1. Increasing the number of calcium channels at axon terminals would likely lead to more facilitating synapses. Calcium ions trigger the release of neurotransmitters at synapses. When an action potential reaches the axon terminal, it activates voltage-gated calcium channels, allowing Calcium ions to flow into the terminal. Higher levels of Calcium ions influx due to more channels would lead to a greater number of neurotransmitter vesicles fusing with the presynaptic membrane and releasing their contents into the synaptic cleft. This increased release of neurotransmitters strengthens the signal between neurons, a characteristic of facilitation.
2. a. When a neuron receives a lot of excitatory synaptic input, the total conductance of its membrane increases. Excitatory synaptic input typically involves the opening of ion channels that allow positive ions (such as sodium and potassium) to flow into the neuron, depolarizing its membrane potential. This influx of positive ions increases the conductance of the neuron's membrane, making it more permeable to ions and thus more conductive. In terms of the effective time constant for changes in membrane potential, it decreases. The time constant is a measure of how quickly the membrane potential changes in response to applied currents. When excitatory synaptic input increases, the membrane potential is driven closer to the threshold for firing an action potential more rapidly due to the increased conductance. Therefore, the effective time constant decreases, indicating that the membrane potential changes more quickly in response to synaptic inputs.

   b. Conversely, when a neuron receives a lot of inhibitory synaptic input, the total conductance of its membrane decreases. Inhibitory synaptic input typically involves the opening of ion channels that allow negative ions (such as chloride) to flow into the neuron or positive ions (such as potassium) to flow out, hyperpolarizing its membrane potential. This influx of negative ions or efflux of positive ions decreases the conductance of the neuron's membrane, making it less permeable to ions and thus less conductive. Regarding the effective time constant for changes in membrane potential, it increases. With increased inhibitory synaptic input, the membrane potential is driven further away from the threshold for firing an action potential. Therefore, the membrane potential changes more slowly in response to synaptic inputs, leading to an increase in the effective time constant.
3. The paired-pulse ratio (PPR) can be calculated using the formula:

   $$PPR = Response2/Response1$$

   Where:
   Response 2 is the response (neurotransmitter release) produced by the second action potential.
   Response 1 is the response produced by the first action potential.
   The expected number of vesicles releasing neurotransmitter following an
   action potential is the number of docked, release-ready vesicles multiplied
   by their individual probability of release.
   For the first action potential, the number of vesicles released can be calculated using the baseline release probability:
   $12x1/3=4$
   Synaptic facilitation increases synaptic efficacy immediately after a presynaptic spike. Synaptic facilitation corresponds to a temporary increase in the release probability of those vesicles that remain docked in the membrane of the axon terminal
   following a spike.

8x(1/3x1/3)=8/9
PPR=(8/9)/4=2/9
A paired-pulse ratio less than 1 indicates Deppression, meaning the second action potential triggered a smaller neurotransmitter release compared to the first.