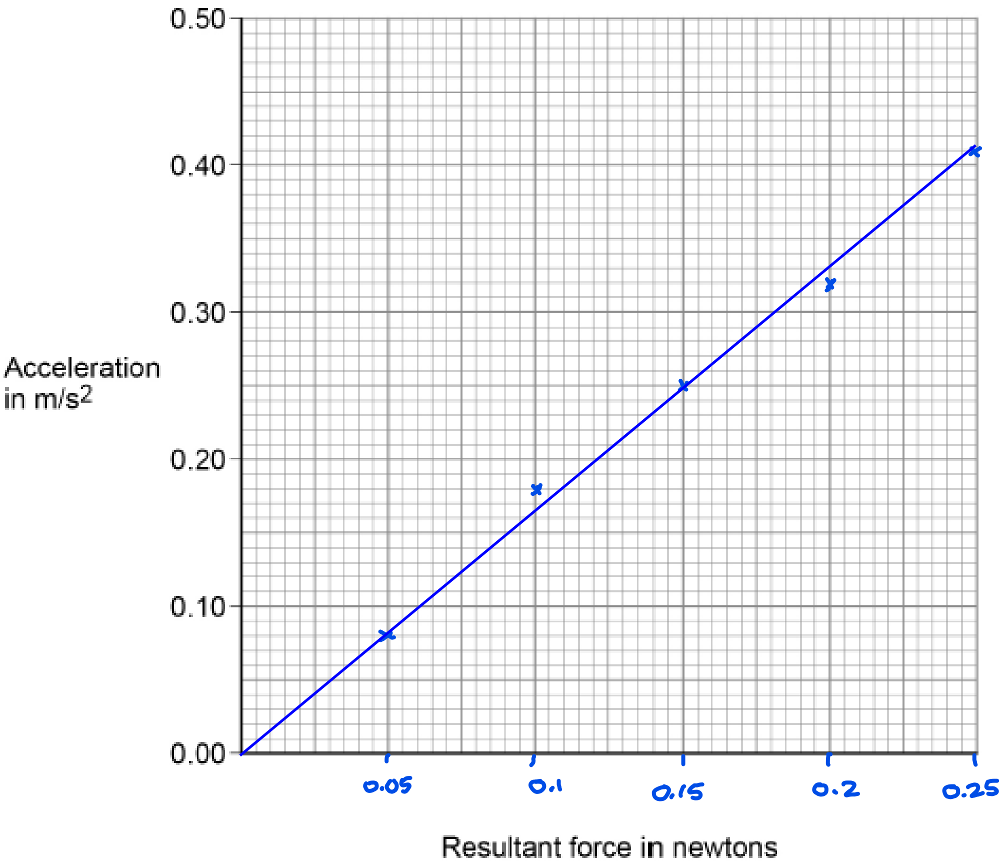
Table 4 shows the results.

Table 4

Resultant force in newtons	Acceleration in m/s²
0.05	0.08
0.10	0.18
0.15	0.25
0.20	0.32
0.25	0.41

Figure 14 is an incomplete graph of the results.

Figure 14



0 8 . 3 Complete **Figure 14**.

- Choose a suitable scale for the x-axis.
- Plot the results.
- Draw a line of best fit.

[4 marks]

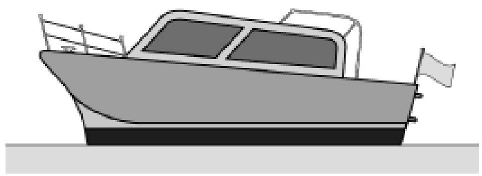
0 8 . 4 Describe the relationship between the resultant force on the trolley and the acceleration of the trolley.

[1 mark]

They are directly proportional to each other.

0 6 **Figure 8** shows a boat floating on the sea. The boat is stationary.

Figure 8

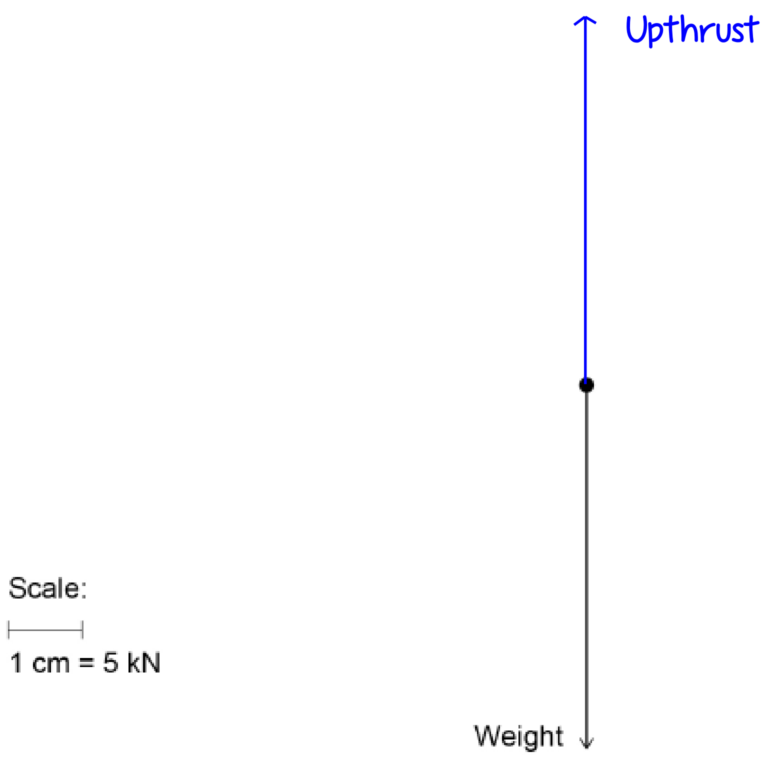


0 6 . 1 **Figure 9** shows part of the free body diagram for the boat.

Complete the free body diagram for the boat.

[2 marks]

Figure 9



0 6 . 2 Calculate the mass of the boat.

Use the information given in **Figure 9**.

gravitational field strength = 9.8 N/kg

Give your answer to **two** significant figures.

[4 marks]

5cm → 25kN

w = mg

25000 = m × 9.8

m = 2551 ≈ 2600

Mass = 2600 kg

0 6 . 3 When the boat propeller pushes water backwards, the boat moves forwards.
The force on the water causes an equal and opposite force to act on the boat.

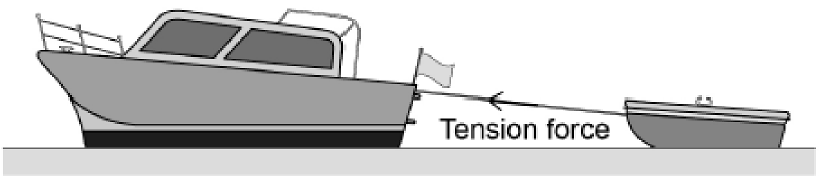
Which law is this an example of?

[1 mark]

Newton's third law.

0 6 . 4 **Figure 10** shows the boat towing a small dinghy.

Figure 10



The tension force in the tow rope causes a horizontal force forwards and a vertical force upwards on the dinghy.

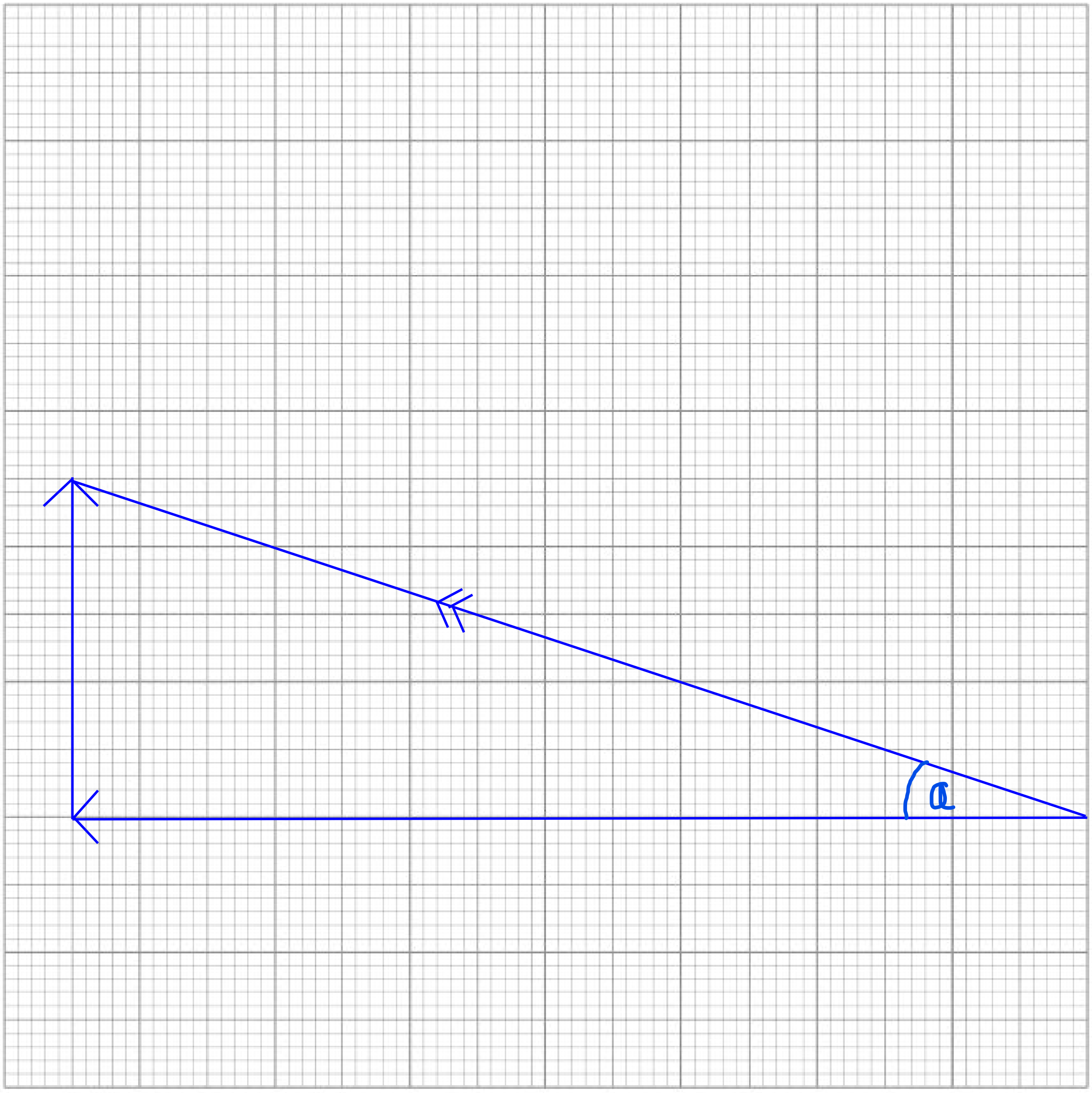
horizontal force forwards = 150 N
vertical force upwards = 50 N

Figure 11 shows a grid.

Draw a vector diagram to determine the magnitude of the tension force in the tow rope and the direction of the force this causes on the dinghy.

[4 marks]

Figure 11



Magnitude of the tension force in the tow rope = 158 N

Direction of the force on the dinghy caused by the tension force in the tow rope = θ = 18.5° from west

0 5 **Figure 7** shows two ice hockey players moving towards each other.

They collide and then move off together.

Figure 7

Before the collision

Player A	**Player B**
Mass = 78 kg	Mass = 91 kg
Velocity = +7.5 m/s	Velocity = –5.5 m/s

During the collision, the total momentum of the players is conserved.

0 5 . 1 What is meant by 'momentum is conserved'?

[1 mark]

The total momentum (product of mass and velocity) is constant throughout the processes that occur.

0 5 . 2 Immediately after the collision the two players move together to the right.

Calculate the velocity of the two players immediately after the collision.

[4 marks]

→+ $m_1 v_1 + m_2 v_2 = (m_1 + m_2)V$

$(78)(7.5) + (91)(-5.5) = (78+91)V$

$585 + (-500.5) = 169V$

$84.5 = 169V$

Velocity = 0.5 m/s

0 5 . 3 The ice hockey players wear protective pads filled with foam.

Explain how the protective pads help to reduce injury when the players collide.

[3 marks]

During a collision the player experiences a large change in momentum. However, the foam increases the time taken for the change in momentum, thereby decreasing the force experienced by the player. This decreases the injuries experienced by the player.. The compressible nature of foam also acts as a soft foam preventing cuts and bruises.

0 6 . 1 An adult of mass 80 kg has more inertia than a child of mass 40 kg

What is inertia?

[1 mark]

The tendency of an object to remain at its current state. of motion.

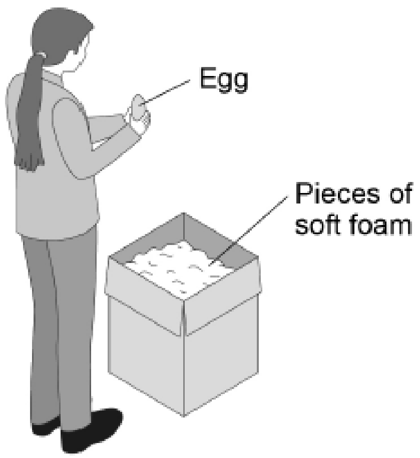
0 6 . 2 A teacher demonstrated the idea of a safety surface.

She dropped a raw egg into a box filled with pieces of soft foam.

The egg did not break.

Figure 10 shows the demonstration.

Figure 10



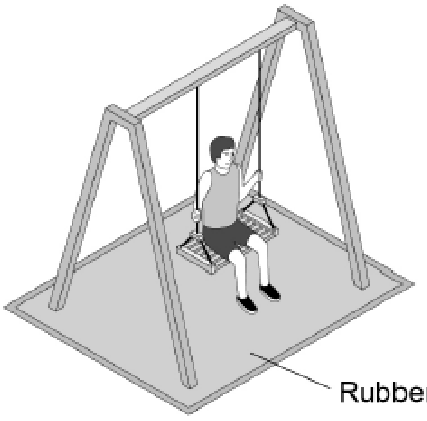
Explain why the egg is less likely to break when dropped onto soft foam rather than onto a concrete floor.

[3 marks]

The egg experiences a change in motion as it contacts with both the concrete and the foam. However, the foam increases the time taken for that change in momentum compared to concrete, decreasing the force experienced by the egg. This force (in foam) is more likely to be lower than the force that is sufficient to crack the egg.

0 6 . 3 **Figure 11** shows a child on a playground swing. The playground has a rubber safety surface.

Figure 11



A child of mass 32 kg jumped from the swing.

When the child reached the ground she took 180 milliseconds to slow down and stop.

During this time an average force of 800 N was exerted on her by the ground.

Calculate the velocity of the child when she first touched the ground.

Use the Physics Equations Sheet.

[4 marks]

$$\text{Force} = \frac{\Delta \text{ momentum}}{\text{time taken}}$$

$$800 = \frac{(32)(v) - (32)(0)}{\left(\frac{180}{1000}\right)}$$

$$144 = 32V$$

$$V = \frac{144}{32}$$

Velocity = 4.5 m/s

0 6 **Figure 8** shows a student playing with a remote-controlled car.

Figure 8

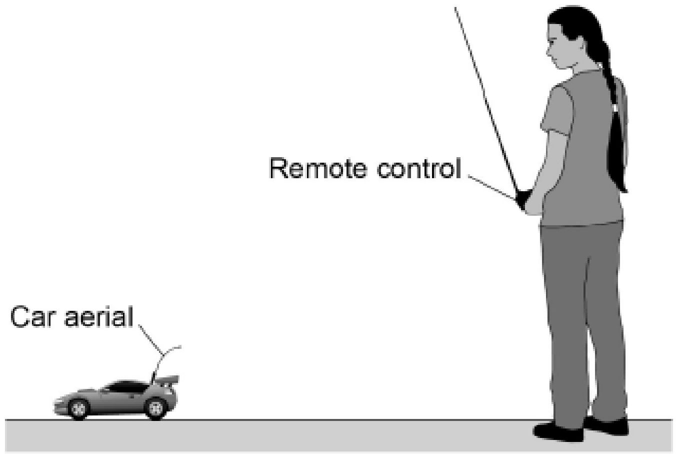
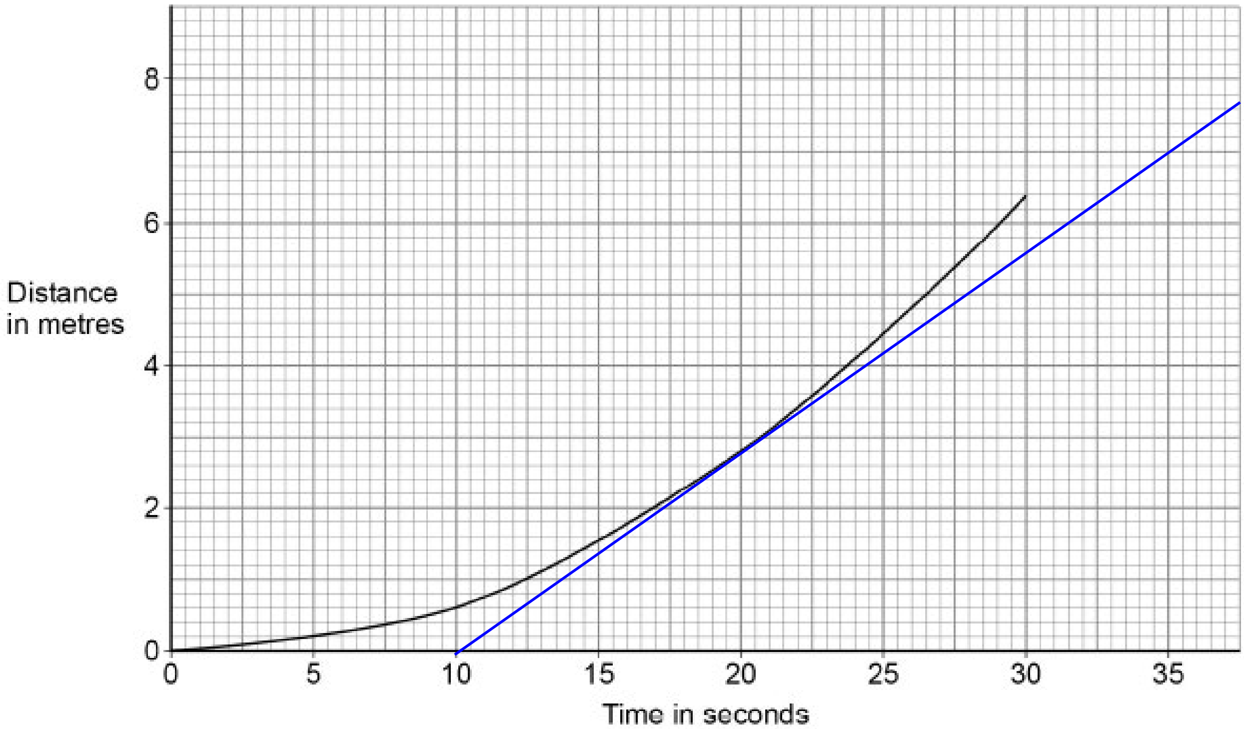


Figure 9 shows the distance-time graph for the first 30 seconds of the car's motion.

Figure 9



0 6 . 4 Describe the motion of the car during the first 30 seconds.

[1 mark]

The car accelerates.

0 6 . 5 Determine the speed of the car 20 seconds after it started to move.

[4 marks]

Speed = gradient of tangent at t = 20 = $\frac{7-0}{35-10} = \frac{7}{25} = 0.28$

Speed = 0.28 m/s