Friction and Incline Practice Problems Name:_____ 7a

$F_f = \mu F_N$

Ff = Force of kinetic friction = measured in Newtons

μ = coefficient of friction

F_N = Normal Force = measured in Newtons

1.) A 5kg box is sitting on a level surface. You push it across the floor. The kinetic friction acting against your exerted force is 57 N. What is the coefficient of friction?

Formula:	Plug in numbers:	Answer:
$F_W = mg$ $F_f = \mu F_N$	$F_W = mg$ $(5kg)(9.8) = 49N$ $F_f = \mu F_N$ $\frac{57N}{49} = \frac{\mu(49N)}{49}$	1.17

2.) You're pushing an object on a level surface whose coefficient of friction is 0.35 and the force of kinetic friction is 135N. What is the weight of the object you are pushing?

Formula:	Plug in numbers:	Answer:
$F_f = \mu F_N$ $F_N = F_W$	$\frac{135N}{.35} = \frac{(.35)F_N}{.35}$ $F_N = 385.7N = F_W$	385.7N

F_N

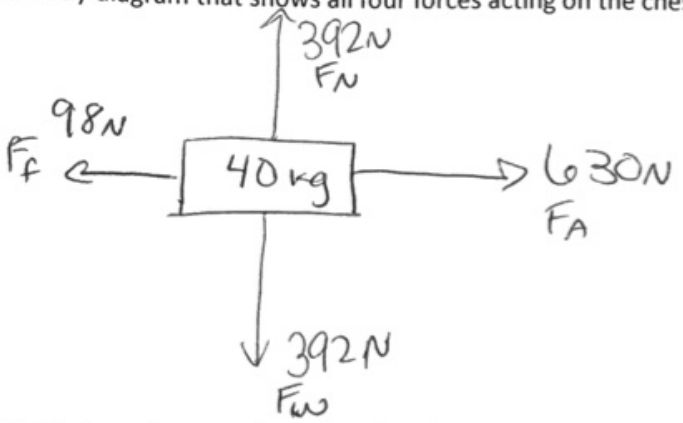
3.) You are pushing an object across the grass that weighs 182N and has a coefficient of friction is .70. What is the force of kinetic friction?

Formula:	Plug in numbers:	Answer:
$F_f = \mu F_N$	$F_f = (.70)(182N)$ $F_f = 129.4N$	127.4N

40kg

4.) You are pushing a chest of drawers across the room whose coefficient of friction is 0.25. You are exerting a force of 630N.

a. Draw a free body diagram that shows all four forces acting on the chest of drawers.



b. Using your work from 4a, state the value of each:

Weight 392 N $F_W = (40)(9.8) = 392N$

Normal force 392 N

Applied force 630N

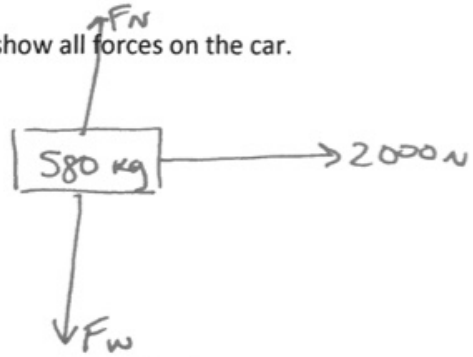
Force of friction 98N $F_f = \mu F_N \quad F_f = (.25)(392)$

Acceleration 13.3 m/s^2 $F_{net} = ma$

$-\frac{630}{98}$ $\frac{532}{40} = \frac{(40)(a)}{40}$

5.) You are pushing a 580 kg car across the road with a force of 2000 N. The acceleration of the car is 1.6 m/s^2.

a. Draw a free body diagram to show all forces on the car.



$a = 1.6 m/s^2$

b. Using your work from 5a, state the value of each:

Weight 5684N $F_W = (580kg)(9.8 m/s^2)$

Normal force 5684N

Applied force 2000N $F_{net} = (580kg)(1.6 m/s^2)$

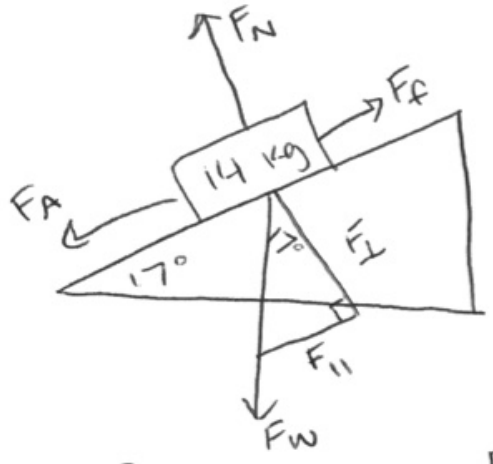
Coefficient of friction .19 $F_f = \mu F_N$ $F_{net} = 928N$

Frictional force 1072N $\frac{1072}{5684} = \frac{\mu(5684)}{5684}$ $F_{net} = F_A - F_f \quad F_f = 1072$

$928 = 2000 - F_f$

6.) A 14 kg box is sitting on an 17° incline. If the incline has a coefficient of friction of 0.23, at what acceleration will the box slide down the incline?

FBD:



$\mu = .23$

Weight: 137.2 N — $F_W = mg \quad (14)(9.8)$

Normal force: 131.2 N — $F_\perp = F_W \cos\theta \quad 137.2\,N \cos 17$

Applied force: 40.1 N — $F_{||} = F_W \sin\theta \quad 137.2\,N \sin 17$

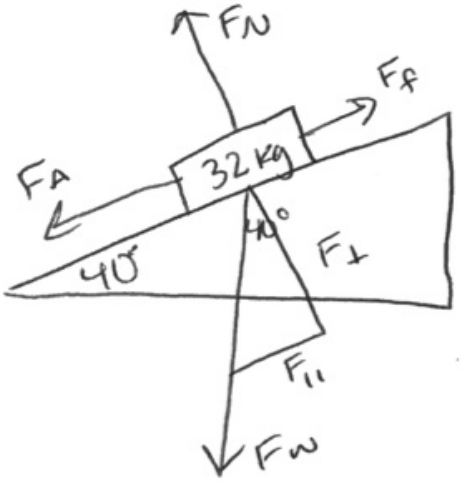
Frictional force: 30.2 N — $F_f = \mu F_N \quad F_f = (.23)(131.2\,N)$

Acceleration: 0.71 m/s² — $F_{net} = F_A - F_f \quad F_{net} = 40.1 - 30.2$

$F_{net} = ma \quad \frac{9.9\,N}{14} = \frac{14\,kg\,(a)}{14}$

7.) A 32kg crate is sitting on a 40° incline. If the incline has a coefficient of friction of 0.12, at what acceleration will the crate slide down the incline?

FBD:



$\mu = .12$

Weight: 313.6N — $F_W = mg \quad (32\,kg)(9.8)$

Normal force: 240.2N — $F_\perp = F_W \cos\theta = 313.6 \cos 40$

Applied force: 154.4N — $F_{||} = F_W \sin\theta = 313.6 \sin 40$

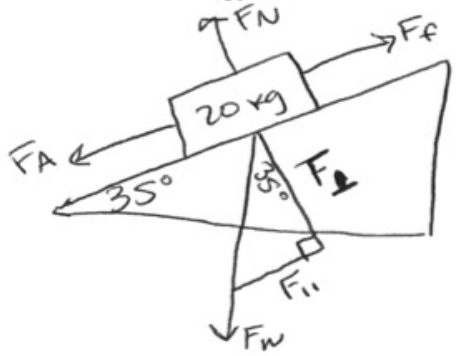
Frictional force: 28.8N — $F_f = \mu F_N = (.12)(240.2N)$

Acceleration: 3.9 m/s² — $F_{net} = F_A - F_f = 154.4N - 28.8N$

$F_{net} = ma \quad \frac{125.6}{32} = \frac{32\,(a)}{32}$

8.) A 20kg crate is sitting on a 35° incline. If the incline has a coefficient of friction of 0.31, at what acceleration will the crate slide down the incline?

FBD:



$\mu = .31$

Weight: 196 N $\quad F_W = mg \quad (20)(9.8)$

Normal force: 160.6 N $\quad F_\perp = F_W \cos\theta = 196\cos(35)$

Applied force: 112.4 N $\quad F_\parallel = F_W \sin\theta = 196\sin(35)$

Frictional force: 49.8 N $\quad F_f = \mu F_N = F_f = (.31)(160.6)$

Acceleration: 3.13 m/s² $\quad F_{net} = ma$

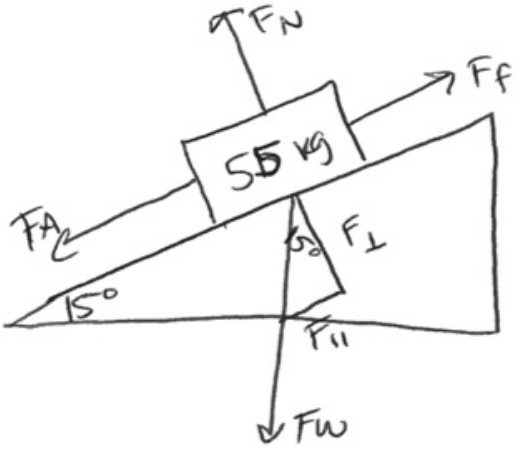
$F_{net} = F_A - F_f = 112.4 - 49.8 = 62.6\,N$

$F_{net} = ma$

$\frac{62.6N}{20} = \frac{20kg}{20}(a)$

9.) A 55kg box is sitting on a 15° incline. If the incline has a coefficient of friction of 0.07, at what acceleration will the crate slide down the incline?

FBD:



$\mu = .07$

Weight: 539 N $\quad F_W = mg \quad (55)(9.8)$

Normal force: 520.6 N $\quad F_\perp = F_W \cos\theta = 539\cos 15°$

Applied force: 139.5 N $\quad F_\parallel = F_W \sin\theta = 539\sin 15°$

Frictional force: 36.44 N $\quad F_f = \mu F_N \quad F_f = (.07)(520.6N)$

Acceleration: 1.87 m/s² $\quad F_{net} = ma$

$F_{net} = F_A - F_f = 139.5 - 36.44 = 103.06\,N$

$\frac{103.06}{55} = \frac{55}{55}(a)$