5. How long would $1250 have to be deposited at 6% per year simple interest to gain $750 simple interest?

6. Andrew lent Roger $4800 for 7 months. At the end of this period Roger had to pay Andrew an interest of $119. What was the rate of simple interest per annum?

7. In a certain year, James put $600 in a bank at the end of March and $400 in the same bank at the end of June. The bank offers 3% per annum simple interest rate. Find the total amount that James receives from the bank at the end of December in that year.

8. A bank increased the rate of interest, which it paid to depositors from 3.5% to 4% per annum. Find how much more interest Susan would receive if she deposited $6400 in the bank for 6 months at the new interest rate.

9. Mrs. Jasmine invested $4000 in a Building Society which paid simple interest at a rate of $7\frac{1}{4}$% per annum to its investors. After 2 years, the rate was increased to 7.6% per annum. Find the amount she had at the end of 7 years.

10. Mr. Chen deposits a certain sum of money in a bank. If the interest rate of the bank decreases from $3\frac{3}{4}$% per annum to $3\frac{1}{2}$% per annum, Mr. Chen's interest will decrease by $50 in a year. Find the sum of money he deposits.

Compound Interest

The interest is not always calculated based on the original principal. Suppose John deposits $2000 in his savings account in a bank for 2 years at 5% per annum and the interest due to him is calculated as follows:

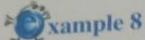First year: $P = \$2000, R = 5, T = 1, I = \dfrac{\$2000 \times 5}{100} = \$100.$

Second year: $P = \$2000 + \$100 = \$2100, R = 5, T = 1, I = \dfrac{\$2100 \times 5}{100} = \$105.$

The total interest for 2 years $= \$100 + \$105 = \$205$.

In the above computation, the interest of **$100** due to him at the end of the first year is **compounded** with, i.e. added on to, the principal of $2000. This amount $2100 becomes the principal for the second year and is used to obtain the interest due to him at the end of the second year.

The total interest of **$205** is called the **compound interest** and the sum $2000 is said to be deposited at compound interest **compounded** annually.

If the sum is deposited at 5% per annum simple interest for 2 years, calculate the simple interest. Which interest is larger, the simple interest or the compound interest?

Example 8

To buy a car, Raymond borrowed $20 000 for $3\frac{1}{2}$ years and paid $5880 simple interest on the loan. What rate of interest did he pay?

Solution

$$I = \frac{PRT}{100}$$

$$5880 = \frac{20\ 000 \times R \times 3.5}{100}$$

$$R = \frac{5880 \times 100}{20\ 000 \times 3.5} = 8.4$$

He paid 8.4% simple interest per year.

Exploration

Credit cards are now a common sight in Singapore. Find out what percentage a shop has to pay a credit card company. What is the interest charged for purchases by the credit card company on a cardholder who fails to pay in full the amount due? What interest rate is charged by the credit card company to cardholders who use their credit extension through an Automated Teller Machine (ATM)?

Exercise 6c

1. Copy and complete the following table:

	Principal	Interest rate	Time	Simple interest	Amount
(a)	$12 000	8%	7 years		
(b)	$500	11%		$220	
(c)		9%	4 years	$108	
(d)	$3000		10 years	$1200	
(e)			2 years	$360	$3960
(f)	$1800		18 months	$189	
(g)	$4500		2 years		$5040
(h)		5%		$90	$1290

2. A finance company charges $55 simple interest on a sum of money which is borrowed for five months. Given that the rate of interest is 12% per annum, find the sum of money.

3. A bank charges 2.25% per month simple interest on personal loans. If John borrows $6400 for a period of 2 years 1 month, find the total interest he has to pay.

4. Mrs. Lee invests $800 at 6% per annum and $1200 at 7% per annum. What is her total annual interest on these two investments?

1. A gold chain is sold for $635 at a gain of 27 percent on the sale price. Find the profit.

2. By selling a book for $16.50, a bookseller loses 12% on cost. What is the cost price of the book?

3. Peter bought an antique chest for $600 and was forced to sell it for $500. Find the loss as a percentage of the cost price.

4. If Susan sells her car at a loss of 6% on the cost, what is her selling price when she paid $18 400 for it?

5. To make a profit of $33\frac{1}{3}\%$ on cost, a bicycle must be sold for $240. What is the cost price of the bicycle?

6. The profit on a certain refrigerator is 35% of the cost price. If the profit is $280, find
   (a) the cost price and
   (b) the selling price of the refrigerator.

7. A man buys a dozen cameras for $1800. He sells them at a profit of $36 each. Find his profit as a percentage of the selling price.

8. A florist bought 360 roses at $10 per dozen. he sold them at $1.10 each, what is his profit as a percentage of the selling price?

9. Mr Lin buys an article and sells it to Mr Chen at a gain of 25% on cost. Mr Chen sells the article to Mr Ang at a gain of 20% on cost. How much money did Mr Lin pay for the article, if Mr Ang pays $360 for it?

10. A shopkeeper buys 300 identical articles at a total cost of $1500. He fixes the selling price of each article at 20% above the cost price and sells 260 articles at this price. As for the remaining articles, he sells them at 50% of the selling price. Calculate the shopkeeper's total profit.

11. Simon ordered 200 boxes of Fuji apples from China. He paid $28 per box for the apples. There were 60 fruits in each box and he expected 15% of them to spoil. If he wants to make a profit of 80% on cost, what should be the selling price per fruit?

Further Examples on Percentages

Example 3

(a) In a school library, 28% of the books are classified as fiction and the remainder as non-fiction. Given that there are 1980 more non-fiction books than fiction books, find the number of books in each category and the total number of books in the library.

(b) The library decides to increase the number of non-fiction books by $7\frac{1}{2}\%$ at an average cost of $15.00 per book and the number of fiction books by 5% at $4.50 per book. Calculate
   (i) the total cost of the new books,
   (ii) the percentage increase in the total number of books in the library.

The Pacific Ocean, the Atlantic Ocean and the Indian Ocean cover 32%, 16% and 14% of the Earth's surface area respectively.

(b) $(5 \quad 6 \quad 6 \quad 7)\begin{pmatrix} 1008.60 \\ 956.60 \\ 612.80 \\ 1246.20 \end{pmatrix}$

$= (23\ 182.80)$

8. (a) $\begin{pmatrix} 22 & 32 & 42 & 28 \\ 18 & 26 & 36 & 32 \\ 27 & 24 & 52 & 25 \end{pmatrix}\begin{pmatrix} 60 \\ 70 \\ 80 \\ 90 \end{pmatrix}$

$= \begin{pmatrix} 9440 \\ 8660 \\ 9710 \end{pmatrix}$

(b) $(26 \quad 29 \quad 30)\begin{pmatrix} 9440 \\ 8660 \\ 9710 \end{pmatrix}$

$= (787\ 880)$ i.e. $7878.80

Review Questions 5

1. (a) $\begin{pmatrix} 3 & 1 \\ 9 & 3 \end{pmatrix}$ (b) (9)

(c) (10) (d) $\begin{pmatrix} 3 & 0 & 1 \\ 6 & 0 & 2 \\ 9 & 0 & 3 \end{pmatrix}$

(e) No solution (f) $\begin{pmatrix} 3\frac{1}{2} \\ -3\frac{1}{2} \end{pmatrix}$

(g) $\begin{pmatrix} 2 \\ 7 \\ -1 \end{pmatrix}$ (h) $\begin{pmatrix} 0 & 8 \\ -2 & -5 \\ 6 & 7 \end{pmatrix}$

(i) $\begin{pmatrix} 1 \\ -7 \end{pmatrix}$ (j) $(4 \quad 14)$

2. (a) $\begin{pmatrix} 16 & 13 \\ 2 & -7 \end{pmatrix}$ (b) $\begin{pmatrix} 43 & 20 \\ 25 & -19 \end{pmatrix}$

(c) $\begin{pmatrix} 97 & -31 \\ 8 & -11 \end{pmatrix}$ (d) $\begin{pmatrix} -6 & 1 \\ 12 & 28 \end{pmatrix}$

(e) $\begin{pmatrix} -24 & -32 \\ 3 & -41 \end{pmatrix}$

(f) $\begin{pmatrix} -96 & -424 \\ -8 & -52 \end{pmatrix}$

3. (a) $a = 0, b = -4$
(b) $x = 12, y = 8$
(c) $a = -3, b = 2, c = 3\frac{1}{2}$

4. (a) Yes (b) Yes
(c) Yes (d) No
(e) Yes, distributive law
(f) No

6. (a) $a = 3, b = 19$
(b) $a = 2, b = 14\frac{1}{3}$

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7. $\begin{pmatrix} 0.6 \\ 0.8 \end{pmatrix}$

8. $\begin{pmatrix} 3 & 8 \\ 7 & 19 \end{pmatrix}, \begin{pmatrix} 10 & 14 & 7 \\ 6 & 8 & 4 \\ 5 & 8 & 4 \end{pmatrix}$

9. $\begin{pmatrix} 480 & 460 & 620 & 430 \\ 350 & 450 & 385 & 540 \\ 420 & 520 & 420 & 620 \\ 380 & 452 & 250 & 486 \end{pmatrix}\begin{pmatrix} 0.10 \\ 0.20 \\ 0.50 \\ 1.00 \end{pmatrix}$

$= \begin{pmatrix} 880 \\ 857.50 \\ 976 \\ 739.40 \end{pmatrix}$,

$(1 \quad 1 \quad 1 \quad 1)\begin{pmatrix} 880 \\ 857.50 \\ 976 \\ 739.40 \end{pmatrix} = (3452.90)$

10. $(0.6 \quad 1.00 \quad 5.00 \quad 3.50 \quad 2.80)$

$\begin{pmatrix} 450 & 250 & 280 \\ 240 & 140 & 120 \\ 120 & 80 & 50 \\ 80 & 60 & 30 \\ 60 & 20 & 24 \end{pmatrix}$

$= (1558 \quad 956 \quad 710.20)$

or $\begin{pmatrix} 450 & 240 & 120 & 80 & 60 \\ 250 & 140 & 80 & 60 & 20 \\ 280 & 120 & 50 & 30 & 24 \end{pmatrix}\begin{pmatrix} 0.60 \\ 1.00 \\ 5.00 \\ 3.50 \\ 2.80 \end{pmatrix}$

$= \begin{pmatrix} 1558 \\ 956 \\ 710.20 \end{pmatrix}$

11. (a) $\begin{pmatrix} 12 & 8 & 12 & 15 \\ 15 & 0 & 16 & 14 \\ 0 & 20 & 25 & 16 \end{pmatrix}\begin{pmatrix} 8.4 \\ 7.8 \\ 8.8 \\ 8.2 \end{pmatrix}$

$= \begin{pmatrix} 391.8 \\ 381.6 \\ 507.2 \end{pmatrix}$

(b) $(22 \quad 18 \quad 25)\begin{pmatrix} 391.8 \\ 381.6 \\ 507.2 \end{pmatrix}$

$= (28\ 168.4)$

12. (a) $\begin{pmatrix} 11 & 4 & 2 \\ 8 & 2 & 10 \\ 6 & 3 & 10 \\ 9 & 4 & 5 \\ 12 & 1 & 9 \\ 10 & 2 & 7 \end{pmatrix}\begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 37 \\ 26 \\ 21 \\ 31 \\ 37 \\ 32 \end{pmatrix}$

(b) $\begin{pmatrix} 17 & 11 & 4 & 2 \\ 20 & 8 & 2 & 10 \\ 19 & 6 & 3 & 10 \\ 18 & 9 & 4 & 5 \\ 22 & 12 & 1 & 9 \\ 19 & 10 & 2 & 7 \end{pmatrix}\begin{pmatrix} 300 \\ 500 \\ 200 \\ -300 \end{pmatrix}$

$= \begin{pmatrix} 10\ 800 \\ 7\ 400 \\ 6\ 300 \\ 9\ 200 \\ 10\ 100 \\ 9\ 000 \end{pmatrix}$

Exercise 6a

1. $135
2. $18.75
3. 16.7%
4. $17 296
5. $180
6. (a) $800 (b) $1080
7. 19.4%
8. 24.2%
9. $240
10. $180
11. 99¢

Exercise 6b

1. (a) 4%
   (b) $25 000, $40 000
2. (a) (i) $450 (ii) $540
   (b) 20%
3. (a) $588 (b) $32 400 000
   (c) $4 536 000, $20 088 000,
       $5 832 000, $1 944 000
4. (a) 6 days (b) 40%
5. 123 008 tonnes
6. $36 000, $43 200, $88 800, 88.8%
7. (a) $134 640 (b) 19.9%
8. (a) 23.0% (b) 1.97%
9. (c) 88.7% (d) 1998

Exercise 6c

1. (a) $6720, $18 720
   (b) 4 yrs, $720
   (c) $300, $408
   (d) 4%, $4200
   (e) $3600, 5%
   (f) 7%, $1989
   (g) 6%, 540
   (h) $1200, $1\frac{1}{2}$ yrs

2. $1100
3. $3600
4. $132
5. 10 years
6. $4\frac{1}{4}\%$
7. $1019.50
8. $16
9. $6100
10. $20 000

Exercise 6d

1. (a) $94.50   (b) $257.34
   (c) $1244.03   (d) $149.84
   (e) $1556.25
2. $5829.57   3. $103.13
4. $9001.46

Exercise 6e

1. (a) (i) $90   (ii) 25%
   (b) (i) $150   (ii) $16\frac{2}{3}\%$
   (c) (i) $3000   (ii) 12%
2. (a) $21   (b) $288
3. (a) (i) $236   (ii) 18%
   (b) (i) $517.50 (ii) 15%
   (c) (i) $1960   (ii) 22.5%
4. (a) (i) $63   (ii) 7%
   (b) (i) $200   (ii) 15%
   (c) (i) $75   (ii) $16\frac{2}{3}\%$
5. (a) $3716.80   (b) $516.80
   (c) 16.15%
6. (a) 18.2%   (b) $108
   (c) 5.13%

Exercise 6f

1. (a) S$738.90   (b) S$8805
   (c) S$1630.40   (d) S$61.71
   (e) S$974.88   (f) S$995
   (g) S$430.32   (h) S$29 456
   (i) S$724.48   (j) S$151.20
2. (a) US$4513   (b) £295
   (c) NZ$4545   (d) 6757B
   (e) 167 224P   (f) 1 319 648Rp
   (g) 28 211¥   (h) RM1933
   (i) A$988   (j) HK$10 280
3. (a) 6114B   (b) US$39.67
4. (a) €464   (b) £659.31
5. (a) US$5000   (b) S$80
6. NZ$852

Exercise 6g

1. $1312
2. $252   3. $161.86

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4. (a) $216   (b) $904
   (c) $3916   (d) $8350
5. (a) $1201.60   (b) $135.20

Exercise 6h

1. $18.80   2. $6346.15
3. $14 400   4. 13.9%
5. $1688   6. $2016
7. (a) $2095, 5.82%
   (b) $2635
8. $47, 23.5%
9. US$932
10. $16 985.53
11. No. Only $179.34
12. (a) 25.87%   (b) $449 million
13. $25.75 million

Exercise 6i

1. 7   2. 20 cents
3. 22, 14, 12   4. 17
5. 127
6. Break even
7. Less than before the pay cut by
   $2\frac{1}{4}\%$.
8. Its final area was less than its
   original area by 4%.
9. 80 books
10. $2.70, 125 files
11. $18 500 at A, $5500 at B.
12. $10 \times 2^{n-1}$; 1.7×10^5

Review Questions 6

1. 10 000
2. $250 000
3. (a) $900   (b) $1170
4. $200, $240
5. Loss $2.40
6. S$79 891.30
7. (a) $6000, 14.3%
   (b) $5700, 15.3%
   (c) $5775
8. (a) $2898; $2852, $4991, $2139
   (b) X: $5332, Z: $3999; $5418
9. No difference in order
10. $5309.14
11. $17 920, $7680, $14 400
12. $10 100

Exercise 7a

1. (a) (i) 9.5 cm   (ii) 15 cm
   (b) 5th day

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2. (a) (i) 150 g   (ii) 240 g
   (b) 11.2 m²
3. (a) (i) $70   (ii) $82
   (b) (i) 3 years (ii) 11 years
4. (a) (i) $1450   (ii) $550
   (b) after 5 years
5. (a) (i) 40°F   (ii) 108°F
       (iii) 176°F
   (b) (i) 20°C   (ii) 38°C
       (iii) 82°C

Exercise 7b

1. (a) 4 p.m.   (b) 30 km
   (c) 2 to 2.30 p.m.
   (d) 22 km   (e) $1\frac{1}{2}$ hours
2. (a) 30 minutes (b) 10 km
   (c) 20 km/h   (d) 40 km/h
   (e) 60 km   (f) 13 30
3. (a) 08 24   (b) 40 km
   (c) 80 km/h   (d) 1 h 12 min
   (e) 2 hours   (f) 85 km/h
   (g) 340 km   (h) $6\frac{3}{5}$ hours
   (i) $51\frac{17}{33}$ km/h
4. (a) 14 36, 25 km/h
   (b) 15 30, $33\frac{1}{3}$ km/h
   (c) 44 km
   (d) about 16 50
   (e) X, 1 hour
   (f) 100 km
   (g) 40 km
   (h) 70 km
5. (a) $53\frac{1}{3}$ km/h (b) 180 km
   (c) about 10.43 a.m.
   (d) 92 km   (e) 12 km
   (f) Lina, 30 min
   (g) 60 km/h

Exercise 7c

2. (b) (i) 41 km/h
       (ii) 59 km/h
       (iii) 104 km/h
   (c) (i) 2 seconds
       (ii) 11 seconds
       (iii) 23 seconds
3. (a) (i) 1350   (ii) 960
       (iii) 750   (iv) 150
       (v) 90