Homework Solutions
10/2/2007

Conceptual Questions

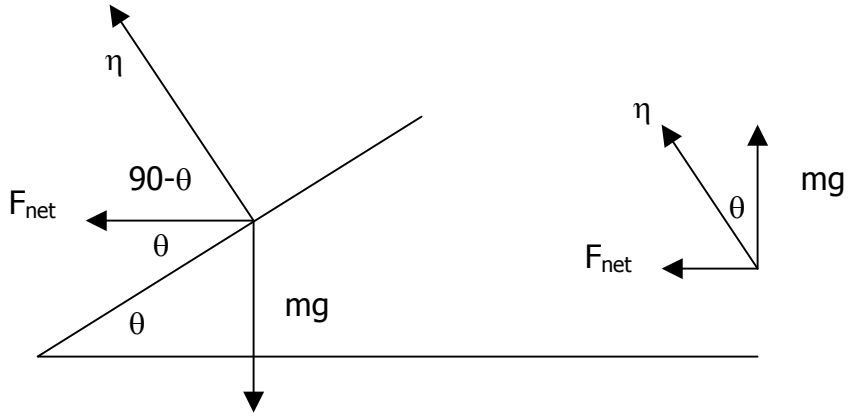
10. A person would weight slightly less at the Equator because the normal force would be less. The normal force is the same as the person's perception of their weight. The reason for this is that the person at the Equator has a higher tangential velocity.

12. The motion of an object with an acceleration perpendicular to its velocity would be best described as a circle with a constant speed. The motion of an object with an acceleration parallel to its velocity would be best described as moving in a straight line while changing speed.

13. The water has inertia due to its velocity. Its tendency is to move in a straight line but the bucket is pushing it in a circular path. The normal force of the bucket on the water provides the centripetal force to move the water in a vertical circle. The water would fall out if it did not have a tangential velocity at the top of its path.

Problems

24. In order for the net force to be inward, mg must be counteracted by a component of the normal force that is upward. If you draw a picture you can convince yourself that the angle θ is the angle between the normal force and the component of the normal force that counteracts the object's weight.



$$\eta = \frac{mg}{\cos\theta}$$

$$F_{net} = \eta \sin\theta$$

$$F_{net} = \frac{mg}{\cos\theta}\sin$$

$$F_{net} = mg\tan\theta$$

$$F_{net} = \frac{mv^2}{r}$$

$$mg\tan\theta = \frac{mv^2}{r}$$

$$\tan\theta = \frac{v^2}{rg}$$

$$\theta = \tan^{-1}\left(\frac{v^2}{rg}\right)$$

$$\theta = \tan^{-1}\left(\frac{\left(13.4\frac{m}{s}\right)^2}{(50.0m)\left(9.8\frac{m}{s^2}\right)}\right) = 20.1\circ$$

25. a.

$$T = mg$$

$$T = (1.0kg)\left(9.8\frac{m}{s^2}\right) = 9.8N$$

b. Tension in the string causes the centripetal acceleration of the puck so 9.8 N is the amount of force.

c.

$$Mg = \frac{mv^2}{r}$$

$$v = \sqrt{\frac{Mgr}{m}} = \sqrt{\frac{(1.0kg)\left(9.8\frac{m}{s^2}\right)(1.0m)}{0.25kg}} = 6.3\frac{m}{s}$$

26.

$$T - mg = \frac{mv^2}{r}$$

$$T = \frac{mv^2}{r} + mg = \frac{(85kg)\left(8.0\frac{m}{s}\right)^2}{10m} + (85kg)\left(9.80\frac{m}{s^2}\right) = 1380N$$

Tarzan is not a very bright a man. Leave the river crossing to Jane.

28. a.

$$N - mg = \frac{mv^2}{r}$$

$$N = \frac{mv^2}{r} + mg$$

$$N = \frac{(500kg)\left(20.0\frac{m}{s}\right)^2}{10m} + (500kg)\left(9.80\frac{m}{s^2}\right) = 2500N$$

b.

$$mg - N = \frac{mv^2}{r}$$

$$mg - 0N = \frac{mv^2}{r}$$

$$v = \sqrt{gr} = \sqrt{\left(9.80\frac{m}{s^2}\right)(15m)} = 12\frac{m}{s}$$