SL key equilibrium

1) CO (g) + 2 H2 (g) CH3OH (g) + ENERGY

a)

* increase the partial pressure of carbon monoxide
* increase the partial pressure of hydrogen
* increase the partial pressure of hydrogen and carbon monoxide
* decrease the partial pressure of methanol * decrease the energy content of the system
* increase the total pressure of the system

b)

$[CO]_i = 2.00 mol/2.50 L = 0.80 M$
$[H_2]_i = 2.00 mol/2.50 L = 0.80 M$
$[CH_3OH]_i = 2.00 mol/2.50 L = 0.80 M$

$$\text{Trial Keq} = \frac{[CH_3OH]}{[CO][H_2]^2} = \frac{(0.80)}{(0.80)(0.80)^2} = 1.25 << 25.0$$

Since Trial Keq << Keq then the reaction must proceed towards products to satisfy the numerical requirement of Keq.

c) For a system already at equilibrium, the addition of a catalyst will increase both the forward and reverse rates, but will do so equally. Consequently there will be NO shift whatsoever, the concentrations (or pressures) of the reactants and products remain unchanged.

1) A. K<1 therefore reactants

B. shift to left, Since this system is exothermic in the forward direction, hence endothermic in the reverse direction, an increase in temperature will cause a shift to the left. This will increase the concentrations of the reactants and decrease the [NO2].

C. Based on 2 b), the [products] increased and the [reactants] decreased, therefore the numerical ratio that is Keq (products over reactants) increases.

2) A. shift right

B. No shift

C. The H+ from the nitric acid will complex with the SCN1- forming the weak acid HSCN. This effectively removes some of the SCN1- from the system causing a shift to the left

D. Increases the [SCN1-] causing a shift to the right

3) A. right

B. right

C. right

D. left

E. left

4) A. K > 1 products

B. K > Q shift to products

C.

	$PCl_{5(g)}$	⟷	$PCl_{3(g)}$	+	$Cl_{2(g)}$
I	10.0		10.0		10.0
C	-x		+x		+x
E	10.0 - x		10.0 + x		10.0 + x

$$Kp = \frac{(PCl_3)(Cl_2)}{(PCl_5)} = \frac{(10.0+x)(10.0+x)}{(10.0-x)} = 30.0$$

$$100 + 20x + x^2 = 300 - 30x$$

$$x^2 + 50x - 200 = 0$$

$$x = \frac{-50 +/- \sqrt{50^2 - (4)(1)(-200)}}{2} = \frac{-50 +/- \sqrt{3300}}{2} = \frac{-50 +/- 57.45}{2}$$

$x_1 = -53.7$ kPa $\quad x_2 = +3.72$ kPa

Eliminate x_1 because it gives a negative pressure for PCl_5

$(PCl_5) = 6.28$ kPa

$(PCl_3) = 13.7$ kPa

$(Cl_2) = 13.7$ kPa