Newton's laws of motion

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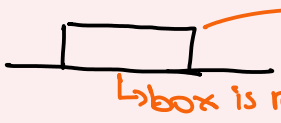
Newton's laws of motion:



no force has been applied on box

↳box is resting on surface ⇒balanced forces ⇒net force = 0

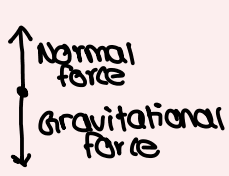
To calculate gravitational force:

$W = mg$

m = mass

g = gravitational field strength

An object at rest will remain at rest unless a force is applied onto the object



equal in magnitude, opposite in direction

Rough surface: More friction --> Longer time for ball to come to rest
smooth surface: Less friction --> shorter time for ball to come to rest

Rest ⇒ Fnet = 0

In motion, constant velocity ⇒ Fnet = 0 (acceleration = 0)

In motion, non-uniform velocity ⇒ Fnet ≠ 0 (acceleration ≠ 0)

↳ deceleration = −
acceleration = +

Recap: $a = \frac{v-u}{t} = \frac{\text{final} - \text{initial velocity}}{\text{time}}$

Second law of motion:

Net force = mass × acceleration

$F = ma$

Fnet ↑ = m↑ × a
Fnet ↑ = m × a↑
Fnet = m↑ × a↓
*Fnet = m↓ × a↑

throwing a basket ball (m↑) vs a ping pong ball (m↓)

The net force is equal to the product of the mass and acceleration

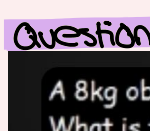
Question 1)

A car travels on the road with a constant velocity. (a) What is the horizontal net force acting on the car? (b) What is the acceleration on the car? (c) If the frictional force acting on the car is 1500N, what force is applied to the car by the engine?

(a) constant velocity ⇒ Fnet = 0 //

(b) Constant velocity ⇒ zero acceleration
∴ Acceleration = 0

(c)



— Balanced forces

∴ force applied by engine on car = 1500N //

Question 2)

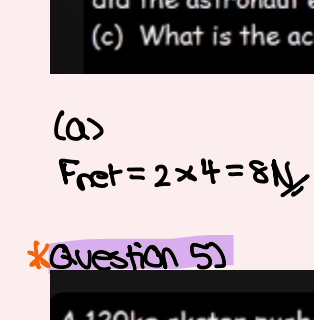
A force of 300N is applied across a 20Kg box. The frictional force acting on the box is 200N. (a) What is the net horizontal force on the box? (b) Calculate the acceleration of the box. (c) How far will the box travel after 12 seconds if it continues to accelerate at this rate starting from rest?

↳ constant acceleration

(a)
Fnet = 300 + (−200) = 100N //

(b)
F = ma
100 = 20 × a
∴ acceleration = $5 m/s^2$

(c)



∴ Distance travelled = $12 \times \frac{1}{2} \times 60 = 360m$ //

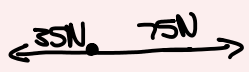
Question 3)

A 8kg object speeds up from 20 m/s to 50 m/s in 6 seconds. (a) What is the acceleration? (b) What is the net horizontal force acting on the object? (c) If the frictional force is 35N, what is the applied force on the object?

(a)
Acceleration = $\frac{50-20}{6} = 5 m/s^2$

(b)
Fnet = 8 × 5 = 40N //

(c)
Applied force of object = 40 + 35 = 75N



***Question 4)**

no friction (negligible)

An 80kg astronaut in space throws a 2kg package with an acceleration of +4m/s^2. (a) What force did the astronaut exert on the package? (b) What force does the package exert on the astronaut? (c) What is the acceleration of the astronaut?

(a)
Fnet = 2 × 4 = 8N //

***Question 5)**

A 120kg skater pushes against an 80kg skater. After contact, the 80kg skater was given an acceleration of 1.5 m/s^2. (a) What is the acceleration of the 120kg skater? (b) What force was exerted on each skater?