1. An elevator is being lifted upward at a *constant speed* by a steel cable that is attached to the elevator. Neglect any frictional forces. In this situation, what can you say about the forces acting on the elevator?

A) There is no force of gravity acting on the elevator.
B) There is no force exerted by the cable on the elevator.
C) The upward force exerted by the cable is equal to the downward force of gravity.
D) The upward force exerted by the cable is greater than the downward force of gravity.
E) The upward force exerted by the cable is smaller than the downward force of gravity.

$F_{net} = ma$

$T - W = 0$

$T = W$

2. Your car has many forces acting on it as it travels down the road. When all of the forces are added up the net force on your car is found to be directed north. What do you know for sure about the motion of your car?

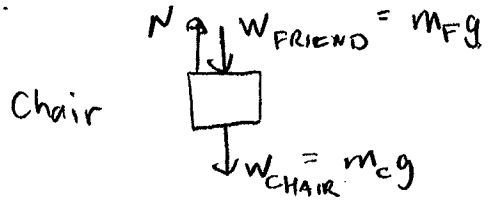
A) It is turning.
B) It is speeding up.
C) It is traveling north.
D) Its velocity is constant.
E) Its velocity is changing.

$\vec{F}_{net} = m\vec{a}$

IF $\vec{F}_{net} \neq 0$, then $\vec{a} \neq 0$

3. Your friend, who has a mass of 80 kg, is standing on a chair to reach something on a high shelf. The normal force of the ground on the chair is 910 N. What is the mass of the chair?

A) 8.0 kg
B) 11 kg
C) 91 kg
D) 110 kg
E) 830 kg



$F_{net} = 0$

$N - W_F - W_c = 0$

$N - m_F g - m_c g = 0$

$m_c g = N - m_F g$

$m_c = \frac{N}{g} - m_F = \frac{910\,N}{10\,m/s^2} - 80$

$= 11\,kg$

4. A baseball is pitched and a batter strikes the baseball, hitting a home run. Which statement is true?

A) There are no forces acting in this situation because it is a collision.
B) The bat exerts a force on the ball, but the ball does not exert a force on the bat.
C) The ball exerts a force on the bat that is greater than the force the bat exerts on the ball.
D) The bat exerts a force on the ball that is greater than the force the ball exerts on the bat.
E) The ball exerts a force on the bat that is equal in magnitude to the force the bat exerts on the ball.

Newton's 3rd law

5. You are driving your car that has a mass of 1400 kg at a speed of 11 m/s when you push down on the gas pedal and accelerate to a new speed of 27 m/s during a time interval of 8.5 s. What was the net force on the car while you were accelerating?

A) 1400 N
B) 1800 N
C) 2200 N
D) 2600 N
E) 4500 N

$V_2 = V_1 + at$

$a = \frac{V_2 - V_1}{t}$

$= \frac{27\,m/s - 11\,m/s}{8.5\,s}$

$= 1.88\,m/s^2$

$F_{net} = ma$

$= (1400\,kg)(1.88\,m/s^2)$

$= 2600\,N$

6. The acceleration due to gravity on Mars is about 3.8 m/s^2. The Curiosity rover has a *weight* of 9000 N on Earth. What is the *mass* of the Curiosity rover on Mars?

A) 240 kg
B) 340 kg
C) 900 kg
D) 2400 kg
E) 3400 kg

mass is the same everywhere

On earth $W = mg$

$m = \frac{W}{g} = \frac{9000\,N}{10\,m/s^2} = 900\,kg$

7. You are riding a roller coaster in a carnival as shown in the figure to the right (looking down on the ride from above). At the moment indicated, the car you are in is moving to the left at a constant speed on a horizontal section of track and turning in a circle. Which arrow below best shows the direction of the acceleration at the moment depicted in the figure?

(A) (B) (C) (D) There is no acceleration (E)

centripetal acceleration

8. A jet pilot experiences an acceleration of about 3.5 "g's" (35 m/s^2) while he is turning his plane in a horizontal circular path with a radius of 1400 m. How fast is this pilot traveling?

A) 130 m/s
B) 220 m/s
C) 310 m/s
D) 400 m/s
E) 490 m/s

$a_c = \frac{v^2}{r}$

$v = \sqrt{a_c r}$

$= \sqrt{(35\ m/s^2)(1400\ m)} = 220\ m/s$

9. Two man-made satellites are orbiting the Earth in circular orbits. One of the satellites has a higher orbit than the other satellite. Which of the following statements is true?

A) The lower satellite will definitely take longer to make a complete orbit.
B) The higher satellite will definitely take longer to make a complete orbit.
C) Both satellites will take the same amount of time to make a complete orbit.
D) More information is needed to determine which satellite takes longer to make a complete orbit.
E) None of the above.

$\frac{T_1^2}{T_2^2} = \frac{r_1^3}{r_2^3}$

10. A watermelon attracts a 140 gram apple with a gravitational force of 3.9×10^{-10} N when the apple and the watermelon are 25 cm apart. What is the mass of the watermelon?

A) 2.6 kg
B) 3.7 kg
C) 5.8 kg
D) 26 kg
E) 37 kg

$F = \frac{G m_a m_w}{r^2}$

$m_w = \frac{F r^2}{G m_a} = \frac{(3.9\times10^{-10}\ N)(.25\ m)^2}{\left(6.67\times10^{-11}\ \frac{N m^2}{kg}\right)(.140\ kg)} = 2.6\ kg$

11. Two identical cars drive around a circular road. The faster car drives at twice the speed of the slower car. How does the net force on the faster car compare with the net force on the slower car?

$F_{net} = \frac{mv^2}{r}$ m, r the same

when $v \rightarrow 2v$

$v^2 \rightarrow 4v^2$

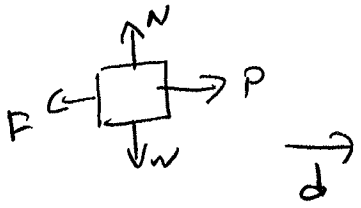
A) It is 1/4 as large
B) It is 1/2 as large
C) It is the same
D) It is 2 times larger
(E) It is 4 times larger

12. You tie a rope to a 21 kg crate and pull the crate at a constant speed for a distance of 4.8 m across the floor by applying a horizontal force on the rope of 3.6 N. How much work does the normal force do on the crate as it slides across the floor?

$W = F_{\parallel} d$

Since normal is perpendicular to displacement,

$W = 0$



(A) 0 N
B) 17 N
C) 76 N
D) 100 N
E) 210 N

13. A pickup truck with twice the mass of a car is traveling at half the speed of the car. How does the kinetic energy of the pickup truck compare with the kinetic energy of the car?

$KE = \frac{1}{2} mv^2$ when $m \rightarrow 2m$

$v \rightarrow \frac{1}{2}v$

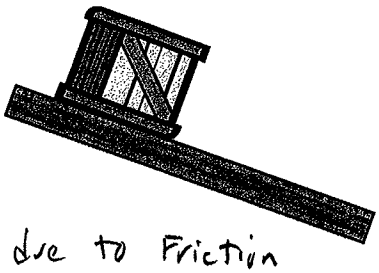
$v^2 \rightarrow \frac{1}{4}v^2$

So KE becomes

$2\left(\frac{1}{2}\right)^2 = 2\left(\frac{1}{4}\right) = \frac{1}{2}$ Smaller

A) It is 1/4 as large
(B) It is 1/2 as large
C) It is the same
D) It is 2 times larger
E) It is 4 times larger

14. A crate starts from rest and gains speed as it slides down a rough inclined ramp which has some friction. Which of the following is true as the crate slides down the ramp?



due to Friction

A) The kinetic energy of the crate is decreasing.
B) The mechanical energy of the crate is constant.
(C) The mechanical energy of the crate is decreasing.
D) The gravitational potential energy of the crate is constant.
E) The gravitational potential energy of the crate is increasing.

15. A toy dart gun uses a spring to shoot a plastic dart. The spring has a spring constant of 380 N/m and the dart has a mass of 32 grams. If the spring is compressed 11 cm when the dart is loaded, how fast is the dart moving when it is shot horizontally from the gun?

A) 2.5 m/s
B) 12 m/s
C) 15 m/s
D) 38 m/s
E) 140 m/s

$v_i = 0 \quad v_f = ?$
$x_i = .11\text{cm} \quad x_f = 0$
$h_i = 0 \quad h_f = ?$

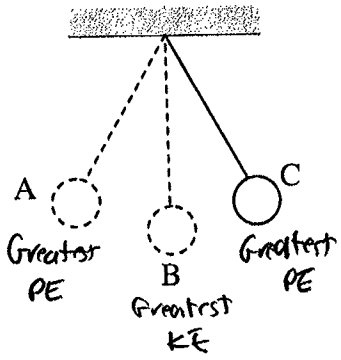
$KE_i + PE_i = KE_f + PE_f$

$\frac{1}{2}mv_i^2 + mgh_i + \frac{1}{2}kx_i^2 = \frac{1}{2}mv_f^2 + mgh_f + \frac{1}{2}kx_f^2$

$0 + 0 + \frac{1}{2}kx_i^2 = \frac{1}{2}mv_f^2 + 0 + 0$

$v_f = \sqrt{\frac{kx_i^2}{m}} = \sqrt{\frac{(380\ N/m)(.11\ m)^2}{.032\ kg}} = 12\ m/s$

16. A simple pendulum is made of a ball attached to the end of a string that is swinging back and forth as shown in the figure. Points A and C are the end points of the motion and Point B is the lowest point in the motion. Assuming there is no friction as the ball swings and the gravitational potential energy has a minimum value of zero, which of the following is *not true*?



A) The kinetic energy is greatest at point B.
B) The total mechanical energy never changes.
C) The potential energy is the greatest at points A and C.
D) The potential energy and kinetic energy are greatest at the same point.
E) Between points A and B the ball has both kinetic and potential energy.

17. An 870-kg airplane starts from rest and accelerates to a speed of 28 m/s while gaining speed before take-off. How much total work was done on the airplane?

A) 1.2×10^4 J
B) 2.4×10^4 J
C) 6.8×10^4 J
D) 1.2×10^5 J
E) 3.4×10^5 J

$W_{net} = \Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$= \frac{1}{2}mv_f^2 - 0$

$= \frac{1}{2}(870\ kg)(28\ m/s)^2$

$= 3.4 \times 10^5\ J$