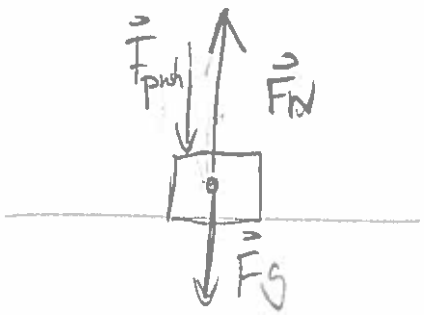
Answers

PHYSICS 11

NORMAL FORCE
(Practice Questions)

1. Determine the magnitude and direction of the normal force acting on a 15.0 kg object that rests on a horizontal frictionless surface while being acted upon by a force of push 45 N downwards. Include a labeled situation diagram.



$F_N = F_g + F_{push}$

$= mg + 45$

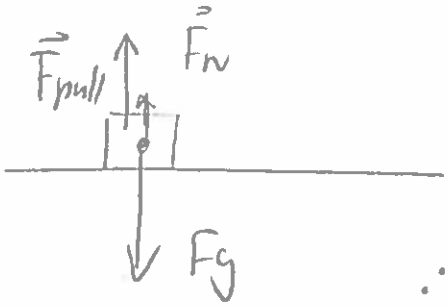
$= (15.0)(9.8) + 45$

$= 192\ N$

$\therefore \vec{F}_N = 1.9 \times 10^2 N\ [U]$.

2. Determine the normal force experienced by a 2.0 kg object that is being pulled upwards with force of 12.6 N while moving along a leveled surface at constant speed.

motion → $a = 0\ m/s^2$



$F_N = F_g - F_{pull}$

$= mg - 12.6$

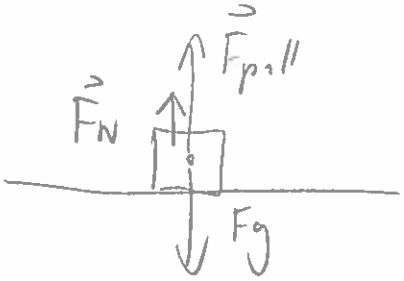
$= 19.6 - 12.6$

$= 7.0\ N$

$\therefore \vec{F}_N = 7.0\ N\ [U]$.

3. Determine the normal force experienced by 10.0 kg object that is being pulled upwards with force 120 N while sliding along a horizontal surface.

motion →



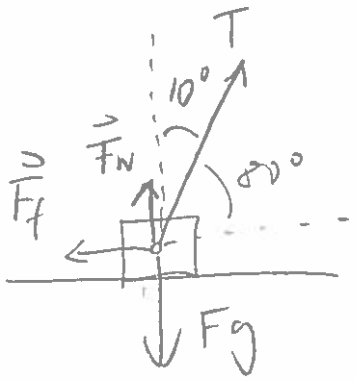
$F_N = F_g - F_{pull}$

$= (10.0)(9.8) - 120$

$= -22\ N$ ⇒ there is no F_N as $\vec{F}_{pull} > F_g$ and the object is lifted up and there is no surface of contact.

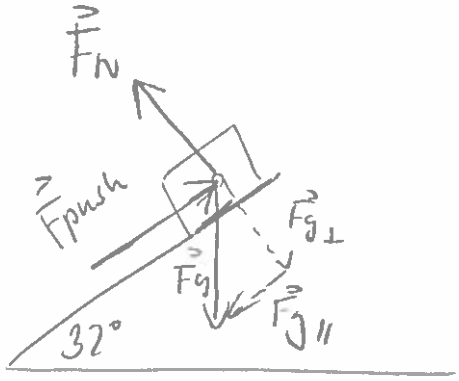
$\therefore \vec{F}_N = 0\ N\ [U]$

6. What is the normal force experienced by an 8.5 kg object resting on a leveled surface with a coefficient of friction of 0.068 and acted upon by a force of tension of 45 N Up 10° Right?



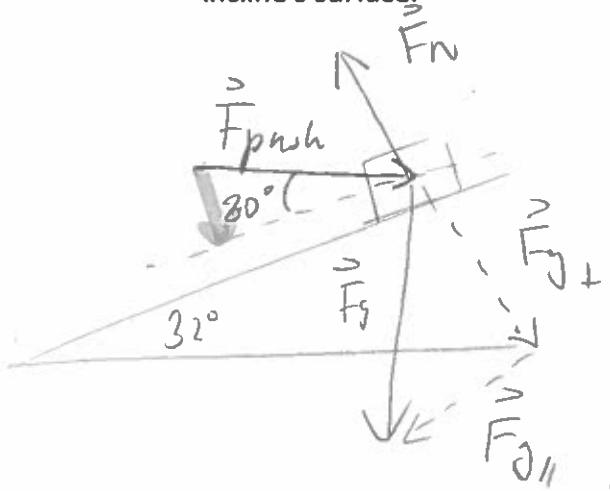
$$F_N = F_g - T_\perp$$
$$= mg - 45 \cdot \sin 80°$$
$$\doteq 39\ N$$
$$\therefore \vec{F}_N = 3.9 \times 10^1\ N\ [U].$$

7. What will be the normal force experienced by an 18 kg crate that is being pushed up an inclined plane with an angle of inclination of 32°.[2]
   A) The pushing force of 230 N is parallel with the inclined plane.



$$F_N = F_{g\perp}$$
$$= (18)(9.8)(\cos 32°)$$
$$\doteq 149.596\ldots\ N$$
$$\therefore \vec{F}_N \doteq 1.5 \times 10^2\ N\ [\perp \text{ up from the inclined plane}]$$

   B) The pushing force of 230 N is up the inclined plane at an angle of 20° above the incline's surface.



$$F_N = F_{g\perp} + F_{push\perp}$$
$$= mg \cdot \cos 32° + 230 \cdot \sin 20°$$
$$= 149.5957 + 78.6646$$
$$\therefore \vec{F}_N = 2.3 \times 10^2\ N\ [\perp \text{ up from the incl. plane}]$$

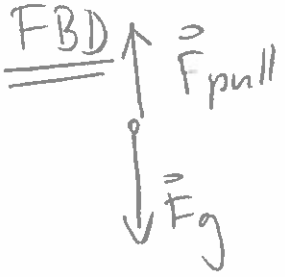
4. What is the acceleration of the object in question 3?

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

$a = \frac{22}{10}$

$\therefore a = 2.2\ m/s^2\ [U]$

FBD



$\vec{F}_{net} = \vec{F}_g + \vec{F}_{pull}$

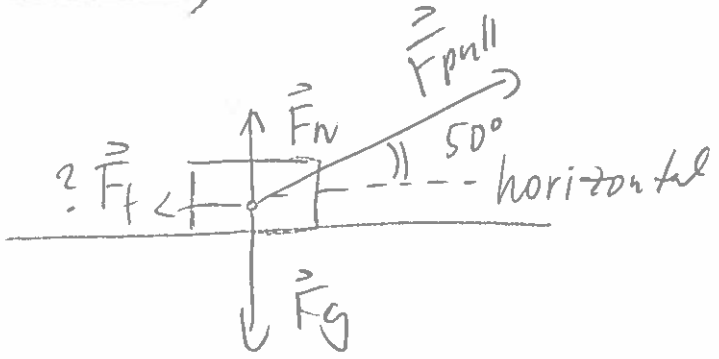
$= -mg + 120$

$= -98 + 120$

$= +22\ N\ [U]$

5. Determine the normal force experienced by 10.0 kg object that is being pulled with force ~~with force~~ of 120 N 50° above horizontal while sliding along a horizontal surface.

motion



$F_N = F_g - F_{pull_\perp}$

$= mg - 120(\sin 50°)$

$= 98 - 91.93$

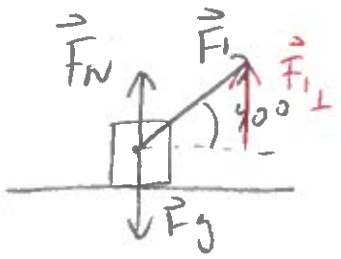
$\therefore 6.1\ N$

$\therefore \vec{F}_N = 6.1\ N\ [U]$

Note: $\vec{F}_N = 6.1\ N\ [up]$ regardless of $\vec{F}_f$ being present.

8. Will a 5.6 kg object experience a normal force when it is placed on a horizontal surface? If yes, find the magnitude of the normal force. If not, explain why and justify your answer.

A) While being pulled with F_1= 25 N [R40°U]?



yes

$\therefore \vec{F}_N = 39\ N\ [U]$

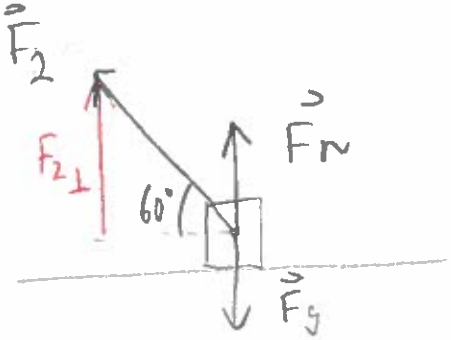
$F_N = F_g - F_{1\perp}$

$= mg - F_1 \sin 40°$

$= (5.6)(9.8) - 25(\sin 40°)$

$\doteq 39\ N$

B) While being pulled with F_2= 13 N [L 60°U]?



yes

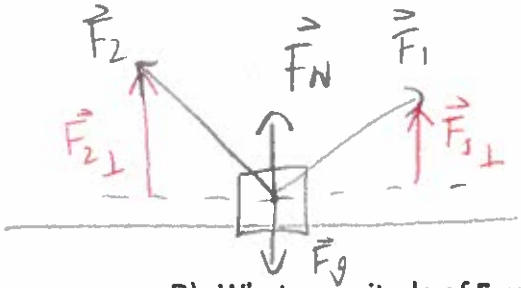
$\therefore \vec{F}_N = 44\ N\ [U]$

$\vec{F}_N = \vec{F}_g - \vec{F}_{2\perp}$

$= mg - 13 \cdot \sin 60°$

$\doteq 44\ N$

C) While being pulled with F_1 and F_2 simultaneously?



yes

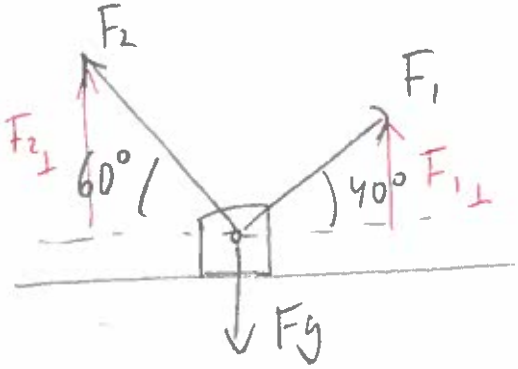
$\therefore \vec{F}_N = 28\ N\ [U]$

$F_N = F_g - F_{1\perp} - F_{2\perp}$

$= (5.6)(9.8) - F_1 \sin 40° - F_2 \sin 60°$

$\doteq 28\ N$

D) What magnitude of F_1 would lift the object if the second force remained the same and the direction of F_1 was also the same? Justify your answer.



To lift the object $F_{2\perp} + F_{1\perp} \geq F_g$

$F_{1\perp} = F_g - F_{2\perp}$

$F_1 \cdot \sin 40° = mg - 13 \cdot \sin 60°$

$F_1 = \dfrac{(5.6)(9.8) - 13 \cdot \sin 60°}{\sin 40°}$

$F_1 = 67.86\ldots\ N$

$\therefore F_1 = 68\ N$ is the minimum force needed to lift the object