(c) Now work on the main question — which line should you join when you have 10 items in your cart? How much longer must the express line be to make the wait on the regular line less?

My first thought is that the single seconds in 59 and 101 are a distraction, and I will approximate them by 60 and 100 seconds. That means the wait behind 5 customers on the regular line is the same as the wait behind 3 customers on the express line — 300 seconds (5 minutes). To decide which line to join I would mentally count the customers in groups of 5 in the express line and groups of 3 in the regular line.

With arithmetic: if the number of customers on the express line is more than 5/3 = 1.7 times the number of customers on the regular line, it's better to wait on the regular line.

I can reach the same answer with algebra. Let R be the humber of customers on the regular line and E the number on the express line. Then I want the regular line when

$$61E > 101R$$

which is the same as

$$E > \frac{101R}{61} = \frac{101}{81}R \approx 1.7R.$$

Exercise 1.8.44. [U] LED lightbulb.

Figure 1.19 shows the specifications for an LED bulb that costs $11.00. It's meant to replace a 60 watt incandescent bulb that costs about a dollar.

(a) Check the claimed Estimated Yearly Energy Cost.

(b) Check that the Rated Life agrees with the claimed 22.8 year Life.

(c) How long will it take for the LED bulb to be cheaper overall than the incandescent bulb (counting both the initial cost and the cost of the electricity to run it) ?

(d) What does the acronym "LPW" stand for? Has it been computed correctly?

(e) What do the words "LED" and "incandescent" mean?

Exercise 1.8.45. [S] Kilowatt hours per day.

Professor Sir David Mackay's obituary in *The Telegraph* observed that

> [His] genius was to express all forms of power consumption and production in a single unit of measurement — kilowatt hours per day (kWh/d). A 40 watt lightbulb, kept switched on all the time, uses one kWh/d, while driving the average car 50km a day consumes 40 kWh/d. [R26]

(a) Confirm that keeping a 40 watt lightbulb left switched on all day would use 1 kilowatt hour of energy.

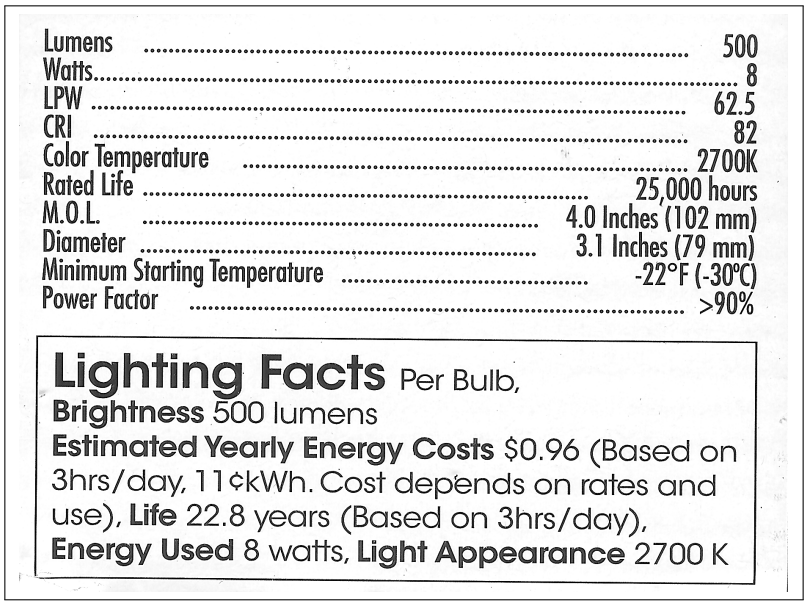

Figure 1.19: Light bulb specs

(b) According to MacKay, "The amount of energy saved by switching off the phone charger [for a day] is exactly the same as the energy used by driving an average car for one second." How many people would have to switch of their cell phone chargers in a day to save as much energy as driving a car 50 km?

(c) Mackay claims that switching your cell phone charger off for one year saves as much energy as is needed for one hot bath. How many kilowatt hours per day does it take to heat that bath water? water?

(d) What did MacKay mean when he stated that gestures like turning of your cell phone charger were akin to "bailing out the Titanic with a teaspoon"? Do you agree?

(a) Confirm that keeping a 40 watt lightbulb left switched on all day would use 1 kilowatt hour of energy.

$$40 \text{ watts} \times 24 \text{ hours} = 960 \text{ watt-hours} \approx 1 \text{ kilowatt-hour}.$$

(b) According to MacKay, "The amount of energy saved by switching off the phone charger [for a day] is exactly the same as the energy used by driving an average car for one second." How many people would have to switch of their cell phone chargers in a day to save as much energy as driving a car 50 km?

I know from the quote that it takes one kilowatt-hour to drive a car 50 km. To figure out how much energy it takes to drive it for one second I need to estimate the speed

of the car. To make the arithmetic easy I'll assume it's driving 50 km/hour (about 30 miles/hour). So the car needs 1 kilowatt-hour to drive for an hour.

MacKay says that each phone charger's energy savings could drive the car for a second, so it would take turning about 3,600 of them off for a day to save the energy to drive the car 50 km.

(c) MacKay claims that switching your cell phone charger off for one year saves as much energy as is needed for one hot bath. How many kilowatt-hours of energy does it take to heat that bath water?

Switching off the cell phone charger for a day saves 1/3,600 of a kilowatt-hour. Multiplying by (approximately) 360 days per year leads to a savings of 0.1 kilowatt-hours. So that's how much energy it takes to heat the bath water.

(d) What did MacKay mean when he stated that gestures like turning of your cell phone charger were akin to "bailing out the Titanic with a teaspoon"? Do you agree?

He means that the gesture is just a gesture, and won't make any difference when it comes to solving the real problem — saving the titanic or conserving energy. I agree with the conclusion. I do wonder if he thought about this quantitatively — how many people with teaspoons would it take to bail out the Titanic?