**FrictionQs**

**12.** (*a*) Show that the minimum stopping distance for an automobile traveling at speed *v* is equal to *v*2/2*μ*S*g* where *μ*S is the coefficient of static friction between the tires and the road, and *g* is the acceleration of gravity.

(*b*) What is this distance for a 1200-kg car traveling 95 kmh if *μ*S = 0.65?

\*\*\*\*\* 95/3.6 = 26.4 m/s, *v*2/2*μ*S*g* = 54.7m (mass is irrelevant! Why?)

(*c*) What would it be if the car were on the Moon (the acceleration of gravity on the Moon is about *g*6) but all else stayed the same?

\*\*\*\*\* 6 times further.

**16.** A small box is held in place against a rough vertical wall by someone pushing on it with a force directed upward at 28° above the horizontal. The coefficients of static and kinetic friction between the box and wall are 0.40 and 0.30, respectively. The box slides down unless the applied force has magnitude 23 N. What is the mass of the box?

\*\*\*\*\* Normal force is 23cos28 = 20.3, static friction, upwards is 0.4 times this, 8.1. Upward component of push is 23sin28 – 10.8, add this to friction to get 18.9, this balances weight at point when sliding begins, so weight is 18.9/9.8 = 1.93kg.

**29.** (II) A child slides down a slide with a 34° incline, and at the bottom her speed is precisely half what it would have been if the slide had been frictionless. Calculate the coefficient of kinetic friction between the slide and the child.

**\*\*\*\*\*** using v2 = 2ax, acceleration is down by a factor of 4. Her acceleration was gsin34, the normal force was mgcos34, so friction contributes retarding force μmgcos34, this must be 0.75 of the gravitational force mgsin34 down the slope, so μ = 0.75tan34 = 0.51.

**8.** (II) A 0.140-kg baseball traveling 35.0 m/s strikes the catcher’s mitt, which, in bringing the ball to rest, recoils backward 11.0 cm. What was the average force applied by the ball on the glove?

\*\*\*\*\* v2 = 2ax question, and F = ma, so F = mv2/2x = 0.140x352/2x0.11 = 780N.

 **23.** (II) An exceptional standing jump would raise a person 0.80 m off the ground. To do this, what force must a 68-kg person exert against the ground? Assume the person crouches a distance of 0.20 m prior to jumping, and thus the upward force has this distance to act over before he leaves the ground.

\*\*\*\* \*\*\*\*\* another v2 = 2ax question, but now we don’t need to find v2! He reaches v as his feet leave the ground, having (we assume) accelerated uniformly over a distance of 0.20m—but then he loses this same v over a distance of 0.80m, accelerating downwards at g. Applying v2 = 2ax to both parts, he must have been accelerating upwards at 4g before leaving the ground. Since his weight was there all along, his push on the ground must have been 5 times his weight.