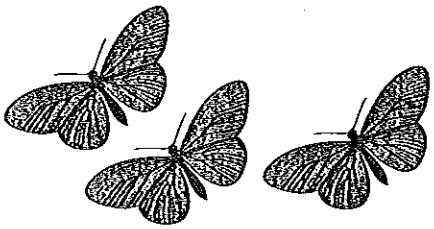
Ratios

Ratios are used to compare quantities.

Example 16



a What is the ratio of bats to butterflies?

b Find the ratio of butterflies to bats.

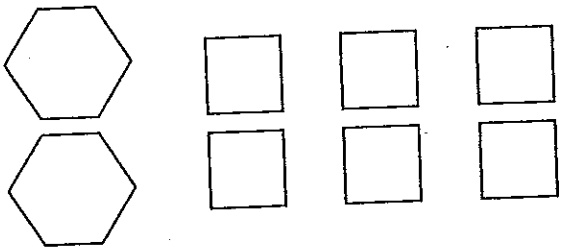
Solution 16

a The ratio of bats to butterflies is 5 : 3.

b The ratio of butterflies to bats is 3 : 5.

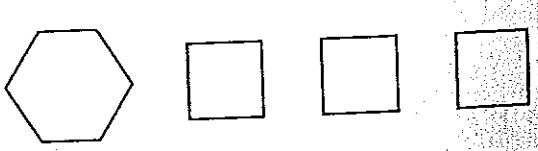
Example 17

What is the ratio of the number of hexagons to the number of squares?



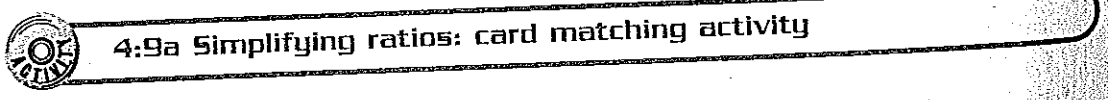
Solution 17

The ratio of hexagons to squares is 2 : 6.
By dividing each of the numbers by 2 the ratio 2 : 6 becomes 1 : 3.



Hint

First write the unsimplified ratio, and then simplify it if you can.



1 A class of 28 students contains 13 boys and 15 girls. What is the ratio of:

a boys to girls?

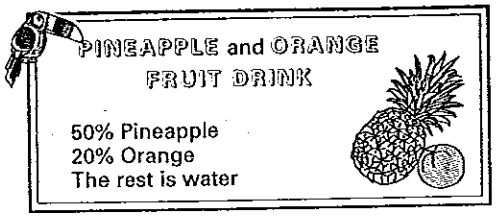
b girls to boys?

c boys to students in the whole class?

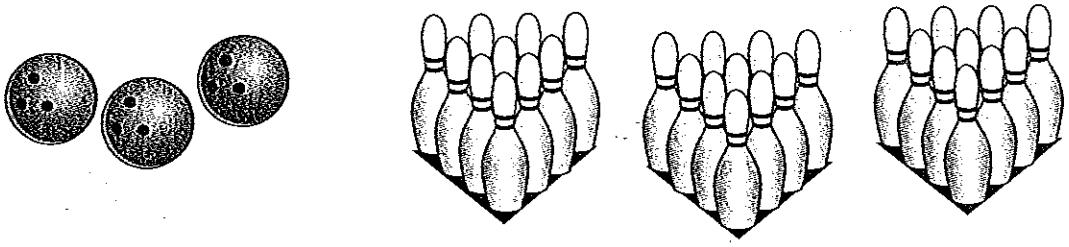
2 In the fruit drink, what is the ratio of:

a pineapple to orange?

b pineapple to water?



3 What is the ratio of bowling pins to bowling balls?



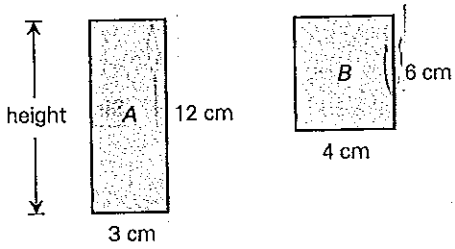
Did you know?

The Ancient Egyptians had bowling alleys similar to the bowling alleys used today

4 For these rectangles, find the following ratios:

a the height of rectangle B to the height of rectangle A

b the area of rectangle A to the area of rectangle B

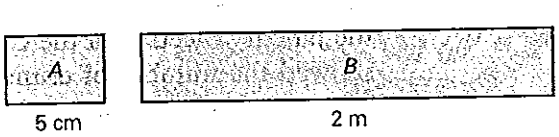


5 Holly counted the number of minutes advertisements were shown while she was watching her favourite TV game show. She counted 14 minutes of advertisements between 7 pm and 8 pm. What was the ratio of time devoted to advertisements to the time the game show was actually shown?

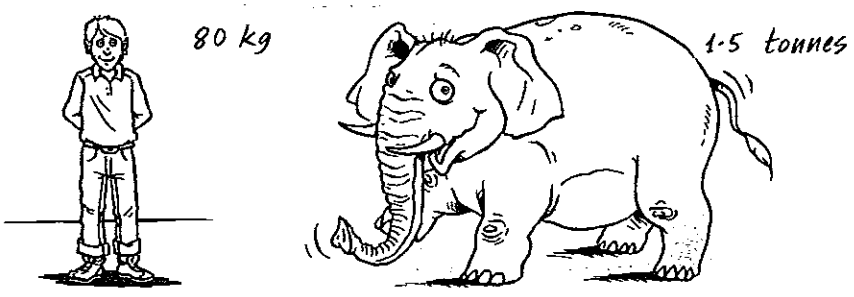
Remember

In ratios the units must be the same.

6 a What is the ratio of the length of rectangle A to the length of rectangle B?

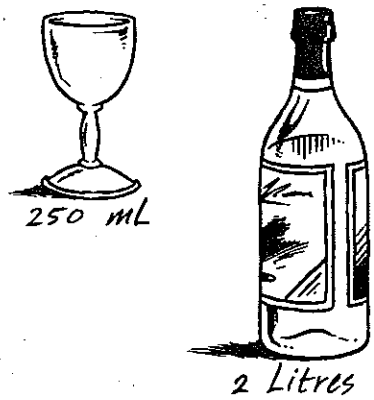


b What is the ratio of the mass of the man to the mass of the elephant?



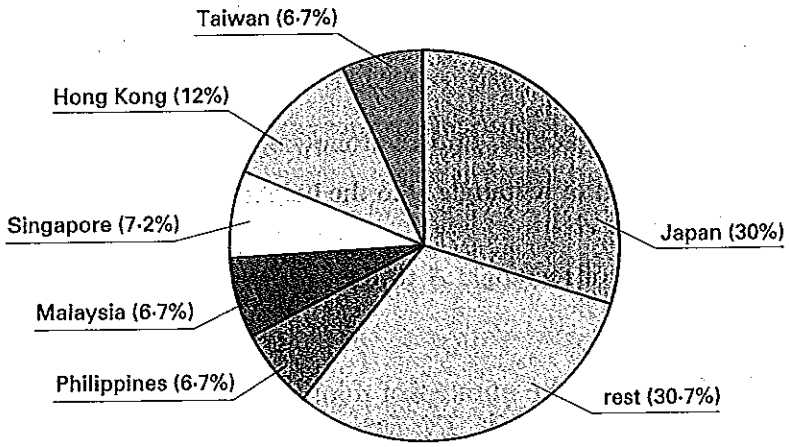
7 a Find the ratio of the volume of the bottle to the volume of the glass.

b How many glasses of this size could be filled from a full 2 litre bottle?



8 In 1995, what was the ratio of the amount of Australian food and drink sold to Japan to the amount of Australian food and drink sold to Hong Kong?

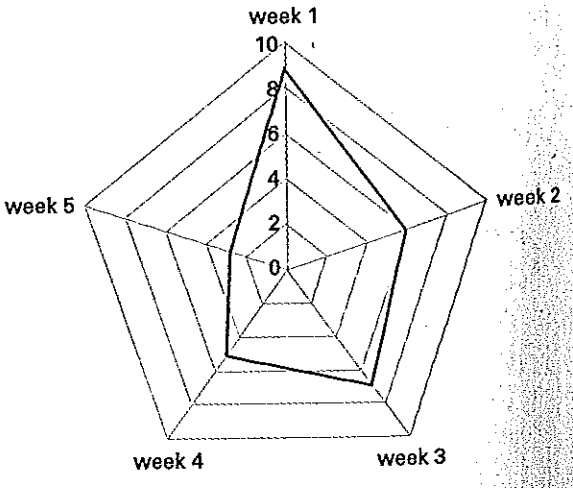
Markets for Australian foods and drinks, 1995



9 In an attempt to reduce crime in Walabourgh the local Council installed video cameras in the town shopping centre for the 5 weeks before Christmas. The report to the January meeting of the Council showed the number of crimes in this period on a radar graph.

What was the ratio of the number of crimes in week 5 to the number of crimes in week 2?

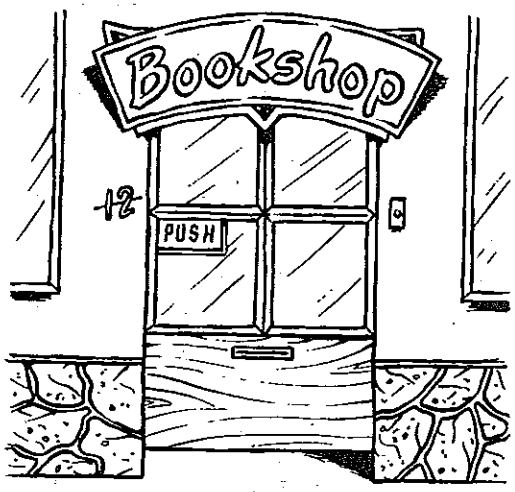
Crimes in the local shopping centre



Solving ratio problems

Example 18

Ruth and Peter invested in a bookshop in the ratio of 4 : 5. Ruth invested $10 000. How much did Peter invest?



Remember
In ratios, order is important.

Solution 18

Ruth invested 4 parts = $10 000

1 part = $10 000 ÷ 4

= $2500

Peter invested 5 parts = $2500 × 5

= $12 500

Example 19

Ali and Mohamad owned a take-away food shop in the ratio of 3 : 2. Their business made a profit of $30 000. How much of the profit will they each receive?

Solution 19

Ali owns three parts of the business and Mohamad owns two parts. The business is divided into five parts.

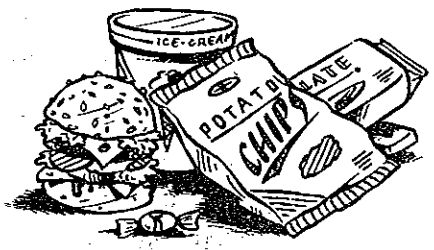
Ali owns $\frac{3}{5}$ of the business and Mohamad owns $\frac{2}{5}$.

$$\text{Ali's profit} = \$30\,000 \times \frac{3}{5}$$

$$= \$18\,000$$

$$\text{Mohamad's profit} = \$30\,000 \times \frac{2}{5}$$

$$= \$12\,000$$



Did you know?
Forgery was a common activity in the 1690s. Within 3 weeks of the first banknotes being issued the first forgery was detected. The first law making forgery a crime was passed in 1697.

ACTIVITY 4:10 Dividing a quantity in a given ratio: card matching activity

Worksheet 4.5 (1)

1 All-purpose cleaner is mixed in various concentrations with water.

a Aaron mixed 15 mL of concentrate with 60 mL of water. What was he cleaning?

b What could Cindy clean with 10 mL of concentrate mixed with 75 mL of water?

c Matthew used 10 mL of concentrate when he mixed a solution to shampoo his carpet. How much water did he use?

All-purpose Cleaner

Ratios given are concentrate to water.

Stoves	1 : 4
Wall cleaning	3 : 10
Carpet shampoo	1 : 12
Furniture	2 : 15
Floor scrubbing	1 : 20

2 Evelyn works as a commercial carpet shampooer. She mixes shampoo with water in the ratio of 1 : 25 to use in her cleaner. How much water will she mix with 75 mL of shampoo?

3 Max mixes 1 litre of red paint with 5 litres of white to make pink paint.

a What ratio of white to red paint does Max use to make pink paint?

b Max needs 24 litres of pink paint. How many litres of red and white paint will he need to mix?

4 Martina makes lollie bags for children's parties. She mixes 4 kg jelly beans, 2 kg chocolates and 3 kg mints to make the party mix.

a What is the ratio of the weight of chocolates to jelly beans in Martina's lollie mixture?

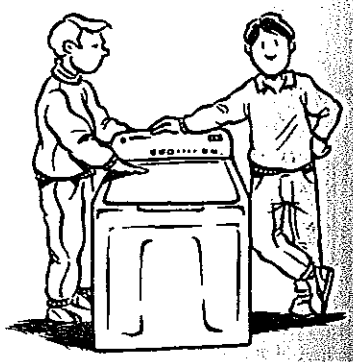
b How many kilograms of mints will she use when she makes a lollie mixture with 5 kg of chocolates?

c Jelly beans cost \$3·60 per kg, chocolates \$8·50 per kg and mints \$4·25 per kg. How much does it cost Martina to make each kilogram of her lollie mixture?

5 Sean and Keith own a laundry business. Sean receives $\frac{4}{9}$ of the profit and Keith receives the remainder.

a In what ratio do they share the profit?

b In February they made a profit of \$7200. How much of the profit did Keith receive?



6 Dates, flour and sugar are mixed in the ratio of 5 : 6 : 1 to make date pudding.

a How much flour is required when 300 grams of dates are used?

b How much sugar is required when 900 grams of flour is used?

7 Laura needs 1 litre of photographic developing solution to develop a film. To make the solution she will mix water and concentrate in the ratio of 9 : 1. How much water and concentrate will she need?

8 In his will Uncle Norman left $72 000 to be shared by his nephews, Andrew, Hugh and Lewis in the ratio of 3 : 2 : 4. How much did Uncle Norman leave each of his nephews?

9 When grandma makes fruit salad she mixes 200 grams of pineapple, 300 grams of peaches and 100 grams of pears.

a How many grams of peaches does grandma need when she makes a fruit salad with 500 grams of pineapple?

b How many grams of pears will she need to make 3 kg of fruit salad?

10 This problem was found on the 'Rhind Mathematical Papyrus', which is one of the oldest collections of maths problems. It was written in Ancient Egypt about 2000 BC.

'A loaf of bread was shared by four people. The amounts they each received were in the ratio of $\frac{2}{3} : \frac{1}{2} : \frac{1}{3} : \frac{1}{4}$. What fraction of the loaf of bread did each person receive?'

Did you know?

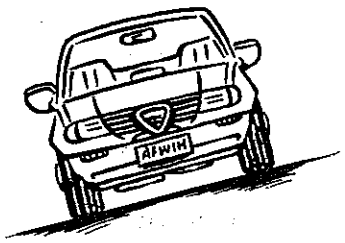
Pythagoras was fascinated by his observation that plucked strings with lengths in each of the simple ratios 1 : 2, 2 : 3 and 3 : 4 produced harmonious sounds when they are played together.

Rates

A rate is a ratio which involves two different units. A rate is usually expressed as an amount per unit, such as 'price per ticket' or 'kilometres per hour'.

Example 20

A car travelled 300 km in 4 hours.
What was its average speed in km/h?



Solution 20

The units often tell you how to do the question.

$$\text{Speed in km/h} = \frac{\text{number of kilometres}}{\text{number of hours}}$$

$$= \frac{300 \text{ km}}{4 \text{ h}}$$

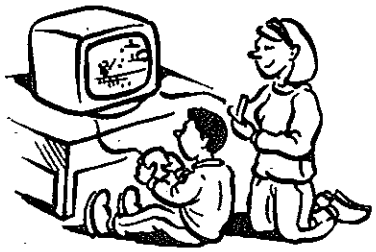
$$= 75 \text{ km/h}$$

Example 21

Kirrilly charges \$9·50 per hour for babysitting.

a How much will she charge for 6 hours babysitting?

b How many hours will she have to work to earn \$47·50?



Solution 21

a Charge = (rate per hour) × (number of hours)

= \$9·50 × 6

= \$57

b Number of hours = $\frac{\text{total amount}}{\text{charge per hour}}$

= \$47·50 ÷ 9·50

= 5 hours

Worksheet 4·3·11

1 A fruit-picking machine can pick 9 avocados per minute.

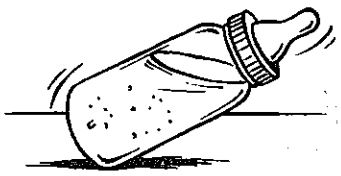
a How many avocados can it pick in an hour?

b How long will it take to pick 1200 avocados?

2 A young baby requires 150 mL of fluid per kg of weight every 24 hours. When Trent was 12 weeks old he weighed 4·8 kg.

a How many mL of fluid did he require per 24 hours?

b At this age his mother gave him four bottles of fluid each day. How many mL were in each bottle?



3 Kylie is knitting a 2 metre long football supporters scarf. She knits 15 cm per night. Will she be able to knit the scarf in 2 weeks? Explain!

4 A highway road crew can lay $5\frac{1}{4}$ km of median strip each day. At this rate, how many days will it take the crew to lay a new median strip along a 200 km strip of the Princes Highway?

5 Ross's car uses 9 litres of petrol to travel 100 km. How much will it cost him to drive 450 km when petrol costs 68·7 cents per litre?

6 When spraying his paddock for pests Fred uses a large spray attached to the back of his tractor. This machine sprays 25 mL/s.

a How many millilitres will he use in 30 minutes?

b How many litres is this?

7 At the height of the flood, 72 000 m^3 of water flooded into a valley every hour. How many litres per second is this? (1000 L = 1 m^3)

8 A new revolutionary method of using treated sewage effluent on farming pastures and crops is being pioneered in Griffith in the Riverina area of NSW. This new method reduces environmental pollution and makes fertilising the land unnecessary. The Griffith sewage works can treat 8 megalitres of sewage per day on a 100 hectare paddock. How many litres of sewage can be treated on a 500 hectare paddock annually. Answer in scientific notation with 3 significant figures.
(1 megalitre = 1 million litres)

9 During peak period the new intercity tunnel toll-gates deal with an average of 2880 cars per hour. The driver of each car pays $2·50 to drive through the tunnel.

a How much money is collected at the toll gates on average during the peak period?

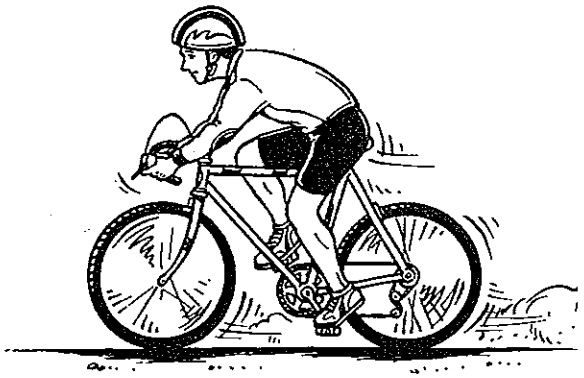
b On average, how many cars per minute go through the toll-gates during the peak period?

c How much money, on average, is collected per minute during the peak period?

Converting rates

Example 22

Matt rode his bike at an average speed of 24 km/h.
What is this speed in metres per second?



Solution 22

His speed is 24 kilometres in 1 hour
is: 24 000 m in 1 hour
or: 24 000 m in 60 minutes
this is: 24 000 ÷ 60 m in 1 minute
or: 400 m in 60 seconds
this is: 400 ÷ 60 m in 1 second
or: 6·67 m/s

Example 23

Simon is a champion athlete. In a coming sprint event he aims to run at a speed of 10 m/s. What is this speed in km/h?

Solution 23

His speed is 10 metres in 1 second
is: 10 × 60 m in 60 seconds
or: 600 m in 1 minute
this is: 600 × 60 m in 60 minutes
or: 36 000 m in 1 hour
that is: 36 000 ÷ 1000 km in 1 hour
or: 36 km/h

Worksheet 4:12

1 In ideal situations bamboo grows 1 metre per day. What is this growth rate in millimetres per minute? Express your answer correct to 1 decimal place.

2 The Australian botanist Ferdinand von Mueller was a prolific writer. Each year he wrote 6000 letters and during his lifetime he published 1500 articles. On average, how many letters did he write per day?

Did you know?
Ferdinand von Mueller encouraged the Italian Government to plant eucalyptus trees in malaria areas. The trees soaked up the swamps where the mosquitoes bred and solved the malaria problem.

3 A supermarket checkout operator can scan eight items in 30 seconds. Calculate her scanning rate in items per hour.

4 The amount of coal remaining in a mine is decreasing at a rate of 20 million tonnes per year. The mine operates for 24 hours per day, 7 days per week. Calculate the rate coal is being removed from the mine in tonnes per minute. Express your answer correct to 2 significant figures.

5 Sound travels at 1100 km/h. What is this speed in metres per second? Express your answer correct to 2 significant figures.

6 A leaking water pipe is dripping water at a rate of 53 drops per minute. Each drop contains 0·3 mL of water.
   a How many litres of water leak from the pipe during a 24-hour period?
   b How long does it take for 1 litre to leak from the pipe? Answer correct to the nearest minute.

7 During a training session a race horse ran 1200 metres in 64·3 seconds. Calculate the horse's average speed in km/h.

8 When Maya was a patient in hospital she was intravenously fed drops of fluid. Maya's doctor said she was to have $2\frac{1}{2}$ litres of fluid per day. One millilitre of fluid contains 15 drops. At what rate should Maya be fed? Express your answer in drops per minute.

9 Water rates are charged per kilolitre of water used.
   a The Birch family's water rates are 80 cents per kilolitre. Last year they used 240 kL of water. How much did they have to pay?
   b This year the cost of water has increased. They had to paid $215 for 250 kL of water. What is the new water rate in cents/litre?

Using percentages

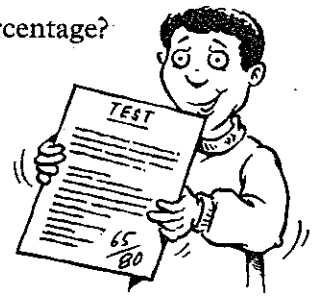
4:13a Fractions, decimals and percentages: card matching activity

Percentages are really only fractions with a denominator of 100.
The zeros at the top and bottom of the per cent sign, %,
remind us of the importance of the 100 in the denominator.

%
⇒/100

Example 24

Kaleb scored 65 out of 80 in a test. What was his mark as a percentage?



Solution 24

$$\frac{65}{80} = \frac{65}{80} \times 100\%$$
$$= 81{\cdot}25\%$$

Example 25

A pepper plant does not produce usable pepper until it is 5 years old and it continues to produce usable pepper until it is 40 years old. For what percentage of the life of a pepper plant does it produce usable pepper?

Solution 25

A pepper plant produces usable pepper for 35 years of the 40-year life of the plant.

$$\text{Percentage of the life of the plant} = \frac{35}{40} \times 100\%$$
$$= 87{\cdot}5\%$$

Did you know?

Salt is a mineral, but pepper comes from a plant and $1{\cdot}7 \times 10^8$ kg of pepper are consumed annually!

Example 26

The price of a computer program was reduced to \$55 from \$80.
What percentage discount is this?

Solution 26

Discount = \$(80 − 55)
= \$25

$$\text{Percentage decrease} = \frac{25}{80} \times 100$$
$$= 31{\cdot}25\%$$

Hint

$$\text{Percentage increase} = \frac{\text{increase}}{\text{original amount}} \times 100\%$$

$$\text{Percentage decrease} = \frac{\text{decrease}}{\text{original amount}} \times 100\%$$

4:13b Percentage conversions: squaresaw

Worksheet 4.13

1 Approximately 3% of Australians are vegetarians. How many of the 2500 Australian people on a large cruise ship would you expect to be vegetarians?

2 One council will not approve house plans if the floor area is greater than 40% of the area of the land on which it is to be built. Jackie's block of land is 480 square metres. What is the floor area of the largest house the council will allow her to build on the block of land?

3 A carpenter ordered 280 nails to complete a job. When she opened the packet she found 15% of the nails were defective. How many defective nails were there?

4 It took an apprentice 72 minutes to replace a broken kitchen cupboard. A qualified tradesman could have done the job in 75% of the time. How long would it have taken a qualified tradesman to do the job?

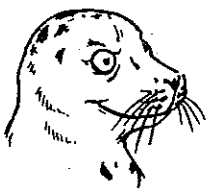
5 Today a good pair of leather shoes costs $120. In 1960 a similar quality pair of leather shoes cost only 15% of today's price. How much did a good quality pair of leather shoes cost in 1960?

6 During his crossing of the Atlantic Ocean on a raft, Thor Heyerdahl saw drifting oil slicks on 40 of the 57 days he was at sea. On what percentage of the days he was at sea did he see drifting oil slicks?

7 During the summer sales Pam bought a towel which is normally priced at $28 for $19. What percentage discount is this?

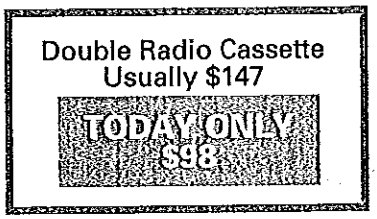
8 Last year a collector purchased a rare manuscript for $3600. Since then its value has increased by 125%. What is the present value of the manuscript?

9 In 1900 the grey seal population in the Baltic Sea was 100 000. Because of pollution and toxic chemicals, the seal population in the Baltic Sea was only 2000 in 1990. By what percentage did the seal population decrease from 1900 to 1990?



10 The cost price of a pair of jeans is $24·50 and the selling price is $37·95. Calculate the percentage profit on the cost price.

11 What percentage discount is being given at this 'Today Only Sale'?



12 The weight of an adult male human brain is 2·49% of his body weight. Calculate the weight of the brain of an 86 kg man.

13 The brain of a 280 gram sparrow weighs 12 grams. What percentage of the sparrow's body weight is the weight of its brain?

14 Slaves in Ancient Rome had a life expectancy of only $17\frac{1}{2}$ years. What percentage of the '3 score years and 10' (70 years) allotted to people in the Bible was the life expectancy of Ancient Roman slaves?

4:13c Working with percentages: review sheet

Repeated percentage calculations

Example 27

Classic Whitegoods offers a 25% trade discount to builders, and a further 3% discount if the account is paid within 10 days. Brian is a builder. He purchased a large refrigerator for $2200 and he paid the account within 10 days.

a How much did he pay for the refrigerator?

b What single discount is equivalent to a 25% discount followed by a 3% discount?

Solution 27

a Trade discount $= \frac{25}{100} \times \$2200$
$= \$550$

Trade price $= \$2200 - \$550$
$= \$1650$

Further discount $= \frac{3}{100} \times \$1650$
$= \$49{\cdot}50$

Final price $= \$1650 - \$49{\cdot}50$
$= \$1600{\cdot}50$

b Total discount $= \$550 + \$49{\cdot}50$
$= \$599{\cdot}50$

Percentage discount $= \frac{\text{discount}}{\text{original}} \times 100\%$
$= \frac{599{\cdot}50}{2200} \times 100\%$
$= 27{\cdot}25\%$

Did you know?

Even though people talk about 5 cents, 10 cents, 20 cents and 50 cents as silver coins, these coins have no silver in them at all. They are 75% copper and 25% nickel. The $1 and $2 coins are 92% copper, 6% aluminium and 2% nickel.

Worksheet 4.14

1 Norman's discount store is having an end-of-year sale, offering 25% off normal prices and a further 10% discount for cash.

a Louise plans to pay cash for a bed which normally sells for $1300. How much will she have to pay for the bed during the sale?

b How much was her total saving?

c What single percentage discount is equivalent to a 25% discount followed by a 10% discount?

2 a Find Sam's Monday Special price for a camera usually priced at $650.

b Is this the same as a 25% discount? Explain your answer.

3 The Thaifoon Restaurant offers 12% discount for take-away meals. They also give 'gold card' customers a further 3% discount. Kate and Jon are gold card customers. They ordered a take-away meal which normally costs $26·40 in the restaurant.

a How much did Kate and John have to pay for their meal?

b What percentage discount did they get?

Did you know?

In 1964 hamburgers cost only 15 cents in American McDonald's stores.

4 In Uther, USA, a federal tax of 12% is added to the selling price of all luxury goods and then a further 4% state sales tax is added. The tax-free selling price of a luxury sports car is $35 000.

a Dean calculated the after-tax price of the sports car by calculating the 12% tax followed by the 4% tax. What did Dean get for the after-tax price of the car?

b The car dealer calculated the 4% tax followed by the 12% tax. Did he get the same price as Dean? Explain your answer.

Did you know?

In 1843, in Virginia USA, the state considered that owning a bathtub was a luxury. An annual tax of $30 was imposed for the privilege of owning such a luxury!

5 a Which store gives the better deal on a 48 cm TV set that usually costs $600?

- Vision Discounts: This week only we are offering a 20% discount, but unfortunately we then have to add a 10% GST.

or

- TV Deals For You: We, of course, have to add a 10% GST, but for this week only we will then give you an enormous 20% off.

b What single discount is equivalent to a 10% increase followed by a 20% discount?

The unitary method of solving problems

Example 28

When Charles bought seven pies from the local bakery they cost him \$16·45. How much would nine pies have cost him?

Solution 28

7 pies cost \$16·45

1 pie costs \$16·45 ÷ 7 = \$2·35

9 pies cost \$2·35 × 9 = \$21·15

Example 29

A farmer estimated that $\frac{3}{4}$ of his sheep were in his shearing pens. He counted 192 sheep in the shearing pens. Approximately how many sheep does he have?

Solution 29

$\frac{3}{4}$ of his sheep = 192

$\frac{1}{4}$ of his sheep = 192 ÷ 3

= 64

$\frac{4}{4}$ (or all) of his sheep = 64 × 4

= 256 sheep

Worksheet 4·15

1 Eight magazines weigh 360 grams. How much will 11 magazines weigh?

2 On average a family used 900 litres of water in 5 days. How much water do they use in a week?

3 Kylie has a holiday job packing boxes in a factory. In 3 hours she packs 45 boxes. How many boxes can she pack during an 8-hour shift?

4 Last Friday only $\frac{2}{5}$ of the beds in the east wing of the hospital were being used by the 30 patients in the wing. How many beds are there in the east wing?

5 In a raffle $\frac{5}{7}$ of the tickets did not win a prize. A total of 36 prizes were won. How many tickets were there?

Percentages in reverse

In England a $17\frac{1}{2}\%$ value added tax (VAT) is added to the price of all goods and services. As they leave the country, overseas visitors can apply for a VAT refund for any large items they purchased.

When Ian bought a jacket for £190 the shop assistant told him he could have the $17\frac{1}{2}\%$ VAT refunded. 'But you don't calculate $17\frac{1}{2}\%$ of £190' he explained.
'The way it works is that 14·89% of the price gives you the $17\frac{1}{2}\%$ VAT refund.'

After you have worked through the examples and questions in Worksheet 4:16 try to write an explanation of why a 14·89% calculation finds the value of a $17\frac{1}{2}\%$ refund.

Example 30

All prices in a shop were reduced by 10% during a sale. Helen paid \$76·50 for a jacket in the sale. What was the normal price of the jacket?

Remember

Adding 10% onto the sale price of the dress does not give the normal price.

Solution 30

The price has been reduced so that

normal price − 10% of normal price = sale price

Let N stand for the normal price of the dress.

$$N - 10\% \text{ of } N = \$76{\cdot}50$$
$$100\% \text{ of } N - 10\% \text{ of } N = \$76{\cdot}50$$
$$90\% \text{ of } N = \$76{\cdot}50$$
$$0{\cdot}9 \times N = \$76{\cdot}50$$
$$N = \frac{76{\cdot}50}{0{\cdot}9}$$
$$N = 85$$

The normal price of the dress is \$85.

Did you know?

Money is one of our most important inventions. Without it, commerce as we know it today would probably never have developed. Many items including shells, coins, rum, cheese and paper notes have been used as money.

Example 31

To determine the selling price of items the 'Corner Clothing Store' adds 35% to the cost price of items. How much profit does the shop make when a coat is sold for $162?

Solution 31

The price has increased so that

cost price + 35% of cost price = selling price

Let C stand for the cost price of the coat.

$$C + 35\% \text{ of } C = \$162$$
$$100\% \text{ of } C + 35\% \text{ of } C = 162$$
$$135\% \text{ of } C = 162$$
$$1{\cdot}35 \times C = 162$$
$$C = 162 \div 1{\cdot}35$$
$$C = 120$$

The cost price of the coat was $120.

$$\text{The shop's profit} = \text{selling price} - \text{cost price}$$
$$= \$162 - \$120$$
$$= \$42$$

The shop makes $42 profit from selling the coat.

Worksheet 4.16

1 Complete the missing values in this table.

Percentage discount	Discount price	Original price
50%	$80	a
20%	$144	b
10%	$99	c
25%	$108	d

2 After it was increased by 20%, the price of a suit became $180. What was the price of the suit before the increase?

3 The number of newspapers sold each day by a newsagency decreased by 10% to 747. How many newspapers were previously sold per day by the newsagency?

4 After Rodney received an 8% pay rise his new annual salary was $39 420. What was his salary before the pay rise?

5 After Christmas Dorothy found her weight had increased to 56 kg which was 12% more than her normal weight. What is her normal weight?

6 Maria collects stamps. During a philatelic (stamp) show and sale she increased the number of stamps in her collection by 3% when she bought 24 stamps. How many stamps did she have in her collection after she added the 24 new ones?

7 A plumber receives a 10% trade discount at the hardware store. After receiving his discount he paid $1710 for his supplies.

a How much did he save with the trade discount?

b What is the normal price of the supplies he bought?

8 During an influenza outbreak 120 students were absent from school with the flu. This represented 30% of the school enrolment.

a How many students were enrolled in the school?

b How many students were not absent from school with the flu?

9 The manager of a bottle shop makes 25% profit on the cost price of all bottles of wine sold in the shop. She charges $12 for a bottle of Open View reisling. A hotel room service charged $30 for a similar bottle of Open View reisling.

a How much profit does the hotel room service make from selling 1 bottle of Open View reisling?

b What percentage profit on their cost price does the hotel room service make?

10 The nursery rhyme 'London's Burning' is about a great fire in London in 1666 in which 80% of the city's buildings were burnt down. During the fire 13 000 houses, 87 churches and St. Paul's Cathedral were burnt down. How many buildings were there in London before the great fire in 1666?

Did you know?

Most of the buildings destroyed in the great fire of London were made of wood. After the fire, stone became the most popular building material.

11 On a questionnaire, 84 students said they liked studying in the library. This represented 16% of the students who completed the survey. How many students who completed the survey didn't like studying in the library?

12 In an 'End of Lease' sale the price of all items in the shop were reduced by 20%. A further 10% discount was given to any customers who paid cash. Barbara paid $360 cash for a lounge suite in the sale. What was the original price of this lounge suite before the 'End of Lease' sale? (Star students only)

13 All goods for sale in England are subject to a $17\frac{1}{2}$% value added tax (VAT). Julian bought two pairs of pants for £188, which included VAT. How much of the price of the pants was the VAT?

Remember to explain why 14·89% of the price of goods in the UK gives the value of the $17\frac{1}{2}$% VAT in the price.