1) • Income, $m = 4000$.
• Price of electricity, $p_1 = 40$.
• Unit of electricity consumption, $x_1$ in megawatt hour.
• Price of other goods is normalized to $1$, $p_2 = 1$.
• Unit of other goods consumption, $x_2$, in dollars since the price is normalized to $1$.

The budget constraint:

\[ p_1 x_1 + p_2 x_2 \leq m \]
\[ 40x_1 + x_2 \leq 4000 \]

To calculate the slope of the budget constraint we rewrite the budget constraint in a way that $x_2$ is left alone on the left hand side. The coefficient of $x_1$ on the
right hand side gives us the slope:

\[ 40x_1 + x_2 \leq 4000 \]
\[ x_2 \leq 4000 - 40x_1 \]

So the slope is \(-40\). The general formula of the slope is \(\frac{m}{p_2}\).

The vertical intercept gives us the maximum amount of \(x_2\) that can be purchased, \(m = \frac{4000}{40} = 400\).

The horizontal intercept gives us the maximum amount of \(x_1\) that can be purchased, \(\frac{m}{p_1} = \frac{4000}{40} = 100\).

(b) \(p_1 = \$100\).

\[ 100x_1 + x_2 \leq 4000 \]

Figure 2: 1999 and 2000 Budget constraints

We have a new slope, \(\frac{-100}{1} = -100\), and a new horizontal intercept, \(\frac{4000}{100} = 40\).

(c) New option results in a decrease in the total disposable income, \(m = 4000 - 400 = 3600\), with the new \(p_1 = \$60\). The figure below depicts the budget line after the new offer along with 2000 budget line.
Figure 3: Budget constraints for 2000 and the new offer

To get the intersection point, we rewrite the budget constraints by leaving $x_2$ alone on the left hand side.

\[
100x_1 + x_2 = 4000 \text{ (for 2000)} \\
\Rightarrow x_2 = 4000 - 100x_1 \\
60x_1 + x_2 = 3600 \text{ (for the new offer)} \\
\Rightarrow x_2 = 3600 - 60x_1
\]

These two lines intersect at $x_1 = 10$.

\[
4000 - 100x_1 = 3600 - 60x_1 \\
\Rightarrow x_1 = 10
\]

2)

Look at the graph below.

a) Budget line A is the initial budget.

b) When Ralph receives $10 in cash, the budget line shifts out. No change in the slope, i.e., no change in relative prices. Note that the horizontal distance at the vertical intercept of the initial budget line gives the amount of tuna that can be purchased with $10.

c) When Ralph receives $10 worth of tuna, the budget line shifts out as in part b, but now the upper part of the budget line is missing.
3)
\[ m = \$1000, \ p_O = \$5, \ p_I = \$10. \] So the slope is \( \frac{-10}{5} = -2. \) The first good news lets her buy the first 100 orchids at a lower price, so in the new budget line we have a steeper slope, \( \frac{-10}{4} = -2.5 \) for the first 100 orchids. After the 100th orchid we have the previous price ratio for every additional orchid. The maximum amount of orchids that can be purchased:

First 100 are bought at \( p_O = 4 \)

\[
\frac{1000 - 100(4)}{5} = 120 \text{ are bought at } p_O = 5
\]

\[
\Rightarrow 120 + 100 = 220
\]

In the figure below, initial budget line is depicted by the black line, and the budget line after good news is depicted by the red lines.

4)

a) The budget equation for John is \( 20W + 80J + 50F = 400. \)

b) The consumption bundle \( (2,3,3) \) costs \( 40 + 240 + 150 = 430; \) therefore it is not affordable, and it is not on the budget line.

c) The consumption bundle \( (2,1,1) \) costs \( 40 + 80 + 50 = 170; \) therefore it is affordable, and it is not on the budget line.

5) Look at the graph below
Notice that the X-intercept is 90, because the first 10 units cost $20, leaving $80 to buy marigold seeds at $1 (80 units). Therefore, if \( Y = 0 \), this corresponds to \( 10 + 80 = 90 \) lbs. of marigold seeds.