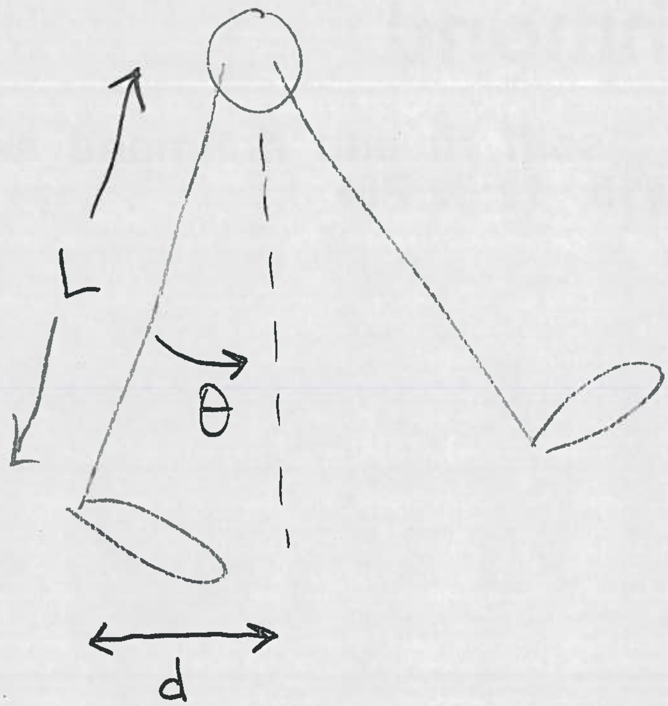

a) time to complete one complete pace is period of pendulum with length L.

$$\omega = \sqrt{\frac{g}{L}}$$

$$\rightarrow \underline{P} = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{L}{g}}$$

b) during this time, animal will move forward by

2d	during right foot in air
2d	during left foot in air
4d	total

but $d = L\sin\theta$, so forward $\underline{4L\sin\theta}$

c) Suppose $\theta = 10$ degrees. Let's compute speeds of various animals.

An adult human will travel during one full pace

$$\frac{\text{distance}}{\text{time}} = \frac{4 L \sin\theta}{2\pi \sqrt{\frac{L}{g}}}$$

So speed will be

$$v = \frac{2\sqrt{g}\sqrt{L}\sin\theta}{\pi}$$

$$= \frac{2\sqrt{9.8\,\frac{m}{s^2}}\sqrt{1\,m}\ \sin 10^\circ}{\pi}$$

$$= 0.35\ m/s$$

Check: adult humans walk at about 3 mph $\equiv$ 1.3 m/s, so this formula and method doesn't seem very accurate.

Perhaps $\theta > 10^\circ$?

d) child with $L = 0.5\,m \Rightarrow v = 0.25\ m/s \approx \frac{1}{2}$ mph

<u>slower</u> than adult.

This does go in the right direction.

e) Allosaurus w/ $L = 2m \Rightarrow v = 0.49\ m/s$

<u>faster</u> than adult human.

This goes in right direction.

f) In general,

$$v \propto \sqrt{L}$$

so longer legs implies faster motion.

g) human on moon. Here $L = 1\ m$, but $g \neq 9.8\ m/s^2$.

Instead, $g_{moon} \approx 1.62\ m/s^2$

$$\rightarrow v \approx \frac{2\sqrt{g_{moon}}\sqrt{L}\sin\theta}{\pi}$$

$$\approx 0.14\ m/s \quad \text{vs. } 0.35\ m/s \text{ on Earth}$$

So, walk <u>slower</u> on planets with lower surface gravity.