Physics 12 Quiz – Dynamics in 2-D - Dec 2018 (1)

Name: KEY Block: ____

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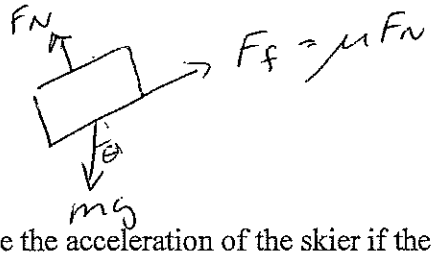
1. A 45.0 kg skier slides down a hill. The hill is inclined at an angle of 18.0° to the horizontal.
   a. Draw the free body diagram for the skier.



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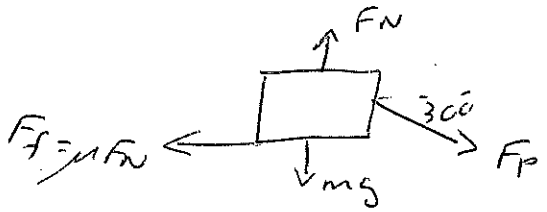
   b. Determine the acceleration of the skier if the coefficient of friction between the snow on the hill and the skis is 0.090

$ma = mg\sin\theta - \mu mg\cos\theta$

$a = (9.8)(\sin 18° - 0.09\cos 18°)$

$a = 2.19\ m/s^2 = 2.2\ m/s^2$

2. Carla pushes an 18.0 kg box along a horizontal floor. She pushes with a force of 300.0 N, directed at an angle of 30.0° below the horizontal. The surface of the floor is rough (there is friction)
   a. Draw the free body diagram for the box.



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   b. Determine the magnitude of the normal force on the box.

$\Sigma F_y = 0 = F_N - F_p\sin 30° - mg$

$F_N = 300\sin 30° + (18)(9.8)$

$F_N = 326\ N$

2

   c. Determine the maximum coefficient of friction if the box is sliding along the floor at a constant speed.

$\Sigma F_x = 0 = F_p\cos 30° - \mu F_N$

$\mu = \frac{(300\cos 30°)}{(326.4)} = 0.796$

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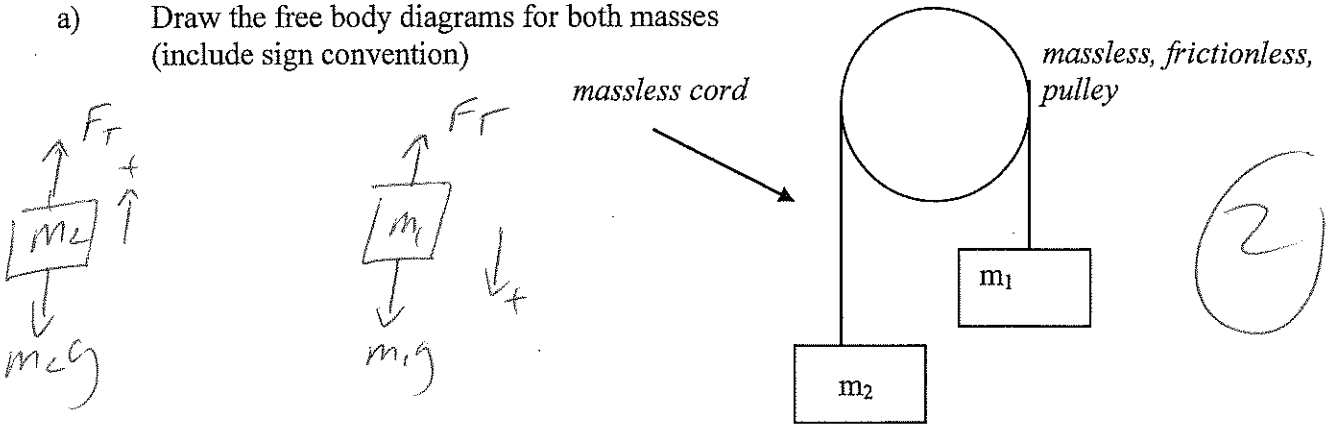
3. For the pulley system shown: $m_1 = 0.50$ kg; $m_2 = 0.35$ kg

a) Draw the free body diagrams for both masses (include sign convention)



b) Determine the acceleration (direction and magnitude) of m_1.

$$a = \frac{g(m_1 - m_2)}{m_1 + m_2} = \frac{(9.8)(0.5 - 0.35)}{0.5 + 0.35} = 1.729\ m/s^2$$

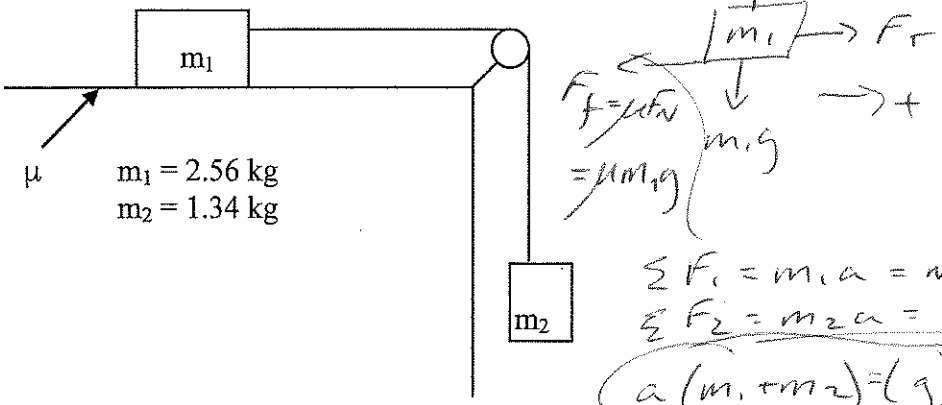
c) Determine the magnitude of the tension on the cord.

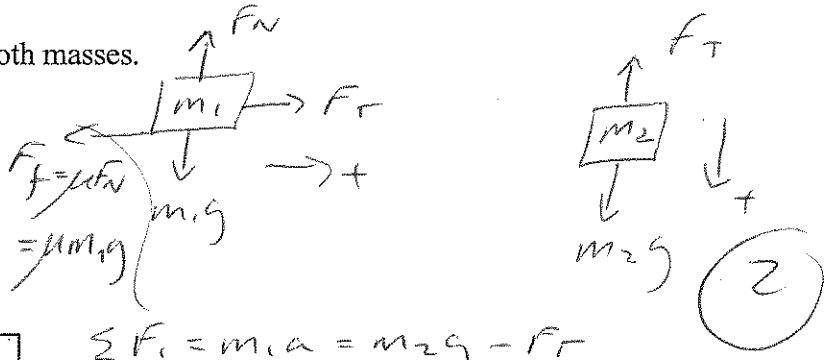
$$m_1 a = m_1 g - F_T$$

$$F_T = m_1(g - a) = (0.5)(9.8 - 1.729) = 4.0\ N$$

4. For the system shown below:

a. Draw the free body diagrams for both masses.





$$\Sigma F_1 = m_1 a = m_2 g - F_T$$

$$\Sigma F_2 = m_2 a = F_T - \mu m_1 g$$

$$a(m_1 + m_2) = (g)(m_2 - \mu m_1)$$

b. Determine the acceleration of the system if the table surface is greased, making $\mu = 0$.

$$a = \frac{m_2 g}{m_1 + m_2} = \frac{(1.34)(9.8)}{(1.34 + 2.56)} = 3.37\ m/s^2$$

c. Determine the minimum value of μ_s that will hold system at rest.

$$\mu = \frac{m_2}{m_1} = \frac{1.34}{2.56} = 0.523$$

d. Determine the acceleration of the system if $\mu_k = 0.156$.

$$a = \frac{(9.8)(1.34 - 0.156 \times 2.56)}{(1.34 + 2.56)} = 2.36\ m/s^2$$

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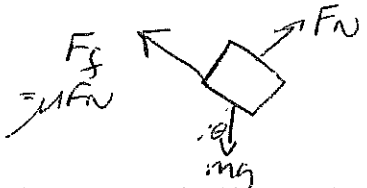
Physics 12 Quiz – Dynamics in 2-D - Dec 2018 (2)

Name: KEY Block: ____

1. A 600.0 kg car is parked (stopped) on a driveway that is sloped at an angle of 23.0° to the horizontal.
   a. Draw the free body diagram for the car.



   b. Determine the magnitude of the force of friction between the car and the driveway.

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$$F_f = mg\sin\theta = (600)(9.8)\sin 23°$$

$$F_f = 2.30 \times 10^3\ N$$

2. Carla pushes an 18.0 kg box along a horizontal floor. She pushes with a force of 250.0 N, directed at an angle of 30.0° below the horizontal. The coefficient of friction between the box and the ground is 0.200.
   a. Draw the free body diagram for the box.

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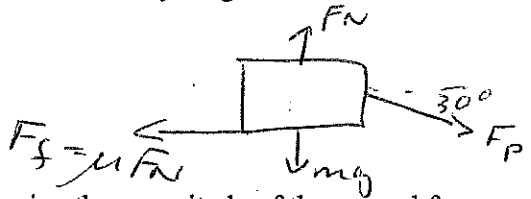

   b. Determine the magnitude of the normal force on the box.

$$\Sigma F_y = 0 = F_N - F_p \sin 30° - mg$$

$$\therefore F_N = F_p \sin 30° + mg$$

$$= (250\sin 30°) + (18)(9.8)$$

2

$$F_N = 301\ N$$

   c. Determine the value of the horizontal acceleration of the cart (magnitude and direction).

$$ma = F_p \cos 30° - \mu F_N$$

$$a = \frac{(250\cos 30°) - (0.2)(301.4)}{18}$$

2

$$a = 8.68\ m/s^2$$

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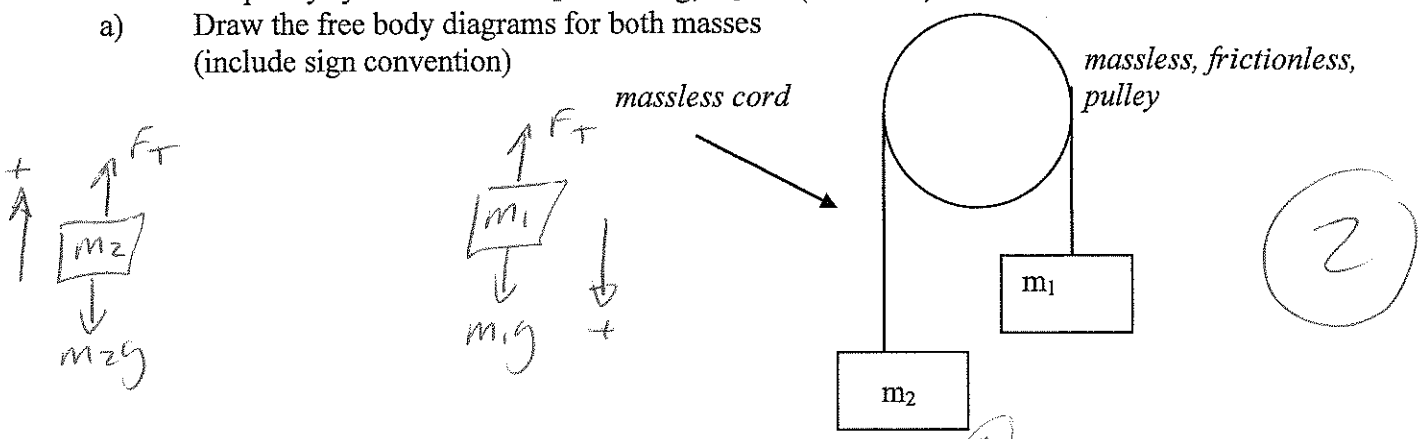
3. For the pulley system shown: $m_2 = 2.35$ kg; $m_1 = ?$ (unknown)

a) Draw the free body diagrams for both masses (include sign convention)



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b) Determine the mass of m_1 that that produces an acceleration of 3.40 m/s^2 [down] for m_1.

$\Sigma F_1 = m_1 a = m_1 g - F_T$

$\Sigma F_2 = m_2 a = F_T - m_2 g$

$m_1 a + m_2 a = m_1 g - m_2 g$

$m_1 = \frac{m_2(a+g)}{g-a} = \frac{(2.35)(3.4+9.8)}{(9.8-3.4)}$

$m_1 = 4.85\,kg$

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c) For the situation in (b), determine the magnitude of the tension on the cord.

$F_T = m_2(a+g) = (2.35)(3.4+9.8)$

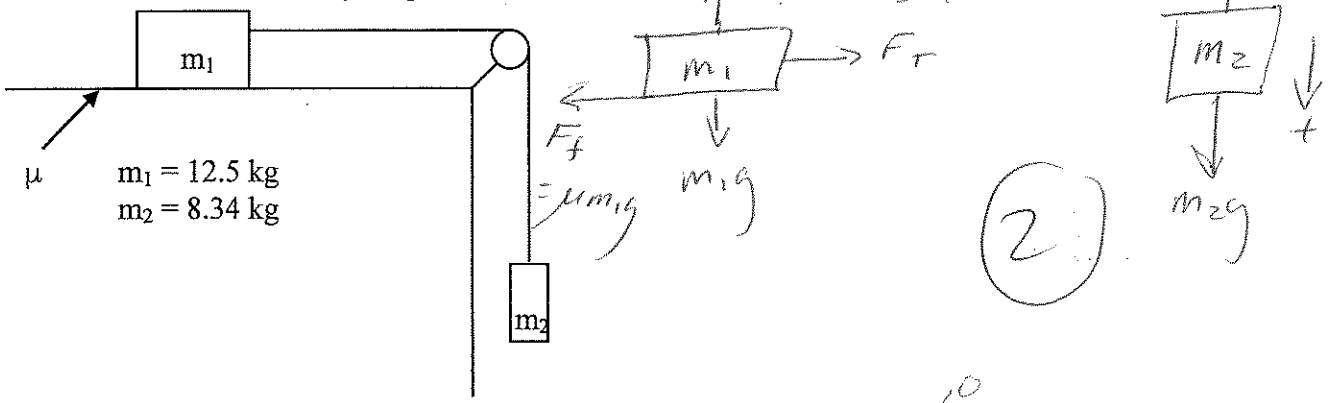
$F_T = 31.0\,N$

1

$F_T = m_1(g-a)$

4. For the system shown below:

a. Draw the free body diagrams for both masses.



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b. Determine the acceleration of the system if the table surface is greased, making $\mu \approx 0$.

$\Sigma F_1 = m_1 a = F_T - \mu m_1 g$

$\Sigma F_2 = m_2 a = m_2 g - F_T$

$a(m_1 + m_2) = g(m_2 - \mu m_1)$

$a = \frac{g(m_2 - \mu m_1)}{m_1 + m_2} = \frac{(9.8)(8.34)}{12.5 + 8.34}$

$a = 3.92\,m/s^2$

2

c. Determine the minimum value of μ_s that will hold system at rest.

$\mu = \frac{m_2}{m_1} = \frac{8.34}{12.5} = 0.667$

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d. Determine the acceleration of the system if $\mu_k = 0.556$.

$a = \frac{(9.8)(8.34 - 0.556 \times 12.5)}{12.5 + 8.34} = 0.654\,m/s^2$

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