Forces - More Practice

Section 1 - $\vec{F}_g$

1.) Calculate the force of gravity on a 25 kg mass at the surface of the earth.

$\vec{F}_g = m \times \vec{g}$ ← SAME AS $\vec{F} = m\vec{a}$

$\vec{F}_g = (25)(-9.81)$

$\vec{F}_g = -245\ N$

2.) A 75 kg mass is on the surface of Mars when an astronaut lifts it with a spring scale. The scale has a reading of 259 N. What is the gravitational field strength on Mars?

$\vec{F}_g = m \times \vec{g}$ $\quad \frac{-259}{75} = \frac{75(\vec{g})}{75}$ $\quad \vec{g} = -3.45\ m/s^2 \Rightarrow -3.45\ N \times kg$

3.) How much force must a horizontal surface exert to hold up a 2.0 kg book and what is the name of that force? $\vec{F}_n$

$\vec{w} = m\vec{g}$ $\quad \vec{w} = (2.0)(-9.81)$

$\vec{w} = -19.6\ N$ $\quad \therefore \quad \vec{F}_n = +19.6\ N$

Section 2 - $\vec{F}_{net}$

1.) A cat is dragged at a constant velocity of $+3.0 \frac{m}{s}$ across sandpaper. What is the total force on the cat?

0 N

- NEWTON'S FIRST LAW
- ALL FORCES IN BALANCE

2.) A 1200 kg car is pushed by three students from rest to $+5.0 \frac{m}{s}$, 30 m along a level surface. What was the unbalanced force used on the car?

(1.) $\vec{V}_F^2 = \vec{V}_0^2 + 2\vec{a}d$

$(+5.0)^2 = 0 + 2(\vec{a})(+30)$

$\vec{a} = +0.4166\ m/s^2$

(2) $\vec{F}_{NET} = m\vec{a}$

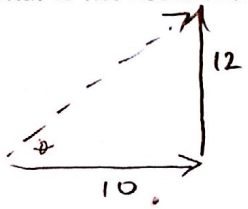
$\vec{F}_{NET} = (1200)(0.4166)$

$\vec{F}_{NET} = +500\ N$

3.) Assuming the force of friction on the car in problem 2 was 100 N how much combined force did the students have to exert?

+600N

4.) What is the acceleration of a 5.0 kg mass when pulled with 10 N [E] and 12 N [N]?



$10^2 + 12^2 = h^2$ $\quad h = 15.6\ N$

$\theta \Rightarrow \tan\theta = \frac{12}{10}$

$\theta = 50.1944°$

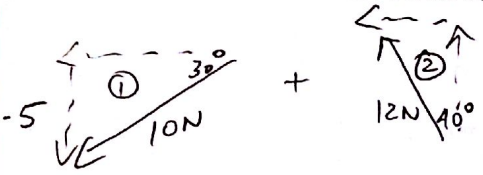
$\vec{F}_{net} = m\vec{a}$

$+15.6 = (5.0)(\vec{a})$

$\vec{a} = 3.12\ m/s^2$

3.12 m/s² at 50.2° N OF E

5.) What is the net force of a mass when pulled with a force of 10 N at 30° S of W and 12 N at 40° W of N.

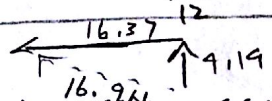


(1.) $\sin 30° = \frac{H_1}{10} \Rightarrow -5\ N$ (2.) $\cos 40° = \frac{V_2}{12} \Rightarrow +9.19\ N$

(1.) $\cos 30° = \frac{h_1}{10} \Rightarrow -8.66\ N$ (2.) $\sin 40° = \frac{h_2}{12} \Rightarrow -7.71\ N$

Vertical = 4.19 N

horiz = -16.37 N



Section 3 - $\vec{F}_f$ and $\vec{F}_n$ (level surfaces)

1.) A 10 kg mass is pulled along a level surface using a force of 25 N. What is the coefficient of friction?

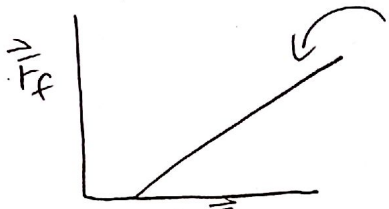
$\vec{F}_f = \mu \vec{F}_n$ $\quad -25 = \mu(+98.1)$ $\quad \boxed{\mu = 0.255}$

2.) A force of 7.5 N is used to pull a rubber friction block across a table at constant speed. If the coefficient of friction is 0.35 what is the mass of the block?

(1.) $\vec{F}_f = \mu \vec{F}_n$ $\quad (-7.5) = (0.35)(\vec{F}_n)$ $\quad \vec{F}_n = +21.42875\ N$

(2.) $\vec{W} = m\vec{g}$ $\quad -21.42875 = m(-9.81)$ $\quad \boxed{m = 2.18\ kg}$

3.) What shape is a graph of $\vec{F}_f$ *vs.* $\vec{F}_n$ and what is the slope?



Section 4 - $\vec{F}_e$

1.) Calculate the extension of a spring whose spring constant is $20 \frac{N}{m}$ when a 0.50 kg mass is hung on it.

(1.) $\vec{F}_e = \vec{W}$ $\quad \vec{W} = m\vec{g}$ $\quad \vec{W} = (0.50)(-9.81)$ $\quad \vec{W} = -4.905$

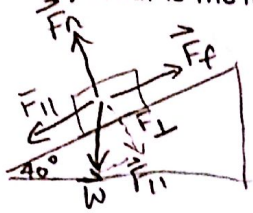
(2.) $\vec{F}_e = kx$ $\quad 4.905 = (20)(x)$ $\quad \boxed{x = 0.245\ m}$

2.) What is the spring constant of a desk if a force of 784 N compresses it from height 1.00 m to 0.92 m?

$\vec{F}_e = kx$ $\quad 784 = k(0.08)$ $\quad \boxed{k = 9800 \frac{N}{m}}$

Section 5: Forces on Ramps

1.) What is the normal force and force down the ramp on a 5.0 kg mass resting on a 40° slope?



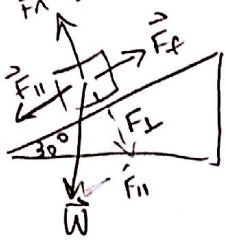
(1.) $\vec{W} = m\vec{g}$ $\quad \vec{W} = (5.0)(-9.8)$

(2.) $\vec{F}_n = \vec{F}_\perp$ / $F_\perp \Rightarrow \cos 40° = \frac{F_\perp}{\vec{W}}$

$\cos 40° = \frac{F_\perp}{49.05}$ $\quad \boxed{\vec{F}_\perp = +37.6\ N}$

(3.) $\vec{F}_{||} \Rightarrow \sin 40° = \frac{\vec{F}_{||}}{49.05}$ $\quad \boxed{\vec{F}_{||} = -31.5\ N}$

2.) What is the acceleration of a 3.0 kg mass on a 30° frictionless slope?



(1.) $\vec{W} = m\vec{g}$ $\quad \vec{W} = (3.0)(-98)$

$\vec{W} = -29.43\ N$

(2.) $\vec{F}_{||} \Rightarrow \sin 30° = \frac{\vec{F}_{||}}{-29.43}$

$\vec{F}_{||} = -14.715\ N$

(3.) $\vec{F}_{net} = m\vec{a}$ $\quad -14.7 = (3.0)(\vec{a})$ $\quad \boxed{\vec{a} = -4.9\ m/s^2}$

3.) What is the normal force on the mass in #2 above?

$\vec{F}_n = \vec{F}_\perp$ $\quad \vec{F}_\perp \Rightarrow \cos 30° = \frac{\vec{F}_\perp}{W}$ $\quad \vec{F}_\perp \Rightarrow \cos 30° = \frac{\vec{F}_\perp}{-29.43}$

$\boxed{\vec{F}_\perp = +25.5\ N}$

4.) What is the force of friction on the mass in #3 above if $\mu = 0.2$?

$\vec{F}_f = \mu \vec{F}_n$ $\quad F_f = (0.2)(25.487)$

$\boxed{\vec{F}_f = -5.1\ N}$

5.) What would be the acceleration of the mass in #4 above given $\mu = 0.2$?**

(1.) $\vec{F}_{net} = \vec{F}_{||} + \vec{F}_f$ $\quad \vec{F}_{net} = -14.715 + (+5.1)$ $\quad \vec{F}_{net} = -9.61757$

(2.) $\vec{F}_{net} = m\vec{a}$ $\quad -9.61 = (3.0)(\vec{a})$ $\quad \boxed{\vec{a} = -3.21\ m/s^2}$

Answers

1.) -245 N 2.) $-3.45 \frac{m}{s^2}$ 3.) +19.6 N, $\vec{F}_n$ 1.) 0 N 2.) + 500 N 3.) +600 N 4.) $+3.12 \frac{m}{s^2}$ at 50° N of E 5.) 16.9 N at 14° N of W

1.) 0.26 2.) 2.19 kg 3.) linear, μ 1.) 0.245 m 2.) $+9800 \frac{N}{m}$

1.) $\vec{F}_n$ = +37.5 N $\vec{F}_{down}$ = -31.5 N 2.) $+4.9 \frac{m}{s^2}$ 3.) +25.5 N 4.) -5.09 N 5.) $+3.20 \frac{m}{s^2}$ Wrong question!