7. Strategy The area of the circular garden is given by $A = \pi r^2$. Let the original and final areas be $A_1 = \pi r_1^2$ and $A_2 = \pi r_2^2$, respectively.

Solution Calculate the percentage increase of the area of the garden plot.

$$\frac{\Delta A}{A} \times 100\% = \frac{\pi r_2^2 - \pi r_1^2}{\pi r_1^2} \times 100\% = \frac{r_2^2 - r_1^2}{r_1^2} \times 100\% = \frac{1.25^2 r_1^2 - r_1^2}{r_1^2} \times 100\% = \frac{1.25^2 - 1}{1} \times 100\% = \boxed{56\%}$$

10. (a) Strategy Move the decimal point eight places to the left and multiply by 10^8.

Solution Write the number in scientific notation.

$$290{,}000{,}000 \text{ people} = \boxed{2.9 \times 10^8 \text{ people}}$$

(b) Strategy Move the decimal point 15 places to the right and multiply by 10^{-15}.

Solution Write the number in scientific notation.

$$0.000\,000\,000\,000\,003\,8 \text{ m} = \boxed{3.8 \times 10^{-15} \text{ m}}$$

34. Strategy and Solution A normal heart rate is about 70 beats per minute and a person lives for about 70 years, so the heart beats about $\frac{70 \text{ beats}}{1 \text{ min}} \times \frac{70 \text{ y}}{\text{lifetime}} \times \frac{5.26 \times 10^5 \text{ min}}{1 \text{ y}} = 2.6 \times 10^9$ times per lifetime, or about $\boxed{3 \times 10^9}$.

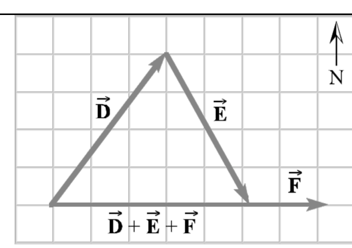
56. Strategy The volume of the spherical virus is given by $V_{\text{virus}} = (4/3)\pi r_{\text{virus}}^3$. The volume of viral particles is one billionth the volume of the saliva.

Solution Calculate the number of viruses that have landed on you.

$$\text{number of viral particles} = \frac{10^{-9} V_{\text{saliva}}}{V_{\text{virus}}} = \frac{0.010 \text{ cm}^3}{10^9 \left(\frac{4}{3}\pi\right)\left(\frac{85 \text{ nm}}{2}\right)^3 \left(\frac{10^{-7} \text{ cm}}{1 \text{ nm}}\right)^3} = \boxed{10^4 \text{ viruses}}$$

11. Strategy Graph the vectors and their sum. Use the scale of the graph to find the magnitude of the vector sum.

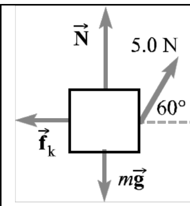
Solution The length of the vector sum is approximately equal to seven sides of a grid square, so the magnitude is 14 N. The vector points east, so the vector sum of the forces is $\boxed{\text{14 N to the east}}$. (Note that $\vec{\mathbf{F}}$ and the vector sum overlap.)



21. Strategy Since the suitcase is moving at a constant speed, the net force on it must be zero. The force of friction must oppose the force of the pull. So, the force of friction must be equal in magnitude and opposite in direction to the horizontal component of the force of the pull. Draw a free-body diagram to illustrate the situation.

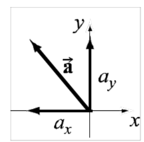
Solution Find the force of friction.

The horizontal component of the pull force is $(5.0\text{ N})\cos 60° = 2.5\text{ N}$. Since the horizontal component of the pull force is equal and opposite to the friction force, the force of friction acting on the suitcase is $\boxed{\text{2.5 N, opposite the direction of motion}}$.



25. Strategy The components of $\vec{a}$ are given. Since the *x*-component is negative and the *y*-component is positive, the vector lies in the second quadrant. Give the angle with respect to the axis to which it lies closest.

Solution Find the magnitude and direction of $\vec{a}$.



(a) $a = \sqrt{a_x^2 + a_y^2} = \sqrt{(-3.0\text{ m/s}^2)^2 + (4.0\text{ m/s}^2)^2} = \boxed{5.0\text{ m/s}^2}$

(b) $\theta = \tan^{-1}\dfrac{4.0}{-3.0} = \boxed{37°\text{ CCW from the }+y\text{-axis}}$

26. Strategy Determine the angle each vector makes with the positive *x*-axis.

Solution Find the components of each vector.

	Vector $\vec{A}$: $A_x = (7.0\text{ m})\cos 20.0° = \boxed{6.6\text{ m}}$ $A_y = (7.0\text{ m})\sin 20.0° = \boxed{2.4\text{ m}}$	Vector $\vec{B}$: $B_x = (7.0\text{ N})\cos(-20.0°) = \boxed{6.6\text{ N}}$ $B_y = (7.0\text{ N})\sin(-20.0°) = \boxed{-2.4\text{ N}}$
	Vector $\vec{C}$: $C_x = (7.0\text{ m})\cos 110.0° = \boxed{-2.4\text{ m}}$ $C_y = (7.0\text{ m})\sin 110.0° = \boxed{6.6\text{ m}}$	Vector $\vec{D}$: $D_x = (7.0\text{ N})\cos(-110.0°) = \boxed{-2.4\text{ N}}$ $D_y = (7.0\text{ N})\sin(-110.0°) = \boxed{-6.6\text{ N}}$

31.Strategy We are concerned with the interactions of pairs of objects that exert forces on each other. Analyze the given forces in light of Newton's first and third laws.

Solution Forces $\boxed{\text{(a) and (b) are third law pairs}}$. This is an interaction between two objects, the bike and the Earth. Each body exerts a gravitational force on the other body; and these forces are equal in magnitude and opposite in direction. Forces $\boxed{\text{(a) and (c) are equal and opposite due to the first law}}$. They act not on each other, but on the same body.

46. Strategy Gravitational field strength is given by $g = GM/R^2$, so let the new field strength be $g' = ng = GM/r^2$, where $n = 2/3$ for part (a) and $1/3$ for part (b).

Solution Determine r in terms of R.

$$\frac{g'}{g} = \frac{ng}{g} = n = \frac{\frac{GM}{r^2}}{\frac{GM}{R^2}} = \frac{R^2}{r^2}, \text{ so } r = \frac{R}{\sqrt{n}}.$$

Find an expression for the altitude, h.

$$h = r - R = \frac{R}{\sqrt{n}} - R = R\left(\frac{1}{\sqrt{n}} - 1\right)$$

(a) $h = (6.371\times10^3\text{ km})\left(\frac{1}{\sqrt{2/3}} - 1\right) = \boxed{1432\text{ km}}$

(b) $h = (6.371\times10^3\text{ km})\left(\frac{1}{\sqrt{1/3}} - 1\right) = \boxed{4664\text{ km}}$

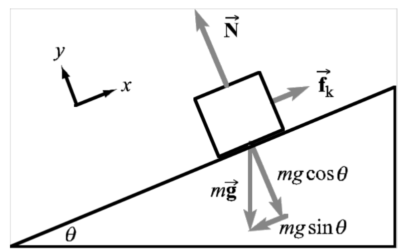
63. (a) Strategy **Draw a diagram and use Newton's laws of motion.**

Solution According to the first law, since the skier is moving with constant velocity, the net force on the skier is zero. Calculate the force of kinetic friction.

$\sum F_x = f_k - mg\sin\theta = 0$, so

$f_k = mg\sin\theta = (85\text{ kg})(9.80\text{ N/kg})\sin 11° = 160\text{ N}.$

The force of kinetic friction is $\boxed{\text{160 N up the slope}}$.



(b) Strategy **Use the diagram and results from part (a).**

Solution **Find the normal force.**

$\sum F_y = N - mg\cos\theta = 0$, so $N = mg\cos\theta$. **Since** $f_k = \mu_k N$,

$$\mu_k = \frac{f_k}{N} = \frac{mg\sin\theta}{mg\cos\theta} = \tan\theta = \tan 11° = \boxed{0.19}.$$

68. Strategy Use Newton's laws of motion. Let $+y$ be down and $+x$ to the right.

Solution Find the force $\vec{\mathbf{F}}$ applied to the front tooth.

$\sum F_x = T\sin\theta - T\sin\theta = 0$ and $\sum F_y = T\cos\theta + T\cos\theta - F = 0$. So, we have

$F = 2T\cos\theta = 2(1.2\text{ N})\cos 33° = 2.0\text{ N}$. By symmetry, the force is directed toward the back of the mouth, so

$\vec{\mathbf{F}} = \boxed{\text{2.0 N toward the back of the mouth}}$.