AP Calculus
Real World Wednesday #1

Name: ______________________________
Date: ______________________ Per: ____

Directions: Read the article associated with the FRQ problem, then on a separate sheet of paper (folded in half: a,b on front; c, d on back similar to the AP test) complete the FRQ. * indicated calculator active.

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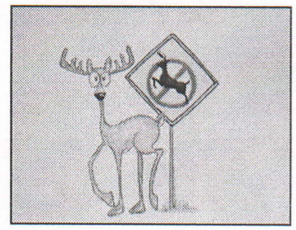
**Volume 1-28**: From The Ottawa Citizen: 3/29/13

## 'Don't Kill Bambi' Former Mayor Urges as Deer Cull Escalates in D.C.

The U.S. capital is well-known for being over-run with politicians, lobbyists and diplomats. But there's another group that's in over-abundance in D.C. and its swaths of leafy parkland — the white-tailed deer, a familiar sight to almost everyone living in the area. Following years of study and ongoing uproar, the National Park Service is in the midst of a three-day hunt aimed at dramatically culling deer in the city's Rock Creek Park, a 20-kilometre stretch of dense forest, rocky ravines and winding trails that run alongside a burbling offshoot of the Potomac River. Like many similar parks in D.C. and its surrounding suburbs, Rock Creek is a veritable deer paradise. The Park Service estimates there about 50 deer per square kilometer in the park, and is hoping sharpshooters can reduce the herd to 15 to 20 per square mile. The deer have had an unlikely ally in Marion Barry, the notorious former D.C. mayor who now sits on city council. "The NPS will be sharp shooting deer in Rock Creek Park. So wrong," Barry wrote in a tweet earlier this week. "Can they be relocated? I mean the NPS. The deer can stay." Advocates of the deer cull have long argued it's necessary to control tick outbreaks and protect vegetation — the deer feast on tree seedlings, not to mention the flower and vegetable gardens of vexed home-owners. They also insist that thinning the herd is humane, given deer are forced into more dangerous, urbanized areas if over-crowded.



The problem below revolves around a culling a population of deer.

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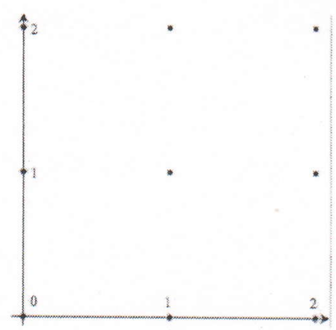
A population of 600 deer lives in a park. The forest service wishes to cull the herd. The population will follow the differential equation $\frac{dP}{dt} = -t(P-1)$ where $t$ is measured in years and $P$ is measured in hundreds of deer.




a) On the axes provided, sketch a slope field for the given differential equation at the nine points indicated.

b) While the slope field in part a) is drawn at only 9 points, it is defined at every point in the plane. On the given graph, shade the region where the deer population is increasing, assuming that $t > 0$.

c) Solve the differential equation for an initial population of 600 deer.

*d) Use the results of part c) to determine the number of years to cull the population in half. How fast is the deer population changing at that time (nearest deer)?

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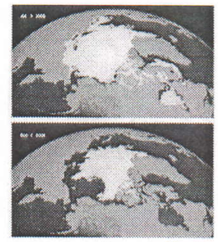
**Volume 1-24**: From Reuters: 3/13/2013

## Warmer climate to open new Arctic shipping routes by 2050.



The quickest way to get goods from Asia to the U.S. East Coast in 2050 might well be straight across the Arctic where a warming climate is expected to open new sea routes through what is now impenetrable ice. Most shipping traffic between these two centers currently goes through the Suez or Panama canals, and that is likely to continue even as melting Arctic sea ice makes the far north more accessible. But increasingly warm temperatures also could make the Northwest Passage north of Canada an economically viable shipping route. Now, it is passable only at the end of most summers. It could also open up a route directly over the North Pole by mid-century. Right now it makes no sense for any ship traveling between eastern North America and Asia to go via the Northwest Passage. The islands in the Canadian archipelago slow navigation, and the ice lingers there in a way that it doesn't along the Northern Sea Route. Even though the Northern Sea Route is a greater distance, it takes less time. However, by 2050, using projections of global warming and Arctic ice loss, the Northwest Passage will be sufficiently navigable to make the trip from the North American east coast to the Bering Strait in 15 days, compared to 23 days for the Northern Sea Route, about a 30 percent time savings.

The problem below revolves around the time for the Arctic route to be available to ships.

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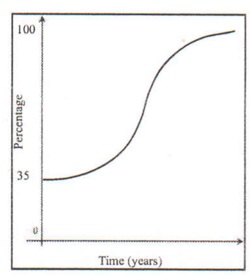
Starting in the year 2014 ($t = 0$), the rate at which the Arctic route is predicted to be cleared of ice is proportional to the difference between the percentage of the route free of ice in a given year and the predicted 100% in the year 2050. If $P(t)$ is the percentage of the route that is ice-free after the year 2014, then $\frac{dP}{dt} = \frac{1}{6}(100 - P)$. Let $y = P(t)$ be the solution to the differential equation above with the initial condition $P(0) = 35$.

a) Is the route being cleared of ice faster when it is 50% clear or 60% clear of ice? Explain your reasoning.

b) Find $\frac{d^2P}{dt^2}$ in terms of $P$. Use $\frac{d^2P}{dt^2}$ to explain why the graph of $P$ cannot resemble the graph to the right.




c) Use separation of variables to find $Y = P(t)$, the particular solution to the differential equation with initial condition $P(0) = 35$.

*d) Certain ice cutter ships will be able to travel the route when it is 90% clear of ice. Use answer c) to determine the year that these ships can travel the Arctic route.

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