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Name:

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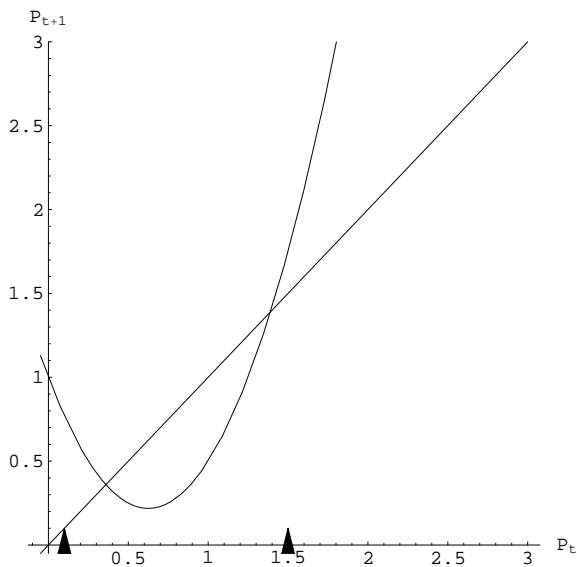
- This quiz forms part of our assessment of your personal learning in this program. Your work must be done independently of others.
  - Attempt all questions on this test. Do not leave answers blank. Marks will be given for partial answers, so show all your working.
  - This is an open book test. You may consult your textbooks, notes, homework and workshop solutions.
  - Your completed test is due at 1:00 pm on Thursday Jan 24th.
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1. Given the following difference equation

$$P_{t+1} = 0.5P_t + 3$$

with  $P_0 = 30$ , find  $P_1$ ,  $P_2$  and  $P_3$ .

2. The following graph gives  $P_{t+1}$  vs  $P_t$  for a particular difference equation. Two possible initial values for  $P_0$  are shown. Draw a cobweb plot for each of these values. Indicate on the graph the location of any fixed points, marking stable fixed points with a solid dot and unstable fixed points with an open dot.



3. A species of butterfly lay eggs in the early fall and then die. In spring the eggs hatch into caterpillars. After a few months of gorging they spin a cocoon, from which a butterfly emerges by mid summer, and then the cycle continues. Suppose 10 of these butterflies are introduced to a butterfly house one summer, and by the end of the next summer there are 35 butterflies. What is the per capita growth rate? Would you expect the per capita growth rate to be approximately the same the following year or would you expect it to decrease or increase? Explain your reasoning.

4. Given the difference equation

$$P_{t+1} = P_t^2 - 3P_t + 3$$

- (a) find an expression for  $\Delta P$ .

- (b) find any equilibrium solutions, and determine their stability by plotting a suitable graph.

- (c) Predict what will happen in the long term if the population starts out with  $P_0 = 2$ . Explain your prediction.

