Name Answer Key
Honors Physics
Period ____________

Date ______________________

Forces WS #6H
Mrs. Nadworny

Balanced and Unbalanced Forces

Directions – Solve the following problems using the GUESS method and correct significant figures. Answer in complete sentences where appropriate. Be sure to show ALL work!

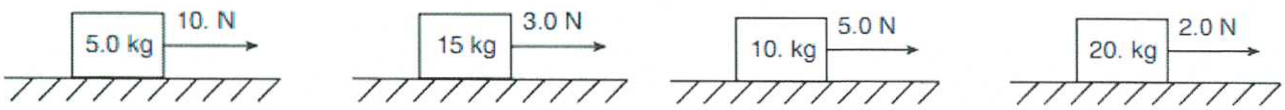
1. When the sum of all the forces acting on a block on an inclined plane is zero, the block

   A) must be at rest
   B) may be slowing down
   C) must be accelerating
   D) may be moving at constant speed

2. A constant eastward horizontal force of 70. newtons is applied to a 20.-kilogram crate moving toward the east on a level floor. If the frictional force on the crate has a magnitude of 10. newtons, what is the magnitude of the crate's acceleration?

   A) 0.50 m/s² B) 3.0 m/s² C) 3.5 m/s² D) 4.0 m/s²

A different force is applied to each of four different blocks on a frictionless, horizontal surface.

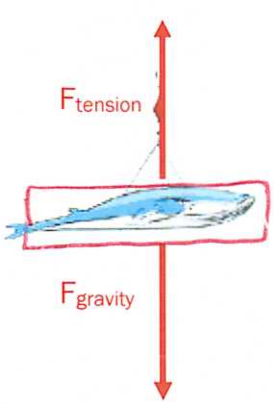


A B C D

3. In which diagram does the block have the greatest inertia 2.0 seconds after starting from rest? D

4. In which diagram(s) does the block experience the greatest acceleration? A

1. The whale shark is the largest type of fish in the world. Its mass can be as large as 2.00×10^4 kg, which is the equivalent mass of three average adult elephants. Suppose a crane lifts the whale shark off the ground. The net holding the whale shark is steadily accelerated from rest over an interval of 2.5 seconds until the net reaches a speed of 1.0 m/s. Draw a free body diagram of the situation. Calculate the acceleration of the whale shark. Calculate the net force acting on the whale shark. Calculate the weight of the whale shark. Calculate the tension in the cable pulling the net.



$$F_{net\,y} = ma$$
$$F_t - F_g = ma$$

$$a = \frac{\Delta v}{t} = \frac{1.0\frac{m}{s}}{2.5s} = 0.40\frac{m}{s^2}\text{ up}$$

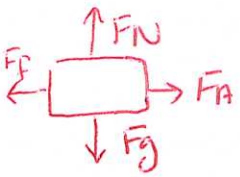
$$F_{net} = ma = (2.00\times10^4 kg)(0.40\tfrac{m}{s^2}) = 8.0\times10^3 N\text{ up}$$

$$F_g = mg = (2.00\times10^4 kg)(-9.81\tfrac{m}{s^2}) = 196{,}000N\text{ down}$$

$$F_{net\ y} = F_{tens} - F_{grav}$$

$$F_{tens} = F_{net} + F_{grav} = 8.0\times10^3 N + 196{,}000N = 204{,}000N\text{ up}$$

2. April Schauer exerts a force of 13.4 N on a 26.0 N book cart to slide it across the floor where the kinetic friction between the surfaces is 0.34. Calculate the mass of the cart. Calculate the force of kinetic friction acting on the cart. Calculate the net force acting on the cart. Calculate the acceleration of the cart.



$$m_{box} = \frac{F_G}{g} = \frac{-26.0N}{-9.81\frac{m}{s^2}} = 2.65kg$$

$$F_f = \mu_k F_N = (0.34)(26.0N) = 8.8N \text{ backward}$$

$$F_{net} = F_{applied} - F_{frict} = 13.4N - 8.8N = 4.6N \text{ forward}$$

$$a = \frac{F_{net}}{m} = \frac{4.6N}{2.65kg} = 1.7\frac{m}{s^2} \text{ forward}$$

x: $F_{netx} = ma$

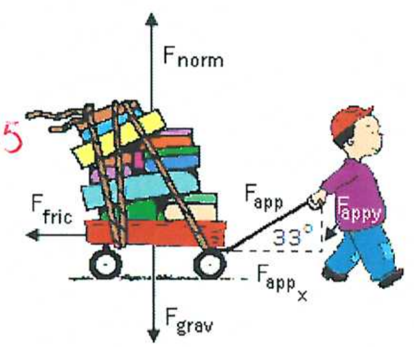
$F_A - F_f = ma$

y: $F_{nety} = 0N$

$F_N - F_g = 0N$ $F_N = F_g = 26.0N$ up

3. Luke Autbeloe is pulling a wagon with a mass of 15.7 kg across a level patch of grass by exerting a force of 19.6 N along the handle that forms an angle of 33.0⁰ above the ground. The coefficient of kinetic friction between the wagon and the grass is 0.25. Calculate the weight of the wagon. Calculate the components of the applied force. Calculate the normal force using all of the vertical information. Calculate the force of kinetic friction acting on the wagon. Calculate the horizontal net force acting on the wagon. Calculate the acceleration of the wagon.

$\mu = .25$



$$F_g = mg = (15.7kg)(-9.81\frac{m}{s^2}) = 154N \text{ down}$$

$$F_{applied\ x} = F_x = F\cos\theta = (19.6N)(\cos 33.0°) = 16.4N \text{ right}$$

$$F_{applied\ y} = F_y = F\sin\theta = (19.6N)(\sin 33.0°) = 10.7N \text{ up}$$

$$F_{net\ y} = F_N + F_y - F_G = 0N$$

$$F_N = F_G - F_y = 154N - 10.7N = 143N \text{ up}$$

x: don't know a or constant v

y: $F_{nety} = 0N$

$F_N + F_{Ay} - F_g = 0N$

$F_{netx} = F_{Ax} - F_f$

(this doesn't help immediately)

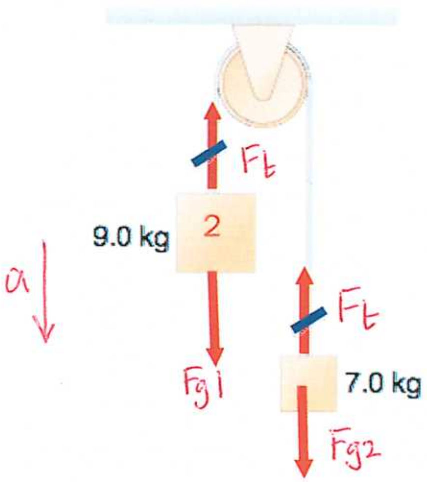
$$F_f = \mu_k F_N = (0.25)(143N) = 36N \text{ left}$$

$$F_{net\ x} = F_{A\ x} - F_f$$

$$F_{net\ x} = 16.4N - 36N = 19.6N \text{ left}$$

$$a = \frac{F_{net\ x}}{m} = \frac{-19.6N}{15.7kg} = 1.2\frac{m}{s^2} \text{ left}$$

4. Two masses are hung as shown over a frictionless, massless pulley. Determine their acceleration.

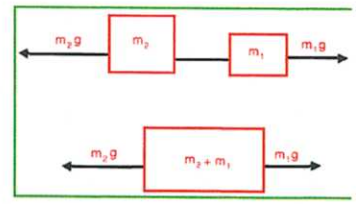


$$a = \frac{F_{net}}{m_{net}} = \frac{F_{g1} - F_{g2}}{m_1 + m_2}$$

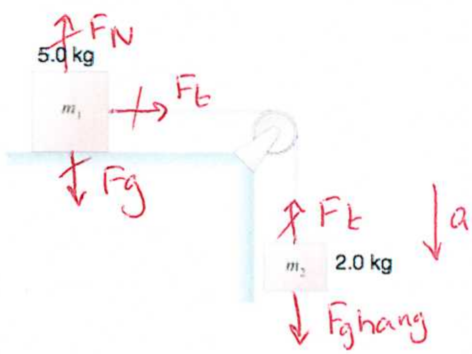
$$a = \frac{m_1 g - m_2 g}{(m_1 + m_2)} = \frac{(m_1 - m_2)g}{(m_1 + m_2)}$$

$$a = \frac{(9.0kg - 7.0kg)(9.81\,\tfrac{m}{s^2})}{(9.0kg + 7.0kg)}$$

$$a = 1.2\,\tfrac{m}{s^2}$$



5. A 5.0 kilogram block rests on a horizontal table of negligible friction. A string is tied to the block and passed over a pulley and a 2.0 kilogram block is hung on the other end of the string as shown. Calculate the acceleration of the system.



$$a = \frac{F_{net}}{m_{net}} = \frac{F_{g\ hanging}}{m_1 + m_2}$$

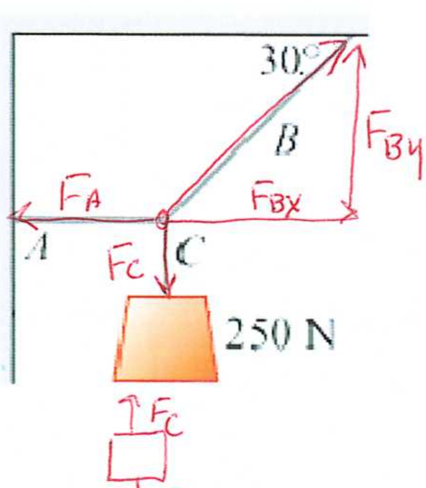
$$a = \frac{m_2 g}{(m_1 + m_2)}$$

$$a = \frac{(2.0kg)(9.81\,\tfrac{m}{s^2})}{(2.0kg + 5.0kg)}$$

$$a = 2.8\,\tfrac{m}{s^2}$$

Remember that *a* can never exceed 10 m/s²

6. A 250 N weight is supported by three ropes, A, B, and C. Determine the tension in each rope.



1. Hanging

$F_{net} = 0N$

$F_C - F_g = 0N$

$F_C = F_g = 250N$ up

2. Vertical Components

$F_{net\ y} = 0N$

$F_{B\ y} - F_C = 0N$

$F_B \sin\theta - F_C = 0N$

$F_B = \frac{F_C}{\sin\theta} = \frac{250N}{\sin 30.°}$

$F_B = 500N = 5.0\times10^2 N$

3. Horizontal Components

$F_{net\ x} = 0N$

$F_{B\ x} - F_A = 0N$

$F_B \cos\theta - F_A = 0N$

$F_A = F_B \cos\theta = 5.0\times10^2 N \cos 30.°$

$F_A = 430N$ left

Answers in size order: 0.40, 1.23, 1.7, 2.65, 2.8, 4.6, 8.8, 10.7, 16.4, 36, 143, 154, 250, 430, 5.0 x 10², 8.0 x 10³, 196,000, 204,000