Part I:

1) False: The original production function is $Y = \bar{A} K^{0.4} L^{0.6}$, so $y = \bar{A}\left(\frac{K}{L}\right)^{0.4} = \bar{A} k^{0.4}$ ✓

2) False: the preponderance of difference is due to differences in $\bar{A}$ ✓

3) False: TFP plays a larger difference in the production model due to its effects on ability to bring capital into production. ✓

4) True: $y = \bar{A}(1-\bar{\ell})(1+\bar{z}\bar{\ell}\bar{L})^t \rightarrow \Delta\bar{\ell}$ changes coefficient and growth rate ✓

5) False: nonrivalry of ideas explains long run growth ✓

Part II:

1) a) $NGDP_{2016} = 160$ ✓

$NGDP_{2017} = 183.7$ ✓

b) $RGDP_{2016,2016} = 160$ ✓

$RGDP_{2017,2016} = 171$ ✓

c) $RGDP_{2016/2017} : 172$ ✓

$RGDP_{2017,2017} = 183.7$ ✓

d) $\% \Delta NGDP = 14.8\%$ ✓

$\% \Delta RGDP_{2016} = 6.88\%$ ✓

$\% \Delta RGDP_{2017} = 6.80\%$ ✓

e) $\Delta \% RGDP = 6.84\%$ ✓

$RGDP_{2016, 2017 \text{ chained prices}} = 171.9$

2) a) + \$1M ✗ +2M (final sale)

b) + \$6000 ✓

c) ∅ ✓

d) ∅ ✓

e) + \$ 80M ✓

f) + \$ 8000 ✓

g) ∅ ✓

h) + \$ 100M ✓

i) ∅ ✗ \$ 5000 per student

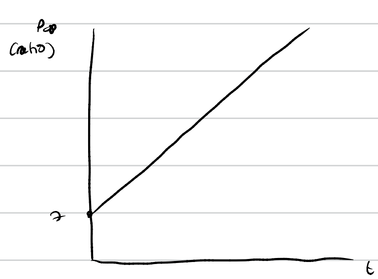
3) a)

time	pop (B)
0	7 ✓
1	7.21 ✓
2	7.43 ✓
10	9.41 ✓
25	14.66 ✓
50	30.68 ✓
100	134.53 ✓

b)

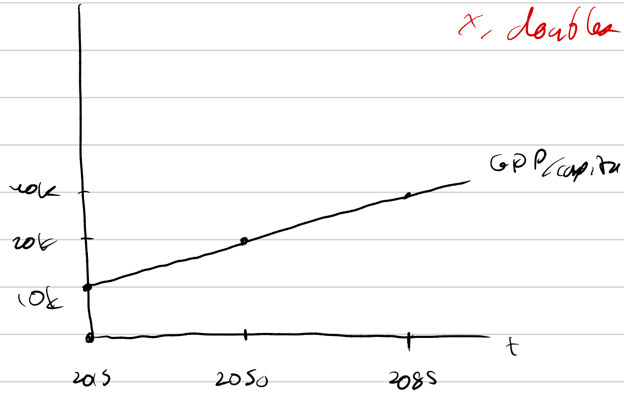
✓

c)

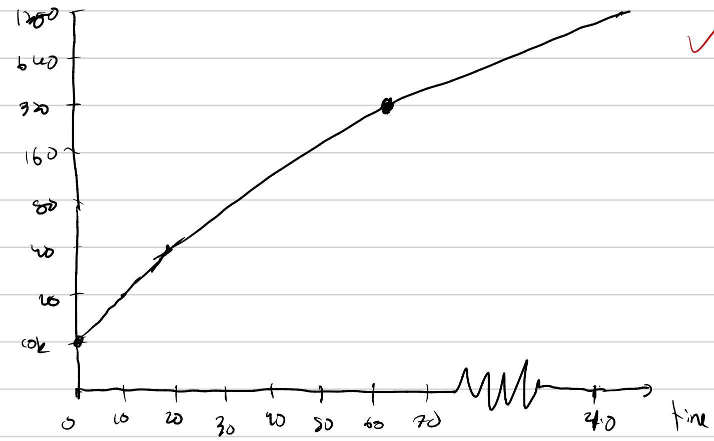


✓

4 a) x, doubles every 14 yrs



b)



5) $\Delta t_1 = \left(\frac{5020}{2840}\right)^{1/(59)} - 1 = 1.7\%$

$\Delta t_2 = \left(\frac{13225}{8020}\right)^{(1/21)} - 1 = 2.4\%$ ← 1929 to 1950 had highest AAGR

$\Delta t_3 = \left(\frac{43238}{13225}\right)^{(1/62)} - 1 = 1.9\%$

6) a) $\frac{1}{3} g_k$

b) $\frac{1}{3} g_k + \frac{2}{3} g_n$

c) $g_m + \frac{1}{3} g_k + \frac{2}{3} g_n$ x $g_m + \frac{1}{2} g_k + \frac{2}{3} g_n$

d) $g_m + \frac{1}{4} g_k + \frac{3}{4} g_n$

e) $g_m + \frac{3}{4} g_k + \frac{1}{4} g_n$

f) $\frac{1}{2}(g_k + g_n + g_m)$

g) $\frac{1}{4}(g_k + g_n) - \frac{3}{4} g_m$

7) a) $Y(2K,2L) = (2K)^{2/3}(2L)^{1/3}$ $2(K^{2/3})(L^{2/3}) < (2K)^{2/3}(2L)^{2/3}$

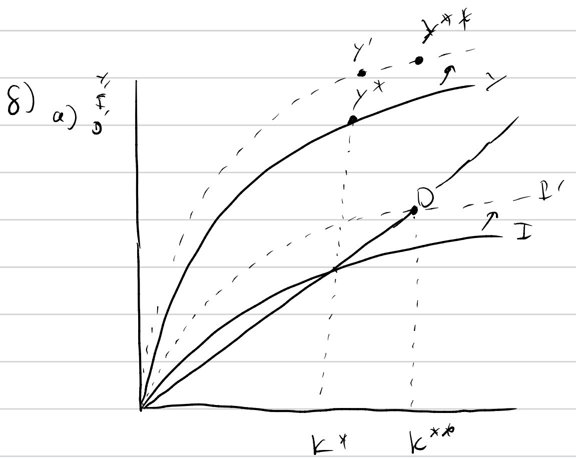
$= 2(K^{2/3}L^{1/3})$ IRS

$= 2Y(K,L)$ ∴ CRS ✗

b) $Y(2K,2L) = 2K+2L = 2(K+L) = 2Y$; CRS ✓

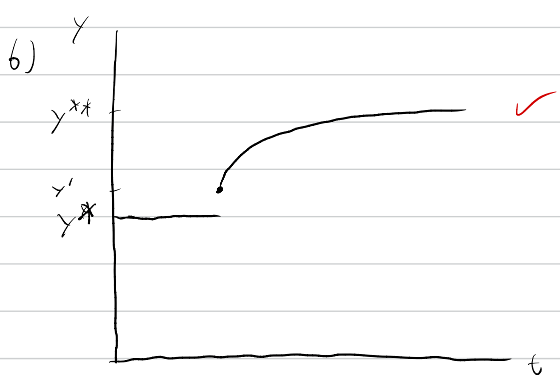
c) $Y(2K,2L) = (2K)^{1/3}(2L)^{2/3} + \bar{A} < 2(K^{1/3}L^{2/3} + \bar{A})$; DRS ✓

8) a)



The economy grows to a new steady state at higher K and Y than previously ✓

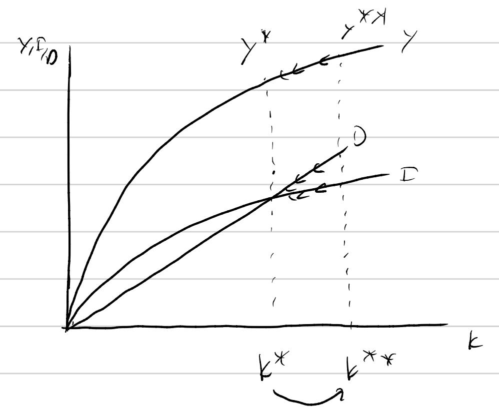
b)



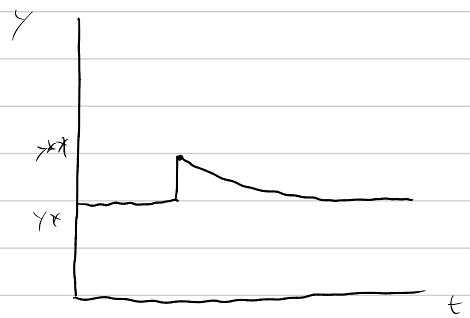
✓

c) The increase in technology allows for higher levels of capital per person and increases output towards a new, higher steady state.

9) a)



Output goes up then returns back to steady state as depreciation removes excess capital



b) Foreign aid has no long term effect because it does not change all lying conditions of $\bar{A}$ or $\bar{s}$.

c) Our findings indicate that aid can have an effect on $\bar{A}$, because overall effects were somewhat lasting.

10) a) $Y_t = \bar{A} K_t^{1/3} L_t^{2/3}$

$\Delta K_t = I - \bar{d} K_t$

$I_t = \bar{s} Y_t$

$L_t = \bar{L}$

$C_t + I_t = Y_t$

b) $y_t = \bar{A} k_t^{1/3}$

$\Delta k_t = i_t - \bar{d} k_t$

$c_t + i_t = y_t$

c) $\bar{s} y_t = \bar{d} k_t$

$\bar{s} \bar{A} k_t^{1/3} = \bar{d} k_t$

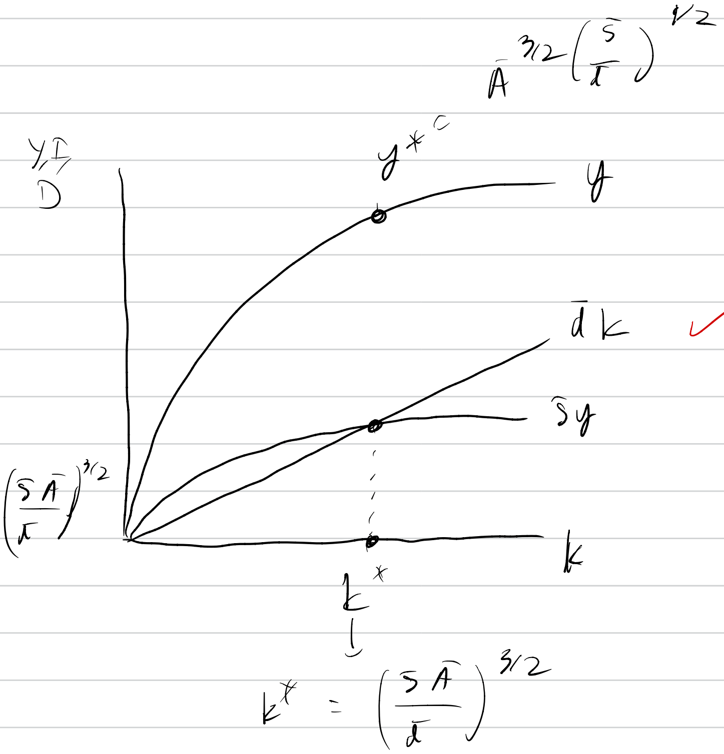
$\frac{\bar{s} \bar{A} k_t^{1/3}}{\bar{d} k_t^{1/3}} = \frac{\bar{d} k_t}{\bar{d} k_t^{1/3}}$

$\frac{\bar{s} \bar{A}}{\bar{d}} = k_t^{2/3} \rightarrow k_t^* = \left(\frac{\bar{s} \bar{A}}{\bar{d}}\right)^{3/2}$

$\left(\frac{\bar{s} \bar{A}}{\bar{d}}\right)^{1/2} = k_t^{1/3}$

$\bar{A} k_t^{1/3} = \bar{A}^{3/2} \left(\frac{\bar{s}}{\bar{d}}\right)^{1/2}$

$Y_t = \bar{A}^{3/2} \left(\frac{\bar{s}}{\bar{d}}\right)^{1/2}$



(1)

Country:	GDP, PC	$\bar{s}$	$\bar{A}$	(a) Predicted PC GDP	(b) % gap	
US	1.000	0.235	1.000	1	∅	
SK	0.666	0.369	0.713	0.754 ✓	13.2% ✓	
MX	0.311	0.196	0.502	0.325 ✓	4.50% ✓	
AR	0.300	0.159	0.532	0.319 ✓	6.3% ✓	
IN	0.117	0.247	0.270	0.144 ✓	23.1% ✗	22.9%
ET	0.029	0.157	0.114	0.031 ✓	6.9% ✗	8.5%

a) we will use the ratio as follows:

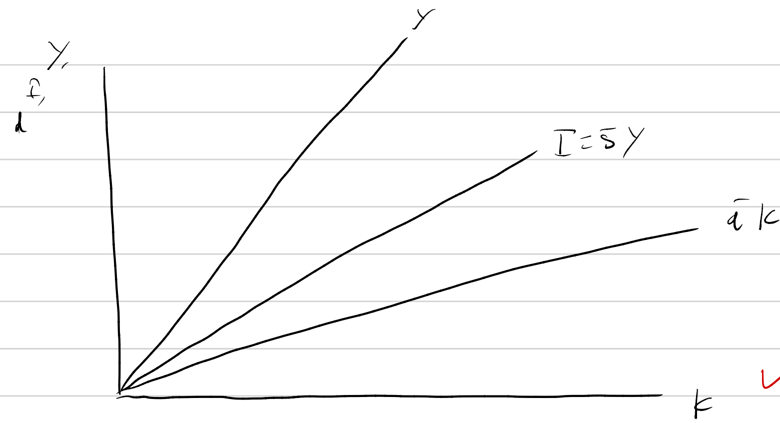
$$\text{Predicted } y^* = \left(\frac{\bar{A}_c}{\bar{A}_{us}}\right)^{3/2} \left(\frac{\bar{s}_c}{\bar{s}_{us}}\right)^{1/2}$$

b) we calculate the % gap

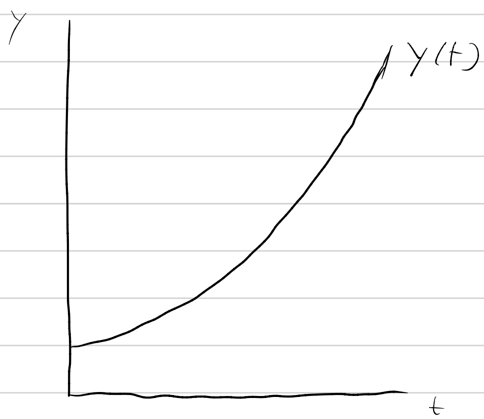
c) fastest growth: India

slowest growth: Mexico

12) a)



b) The economy continues accumulating capital and growing as a result of investment always being higher than depreciation



c) $K_{t+1} = K_t + \bar{s}\bar{A}K_t - \bar{d}K_t$

$\Delta K_t = \bar{s}\bar{A}K_t - \bar{d}K_t$

$\frac{\Delta K_t}{K_t} = \bar{s}\bar{A} - \bar{d}$

$g_K = \bar{s}\bar{A} - \bar{d}$

d) $g_Y = g(\bar{A}K_t)$

$= g(\bar{A}) + g(K_t)$

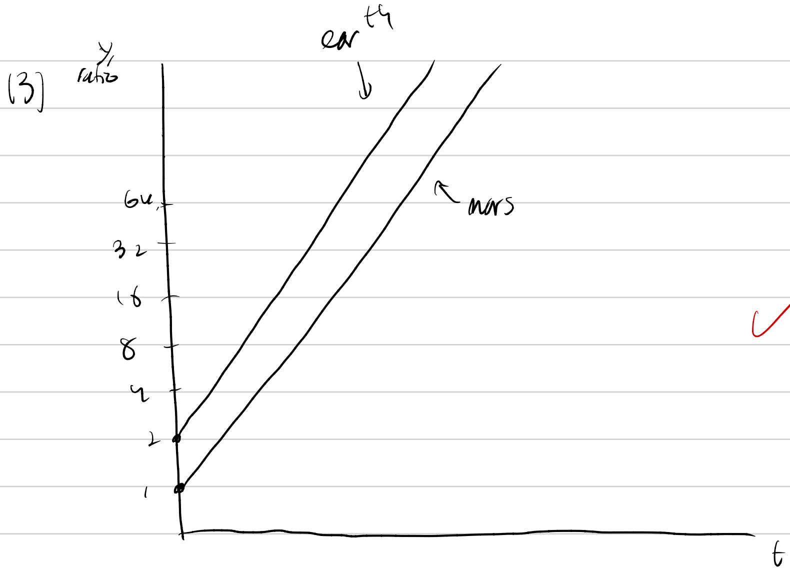
$= \bar{s}\bar{A} - \bar{d}$

e) $g_y = g\left(\frac{Y}{L}\right)$

$= g(Y) - g(L)$

$= \bar{s}\bar{A} - \bar{d}$

13)



- The level of output is higher while the growth rates are similar ✓

14) a) $g = \bar{z}\bar{\ell}\bar{L} = 0.02$ ✓

b) $y_0 = (100)(0.94)(1) = 94$ ✓ ; $y_{100} = (100)(0.94)(1.02)^{100} = 681$ ✓

c) $g = 0.16$ ✗ double each at a separate instance

$y_0 = (200)(0.88) = 176$

$y_{100} = (200)(0.88)(1.16)^{100} = 491{,}260{,}212$

d) either double $\bar{z}$ or double $\bar{L}$; both of these have a positive growth effect without reducing levels. ✓

15) a) - eqn 1: production is a function of workers and ideas, which have diminishing marginal returns ✓

- eqn 2: change in ideas is a function of research productivity, current stock of ideas, and researchers ✓

- eqn 3: resource constraint, people either create output or ideas. ✓

- eqn 4: researchers are a fraction $\bar{\ell}$ of total workers ✓

b) $g_A = \bar{z}\bar{\ell}\bar{L}$, as with the original Romer model

c) $y = \left(A_0(1+\bar{z}\bar{\ell}\bar{L})^t\right)^{1/3}(1-\bar{\ell})$

$= A_0^{1/3}(1+\bar{z}\bar{\ell}\bar{L})^{t/3}(1-\bar{\ell})$

$g_y = \frac{\bar{z}\bar{\ell}\bar{L}}{3}$

d) $y_t = A_0^{1/3}(1-\bar{\ell})(1+\bar{z}\bar{\ell}\bar{L})^{t/3}$

16) - Fact 1: differences in savings rates and $\bar{A}$ determine eventual income levels

- Fact 2: differences in human capital and institutions, $\bar{A}$, explain growth differences X: higher research productivity, share researching, and population

- Fact 3: After around 1800, we found some major ideas and institutional changes that started the growth of A

- Fact 4: Countries vary in institutions, which helps explain differences in $\bar{A}$ and thus allows some countries to be rich and others lose out