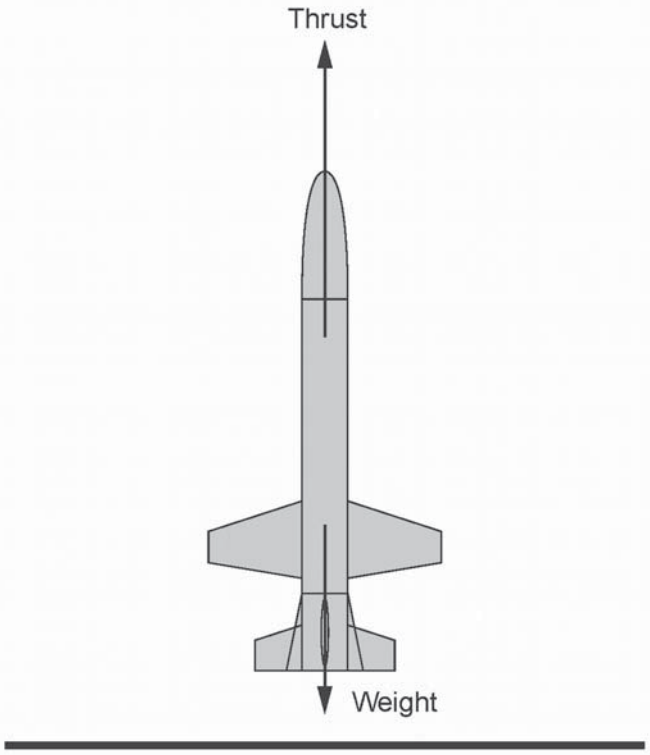
WJEC Physics GCSE
Topic 2.2: Newton's laws
Questions by topic

1.

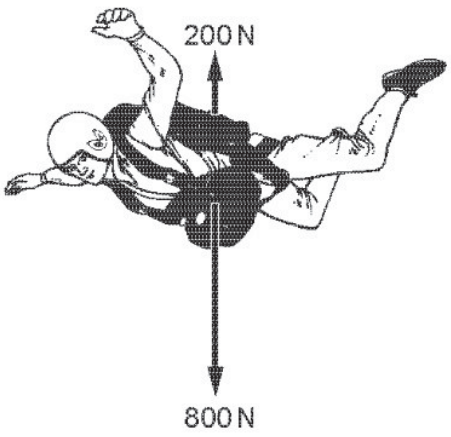
Explain how all Newton's Laws of Motion apply to a rocket as it lifts off from the ground.

[6 QWC]



2.

(a) A skydiver of mass 80 kg weighs 800 N.



Use the equation:

$$\text{acceleration} = \frac{\text{resultant force}}{\text{mass}}$$

to calculate the acceleration of a skydiver of mass 80 kg when the air resistance force is 200 N. [3]

acceleration = ... m/s^2

(b) When a skydiver opens a parachute, he decelerates until he reaches a small terminal speed of about 3 m/s for landing.

(i) Discuss the above statement. Include in your answer the following points:

- An explanation in terms of forces – why a skydiver decelerates when the parachute is opened.
- An explanation of how a small terminal speed is achieved for landing. [6 QWC]

(ii) The correct size of parachute is important to give a small terminal speed. A heavy person needs to have a different size parachute from a lighter person.

Explain why a heavier person needs a different area parachute from a lighter person to achieve the same small landing speed. [3]

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3.

(a) The diagrams below show the drag and forward driving forces acting on a car at different times in a journey.

Draw a line to link each diagram to the description of the car's motion. [3]

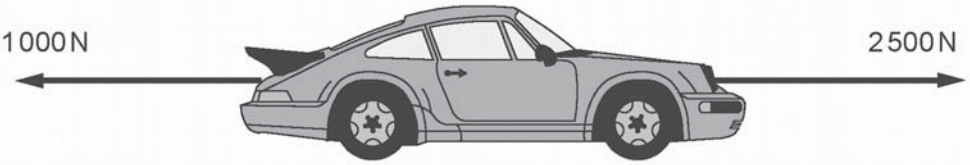
at rest

speeding up

constant speed

slowing down

(b) The diagram below shows the horizontal forces acting on car **A** of mass 1200 kg.



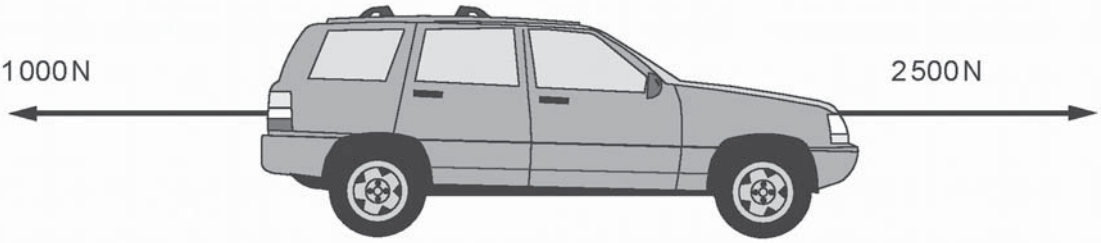
Use the equation:

$$\text{acceleration} = \frac{\text{resultant force}}{\text{mass}}$$

to calculate the acceleration of car **A**. [3]

acceleration = ... m/s^2

(c) The same two horizontal forces act on car **B**.



Car B has a **mass twice as big** as car A.

(i) Write down the acceleration of car **B**. [1]

acceleration of car **B** = ... m/s^2

(ii) State what happens to the size of the drag force as car **B** accelerates. [1]

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(iii) Explain why car **B** reaches a maximum speed. [2]

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4.

(a) Describe how Newton's 3rd law applies to a rocket on take-off. [2]

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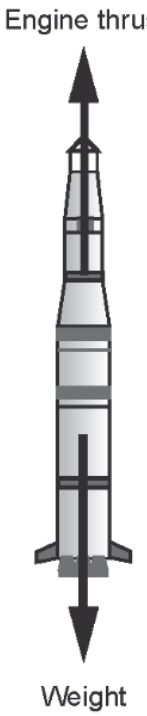
(b) The Cassini spacecraft with its Huygens probe was launched by rocket in 1997 to study one of Saturn's moons. On 14 January 2005 the Huygens probe landed on the moon, Titan, and was slowed down by a parachute which opened 120 km above the surface.

Take-off mass of rocket, spacecraft and probe = $9{\cdot}5 \times 10^5$ kg
Engine thrust of rocket on take-off = $1{\cdot}5 \times 10^7$ N
Gravitational field strength on Earth = 10 N / kg
Gravitational field strength on Titan = 1·35 N / kg
Mass of Huygens probe = 320 kg

(i) Discuss the acceleration of the rocket at its launch. Include in your answer:

- A calculation of the initial acceleration. (Hint: consider the weight of the rocket.)
- An explanation of the way the acceleration changes as the rocket rises. (Hint: ignore the effects of air resistance.) [6 QWC]



initial acceleration = ... m/s^2

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(ii) Calculate the loss in gravitational potential energy of the Huygens probe during its descent by parachute to the surface of Titan. [3]

change in potential energy = ... J

(iii) Explain what has happened to this potential energy as the probe falls to the surface of Titan. [2]

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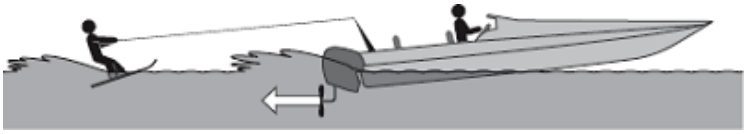
5. The diagram shows a boat pulling a water skier.



(a) The arrow represents the force on the water produced by the engine propell
This force causes the boat to move.

Explain why.

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(2)

(b) The boat accelerates at a constant rate in a straight line. This causes the velocity of water skier to increase from 4.0 m/s to 16.0 m/s in 8.0 seconds.

(i) Calculate the acceleration of the water skier and give the un

Use the correct equation from the Physics Equations Sheet.

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Acceleration = ...

(3)

(ii) The water skier has a mass of 68

Calculate the resultant force acting on the water skier while accelerating.

Use the correct equation from the Physics Equations Sheet.

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Resultant force = ... N

(2)

(iii) Draw a ring around the correct answer to complete the sent

The force from the boat pulling the water skier forwards

will be | less than / the same as / greater than | the answer to part **(b)(ii)**.

Give the reason for your answer.

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(2)

(Total 9 marks)