Practice Quiz on Forces

FORMULAS AND CONSTANTS YOU MAY FIND USEFUL:

FORMULAS YOU MAY FIND USEFUL

$s_f = s_i + v_i\Delta t + \frac{1}{2}a\Delta t^2$ $\quad v_f^2 = v_i^2 + 2a\Delta s$ $\quad x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$g = 9.8\ m/s^2$ $\quad a_r = \frac{v_t^2}{r} = r\omega^2$ $\quad v_t = r\omega = \frac{2\pi r}{T}$ $\quad a_t = r\alpha$

$F_G = \frac{GMm}{r^2}$ $\quad G = 6.67x10^{-11}\ Nm^2kg^{-2}$ $\quad T = \frac{2\pi}{|\omega|}\ OR\ \frac{1}{|\omega|}\ OR\ \frac{360}{|\omega|}$

REMEMBER THIS QUIZ IS PRACTICE. NO GUARANTEES MADE AS TO THE CONTENT OF THE ACTUAL QUIZ

1) The same constant force is applied to 3 objects. Object A accelerates at 5 m/s^2, object B accelerates at 12 m/s^2, object C accelerates at 8 m/s^2.

a) Which object has the largest mass? A

b) Which object has the smallest mass? B

c) What is the ratio of the mass of object C to the mass of object B, m_C/m_B? 3/2

4) Three forces act on a 1 kg object. F_1 is 40 N upward. F_2 is 30 N to the right. F_3 is 45 N at an angle 40° below the negative x-axis. Is this object in equilibrium? If not, what is its acceleration (in i and j vector form)?

$-4.5\hat{i} + 11.1\hat{j}\ (m/s^2)$

3. Two blocks attached with a massless string are placed on a frictionless ramp with an incline of 15°. The lower block has a mass of 2 kg, while the upper block has a mass of 3 kg. A force of 25 N is applied to the upper block to pull them both up the ramp.

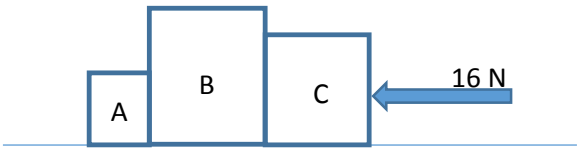
a) What is the acceleration of each block?

$2.46\ m/s^2$ (for both)

b) What is the tension in the string?

10 N

1. Blocks A, B, and C are lined up in a row on a frictionless surface as shown in Figure 1. Block A has a mass of 1 kg, Block B has a mass of 4 kg, and Block C has a mass of 3 kg. A force to the left of 16 N is applied to Block C.



a) What is the magnitude and direction of acceleration of each block?

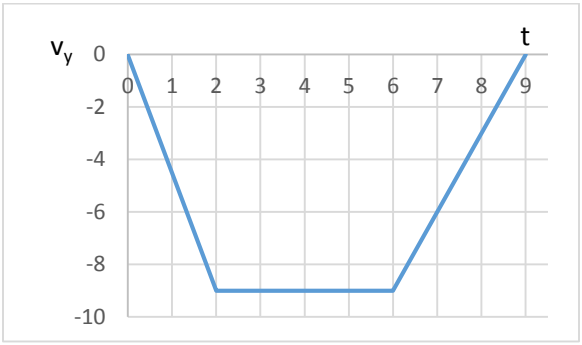
$2\ m/s^2$ to left (for all)

c) What is the force of block B on block C? What is the force of block B on block A?

$F_{B\text{ on }C} = 10\ N$

$F_{B\text{ on }A} = 2\ N$

2. The figure below shows the velocity graph of a 70 kg Business Shark in an elevator on his way home from a very important Business Meeting.



a) What is the apparent weight of the Business Shark at t = 1 s?

371 N

b) What is the apparent weight of the Business Shark at t = 4s?

686 N

c) What is the apparent weight of the Business Shark at t = 8s?

896 N

4. You are stealing a shark from an aquarium. The shark tank, including one large sand tiger shark, has a mass of 500 kg. (There's no water in the tank to save weight. You'll pour some back in once you get the shark home.) The coefficients of friction between the tank and the aquarium floor are μ_s = .2 and μ_k= .1. You apply a force of 250 N horizontally to the side of the tank but it doesn't budge. The shark laughs at you.

a) What is the force of static friction acting on the tank as you futilely push?

250 N

b) The shark, embarrassed on your behalf, climbs out of the tank to help you push. Without the shark, the tank weighs 300 kg. The shark applies 400 N of force, easily putting you to shame. With both you and the shark pushing, does the box move? If so, what is its acceleration?

$1.19\ m/s^2$

c) Eventually, with the help of several other sharks, you manage to load the tank into your pick-up truck. The coefficient of static friction between the tank and the truck bed is 0.5.

The shark wants to drive, and at this point you owe her a favor. The shark wants to take off as fast as possible without the tank sliding in the back of the truck. What is the greatest acceleration the truck can have without the tank sliding?

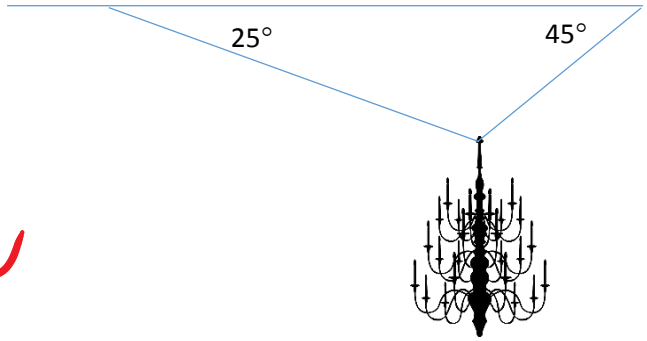
$4.9\ m/s^2$

5. The shark really likes driving, so you let her borrow your car for a trip to Starbucks. On the way, she comes upon a highway on-ramp that is curved and banked. The curve can be considered to be part of a circle with a radius of 350 m, and the road is inclined at 10°. How fast can she go around this curve without relying on frictional forces to keep her on the road?

(Hint: unlike most inclined plane problems, do not set your x-axis parallel to the surface!)

$24.6\ m/s$

6. A 200 kg chandelier is hung from the ceiling with two ropes as shown in the figure below. What is the tension in each of the massless ropes?



$T_1 = 1474\ N$

$T_2 = 1890\ N$

7. Venus orbits the Sun at a distance of 1.08×10^8 km. If the Sun's mass is 1.98×10^{30} kg, what is Venus' orbital period? (In days)

224.6 days