

Area 3: Newton's Laws of Motion

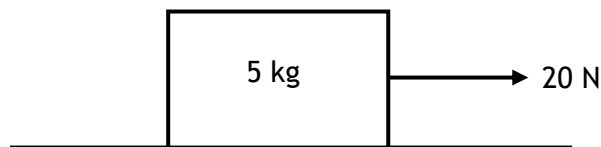
Multiple Choice Questions 1 → 10

1. A space probe built on Earth has a mass of 750 kg.
Calculate the weight of the space probe on Earth.

A 77 N
B 750 N
C 760 N
D 7350 N
E 7500 N
2. A lunar lander module has a weight of 147000 N on Earth.
Calculate the weight of the lunar lander module on the Moon.

A 15000 N
B 24000 N
C 30000 N
D 132000 N
E 147000 N
3. A space probe has a mass of 60 kg. The weight of the space probe at the surface of a planet in our solar system is 534 N.
Determine the planet the space probe has encountered.

A Venus
B Mars
C Jupiter
D Saturn
E Neptune
4. A block is pulled across a horizontal surface as shown.



The mass of the block is 5 kg.
The block is travelling at a constant velocity.
Calculate the force of friction acting on the block.

- A 0 N
- B 4 N
- C 15 N
- D 20 N
- E 25 N

5. A 5 kg mass is hung on a Newton balance and both are allowed to **fall freely**. State the reading on the balance while the mass and the balance are falling.

- A 0 N
- B 5 N
- C 50 N
- D 500 N
- E 5000 N

6. Determine which of the five blocks has the largest unbalanced force acting on it.

A



B



C



D



E



7. Far out in space the gravitational field strength experienced is negligible. The rocket motor of a space probe is fired for a short time and the rocket accelerates. Determine what will happen to the rocket when the motor is **switched off**.
- A The rocket decelerates until it comes to rest.
 - B The rocket will follow a curved path.
 - C The rocket will continue to accelerate forwards.
 - D The rocket will move at a constant velocity.
 - E The rocket will change direction.
8. Determine which of the following an unbalanced force of one newton will cause.
- A 0.1 kg mass will accelerate at 1 ms^{-2}
 - B 1 kg mass will accelerate at 1 ms^{-2}
 - C 1 kg mass will accelerate at 10 ms^{-2}
 - D 0.1 kg mass will move at a constant speed of 1 ms^{-1}
 - E 1 kg mass will move at a constant speed of 10 ms^{-1}
9. In order for an aircraft to move in the direction of travel, the aircraft engine exerts a force on the air. State which of the following completes the “Newton pair” of forces.
- A The force of the air on the aircraft engines
 - B The force of friction between the aircraft engine and the air
 - C The force of friction between the aircraft and the aircraft engine
 - D The force of the Earth on the aircraft engine
 - E The force of the aircraft engine on the Earth
10. The diagram shows the horizontal forces acting on a box.

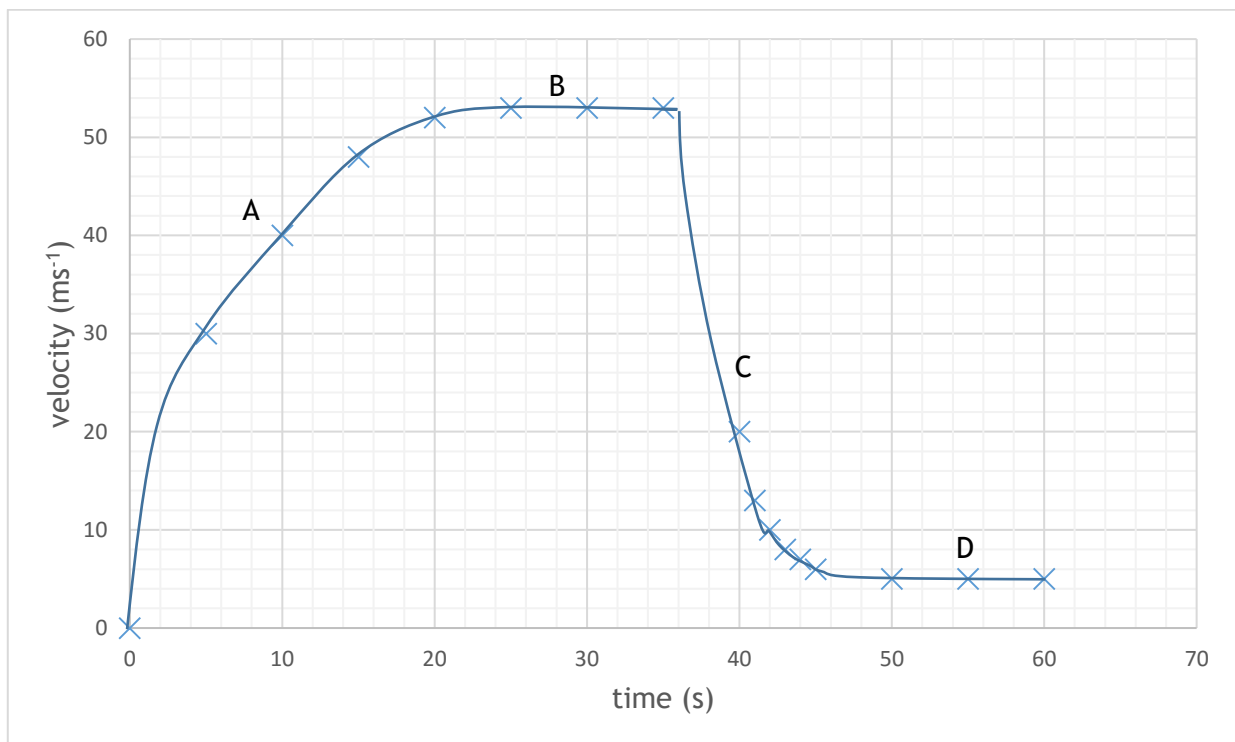


The box accelerates at 1.6 ms^{-2} .
Determine the mass of the box.

- A 0.10 kg
- B 10.0 kg
- C 15.0 kg
- D 25.6 kg
- E 38.4 kg

Full Response Questions 11→ 15

11. A skydiver jumps out of an aeroplane. The graph shows the vertical velocity of the sky diver for the first 60 seconds of the jump.

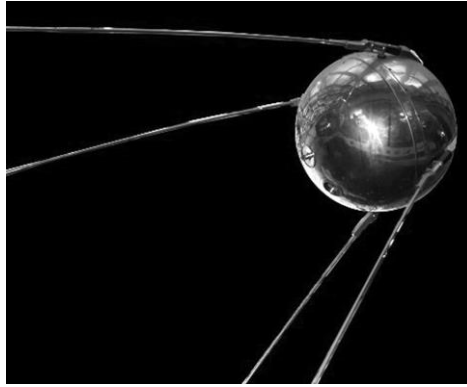


- State the names of the two vertical forces acting on the sky diver during the jump.
- State the meaning of terminal velocity.
- State the magnitude of the terminal velocity of the skydiver.
- Using the vertical forces from part (a), explain the motion of the skydiver at the following positions:
 - A
 - B
 - C
 - D

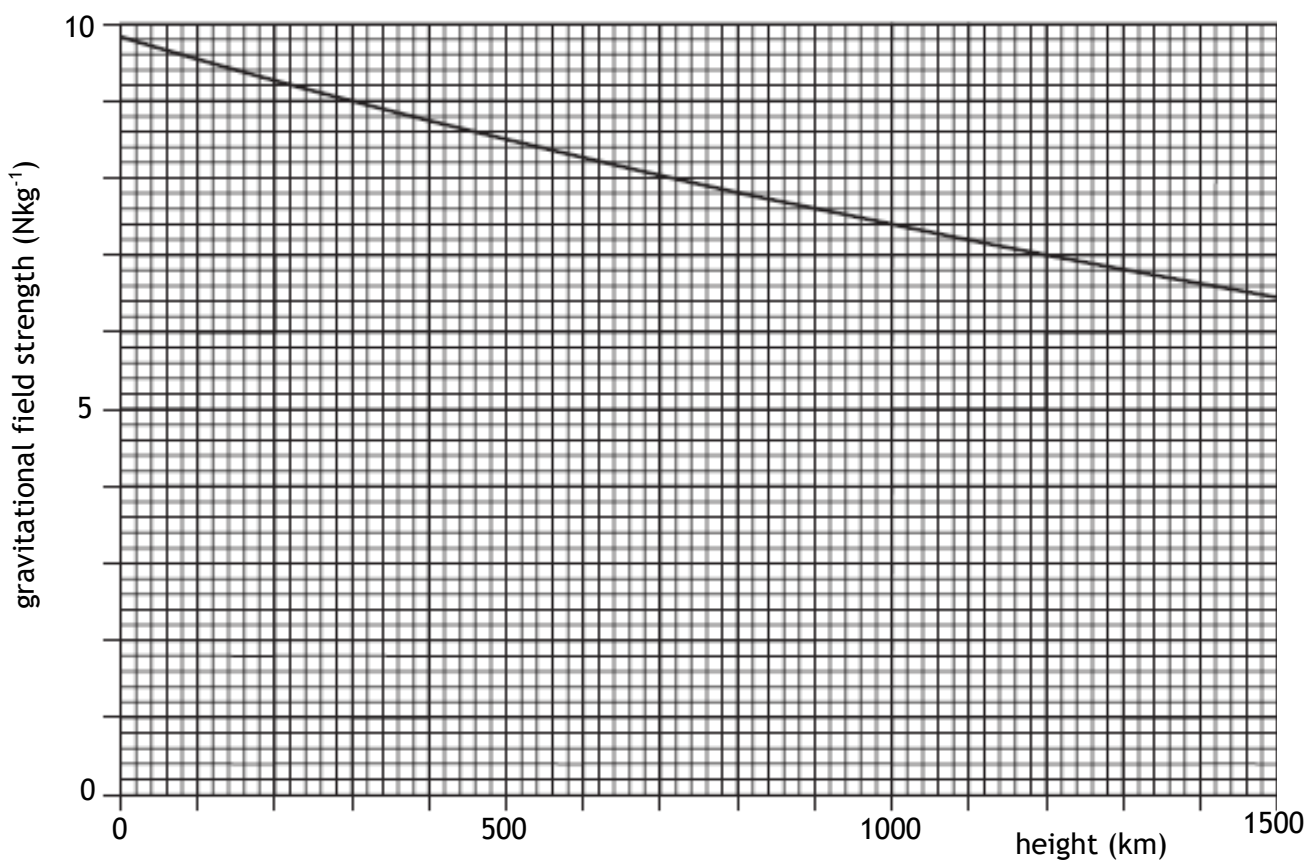
12. A rocket has a mass of 1200 kg. It is launched with an initial thrust of 20000 N. The air resistance at launch is negligible.

- Create a free-body diagram to show the two vertical forces acting on the rocket at the launch.
You must name both of the forces.
- Calculate the weight of the rocket.
- Calculate the magnitude of the unbalanced vertical force acting on the rocket, at the launch.
- Calculate the magnitude of the acceleration of the rocket, at the launch.

13. Sputnik 1, the first man-made satellite, was launched in 1957. It orbited the Earth at a speed of 8300 ms^{-1} and had a mass of 84 kg .

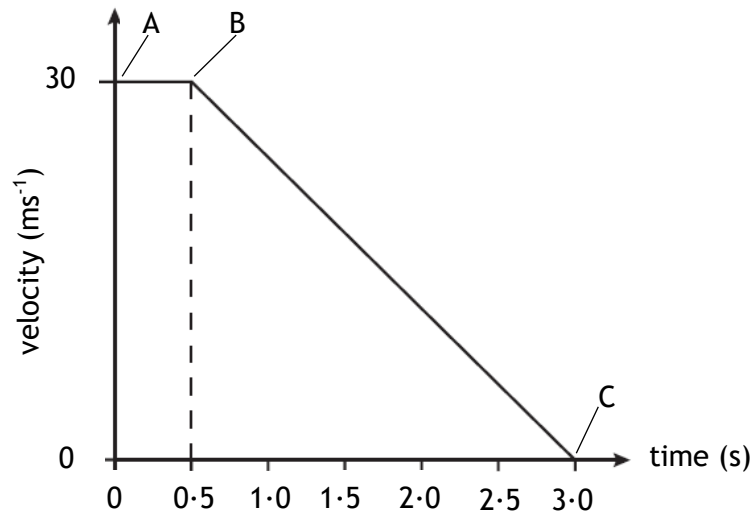


The graph shows how the gravitational field strength varies with height above the surface of the Earth.



- (a) State the meaning of the term **gravitational field strength**.
- (b) State the magnitude of the gravitational field strength at a height of 800 km .
- (c) Calculate the weight of Sputnik 1 at this height.

14. A car of mass 700 kg travels along a motorway at a constant speed. The driver sees a traffic hold-up ahead and performs an emergency stop. A graph of the car's motion is shown, from the moment the driver sees the hold-up.



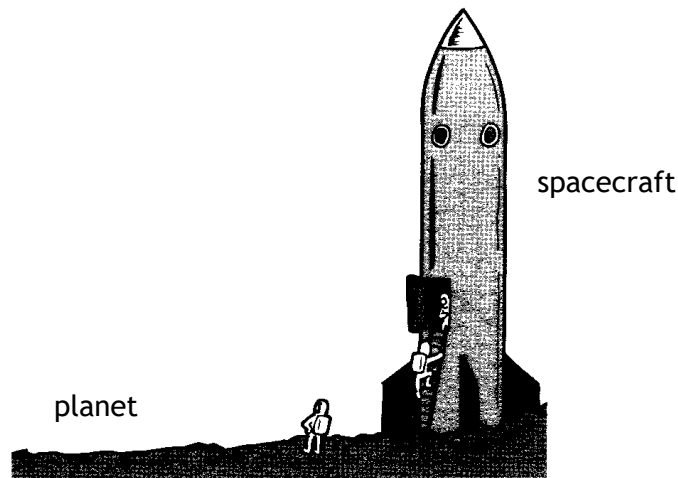
- (a) Describe the motion of the car between points A and B.
- (b) Explain the motion of the car between A and B, in terms of the forces acting.
- (c) Calculate the magnitude of the unbalanced force required to bring the car to rest.

15. A spacecraft travels through space between planet X and planet Y. Information about these two planets is given in the table.

	Planet X	Planet Y
gravitational field strength on the surface (Nkg^{-1})	8.4	13
surface temperature ($^{\circ}\text{C}$)	17.0	9.0
atmosphere	no	yes
period of rotation (hours)	48	17

The spacecraft has a total mass of $2.5 \times 10^6 \text{ kg}$.

The spacecraft engines produce a total upwards thrust of $3.8 \times 10^7 \text{ N}$.



(a) The spacecraft is initially on planet X.

(i) Calculate the weight of the spacecraft when it is on the surface of planet X.

(ii) Create a free-body diagram showing the vertical forces acting on the spacecraft just as it lifts off from the surface of planet X.

You must label the forces with their name and show their direction.

(iii) Calculate the acceleration of the spacecraft as it lifts off from planet X.

(b) On another occasion, the spacecraft lifts off from planet Y. The mass and engine force of the spacecraft are the same as before.

State whether the acceleration of the rocket at lift off from planet Y is less than, more than or equal to the acceleration at lift off from planet X.

You must justify your answer.