46. G; $a = -5$, so as the absolute value of y decreases, y is actually increasing.

47. D; $865(1.05)^3 = \$1001.35$

48a. $y = a(1 + r)^t$
$= 1000(1 + 0.05)^t$
$= 1000(1.05)^t$

b. $1300 = 1000(1.05)^t$
$t \approx 5$; about 2005

CHALLENGE AND EXTEND

49. about 20 years

50. $y = a(1 + r)^t$
$1000 = 500(1.04)^t$
$t \approx 18$ yr
for $r = 0.08$
$1000 = 500(1.08)^t$
$t \approx 9$ yr

51. $A = P(0.5)^t$
$10 = 80(0.5)^t$
$t = 3$
So, half-life $= \dfrac{300}{t} = 100$ min or 1 h 40 min

52. $A = P(0.5)^t$
$15 = P(0.5)^{\frac{6}{2}}$
$P = 120$ g

53. $A = P\left(1 + \dfrac{r}{n}\right)^{nt}$
$250{,}000 = P(1 + 0.013)^{(4 \cdot 8)}$
$P = \$225{,}344$

54.

Month	Balance ($)	Monthly Payment ($)	Remaining Balance ($)	1.5% Finance Charge ($)	New Balance ($)
1	200	30	170	2.55	172.55
2	172.55	30	142.55	2.14	144.69
3	144.69	30	114.69	1.72	116.41
4	116.41	30	86.41	1.30	87.71
5	87.71	30	57.71	0.87	58.58
6	58.58	30	28.58	0.43	29.01
7	29.01	29.01	0	0	0

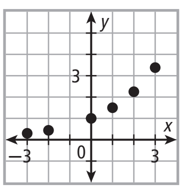
b. Table shows balance is paid off in 7 months.

c. $\big(6(30) + 29.01\big) - 200 = 9.01$

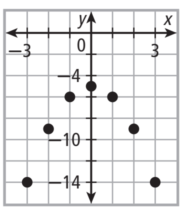
9-4 LINEAR, QUADRATIC AND EXPONENTIAL MODELS

CHECK IT OUT!

1a. exponential



b. quadratic



2. Quadratic; for every constant change in the x-values of +1, there is a constant second difference of −6 in the y-values.

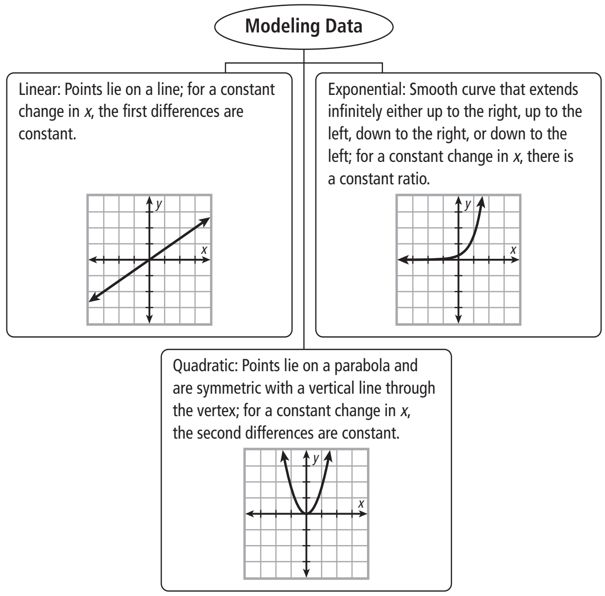
3. The oven temperature decreases by 50°F every 10 minutes; $y = -5x + 375$; 75°F

THINK AND DISCUSS

1. No; most real-world data probably will not fit exactly into one of these patterns.

2. No; this is just a prediction based on the assumption that the observed trends will continue, which they may or may not do.

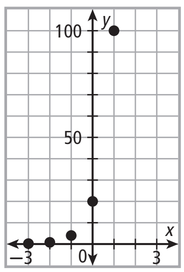
3.



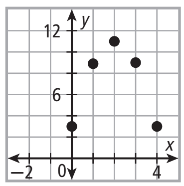
EXERCISES

GUIDED PRACTICE

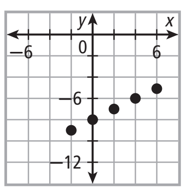
1. exponential



2. quadratic



3. linear



4. Quadratic; for every constant change of +1 in the x-values, there is a constant second difference of −1 in the y-values.

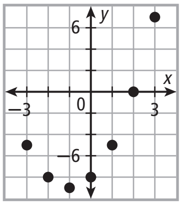
5. Exponential; for every constant change of +1 in the x-values, there is a constant ratio of 2.

6. Linear; for every constant change of +1 in the x-values, there is a constant change of +2 in the y-values.

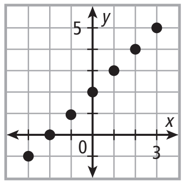
7. Grapes cost \$1.79/lb; $y = 1.79x$; \$10.74

PRACTICE AND PROBLEM SOLVING

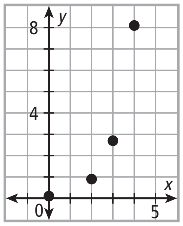
8. quadratic



9. linear



10. exponential



11. Linear, for every constant change of +1 in the x-values, there is a constant change of −1 in the y-values.

12. Quadratic, for every constant change of +1 in the x-values, there is a constant second difference of −2 in the y-values.

13. Exponential, for every constant change of +1 in the x-values, there is a constant ratio of 0.5 in the y-values.

14. The company's sales are increasing by 20% each year; $y = 25{,}000(1.2)^x$; \$154,793.41

15. $l = 6k$; linear with $m = 6$ and $b = 0$

16. Linear; for every weekly interval, the height of the plant has a constant increase of 0.5 inches.

17. Linear; for each successive year, the number of games has a constant change of 0.

18. Quadratic; for each successive time interval, the height of a ball has a constant second difference of −0.28.

19. $y = 0.2(4)^x$

20. $y = -\frac{1}{2}x + 4$

21. linear

22. quadratic

23. Possible answer: (0,3), (1,6), (2,12), (3,24); for a constant change in x of +1, there is a common ratio of 2.

24. Possible answer: the first differences are constant, so there is no need to check the second differences. A linear function would best model the data.

25. Possible answer: make a table of ordered pairs and see whether the y-values show a pattern of constant second differences or constant ratios.

26a. college 1: linear because it has constant changes of \$200 each year; college 2: exponential because it has a constant yearly ratio of 1:1.1.

b. college 1: $y = 200x + 2000$;
college 2: $y = 2000(1.1)^x$

c. Both have the same tuition (\$2000) in 2004.

d. For college 1, \$200 is added each year, so 2000 + 200 = 2200. For college 2, 10% is added each year, so 2000 + (0.1)(2000) = 2200.

27. C; the data is linear since it has a constant change in the y-values for each constant change in the x-values.

28. F; 2% is a common ratio.

29. C; For every constant change of +1 in the x-values, there is a constant change of +2 in the y-values.

CHALLENGE AND EXTEND

30a.

Year	Value (\$)
0	18,000
1	15,120
2	12,700.80
3	10,668.67
4	8961.68

Year 0 is the year when the car is purchased.

b. exponential, for each successive year, the value decreases by 16%, the common ratio.

c. $y = 18{,}000(0.84)^x$

d. $y = 18{,}000(0.84)^{5\frac{1}{2}} = \$6899.36$

e. $y = 18{,}000(0.84)^8 = \$4461.77$

31a. Possible answer: quadratic; the second differences are approximately constant at −2.

b. about 48 kg

c. No; this quadratic model will begin to decrease although the dog's weight will either continue to grow or eventually remain constant.

9-5 COMPARING FUNCTIONS

CHECK IT OUT!

1. Slope: For Dave, use (0, 30) and (1, 42). $\frac{42-30}{1-0} = 12$. For Arturo, use (0, 24) and (1, 32). $\frac{32-24}{1-0} = 8$. Dave is saving at a higher rate (\$12/wk) than Arturo (\$8/wk); y-int.: The y-intercept for Dave is (0, 30) and for Arturo is (0, 24). Dave started with more money (\$30) than Arturo (\$24).

2. Average rate of change of Investment A: use (10, 17.91) and (25, 42.92).
$\frac{42.92-17.91}{25-10} \approx 1.67$; A increased about \$1.67/yr; Average rate of change of Investment B: use (10, 17) and (25, 34). $\frac{34-17}{25-10} \approx 1.13$; B increased about \$1.13/yr.

3. Rosetta's new model:
max ht.: $x = -\frac{b}{2a} = -\frac{1.1}{2(-0.01)} = \frac{1.1}{0.02} = 55$;
$y = -0.01(55)^2 + 1.1(55) = 30.25$ ft;
length: (x–intercepts)
$-0.01x^2 + 1.1x = 0$
$-x(0.01x - 1.1) = 0$