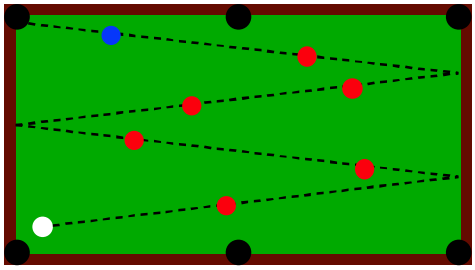
Newton's Snooker Challenge

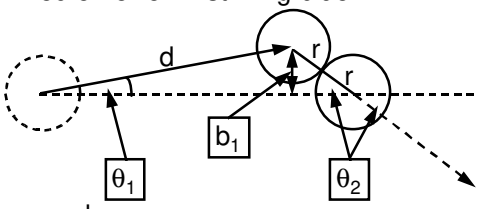
- The challenge is to pot the blue ball!



- Can ignore reflections at cushions, i.e. consider problem on big table.

Newton's Snooker Challenge cont.

- Look at effect of error (impact parameter b) made in striking first red on error in striking blue.



$$\sin\theta_1 = \frac{b_1}{d}$$

$$\sin\theta_2 = \frac{b_2}{d} = \frac{b_1}{2r} \Rightarrow b_2 = b_1\frac{d}{2r}$$

$$\sin\theta_3 = \frac{b_3}{d} = \frac{b_2}{2r} \Rightarrow b_3 = b_2\frac{d}{2r} = b_1\left(\frac{d}{2r}\right)^2$$

$$b_n = b_1\left(\frac{d}{2r}\right)^{n-1}$$

Newton's Snooker Challenge cont.

- What is effect of gravitational attraction of referee? (Assume mass of referee 100 kg, of ball 100g.)
- Force

$$F = \frac{GMm}{l^2}$$

$$\approx \frac{6 \cdot 67 \times 10^{-11} \times 100 \times 0.1}{1^2} \approx 10^{-9}\,\mathrm{N}$$

- Resulting first impact parameter if travel time of cue ball ~ 1 sec.

$$b_1 = \frac{1}{2}\frac{F}{m}t^2 \approx 10^{-8}\,\mathrm{m}$$

Newton's Snooker Challenge cont.

- Resulting seventh impact parameter, assuming d ~ 1 m, r ~ 1 cm:

$$b_7 = b_1\left(\frac{d}{2r}\right)^{n-1}$$

$$= 10^{-10} * \left(\frac{1}{0.02}\right)^6$$

$$\approx 10^{-8} \times 10^{10} = 100\,\mathrm{m}.$$

- That is, at some point (where?) in the chain, one of the balls misses its target completely.