I: (50 percent)

Do you agree with the following statements? Explain why or why not.

a:

'Ideas are public goods'.

b:

'In the absence of technological progress, there cannot be long run growth in output per capita unless there are increasing returns to scale'.

c:

'Growth is higher when consumers are more patient'.

II: (50 percent)

Consider an economy with the aggregate production function

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} [A(t)L(t)]^{1-\alpha-\beta} \tag{1}$$

where Y is production, K is the stock of physical capital, and H is the stock of human capital. L is the size of the population which grows at an exogenous rate n, and A is a technology parameter which grows at an exogenous rate g. The parameters satisfy $\alpha, \beta > 0$ and $\alpha + \beta < 1$.

One unit of the good Y can give either one unit of consumption, one unit of physical capital or one unit of human capital. Both K and H depreciates at a fixed rate δ. A fixed fraction s_k of income is invested in physical capital and a fixed fraction s_h of income is invested in human capital.

a) Derive the steady state levels of $k = K/AL$ and $h = H/AL$. (You do not have to show why the economy reaches the steady state.)

b) Show that on the balanced growth path, income per capita can be expressed as

$$\begin{aligned} \ln(Y(t)/L(t)) = \ln(A(0)) + gt + \frac{\alpha}{1-\alpha-\beta}\ln(s_k) \\ + \frac{\beta}{1-\alpha-\beta}\ln(s_h) - \frac{\alpha+\beta}{1-\alpha-\beta}\ln(n+g+\delta) \end{aligned} \tag{2}$$

c) How can the regression equation

$$\ln(Y(t)/L(t)) = \gamma_0 + \gamma_1 \ln(s_k) + \gamma_2 \ln(s_h) - \gamma_3 \ln(n + g + \delta) + \epsilon \qquad (3)$$

(where ϵ is a disturbance term) be used to assess the validity of the theoretical model presented above (i.e. to 'test' the model)?

d) Mankiw, Romer and Weil (1995) use the fraction of the population aged 12 to 17 enrolled in secondary school to represent the term s_h in (2). Discuss this choice.

e) Show that (1) implies that

$$\widehat{Y/L} = (1 - \alpha - \beta)g + \alpha\widehat{K/L} + \beta\widehat{H/L} \qquad (4)$$

(the $\widehat{\ }$ operator represents growth rates, i.e. $\widehat{X} = \frac{dX}{dt}\frac{1}{X}$ for any measure X evolving over time).

f) What kind of data can be used to empirically represent the term $\widehat{H/L}$ above?

g) The table below reproduces a regression result reported by Pritchett (2001). Discuss these results.

	Dependent variable: per annum growth of GDP per worker
Growth of education per worker	-0.049 (-1.07)
Growth of physical capital stock index per worker	0.524 (12.8)
Number of countries	91
R^2	0.653

OLS-estimation. t-statistics in parentheses.