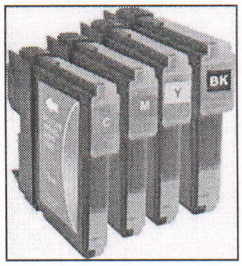
AP Calculus
Real World Wednesday #2

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.

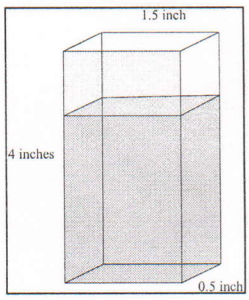
Volume 1-26: From Independent Online: 3/5/13

Why Your Ink Cartridge Costs so Much



The people who make printer cartridges must see us coming and laugh all the way to the bank. As many have discovered to their horror, refills are so exorbitantly expensive that printer ink costs far more drop for drop than fine champagne, vintage port or Chanel No 5 - a typical family running a busy printer can easily spend $400 a year on ink alone. If you think that you are getting through ink cartridges more quickly than ever, you are probably right. Over the past decade manufacturers have actually reduced the amount of ink inside them. At the same time they are making it as hard as possible for shoppers to buy cheaper second hand, recycled and refilled cartridges. An HP all-in-one inkjet printer, copier and scanner can be bought for less than $60. It's a fantastic bargain. But what the purchaser may not appreciate is that the two ink cartridges that work with the printer cost at least $40. Within a few months the owner will have spent twice the cost of the printer on ink. The cost of ink is truly astronomical. A typical HP cartridge costing $25 contains a measly 4ml of ink — the equivalent of more than $6,000 a liter. In contrast, you can buy a bottle of very decent 1995 Dom Perignon champagne for $300. Some brands of printers use up far more ink than others because they keep on running pointless "cleaning cycles". When some printers are turned on, they clean the cartridge's nozzles by running ink through them and splattering it on to an absorbent pad within the printer. The cycle is supposed to keep the tiny nozzles free of dirt. But it means that people who leave their printer on, or who print masses of documents in one go, use less ink than people who turn their printer off and on and who print the same number of documents over several weeks. Some printers use four times as much ink when they are turned off between jobs.

The problem below revolves around the amount of ink an ink cartridge uses.



An ink cartridge has the shape of a rectangular prism with dimensions 4 inches by 1.5 inches by 0.5 inches as shown in the figure to the right. Let h be the height of the ink in the cartridge, measured in inches as the cartridge is being used continuously. h is a function of time, measured in minutes. The volume of ink is changing at the rate of $\frac{-1}{4\sqrt{h}}$ cubic inches per minute.

a) Show that $\frac{dh}{dt} = -\frac{1}{3\sqrt{h}}$

b) How fast is the height changing when the cartridge is half-full? Specify units.

c) Given the cartridge is full at time $t = 0$, solve the differential equation $\frac{dh}{dt} = -\frac{1}{3\sqrt{h}}$ for h as a function of t.

d) At what time t is the cartridge empty?

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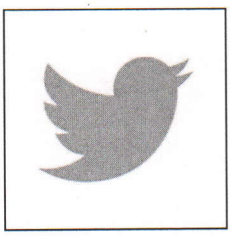
Volume 1-21: Forbes Magazine: 3/26/2013

*calculator allowed

Paying for Twitter Followers May Cost You a Job



This morning, my husband and I were discussing a potential job that requires him to have a high number of Twitter followers. It's not surprising. Many social media jobs are emphasizing the importance of a digital following as a requirement for the job. *How many Twitter followers do you have? How many likes do you average per week? Have you made Instagram's popular page?* Consider it a new-age online popularity contest. As I took our issue to Google naturally, I discovered that for the price of my iced chai latte, I could unethically buy up to 1,000 new followers. And that was the minimum package, another $20 could buy me triple the amount, and so forth. Essentially, you can become a social media superstar overnight. With the pressure to impress employers, job seekers are turning to this social media black market to increase their digital worth. It's not just job seekers that are buying. Celebrities, politicians, start ups, and bloggers are rumored to be doing the same. But here's the catch – you can get caught. On Twitter.com there is the option to enter the name and receive a three-month view of the follower count. If there are irregular significant jumps, then all signs point to fake. So think twice before cashing in for a few extra (thousand) followers. If caught, it could actually cost you the job. It's just not worth it.

The problem below revolves around a person who suspiciously gathers social media followers on the new app, Titter.

Let f be a differentiable function of time that represents the number of Titter, a new social media app, followers that Aunt Widiot gathered over a week where t is measured in days. Data for $f'(t)$ and $f''(t)$ are given in the table below. At the start of the week, she had 100 Titter followers.

t	0	1	2	3	4	5	6
$f'(t)$	4	41	109	177	221	217	141
$f''(t)$	24	60	72	60	24	−36	−120

a) Use a midpoint Riemann sum with 3 intervals to approximate the number of followers she has at the end of the week.

b) Use a trapezoidal approximation with 6 intervals to approximate the average rate of change of her Titter growth rate for the week. Specify units.

*c) A Titter employee finds that her f'' data can be approximated by $-12t^2+48t+24$ for $0 \le t \le 6$. Use that information along with data at $t=0$ to approximate $f(t)$ and then approximate the number of followers she will have on day 6.

d) Titter will flag a person possibly purchasing followers if their average growth rate is more than 125 followers a day. Estimate the average growth rate over 6 days using the formulas from part c) and determine if Titter will flag Aunt Twidiot as possibly purchasing followers.

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