Problem 1:
We know that the population of the world is roughly 7 billion, and that population has grown at a rate of roughly 1.5% in the modern era. Using the rule of 70, this means that the population doubles a bit less than every 50 years. This would mean doubling a bit more than twice. I think I was a bit high in my assumption of the growth rate, so assuming that population increased by a factor of four, leads to a prediction that population in 1900 was 1.75 billion

Problem 2:
There are 20 years during which women have a 30/
Mathematically:

\[
NRR = \beta \sum (\pi(i) \times F(i)) \tag{1}
\]

Where beta is 1/3, \( \pi(i) \) for all child bearing years is 0.5 and \( F(i) \) is 0.3 for years 20-39 and zero otherwise. Thus

\[
NRR = 1/3 \times 20 \times 0.5 \times 0.3 = 1 \tag{2}
\]

Now we know if the NRR=1 this is replacement so the population is in SS and the growth is 0.
Problem 3:
If the returns to schooling is 10 \%, then wages double for every $\frac{70}{11} = 7$ years of schooling. 14 years it will increase productivity by a factor of 4. So assuming the return to 0 years of education is w we get a total wage of $0.5 \times 2w + 0.5 \times 4w = 3w$ and a wage from HC of $0.5(2w-w)+0.5(4w-w)=2w$ for an answer of $2/3$.

Problem 4:
There are 2 important parts to this question. If h quadruples this will impact production today and impact production in the future. Let’s consider today first. We have:

$$y^{ss} = Ah^{0.5}k^{0.5}$$  \hspace{1cm} (3)

So if h increases by a factor of 4, y will instantaneously increase by a factor of 2 to 200. The increase in h and y today will increase capital accumulation in the long run and therefore the SS. Now solving out for the SS we get:

$$k^{ss} = \left(\frac{(Ah^{0.5} \gamma)}{\delta + n}\right)^2$$  \hspace{1cm} (4)

Substituting back in we get:

$$y^{ss} = Ah^{0.5}(Ah^{0.5} \gamma)/(\delta + n)$$ \hspace{1cm} (5)

or simplifying:

$$y^{ss} = A^2h(\gamma)/(\delta + n)$$  \hspace{1cm} (6)

So we can see if we increase h by a factor of 4 will increase the new SS level of output by a factor 4. To summarize we initially jump up to 200 and than asymptote to 400.
Problem 5:

So the graph has ln(k) on the horizontal and ln(y) on the vertical. Taking logs of the production function:

\[ \ln(y) = \ln(A) + \frac{1}{3} \times \ln(k) \] (7)

A) The slope of the line is clearly \( \frac{1}{3} \). Differences in investment rates will impact \( k_s \)s and determine where in the line a particular country falls.

B) \( A \) impacts \( y \) both directly and through \( k \). Recall the SS equation for \( k \) and \( y \).

\[ k^{ss} = \left( \frac{A \gamma}{(\delta + n)} \right)^{3/2} \] (8)

\[ y^{ss} = A^{3/2} \left( \frac{\gamma}{(\delta + n)} \right)^{1/2} \] (9)

Now putting this all in logs

\[ \ln(k^{ss}) = \frac{3}{2} [\ln(A) + \ln(\gamma) - \ln(\delta + n)] \] (10)

\[ \ln(y^{ss}) = \frac{3}{2} \times \ln(A) + \frac{1}{2} [\ln(\gamma) - \ln(\delta + n)] \] (11)

Now I can see if ln(A) were to change by 1 both ln(y) and ln(k) would change by 3/2. So holding all else equal we will get a slope of 1. (Again you could have done this using the slope equation)