Physics 20 - Lesson 16
Friction – Answer Key

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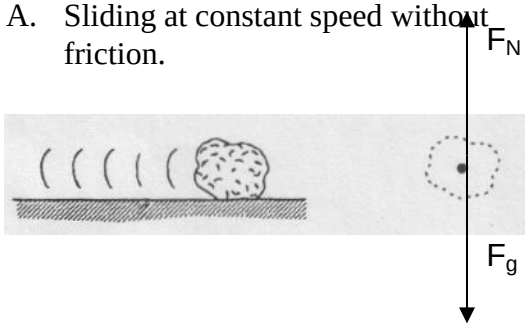
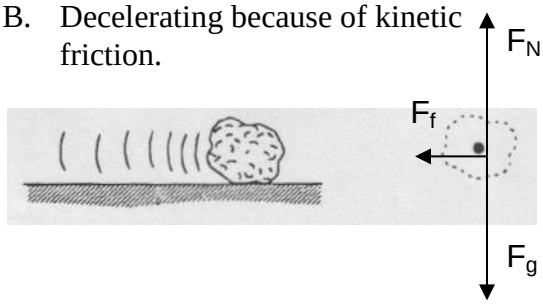
1) /4

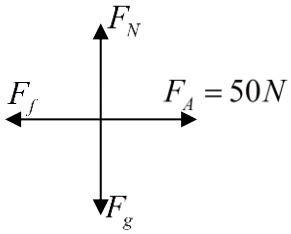
A. Sliding at constant speed without friction.



B. Decelerating because of kinetic friction.



2) /7



since $a = 0$ $F_f = F_A = 50N$

$F_N = F_g = mg$

$F_N = 20kg(-9.81\,m/s^2)$

$F_N = 196.2N$

$\mu = \dfrac{F_f}{F_A} = \dfrac{50N}{196.2N}$

$\boxed{\mu = 0.26}$

3) /4

$\mu = 0.30$

$m = 15kg$

$F_f = \mu F_N = \mu F_g \leftarrow F_g = mg$

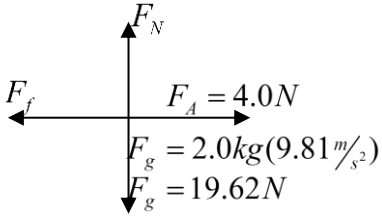
$F_f = \mu mg$

$F_f = 0.30(15kg)(9.81\,m/s^2)$

$F_f = 44N$

$\therefore$ for constant velocity $F_A = F_f = \boxed{44N}$

4) /8



$F_N = F_g = 19.62N \rightarrow F_f = \mu F_N = 0.12(19.62N)$

$F_f = 2.35N$

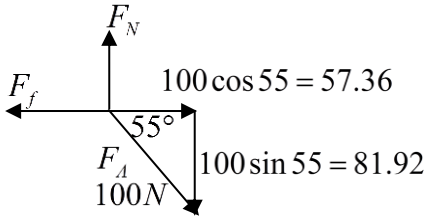
$F_{net} = F_A - F_f = 4.0N - 2.35N$

$F_{net} = 1.65N$

$a = \dfrac{F_{net}}{m} = \dfrac{1.65N}{2.01kg}$

$a = \boxed{0.82\,m/s^2}$

5) /6



$F_N = 81.92N$

$F_f = 57.36N$

$\mu = \dfrac{F_f}{F_N} = \dfrac{57.36N}{81.92N}$

$\boxed{\mu = 0.70}$

6) a)

/6

$F_f = \mu F_N = \mu mg = 0.010(70kg)(9.81\,^{m}/_{s^2})$

$\boxed{F_f = 6.9N}$

b) $a = \dfrac{F_{net}}{m} = \dfrac{F_f}{m} = \dfrac{-6.9N}{70kg}$

$a = -0.0981\,^{m}/_{s^2}$

$\vec{v}_1 = 1.0\,^{m}/_{s}$

$\vec{v}_2 = 0$

$\Delta t = ?$

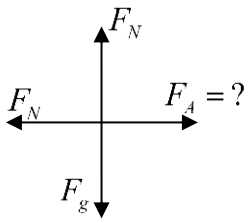
$\vec{a} = -0.0981\,^{m}/_{s^2}$

$\Delta t = \dfrac{\vec{v}_2 - \vec{v}_1}{\vec{a}}$

$\Delta t = \dfrac{0 - 1.0\,^{m}/_{s}}{-0.0981\,^{m}/_{s^2}} = \boxed{10.2s}$

7)

/8



find F_{net}

$F_{net} = ma = 10kg(2.0\,^{m}/_{s^2})$

$F_{net} = 20N$

find F_f

$F_f = \mu F_N = \mu mg = 0.35(10kg)(9.84\,^{m}/_{s^2})$

$F_f = 34.3N$

find F_A

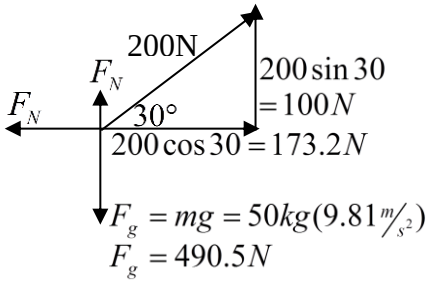
$F_{net} = F_A - F_f$

$F_A = F_{net} + F_f = 34.3N + 20N$

$\boxed{F_A = 54.3N}$

8)

/10



Find F_N

$F_N + 100N = F_g$

$F_N = F_g - 100N = 490.5N - 100N$

$\boxed{F_N = 390.5N}$

Find F_f

$F_f = \mu F_N = 0.30(390.5N)$

$\boxed{F_f = 117N}$

Find F_{net} and a

$F_{net} = 173.2N - 117.15N$

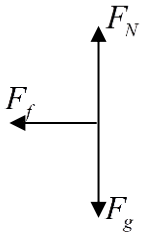
$F_{net} = 56.05N$

$a = \dfrac{F_{net}}{m} = \dfrac{56.05N}{50kg}$

$\boxed{a = 1.12\,^{m}/_{s^2}}$

9)

/7



$F_g = F_N$

$\vec{V}_1 = 2.0\,{}^{m}\!/_{s}$
$\vec{V}_2 = 0$
$\Delta d = ?$
$\vec{a} = ?$

find $\vec{a}$

$F_{net} = ma$
$F_f = ma$
$-\mu F_N = ma$
$-\mu \cancel{m} g = \cancel{m} a$
$a = -\mu g$
$a = -0.20(9.81\,{}^{m}\!/_{s^2})$
$a = -1.962\,{}^{m}\!/_{s^2}$

find $\Delta\vec{d}$

$$\Delta d = \frac{\vec{v}_2{}^2 - \vec{v}^2}{2\vec{a}} = \frac{0 - (2.0\,{}^{m}\!/_{s})^2}{2(1.96\,{}^{m}\!/_{s^2})}$$

$\boxed{\Delta d = 1.02m}$