12. a) $A = P + Prt$
A is \$9400; P is \$4700; t is 8

$$9400 = 4700 + (4700)(r)(8)$$
$$4700 = 37\ 600r$$
$$\frac{4700}{37\ 600} = r$$
$$0.125 = r$$

The annual interest rate is 12.5%.
b) $A = P(1 + rt)$
P is \$4700 ; r is 12.5% or 0.125; t is 16
$A = 4700(1 + (0.125)(16))$
$A = 14\ 100$
The value of the investment would be \$14 100.

13. a) The slope of the graph would increase if the interest rate increased. For example, the investment currently earns \$1 of interest every 3 years, so it has a slope of $\frac{1}{3}$. A steeper graph with a slope of $\frac{2}{3}$ would mean the investment is earning \$2 of interest every 3 years. This could only happen if the interest rate increased.
b) e.g., Similar: They have the same interest rate. The situations are represented by a linear relation that slopes upward to the right. The graphs relate money to time. The graphs have the same slope.
Different: They have different principals. The interest graph starts at (0, 0) while the investment graph starts at (0, 3). The investment graph shows the value of the investment and the interest while the interest graph only shows only the interest.

14. The CSB Graham buys in year 1 is invested for 5 years. The CSB he buys in year 2 is invested for 4 years, and so on. The CSB he buys in year 5 will be invested for 1 year. Determine the yearly value of the five-year CSB then add the values together.
$A = P(1 + rt)$
P is \$1000; r is 3.8% or 0.038; t is 1, 2, 3, 4, 5

Year	Year End Value (\$)
1	1038
2	1076
3	1114
4	1152
5	1190
Total	5570

Graham's investment will be worth \$5570 after 5 years.
15. Carole's account pays interest daily so she will earn 86 days of interest when she withdraws her money.
Convert 86 days to a fraction of a year:

$$\frac{86}{365} = 0.235...$$

$A = P(1 + rt)$
P is \$24 000; r is 5.2% or 0.052; t is 0.235…
$A = 24\ 000(1 + (0.112)(0.235…))$
$A = 24\ 294.049…$
Carole withdrew \$24 294.05 when she closed her savings account.

Lesson 1.2: Exploring Compound Interest, page 19

1. $A = P(1 + rt)$
Eve: P is \$3000; r is 4% or 0.04; t is 5
$A = 3000(1 + (0.04)(5))$
$A = 3600$
Eve's investment is worth \$3600.00 after 5 years.
Larry: The initial principal is \$3000; r is 4% or 0.04; t is 1 since each year has a new principal.
$A = P(1 + (0.04)(1))$
Calculate the interest 5 times, using the value of A as the new value of P for each new year. Use a table to organize the answers.

Year	Principal (\$)	Year-end Value (\$)
1	3000.00	3120.00
2	3120.00	3244.80
3	3244.80	3374.59
4	3374.59	3509.58
5	3509.58	3649.96

Larry's investment is worth \$3649.96 after 5 years.
Calculate the difference in interest.
3649.96 – 3600 = 49.96
Larry's investment earned \$49.96 more in interest than Eve's because his investment earned interest on the principal and on the accumulated interest.

2. $A = P(1 + rt)$
Account A: P is \$6500; r is 5.1% or 0.051; t is 4
$A = 6500(1 + (0.051)(4))$
$A = 7826.00$
The investment in account A is worth \$7826.00 after four years.
Account B: Initial principal is \$6500; r is 4.8% or 0.048; t is 1.
$A = P(1 + (0.048)(1))$
Calculate the interest 4 times, using the value of A as the new value of P for each new year. Use a table to organize the answers.

Year	Principal (\$)	Year-end Value (\$)
1	6500.00	6812.00
2	6812.00	7138.98
3	7138.98	7481.65
4	7481.65	7840.77

The investment in account B is worth \$7840.77 after four years. Sydney should choose account B because it will earn more interest.

3. a) e.g., no it is not possible to tell, as the principals, interest rates, and timelines all differ.
b) $A = P(1 + rt)$
Investment A: initial P is \$6000; r is 1.2% or 0.012; t is 1 (for 4 years).
$A = P(1 + (0.012)(1))$

Year	Principal (\$)	Year-end Value (\$)
1	6000.00	6072.00
2	6072.00	6144.86
3	6144.86	6218.60
4	6218.60	6293.23

Return on investment A: 6293.23 – 6000 = 293.23

Investment B: P is \$5000; r is 5% or 0.05; t is 5.
$A = 5000(1 + (0.05)(5))$
$A = 6250$
Return on investment B: 6250 – 5000 = 1250
Investment C: initial P is \$4000; r is 6% or 0.06; t is 1 (for 6 years)
$A = P(1 + (0.06)(1))$

Year	Principal ($)	Year-end Value ($)
1	4000.00	4240.00
2	4240.00	4494.40
3	4494.40	4764.06
4	4764.06	5049.91
5	5049.91	5352.90
6	5352.90	5674.08

Return on investment C: 5674.08 – 4000 = 1674.08
Investment C has the greatest return on investment.

Lesson 1.3: Compound Interest: Future Value, page 30

1. Row 1: $i = \frac{10.2}{2}$, $n = (4)(2)$
$i = 5.1$, $n = 8$

Row 2: $i = \frac{4.1}{12}$, $n = (6)(12)$
$i = 0.341..$, $n = 72$

Row 3: $i = \frac{13.2}{4}$, $n = (7)(4)$
$i = 3.3$, $n = 28$

Row 4: $i = \frac{3.5}{365}$, $n = \left(\frac{9}{12}\right)(365)$
$i = 0.009...$ $n \doteq 274$

2. $A = P(1 + i)^n$
a) $P = 520$; $r = 4.5\%$ compounded monthly,
$i = \frac{0.045}{12} = 0.003\ 75$; $t = 8$ years, $n = 8 \cdot 12 = 96$
$A = 520(1 + 0.00375)^{96}$
$A = 744.829…$
The future value of the investment is \$744.83.
744.829… – 520 = 224.829…
The total interest earned on the investment is \$224.83.
b) $P = 1400$; $r = 8.6\%$ compounded semi-annually,
$i = \frac{0.086}{2} = 0.043$; $t = 15$ years, $n = 15 \cdot 2 = 30$
$A = 1400(1 + 0.043)^{30}$
$A = 4950.593…$
The future value of the investment is \$4950.59.
4950.593… – 1400 = 3550.593…
The total interest earned on the investment is \$3550.59.

3. i) a) $\frac{72}{6.8} = 10.588...$
By the rule of 72, the investment will double in 10.59 years.
To determine the actual doubling time:
The principal is \$7000. The annual interest rate is 6.8%.
The compounding period is annual, or once per year.
The term (in years) is unknown.
The future value is double \$7000, or \$14 000.
I used the financial application on my calculator:
The doubling time is 10.54 years, which is very close to the estimate of 10.59 years.

b) $\frac{72}{9.2} = 7.826...$
By the rule of 72, the investment will double in 7.83 years.
To determine the actual doubling time:
The principal is \$850. The annual interest rate is 9.2%.
The compounding period is monthly, or 12 times per year.
The term (in years) is unknown.
The future value is double \$850, or \$1700.
I used the financial application on my calculator:
The doubling time is 7.56 years, which is very close to the estimate of 7.83 years.

c) $\frac{72}{15.6} = 4.615...$
Using the rule of 72, it takes 4.62 years for the investment to double in value.
The principal is \$12 500.
The annual interest rate is 15.6%.
The compounding period is weekly, or 52 times per year.
The term (in years) is unknown.
The future value is double \$12 500, or \$25 000.
I used the financial application on my calculator:
The doubling time is 4.45 years, which is very close to the estimate of 4.62 years.

d) $\frac{72}{2.7} = 26.666...$
Using the rule of 72, it takes 26.67 years for the investment to double in value.
The principal is \$40 000.
The annual interest rate is 2.7%.
The compounding period is semi-annual, or 2 times per year.
The term (in years) is unknown.
The future value is double \$40 000, or \$80 000.
I used the financial application on my calculator:
The doubling time is 25.85 years, which is close to the estimate of 26.67 years.