Conceptual Task: Saving for a Boat

Exploration Questions Sample Responses

a. What is APR?

APR, or "annual percentage rate," is the percentage amount by which the account balance will grow in a year. Students should recall that the APR in Option 2 can be applied directly to the balance, whereas the APR in Option 3 must first be converted to a monthly amount.

b. How is each option different? Predict which one you think will be worth the most after 30 years. Justify your answer.

Students may point out that each option has a different starting amount. Also, only two options earn a percent interest rate; one compounds yearly and the other compounds monthly. Students should recognize that the balances in Option 1 and Option 3 increase monthly, whereas Option 2 increases yearly. How many times the balance is compounded will affect the total amount in the account. Some students may be able to identify that the first option is linear while the second and third options are exponential functions. Some students may predict Option 1 ends up with the most, because it starts with the biggest deposit. Some students may choose Option 2 because it has the biggest interest rate.

c. Below are the tables for each option. How do they relate to the verbal description? How are the tables the same? How are they different? Which option do you think might be worth the most after 30 years? Is your choice the same as before? Why or why not?

Option 1

Number of years (x)	Account balance (y)
0	$2,000
4	$2,480
8	$2,960
12	$3,440
16	$3,920
20	$4,400

Option 2

Number of years (x)	Account balance (y)
0	$1,000.00
4	$1,360.49
8	$1,1850.93
12	$2,518.17
16	$3,425.94
20	$4,660.96

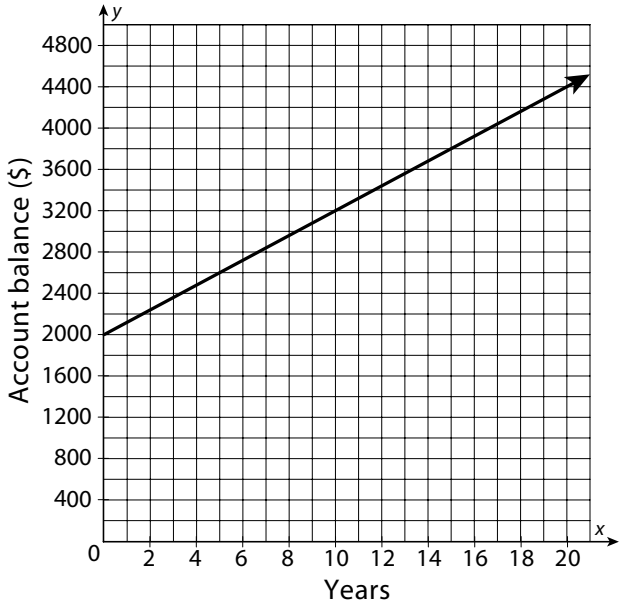
Option 3

Number of years (x)	Account balance (y)
0	$1,500.00
4	$1,886.86
8	$2,373.50
12	$2,985.65
16	$3,755.67
20	$4,724.30

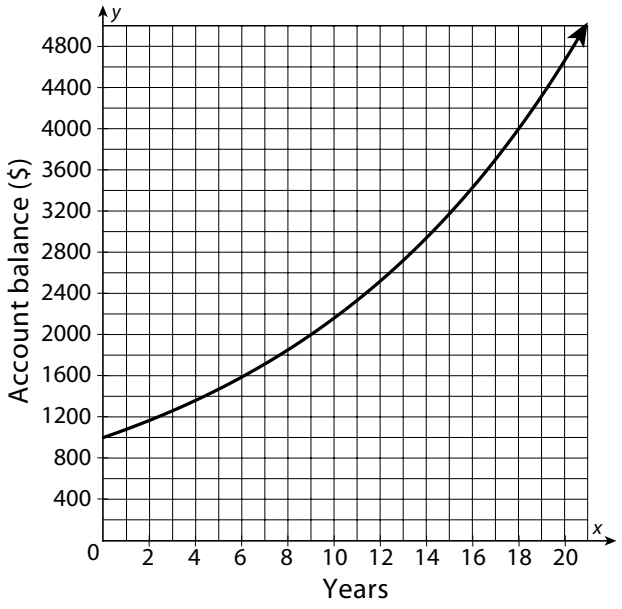
The verbal descriptions tell the deposit amount, which is the starting value in each table. The tables all start with zero and show the same scale. The starting and ending amounts are all different. Options 2 and 3 grow slower than Option 1 in the beginning, but faster in the end. Some students may want to switch their prediction to Option 3 because after 20 years it has the most money. Some students may argue that if the tables were extended, Option 2 would show the most money after 30 years. Encourage students to discuss which options are growing the fastest considering the initial values of the deposits. Note that for Option 1, x has been changed to a yearly increase ($120/year), equivalent to 12 monthly increases of $10.

d. Below are the graphs for each option. How are the graphs the same? How are they different? Would you keep the same option as your prediction for part c? Why or why not?

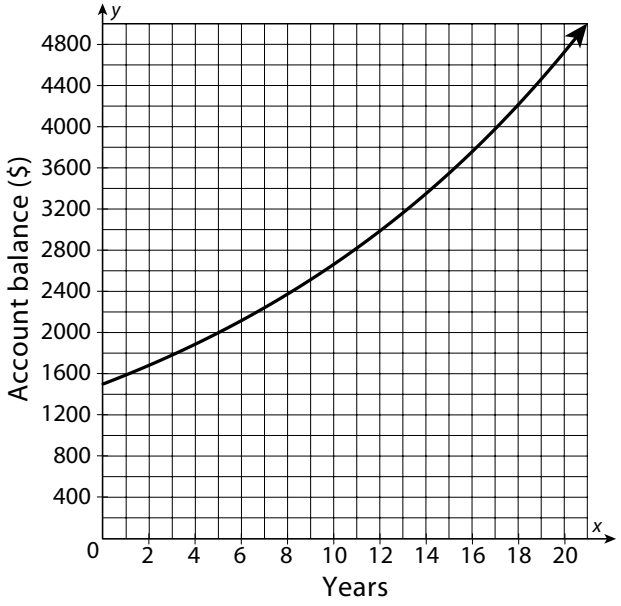
Option 1



Option 2



Option 3



The graphs are the same scale on the *x*-axis. They are also the same in the sense that they are all increasing. The curved lines of options 2 and 3 show that they will eventually surpass the amount in Option 1. Option 2 looks like it is rising at a faster rate; the curve is a little steeper than Option 3.

e. Which option would earn Malik the greatest amount after 10 years? After 20 years? After 30 years?

Looking at the tables and graphs, Option 1 would be the best choice for Malik if he worked for only 10 more years. Option 2 is best if Malik plans to work for 20 years. To find out how much Malik would make after 30 years, students can extend the table or use equations to find the answers.

- The Option 1 equation is $f(x) = 120x + 2000$. After 30 years, the account will have \$5,600. (Note that x is years, rather than months as given in the prompt.)
- The Option 2 equation is $f(x) = 1000(1.08)^x$. After 30 years, the account will have \$10,062.66.
- The Option 3 equation is $f(x) = 1500\left(1 + \frac{0.0575}{12}\right)^{12x}$. After 30 years, the account will have \$8,384.17. Students may need reminding of the compound interest formula.

Students should recognize through the tables and graphs that options 2 and 3 are growing the fastest and will eventually surpass Option 1. Option 2 is growing the fastest overall and will eventually surpass Option 3 as well.

f. Using your mathematical models, determine which option Malik should choose and explain your reasoning.

Students could point out the intersection points where one option becomes better than another option. Seeing how Malik's age or work experience are not given, we are unsure how many years he has left to work. If Malik retires within 14 years, he would be better off to choose Option 1. Option 3 is best in years 14 through 20. Option 2 would be the best if working for any number of years over 20. It is growing at the fastest rate.