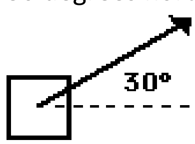
Name: ____ Date: ______________ Period: ________

AP Physics 1 – Two Dimensional Force in Equilibrium Quiz ANSWER KEY

1. Three pictures of equal weight (20 N) are hung by wires in three different orientations. In which orientation are the wires least likely to break? _______ Explain why.

Answer: 60-degree angle to the horizontal
The tension in the wire will have the greatest impact upon its tendency to break. As the wire becomes most vertically oriented, the horizontal component of the tension force is reduced and the tension becomes less. The moral of the story -- to support the weight of a picture, one only needs to pull upwards, not leftwards and rightwards. Of course, the best arrangement would be two wires pulling completely vertically.

2. A 50-N force is applied at an angle of 30 degrees north of east. This would be the same as applying two forces at
   A. 43 N, east and 7 N, north
   B. 35 N, east and 15 N, north
   C. 25 N, east and 25 N, north
   D. 43 N, east and 25 N, north

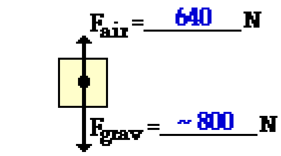


Answer: D
A 50-N force at 30 degrees would have two components - 43 N, east and 25 N, north. These two forces would be equal to the 50-N force at 30 degrees N of E. They are calculated as:

$$F_{east} = (50\text{ N})*\cos(30\text{ deg})$$
$$F_{north} = (50\text{ N})*\sin(30\text{ deg})$$

For the next three problem, use the approximation that g = 10 m/s^2 to fill in the blanks in the following diagrams. Show all of your work.

3.



m = 80 kg

a = 2.0 m/s/s, down

F_{grav} = m•g = **~800 N**

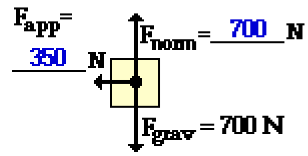
$\sum F_y = ma_y$ = (80 kg)•(2.0 m/s/s)

$\sum F_y$ = 160 N, down

The F_{grav} (down) and the F_{air} (up) must add up to 160 N, down. Thus, F_{air} must be smaller than F_{grav} by 160 N.

F_{air} = 640 N

4.



m = ~ 70 kg

a = 5.0 m/s/s, left

Since F_{grav} = m•g, m can be calculated to be **~70 kg** (m=F_{grav}/g).

Since a_y = 0 m/s/s, F_{norm} must equal F_{grav}; so **F_{norm} = 700 N**.

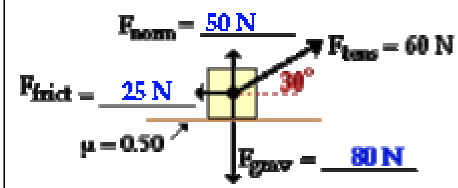
$\sum F_x$ = m•a_x = (70 kg)•(5.0 m/s/s)

$\sum F_x$ = 350 N, left

(Note that the ·**F_x** direction is always the same as the **a_x** direction.)

With F_{app} being the only horizontal force, its value must be **350 N** - the same as ·F_x.

5.



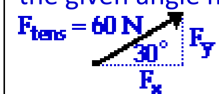
m = 8 kg

a = 3.4 m/s/s, right

ΣF = 27 N, right

A quick blank is F_{grav}: **F_{grav}** = m•g = **~80 N**

Now resolve the 60-N force into components using trigonometry and the given angle measure:



F_x = 60 N•cos(30 deg) = 52 N

F_y = 60 N•sin(30 deg) = 30 N

Since the acceleration is horizontal, the sum of the vertical forces must equal 0 N. So $F_{grav} = F_y + F_{norm}$.

Therefore **F_{norm}** = F_{grav} - F_y = **50 N**.

Knowing F_{norm} and mu, the F_{frict} can be determined:

F_{frict} = mu•F_{norm} = 0.5*(50 N) = **25 N**

Now the horizontal forces can be summed:

$\sum F_x = F_x + F_{frict}$ = 52 N, right + 25 N, left

$\sum F_x$ = 27 N, right

Using Newton's second law, $\sum F_x$ = m•a_x

So a_x = (27 N)/(8 kg) = **3.4 m/s/s, right**