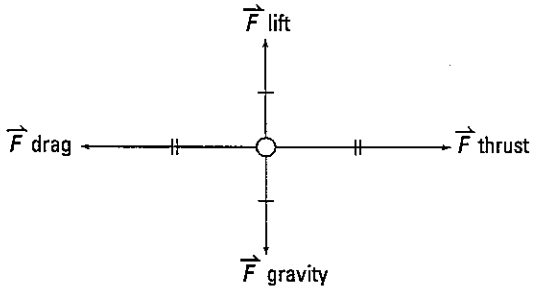
CHAPTER 4 BLM ANSWER KEY

BLM 4-1: Sections 4.1–4.2 Review/ Reinforcement

Answers

1. **(a)** F: An object's inertia is related to it mass.
   (b) F: It is greater at Earth's poles.
   (c) T. **(d)** T.
   (e) F: It shows only action forces acting on an object.
   (f) T.
   (g) F: It is usually greater.
   (h) F: The force of gravity on an object is equal to the product of its mass and the acceleration due to gravity.
2. Weight is the force of gravity acting on an object, measured in N, and mass is the amount of matter in an object, measured in kg.
3. $\vec{g} = \frac{\vec{F}}{m} = \frac{1554\text{ N}}{60\text{ kg}} = 25.9\ \frac{\text{N}}{\text{kg}} = 25.9\ \frac{\text{m}}{\text{s}^2}$
4. Refer to the free body diagram below.



5. $\vec{F}_N = mg$
   $\vec{F}_N = 100.0\text{ kg} \times 9.81\ \frac{\text{N}}{\text{kg}} = 981.0\text{ N}$
   $\vec{F}_f = \mu_k \vec{F}_N$
   $\vec{F}_f = 0.4 \times 981.0\text{ N}$
   $\vec{F}_f = 392.4\text{ N[W]}$
   $\vec{F}_{net} = \vec{F}_a + \vec{F}_f$
   $\vec{F}_a = \vec{F}_{net} - \vec{F}_f$
   $\vec{F}_a = 0\text{ N} - (392.4\text{ N[W]})$
   $\vec{F}_a = 392.4\text{ N[E]}$
6. Galileo showed that uniform motion was not the result of the application of a continuous force, as Aristotle believed, but was a state just as natural as rest, called "inertia." He also disproved Buridan's impetus theory by showing that an object's movement remains unchanged because there is no force resisting the motion, not because of something inherent in it.

BLM 4-2: Applications of Newton's First and Third Laws/Skill Builder

Answers

1. – Newton's First Law
   (a) In a rear-end collision, as the car and body are pushed forward, a driver's head would jerk backward relative to the body, due to inertia. Headrests prevent this from happening, and thus prevent severe whiplash.
   (b) A centrifuge is a spinning device that separates the solid and liquid parts of a substance. Due to inertia, the more massive parts sink to the bottom and the liquid parts remain on top, as they have less resistance to being spun around.
   (c) The tendency to remain in a straight line (inertia) is what keeps people from falling out of their seats when they are turned upside on a roller coaster loop.

   – Newton's Third Law
   (a) Earth pulls on the Moon and the Moon pulls on Earth. The world's oceans flow toward the Moon in response to its pull, creating a tide on the side of Earth facing the Moon. On the side of Earth facing away from the Moon, the oceans also flow outward, causing a tide, but this time it is because of the ocean's inertia or resistance to rotating with Earth.
   (b) Exhaust gases from burning fuel are pushed backward at a high speed by the rocket. The gases react by pushing the rocket forward. In essence, a rocket accelerates in one direction, while throwing mass in the opposite direction.
   (c) The person's feet push backward on the ground and the ground pushes forward on the person's feet, moving the person forward. Walking is difficult on waxed floors and on ice, because the friction coefficient is below 0.2. This means that on these surfaces, a person cannot exert much force of friction on the ground and the ground cannot exert much force of friction on the person.

2. (a) $\vec{a} = \frac{\vec{v_f} - \vec{v_i}}{\Delta t}$

$\vec{a} = \frac{+2.5\ \frac{m}{s} - 0\ \frac{m}{s}}{0.5\ s}$

$\vec{a} = \frac{2.5\ \frac{m}{s}}{0.5\ s}$

$\vec{a} = +5\ \frac{m}{s^2}$

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

$\vec{F} = 15.0\ kg \times \left(+5\ \frac{m}{s^2}\right)$

$\vec{F} = 75\ N[up]$

The average force on the squid is 75 N[up]

(b) $\vec{F} = 75\ N[down]$ Third Law

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

$m = 1.8\ kg$

$\vec{a} = \frac{\vec{F}}{m} = \frac{-75\ N}{1.8\ kg}$

$\vec{a} = -41.67\ \frac{m}{s^2}$

$\vec{a} = 41.7\ \frac{m}{s^2}[down]$

The mass of the water is accelerated down at 41.7 m/s^2.

BLM 4-3: Newton's Laws Problems/Problem Solving

Answers

1. (a) Find the weight of the sign.

$\vec{F_g} = m\vec{g}$

$\vec{F_g} = 150.0\ kg \times 9.81\ \frac{N}{kg}$

$\vec{F_g} = 1471.5\ N$

Each cable supports half the weight of the sign. The tension in each cable is given by the following equation.

$T = \frac{\frac{\vec{F_g}}{2}}{\sin 25°}$

$T = \frac{\frac{1471.5\ N}{2}}{0.4226}$

$T = \frac{\frac{1471.5\ N}{2}}{0.4226} = \frac{735.75\ N}{0.4226}$

$T = 1741.0\ N$

Each cable has a tension of 1741.0 N

(b) Again, each cable supports half the weight

$T = \frac{\frac{\vec{F_g}}{2}}{\sin 5°}$

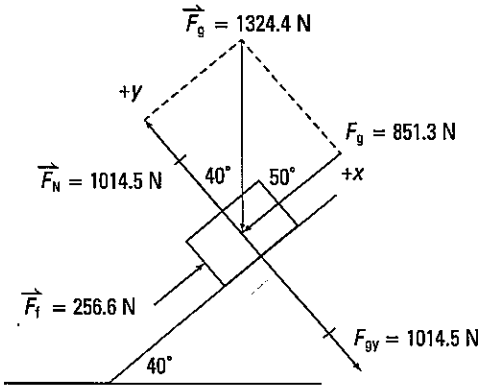
$T = \frac{\frac{1471.5\ N}{2}}{0.0872}$

$T = \frac{\frac{1471.5\ N}{2}}{0.0872} = \frac{735.75\ N}{0.0872}$

$T = 8437.5\ N$

In this case, the tension is each cable is much higher: 8437.5 N.

2. Refer to the free body diagram below. Select the *x*-axis and *y*-axis at right angles to the incline.



$\vec{F_g} = m\vec{g}$

$\vec{F_g} = 135.0\ kg \times \left(-9.81\ \frac{N}{kg}\right)$

$\vec{F_g} = -1324.35N$

$\therefore \vec{F_g} = -1324.4\ N$

$\theta = 50°$

$\vec{F_{g_x}} = -\left|\vec{F_g}\right| \cos\theta$

$\vec{F_{g_x}} = -1324.35\ N(\cos 50°)$

$F_{g_x} = -1324.35N \times (0.6428)$

$F_{g_x} = -851.28\ N$

$\therefore F_{g_x} = -851.3N$

$F_{g_y} = -\left|\vec{F_g}\right| \sin\theta$

$F_{g_y} = -1324.35\ N(\sin 50°)$

$F_{g_y} = -1324.35\ N \times (0.7660)$

$F_{g_y} = -1014.51\ N$

$\therefore F_{g_y} = -1014.5\ N$

$\vec{F_N} = -(F_{g_y})$

$\vec{F_N} = 1014.5\ N$

$\vec{F_f} = \mu_k F_N$

$\vec{F_f} = 0.25 \times 1014.51\ N$

$\vec{F_f} = +253.63\ N$

$\therefore \vec{F_f} = +253.6\ N$