Your Name: _____

PHY203

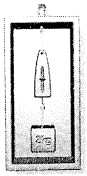
Exam #2
Chapters 5-8
~~10/29~~/21
11/5/21

Solutions

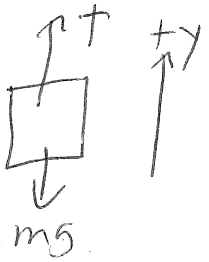
P21

Exam2 $21 Workshop

1. A 2.50 kg block hangs from a spring balance calibrated in Newtons that is attached to the ceiling of an elevator.



a. Assume the elevator is ascending with a constant speed of 35.0 m/s. Draw a free body diagram of the block, write down Newton's 2nd Law for the block, and find the reading on the spring balance. **10**

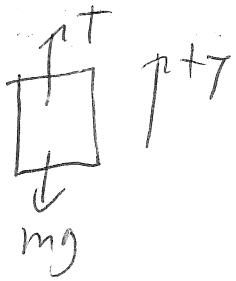


$T - mg = ma = 0$

$T = (2.50)g$

$= 24.5\ N$

b. Now assume the elevator is descending and gaining speed at a rate of 4.00 m/s^2. Draw a free body diagram of the block, write down Newton's 2nd Law for the block, and find the reading on the spring balance. **15**

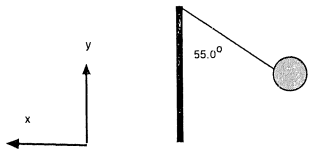


$T - mg = ma = -m(4.00)$

$T = m(g - 4.00)$

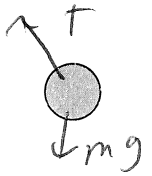
$= 2.50(g - 4.00)$

$= 14.5\ N$



2. A ball of mass m is attached to a vertical pole with a length of string L and spun with a constant speed v in a horizontal circle.

a. Draw a free body diagram of the ball below: **5**



b. Write expressions for Newton's 2nd Law in the x- and y-directions. **20**

x: $T \sin 55^\circ = mg = \frac{mv^2}{r}$

y: $T\cos\theta - mg = 0$

Assume that m = 3.50 kg, and the speed of the ball is 6.50 m/s.

c. Find the magnitude of the tension in the string. **5**

$$T = \frac{mg}{\cos\theta} = \frac{3.50\,g}{\cos 55^\circ} = 59.9\ N$$

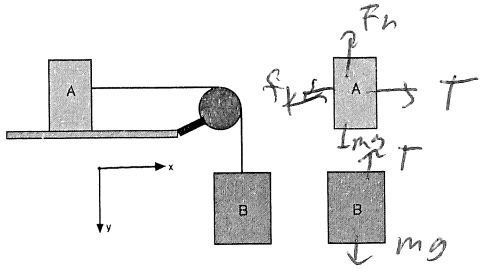
d. Find the length of the string. **10**

$r = L\sin 55^\circ$

$$T\sin 55^\circ = \frac{mv^2}{L(\sin 55^\circ)}$$

$$L = \frac{mv^2}{T(\sin 55^\circ)^2} = \frac{(3.50)(6.50)^2}{59.9(\sin 55^\circ)^2}$$

$$= 3.68\ m$$



3. Blocks A and B are connected by a light string and attached over a massless pulley and are initially at rest. Assume a rough surface under block A with coefficient of kinetic friction μ_k and masses m_A and m_B. The blocks are released and start to move. The floor is 4.50 m below block B when the blocks start to move. Take the floor as h=0.

a. Draw free body diagrams on the blocks shown above and on the right. **10**

Assume that M_A =9.50 kg, M_B = 7.50 kg, and μ_k= 0.350.

b. Find the initial potential energy of block B just before the blocks start to move. **5**

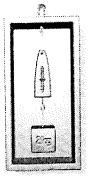
$$U_B = m_B g h = (7.50) g (4.50)$$
$$= 331 J$$

c. Use Conservation of Energy to find the speed of the blocks after they have traveled 4.50 m. **20**

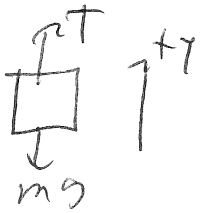
$$331 J = \frac{1}{2}(m_A + m_B)v^2 + \mu_k F_{nA} \Delta s$$
$$= \frac{1}{2}(17)v^2 + (0.350) m_A g (4.50)$$
$$= 8.5 v^2 + \underbrace{(0.350)(9.50) g (4.50)}_{147 J}$$
$$184 = 8.5 v^2$$
$$v = 4.64 m/s$$

F21 ~~Exam2 S21 makeup~~

1. A 4.50 kg block hangs from a spring balance calibrated in Newtons that is attached to the ceiling of an elevator.



a. Assume the elevator is ascending with a constant speed of 30.0 m/s. Draw a free body diagram of the block, write down Newton's 2nd Law for the block, and find the reading on the spring balance. **10**

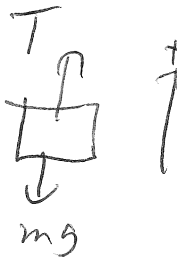


$T - mg = ma = 0$

$T = mg = (4.50)\,g$

$= 44.1\ N$

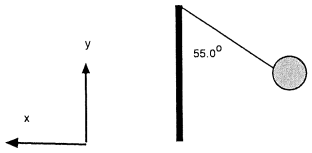
b. Now assume the elevator is descending and gaining speed at a rate of 3.00 m/s^2. Draw a free body diagram of the block, write down Newton's 2nd Law for the block, and find the reading on the spring balance. **15**



$T - mg = ma = m(-3.00)$

$T = m(g - 3.00)$

$= 30.6\ N$



2. A ball of mass m is attached to a vertical pole with a length of string L and spun with a constant speed v in a horizontal circle.

a. Draw a free body diagram of the ball below: **5**

b. Write expressions for Newton's 2nd Law in the x- and y-directions. **20**

x: $T\sin 55^\circ = ma = \frac{mv^2}{r}$

y: $T\cos 55^\circ - mg = 0$

Assume that m = 4.50 kg, and the speed of the ball is 7.50 m/s.

c. Find the magnitude of the tension in the string. **5**

$$T = \frac{mg}{\cos 55^\circ} = \frac{4.50g}{\cos 55^\circ} = 77.0\,N$$

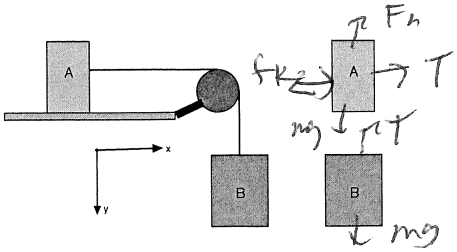
d. Find the length of the string. **10**

$$r = L\sin 55^\circ$$

$$T\sin 55^\circ = \frac{mv^2}{L\sin 55^\circ}$$

$$L = \frac{mv^2}{T(\sin 55^\circ)^2} = \frac{(4.50)(7.50)^2}{77.0(\sin 55^\circ)^2}$$

$$= 4.90\,m$$



3. Blocks A and B are connected by a light string and attached over a massless pulley and are initially at rest. Assume a rough surface under block A with coefficient of kinetic friction μ_k and masses m_A and m_B. The blocks are released and start to move. The floor is 4.50 m below block B when the blocks start to move. Take the floor as h=0.

a. Draw free body diagrams on the blocks shown above and on the right. **10**

Assume that M_A =8.50 kg, M_B = 6.50 kg, and μ_k= 0.350.

b. Find the initial potential energy of block B just before the blocks start to move. **5**

$$U_B = m_B g h = (6.50) g (4.50) = 287 J$$

c. Use Conservation of Energy to find the speed of the blocks after they have traveled 4.50 m. **20**

$$287 J = \frac{1}{2}(m_A + m_B) v^2 + \mu_k F_{n_A} \Delta s$$

$$= \frac{1}{2}(15) v^2 + (0.350) m_A g (4.50)$$

$$= 7.5 v^2 + (0.350)(8.50) g (4.50)$$

$$= 7.5 v^2 + 131 J$$

$$156 = 7.5 v^2$$

$$v = 4.56 m/s$$