Ch5 Q3. Will the acceleration of a car be the same when a care travels around a sharp curve at a constant 60 km/h as when it travels around a gentle curve at the same speed? Explain.

The acceleration is v^2/r, so for a sharp curve, r is smaller, making the acceleration larger.

Ch5 Q6x. Sometimes it is said that water is removed from clothes in the spin dryer by centrifugal force throwing the water outward. Is this correct? Discuss.

The lack of normal force to keep the water from going in a circle over the holes is what let's them out.

Ch5. P9. What is the maximum speed a 1200-Kg car can roudn a turn of radius 90.0 m on a flat road if the coefficient of friction between the tires and the road is 0.65? Is this result independent of the mass of the car?

We have that the force moving the car in a circle is

$$ma = f.$$

In the case where f is a maximum, $f = \mu_s mg$, so

$$\begin{aligned} ma &= \mu_s mg \\ \Rightarrow a &= \mu_s g \\ &= v^2/r \\ \Rightarrow v &= \sqrt{\mu_s gr} \\ &= \sqrt{0.65\,(9.8)\,90} \\ &= 24\,\mathrm{m/s}. \end{aligned}$$

Ch5 P50x. Two satellites orbit the Earth at altitudes 7500 km and 15000km above the Earth's surface. Which satellite is faster, and by what factor?

For a circular orbit, we have that

$$\begin{aligned} Gmm_\oplus/r^2 &= mv^2/r \\ \Rightarrow Gm_\oplus/r &= v^2 \\ \Rightarrow v &= \sqrt{Gm_\oplus/r}. \end{aligned}$$

Thus, the closer satellite orbits quicker. Their ratio in speeds is

$$\begin{aligned} v_{7500}/v_{15000} &= \frac{\sqrt{Gm_\oplus/(7500+R_\oplus)}}{\sqrt{Gm_\oplus/(15000+R_\oplus)}} \\ &= \sqrt{\frac{15000+6371}{7500+6371}} \\ &= \sqrt{\frac{21371}{13871}} \\ &= \sqrt{\frac{21000}{13800}} \\ &\approx \sqrt{3/2} \\ &= 1.2. \end{aligned}$$

Ch6 Q3. Why is it tiring to push hard against a soid wall even though you are doing no work?

No work is done on the wall, but contraction of muscles requires expendicture of chemical energy.

Ch6 Q6. If the speed of a particle triples, by what factor does its kinetic energy increase?

The square of the speed so 9 times.

Ch6 P9x. A box of mass 4.0 Kg is accelerated from rest by a force across a floor at a rate of 2.0 m/s^2 for 7.0 s. Find the net work done on the box.

Work is force times distance, so we need a distance (the net force is simply 4.0 Kg $\times$ 2.0m/s^2=8.0 N). Given it started from rest, we have that

$$\begin{aligned}\Delta x &= \frac{1}{2}2.0\text{m/s}^2(7.0\text{s})^2 \\ &= 1.0 \cdot 49\,\text{m} \\ &= 49\,\text{m},\end{aligned}$$

so the net work is 49m$\times$8.0 N=390J.

Ch6 P21x. An 85 g arrow is fired from a bow whose string exerts an average force of 105 N on the arrow over a distance 75cm. What is the speed of the arrow as it leaves the bow?

We can do Newton's Laws, but energy is easier here. The work done on the bow is

$$\begin{aligned}W &= 105\text{N}\cdot.75\text{m} \\ &= 78.75\,\text{J}.\end{aligned}$$

This is converted into kinetic energy, the energy of motion. Thus,

$$\begin{aligned}W &= \text{KE} \\ &= \frac{1}{2}mv^2 \\ \Rightarrow v &= \sqrt{2W/m} \\ &= \sqrt{2 \times 78.75\text{kg}\cdot\text{m}^2/\text{s}^2/0.085\text{kg}} \\ &= 43\,\text{m/s}.\end{aligned}$$

Ch6 P26x. By how much does the gravitational potential energy of a 54-Kg pole vaulter change if her center of mass rises about 4.0 m during a jump?

We have that

$$\begin{aligned}\Delta U_g &= mg\Delta h \\ &= 54\text{Kg}(9.8\text{m/s}^2)(4.0\text{m/s}) \\ &= 2100\,\text{J}.\end{aligned}$$