Lecture 16

Thurs: Seminar 12:30 WS 160

Thurs: Discussion /quiz

Ex 130, 131, 132, 137, 139, 142

Non-equilibrium dynamics

In general Newton's Second Law gives:

> The acceleration of an object, mass m, is related to the forces acting on the object via
>
> $$\vec{F}_{net} = m\vec{a}$$
>
> where
>
> $$\vec{F}_{net} = \sum_{\text{all forces on object}} \vec{F}_i = \vec{F}_1 + \vec{F}_2 + \cdots$$

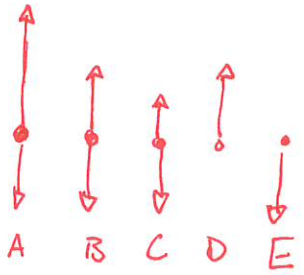
In terms of components

$$\Sigma F_{ix} = m a_x$$

$$\Sigma F_{iy} = m a_y$$

We use these two equations, inserting as much information as possible about acceleration and forces to learn the remaining information about these.

Warm Up 1



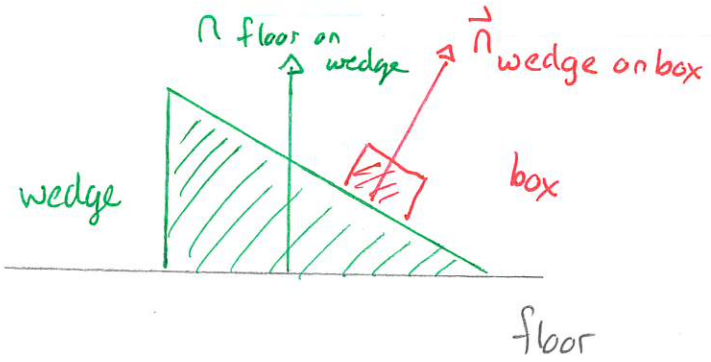
Quiz1 30%

Quiz2

Normal forces

Normal forces result from the interactions between surfaces. They

1) are repulsive and perpendicular to surface
2) have a magnitude that adjusts to the circumstances.



Quiz 3 60% - 90%

Warm Up 2

Quiz 4

General Physics: Group Exercise 3

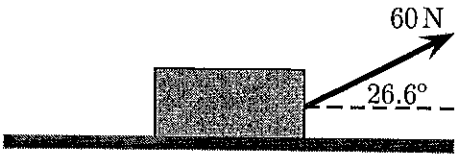
27 September 2023

Names: _____ _____ _____

_____ _____

1 Dynamics of a single object

A 9.0 kg box can move along a frictionless horizontal surface. A person exerts a force at the illustrated angle and the box moves along the horizontal surface, which is frictionless. Ignore air resistance.



a) Draw a free-body diagram for the block.

b) Determine the magnitude of the gravitational force $\vec{w}$.

c) Let n be the magnitude of the normal force. Do you expect that $n = w$?

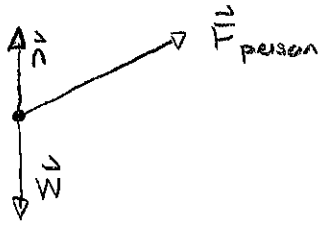
d) List the x and y components of each force (a table is preferable).

e) Write down Newton's second law in component form and use this to find the acceleration of the block and the normal force. Is $n = w$?

f) Is it possible that the block moves right while the person pulls on it as illustrated? If so, does it speed up, slow down or move with constant speed? Explain your answer.

g) Is it possible that the block moves left while the person pulls on it as illustrated? If so, does it speed up, slow down or move with constant speed? Explain your answer.

Answer: a)



b) $W = mg = 9.0\,kg \times 9.8\,m/s^2$

$= 88\,N$

c) No because the person force has a vertical component and $n + F_{py} = w$.

d)

	x	y
$\vec{W}$	0	$-88N$
$\vec{n}$	0	n
$\vec{F}_{person}$	$54N$	$27N$

$F_{px} = F_p \cos 26.6°$

$= 54N$

$F_{py} = F_p \sin 26.6°$

$= 27N$

e) $\sum F_{ix} = ma_x$

$\Rightarrow 54N = 9.0kg\ a_x \Rightarrow a_x = \frac{54N}{9.0kg} \Rightarrow$ $a_x = 6.0 m/s^2$

$\sum F_{iy} = ma_y = 0$ (stays on surface so $v_y = 0$ always $\Rightarrow a_y = 0$)

$\Rightarrow -88N + n + 27N = 0$

$\Rightarrow n - 61N = 0 \Rightarrow$ $n = 61N$

f) Yes, then acceleration + velocity are both positive $\Rightarrow$ speeds up

g) Yes, then acceleration + velocity are opposite $\Rightarrow$ slows down.