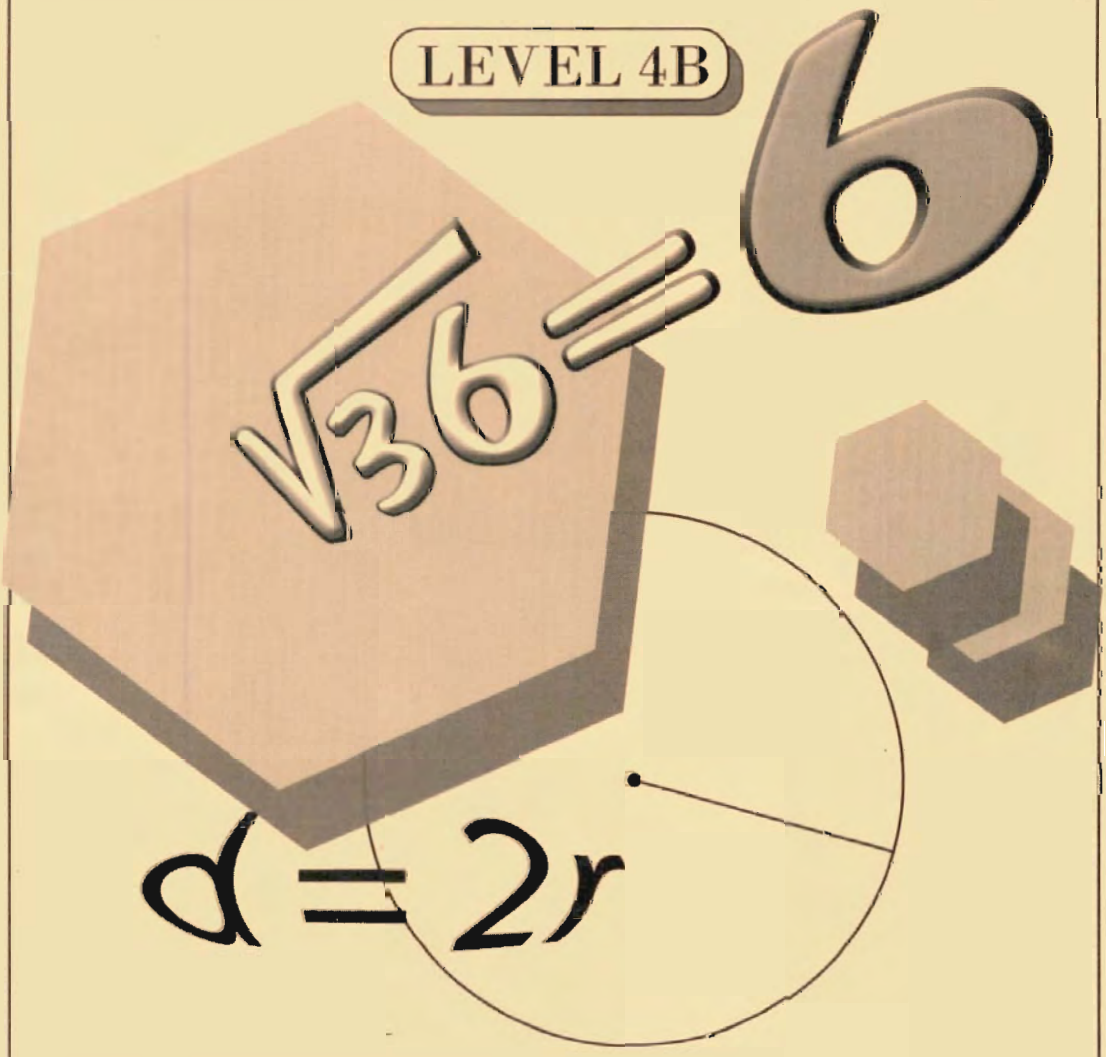
ACCELERATED LEARNING PROGRAM

MATHEMATICS

LEVEL 4B



SECRETARIAT OF EDUCATION
NEW SUDAN

ACCELERATED LEARNING PROGRAM

MATHEMATICS

LEVEL 4B

Secretariat of Education
New Sudan

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2.5 Money

2.5 (a) Profit and loss

Profit = selling price - buying price

Profit percentage = $\frac{\text{profit}}{\text{buying price}} \times 100$

Example

1. Lujang bought some trousers for £s 60 and sold them for £s 110. Calculate
   (i) his profit (ii) his profit percent

Solution

(i) Profit = selling price - buying price
Selling price = £s 110
Buying price = £s 60
Profit = 110 - £s 60 = £s 50

(ii) Profit percent = $\frac{\text{profit}}{\text{buying price}} \times 10 = \frac{50}{60} \times 100$

$= \frac{250}{3} = 83\frac{1}{3}\%$

2. Welnyang bought a chicken for £s70 and later sold it for £s45.
   (i) How much was his loss?
   (ii) Calculate the percentage loss

Solution

(i) Loss - buying price - selling price
Buying price = £s 70
Selling price = £s 45
Loss = £s 70 - £s 45
= £s 25

(ii) Percentage loss = $\frac{\text{loss}}{\text{buying price}} \times 100$

$= \frac{250}{7}$

$= 35\frac{5}{7}\%$

Exercise 30

1. Complete the table below

	Buying price £s	Selling price £s	Profit £s	Percentage profit
(i)	300	450		
(ii)	120	180		
(iii)	500		100	
(iv)		200		40%
(v)	200			30%

2. Adwok bought a cow for £s 2800 and later sold it for £s 3400.
   (i) What was his profit?
   (ii) What was his profit as a percentage?

3. Nyilueth bought a bag of groundnuts during harvest time for £s 450. During the dry season she sold it for £s800.
   (i) Calculate her profit.
   (ii) Write her profit as a percentage.

4. Gatluak bought four goats at £s 250 each. He later sold them for £s 200 each.
   (i) Calculate his loss.
   (ii) Express this loss as a percentage.

5. Find the missing values in the table below

	Buying price £s	Selling price £s	Loss £s	Percentage Loss %
(i)	180			60%
(ii)	360	300		
(iii)		600		40%
(iv)	750			10%
(v)	200	560	40	
(vi)	250			20%

Finding buying or selling price given profits

Examples

(i) Kiden bought a cow which she later sold, making a profit of £s 30. Calculate her buying price, if she sold it at £s 180.

Solution

Buying price = selling price - profit
= 180 - 50
= £s <u>150</u>

(ii) Korok bought a bag of simsim for £s800. Find the selling price if she sold it for a profit of £s100.

Solution

Buying price = selling price - profit
=180 -30
=£s <u>900</u>

(iii) Jackson bought a cow for £s600. He later sold it making a profit of 40%. Calculate his buying price.

Solution

<u>Method (i)</u>

Buying price £s600 = 100%

Percentage profit = 40%

Profit = $\frac{40}{100}$ of £s600 = $\frac{40}{100}$ x 600 = £s240

Selling price = buying price + profit
= 600 + 240
= £s 840

Method (2)
Buying price = £s 600 =100%
Percentage profit = 40%
Selling price = B .P% + profit% = 140%

$$\therefore \text{ Selling price} = \frac{140}{100} \text{ of buying price}$$

$$= \frac{140}{100} \times 600$$

$$= £s\ 840$$

(iv) Peter bought goods worth £s80,000. He later sold them making a loss of 25%. Calculate his selling price.

Method (I)
Buying price £s80,000 = 100%
Loss percentage 25%

$$\therefore \text{ Loss in £s} = \frac{25}{100} \times 80000$$

$$= £s\ 20,000$$

selling price = buying price - loss
= 80,000 – 20000
= £s 60,000

Method (2)
Buying price £s 80,000 = 100%
Loss percentage = 25%

$$\therefore \text{ Selling price} = \frac{75}{100} \times 80,000$$

$$= £s\ 60,000$$

Exercise 31

1. Fill in the table below.

	Buying price (£s)	Selling price (£s)	Profit (£s)
(i)	700	820	
(ii)		600	45
(iii)	400		80
(iv)		300	60
(v)	2500		800
(vi)		4500	150

2. Mary bought goods worth £s75,840 and sold them making a profit of £s 3,450. What was her selling price?

3. A trader bought 4 bags of oranges each for £s650. He later sold them making a profit of £s70 per bag. Calculate his total selling price for the four bags.

4. Taban bought a bag of sugar for £s600. He sold it making a profit of 25%. Calculate his selling price.

5. Akot bought 6 bags of cassava at £s250 each. Later he sold all the bags making a profit of 30%. For how much did he sell them?

6. A trader bought goods worth £s45,000 and sold them making a profit of 30%. What was his selling price?

7. Deng bought a bag of simsim at £s7, 000. He sold it making a profit of £s 1,300.

   (a) Find the selling price
   (b) Express the profit as a percentage of the buying price.

8. Poni bought a bale of second-hand clothes for £s70, 000. She sold it making a profit of 40% of the buying price.

   (a) What was her selling price?
   (b) How much profit did she make?

9. Asha bought a chicken from Zeinab. She later sold it making a profit of 25%. If she made a profit of £s60, find

   (a) The buying price
   (b) The selling price

10. Daniel bought 960 mangoes at £s50 for every 12 mangoes. He later sold them for £s70 for 6 mangoes. Find

   (a) Buying piece
   (b) Total selling price
   (c) Total gain
   (d) Percentage gain

Exercise 32

1. Fill in the following table

	Buying price (£s)	Selling price (£s)	Loss percentage%
(i)	300	240	
(ii)	150		20%
(iii)		200	10%
(iv)	400	320	
(v)	500		30%
(vi)		600	20%

2. Adu bought one ton of oranges for £s9,600. On the way home, some of them were spoiled. Calculate her selling price if she made a loss of 10%.

3. Kiden bought a bag of groundnuts for £s8,600. She later sold it, making a profit of 50%. What was her selling price?

4. Alphayo bought a second-hand car for £s780,000. After one year, he sold it to his friend but at a loss of 25%. How much did Alphayo receive for his car?

5. A dealer in second-hand clothes bought a bale of T-shirts for £s60,000. When he opened it he found some T-shirts were not worthy for sale. He threw them away and sold the rest, making a loss of 30%. Calculate his selling price.

6. An article was sold at 10%. Find its selling price if it was bought for £s500.

7. Samson bought a bag of sugar weighing 70kg for £s30,000. During the course of transporting the sugar, some poured out. When he reached his shop, he found that the bag weighed 60kg. If he sold the sugar at £s400 per kg, find:

   (a) Total selling price.
   (b) Loss in £s.
   (c) Percentage loss.

8. Anguec bought a chicken for £s250. She later sold it, at a loss of 3%. Find

   (a) Her loss in £s.
   (b) Her selling price.

9. Haram bought 10 trays of eggs at £s6, 000. When she arrived home, she found that 2 trays of eggs were broken. She sold the remainder at £s400 per tray.

   (a) Calculate her total sales.
   (b) Calculate her loss.
   (c) Calculate her percentage loss.

10. Fill in the table below.

	Buying price (£s)	Selling price (£s)	Profit (£s)	Loss (£s	Profit (%)	Loss%
(a)	2500		700			
(b)		8000				20%
(c)	6000				30%	
(d)	4500			500		
(e)		30,000		5000		

2.5 (b) Discount and percentage

A discount is an amount reduced from the selling price or the amount deducted from the marked price when selling goods.

Example

Discount = marked price - selling price

(i) The marked price for a dress in a certain shop was £s120. After bargaining, Rita bought the dress for £s100. Calculate her discount.

Solution

Discount = marked price-selling price
=120 -100 = £s 20

(ii) The marked price of a teapot is £s540. If Saida was allowed a discount of £s20. What was the:

(a) selling price?
(b) percentage discount allowed?

Solution

(a) selling price = marked price - discount
= 540 – 20
= £s 520

(b) percentage discount

N.B percentage discount

$$= \frac{\text{Discount} \times 100}{\text{marked price}} \%$$

$$= \frac{210^{10}}{540^{27}} \times 100 = \frac{100}{27}$$

$$= 3\frac{19}{27} \%$$

(ii) Uchalla bought a hammer for £s619, after being given a discount of £s31. Calculate the marked price for the hammer.

Solution

Marked price = selling price +discount
= 619 + 31
= £s 650

Exercise 33

1. Fill in the following table

	Marked price(£s)	Selling price(£s)	Discount (£s)	Percentage Discount%
(i)	800	720		
(ii)		620	30	
(iii)	400			20%
(iv)		950		5%
(v)	350		50	
(vi)		540	60	

2. Kergogo bought a pair of shoes for £s800. If the marked price was £s875, how much discount was allowed?

3. The marked price for a shirt was £s 450. If Wayo bought it for £s425, how much discount was allowed?

4. The marked price for a towel is £s 85. Santino bought 4 such towels for £s 65 each. How much discount was allowed for the 4 towels?

5. A customer bought a pair of trousers for £s 560. If the marked price was £s815. How much was the discount?

6. The marked price for an umbrella is £s 850. If the discount of £s30 is allowed, find the selling price.

7. The marked price for a pair of shoes is £s 200. Michael bought them for £s 180. Calculate the:

   (i) Discount allowed
   (ii) Percentage discount

8. Kenyi bought a pair of trousers for £s 2200 after being allowed a discount of 12%. Find the marked price.

9. Adwok bought a bag of beans for £s550 after a discount of £s50. Calculate the

   (a) marked price
   (b) percentage discount

10. A clearance sale has given a discount of 10% on the following items, whose marked prices are shown below.

    (i) A pair of shoes £s8700
    (ii) A set of water glasses £s 800
    (iii) A dress £s 1800.

    Find the buying price for each item

2.5 (c) Commission and discount

Commission is the amount of money paid for the service rendered. For example when we send money orders or postal orders, the post office charges a commission for the services. Some salesmen are paid commission depending on the number of sales made.

Examples

(i) For every sale of goods worth £s 2,000, Guma has paid a commission of £s 250.

   (a) What would be his commission if he makes sales worth £s6,000?

   (b) Find his commission percentage rate

Solution

(a) Commission for every £s 2,000 worth of sales = £s 250

$\therefore$ Commission for £s 6000 = $\frac{250}{2000} \times 6000$

= £s 750

(b) Commission for every £s 2,000 = £s 250

$\therefore$ Commission percentage rate = $\frac{250}{2000} \times 100$

= 12½%

(ii) A salesman is paid 5% commission on the sales he makes. One day he made a sale of £s 5660. How much commission was he paid?

Solution

Total Sales = £s 5660
Commission = 5% of 5660

$= \frac{5}{100} \times 5660$

= £s 283

(iii) A saleslady received £s 200 commission. If this commission is equal to 25% of the total sales, find the total sales.

Solution

Commission received = £s 200
Commission % = 25%
Total sales = 100%

$\therefore$ Total sales $= \frac{100}{25} \times 200$

= £s 800

Exercise 34

1. For every sale of goods worth £s 400, the salesman receives £s 60 as commission.
   (a) Express the commission as a percentage.
   (b) How much will the salesman get for the sale of goods worth:

   (i) £s 7,800 (ii) £s 4500 (iii) £s 10,300
   (iv) £s 8,000 (v) £s 35,000

2. Bahara, a salesman in a food store, is paid £s 60 commission for every sale of goods worth £s 400.
   (a) Express this commission as a percentage
   (b) How much would he receive for the sale of goods worth

   (i) £s 500 (ii) £s 900
   (iii) £s 450 (iv) £s 860

3. Gore charges a commission of 5% for every cow he sells for his employer. How much commission would he receive for selling a cow worth:
   (a) £s 750 (b) £s 3200 (c) £s7400

4. A sales girl receives 2½% commission for the value of her sales. Calculate the amount of commission she would receive for the following sales:
   (a) £s 8000 (b) £s 3750
   (c) £s 9500 (d) £s 15,600

5. Each primary mathematics book costs £s70. If a book seller sells 500 books at a commission of 10%, how much commission is he paid?

6. Lydia, a sales girl earns a salary of £s 2000 per month. On top of her salary she earns a commission of 15% of the total sales she makes. How much does Lydia earn at the end of the month if she sells goods worth £s 6500?

8. Rokombo earns a salary of £s 4,500 and he is allowed a commission of 6% on goods sold. One month he sold goods worth £s3,500.
   (a) What was his commission?
   (b) How much money did he earn that month?

9. A salesman received £s 25,500 as commission on total sales he made. If this was 20% of the total sales, calculate the total sales.

10. Ajongo is paid a commission of 20% for the first £s 1000 sales he makes and 10% for the rest of sales over £s 1000. One month he made sales worth £s 8,750. What commission was he paid?

2.5 (d) Hire Purchase

Hire Purchase is a method of paying for items slowly over an agreed period of time. The principle of hire purchase is that a person can own property by first paying a deposit (down payment) and the rest of the payment is paid in installments spread over a period of time.

Examples

(i) Gregory bought a washing machine on hire purchase terms. He paid a deposit of £s 600. The rest of the money was to be paid in 8 monthly installments of £s600 each. Find the total hire purchase price for the washing machine.

Solution

Deposit = £s 600

Total money paid in 8 installments = 8 x 600 = £s 4800

5400

(ii) Wani bought a sewing machine on hire purchase for £s13.00 and the balance in equal monthly installments of £s10,000. In how many installments did he pay the balance?

Solution

Hire purchase price	£s = 63,000
Deposit	£s = 13,000
Balance	£s = 50,000

Monthly installments =£s 10,000

Number of installments = $\frac{50000}{10000}$ = 5 months

2.5 (e) Solving problems on Hire Purchase, Profit and Loss

1. Okony bought a radio on hire purchase terms. He paid a deposit of £s 700. He agreed to pay the rest of the money in 8 equal monthly installments of £s98 each. How much money did Okony pay for the radio?

2. Pia bought a bed on hire purchase terms. She paid a deposit of £s 800 and agreed to pay the rest of the amount in 5 monthly installment of £s 200. How much was the total hire purchase price?

3. Agali bought groundnuts from Aya on hire purchase terms. She paid a deposit of £s6,100 and the rest of the money by monthly installments of £s 600. How many months did she pay for the groundnuts if the total cost was £s 11,500?

4. Majak bought an ox-plough for £s10,000 on hire purchase terms. He first paid a deposit of £s 3500 and the rest of the money is 13 equal monthly installments. How much money did he pay every month?

5. The marked price for a radio is £s 5400. Aduok bought it on hire purchase terms. If he paid 30% of marked price as deposit and the rest of the money he was to pay in 12 monthly installment of £s 375,

   (i) What was the total hire purchase price?
   (ii) How much more did he pay than the marked price?

6. Sebit bought a bicycle on hire purchase terms. He paid a deposit of £s 15,000. The rest of the money was to be paid in 12 equal monthly installments of £s 600 each. Find the total hire purchase price.

7. The cash price of a table is £s 12, 000. Ujiri bought it by hire purchase by paying first a deposit of £s 6000. If he paid the rest of the money in 5 equal monthly installment of £s 2,000, what would he have saved if he bought the table cash?

8. The marked price for a bed is £s 30,000. Zackaria bought it on hire purchase terms by first paying £s 12,000 deposit. If he paid the rest of the money in 15 equal monthly installments of £s 2,000 each.

   (a) How much was the hire purchase price?
   (b) How much less could he have paid if he bought the bed by cash?

9. An ox-plough cost £s 74,000 on hire purchase terms. Deng bought the ox-plough by first paying a deposit of £s 40,000. If he agreed to pay the rest of the money in 17 equal monthly in installments, how much was each installment?

10. Yugusuk bought a plough on hire purchase. He paid a deposit of £s 10,000 and the balance in equal monthly installments which were 25% of the deposit. The hire purchase price was £s 27, 500. In how many installments did he pay

2.5 (f) Solving problems involving simple interest and compound interest

2.5 (e) (i) Simple Interest

Banks receive money from customers as deposits. The bank lends out their money to borrowers. The bank pays the depositors some amount of money for use of their deposits. Similarly, the borrowers pay some amount of money to the bank for the use of their money.

This amount paid for the use of money is called interest. Interest is expressed as a percentage of the money borrowed or deposited per year.

Terms used in this topic:

- **principal (p)** Amount deposited or borrowed
- **rate (r)** Percentage interest rate per annum (year)
- **time (t)** Period for which money is deposited or borrowed

$$\text{Interest} = P \times T \times \frac{R}{100} \text{ or } \frac{P \times T \times R}{100}$$

Examples

(i) Lako borrowed £s 7500 from a bank at an interest of 10% p.a. How much interest did he pay at the end of 1 year?

Solution

$$\text{Interest} = p \times t \times \frac{r}{100}$$

Where principal = £ 7500
Rate = 10%
Time = 1 year

$$\text{Interest} = 7500 \times 1 \times \frac{10}{100}$$

$$= £s\ 750$$

(ii) Kaku deposited £s 45,000 in a bank for 8 months at a rate of 15%. How much interest did her money earn for the 8 months?

Solution

P = £s 45,000
T = 8 months $\left(\frac{8}{12}\right)$ years

R = £s 15%

$$\therefore \text{Interest} = P \times T \times \frac{R}{100}$$

$$= 45{,}000 \times \frac{\overset{2}{\cancel{8}}}{\underset{3}{\cancel{12}}} \times \frac{\overset{5}{\cancel{15}}}{\cancel{100}} = £s\ 4{,}500$$

(iii) Chol borrowed a loan of £s 520,000 from a bank. He repaid the money in 4 years. If the bank received an interest of £s 130,000, what was the rate of interest charged?

Solution

P = £s 520,000
I = £s 130,000
T = 4 years
R = £s

$$\therefore R = \frac{1 \times 100}{P \times T} = \frac{130{,}000}{520{,}000} \times \frac{100}{4} = 6\tfrac{1}{4}\%$$

(iv) Agum deposited £s 40,000 in a bank. If the bank offered her an interest rate of 10%, how long would it take for her to earn 10,000 as interest?

Solution

P = £s 40,000
R = £s 10%
I = £s 10,000
T = ?

$$\therefore T = \frac{I \times 100}{P \times R} = \frac{10{,}000}{40{,}000} \times \frac{100}{10} = \frac{5}{2} = 2\tfrac{1}{2}\%$$

(v) Juma invested some money in the bank for 5 years. At the end of the period he earned an interest of £s 150,000. If the interest was calculated at 12% p.a.

(a) Calculate the amount invested
(b) Total amount paid to Juma by the bank

Solution

$$P = \frac{I \times 100}{R \times T}$$

(a) P = ?

$$\therefore P = \frac{\overset{10{,}000}{\cancel{150{,}000}}}{\underset{4}{\cancel{12} \times \cancel{5}}} \times = \frac{25}{\cancel{100}} = £s\ 250{,}000$$

T = 5 years
R = 12%
I = £s 150,000

(b) Total Amount = Principal + Interest
= £s 25,000 + £s 150,000
= £s 400,000

Exercise 36

1. Calculate the interest earned by the following deposits:

   (a) £s 8,000 for 3 years at 12% p.a
   (b) £s 90,000 for 8 months at 15% p.a
   (c) £s 130,000 for 2 years at 18% p.a
   (d) £s 60,000 for 3½ years at 10% p.a

2. A certain firm deposited £s 60,000 in a bank at an interest rate of 15% p. a. After 4 years the firm withdrew all the money they had in their account including the interest earned for the 4 years.

   (a) Calculate the interest earned by the firm in the 4 years.
   (b) How much money did they have altogether in their account after the 4 years?

3. Calculate the interest earned on £s 720,000 saved for a period of 4 years. The interest was calculated at the rate of 18% p.a

4. Makuac invested £s 3,250,000 in a bank for a period of 1¼ years. If he earned interest of £s 700,000, at what rate was the interest paid?

5. A businessman invested £s 80,000 in a bank which paid him interest of £s 48,000 at the rate of 12% p.a for how long did the money stay in the bank?

6. Rizig invested some money in a bank. After 4 years he earned interest of £s 32,000. If this interest was calculated at 8% p.a

   (a) Find the original amount invested
   (b) Find the total amount Rizig received from the bank.

7. From the chart below calculate the principal and total amount

	Principal(£s)	Time	Rate %	Interest (£s)	Total amount
(a)		2 years	10	37,800	
(b)		8 months	8	51,600	
(c)		4 years	13	34,650	
(d)		3 ½ years	6	135,000	
(e)		2 years	6 ½	150,000	
(f)		1 ½ years	$12\frac{1}{3}$	47,065	

8. Calculate the interest in the tale below.

	Principle	Rate	Time	Interest
(a)	£s 55,000	7%	1 year	
(b)	£s 40,000	$4\frac{1}{3}$%	8 months	
(c)	£s 25,000	6½%	6 months	
(d)	£s 42,000	8½%	4½ years	
(e)	£s 890,000	6%	2¾ years	
(f)	£s 390,000	12½%	3 years	

9. Calculate the rate for the following investment.

	Deposit (£s)	Time	Rate %	Interest earned(£s)
(a)	160,000	3 years		38,400
(b)	224,000	3 years		63,840
(c)	25,800	4 years		6,192
(d)	820,000	2 ¼ years		129,150
(e)	546,000	5 years		300,300
(f)	666,000	8 months		8,800
g)	596,000	1 ¼ years		62,580
h)	750,000	9 months		720,000

10. Find the time required in the table below.

	Principal	Rate %	Interest ((£s)	Time
a)	48,000	12	3,840	
b)	860,800	7½	146,336	
c)	200,000	$5\frac{1}{5}$	25,263	
d)	153,900	$3\frac{2}{5}$	43,180	
e)	750,000	9¼	450,000	
f)	850,800	5	390,000	

2.5 (e) (i) Compound Interest

In compound interest, the interest earned at the end of each period is added to the principal to form the principal for the next period.

Example

Bakumba deposited £s 400,000 in the bank. The bank paid compound interest at the rate of 10% per annum. Find

(a) Total interest paid by the end of the 3 years.
(b) Total amount with drawn at the end of the 3 years.

Solution

First year

Calculate the interest in the first year.
Principal =£s 400,000
Time I = 3 year
Rate = 10%
I = ?

Solution

$$I = P \times \frac{R \times T}{100}$$

$$= 400{,}000 \times \frac{10}{100} \times 1 = 40{,}000$$

Second year

New principal = original principal +Interest
= 400,000 +40,000
= £s440,000
I = 44,000

Third year

New principal = 440,000 + 44,000

= 484,000

$I = 484{,}000 \times \frac{10}{100} \times 1$

(a) Total interest at the end of 3 years
interest earned first year = 40,000
interest earned second year =44,000
interest earned third year = 48,400
Total interest earned £s 132,400

(b) Total amount withdrawn at the end of three years
= original principal + interest for 3 years
= 400,000 + 132,400 = £s 532,400

Exercise

1. A Trader deposited £s 300,000 with a bank which paid compound interest at the rate of 15% p.a

   (a) What interest did he get at the end of the 2 years?
   (b) If he withdraw all the money at the end of this period, how much money did he withdraw?

2. A farmer deposited £s800,000 in a bank for 3 years. He was paid compound interest at the rate of 10% p.a If he withdraw the interest at the end of 3 years, how much money was he given?

3. A businessman borrowed £s 600,000 from his bank which charges compound interest at the rate of 12% p.a If he paid the loan plus the interest within 2 years, how much money did he pay back?

4. A shopkeeper took a bank loan of £s90,000 to improve his business and repaid it after 3 years. If he was charged compound interest of 10% p.a, how much money did he pay back?

5. A group of 20 women contributed £s 20,000 each in order to start a business. They deposited this amount in a bank for 3 years while deciding on which business to start. The bank paid compound interest at the rate of 18% p. a .

(a) If they withdrew all the money at the end of the 3 years, how much money did they get?
(b) If they shared the money so that each person could start her own business, what was the share for each person?

6. Malual deposited three quarters of a million Sudanese pounds in a bank that paid him compound interest at the rate of 15% per annum:

(a) How much interest did his money earn after 2 years?
(b) What was the total amount of money he withdrew at the end of 4 years?

2.6 Time and Speed

2.6 (a) 60 seconds = 1 minute,
60 minutes = 1 hour

Example

(a) Convert into minutes:
(i) 240 sec (ii) 145 sec

Solution

(i) 60 sec = 1min
$\therefore 240 \text{ sec} = \left(\frac{240}{60}\right) \text{ min}$
$= 4 \text{ min}$

(ii) $145 \text{ sec} = \left(\frac{145}{60}\right) \text{ min}$
$= 2\frac{5}{12} \text{ min}$

(b) Change into seconds

(i) 3 min (ii) $4\frac{3}{4}$ min

Solution

(i) 1 min = 60 seconds

$\therefore$ 3 min = (3 x 60) sec

= 180 sec

(ii) 1 min = 60 seconds

$\therefore 4\frac{3}{4}$ min = $(\frac{19}{4} \times 60)$ sec

= 19 x 15 = 285 sec

(c) Change into hours

(i) 360 min (ii) 140 min

Solution

(i) 60 min = 1 hour

$\therefore 360 = (\frac{360}{60})$ hours

= 6 hrs

(ii) 60 min = 1 hour

$\therefore 140 = (\frac{140}{60})$ hours

$= 2\frac{1}{3}$ hrs

(d) Change into minutes

(i) $5\frac{1}{2}$ hrs (ii) $2\frac{3}{4}$ hrs

Solution

(i) 1 hour = 60 min

$\therefore$ $5\frac{1}{2}$ hrs = $(\frac{11}{2} \times 60)$ min = 11 x 30 min = 330 min

(ii) 1 hour = 60 min

$\therefore$ $2\frac{3}{4}$ hrs = $(\frac{11}{4} \times 60)$ min = 11 x 15 min = 165 min

Exercise 38 (a)

1. Change the following seconds into minutes.
   (i) 75 sec (ii) 480 sec (iii) 160 sec (iv) 1120 sec

2. Convert the following minutes into seconds.
   (i) 1½ min (ii) 3.8 min (iii) $5\frac{1}{3}$ min (iv) $4\frac{3}{5}$ min

3. Change the following minutes into hours.
   (i) 650 min (ii) 290 min (iii) 3480 min (iv) 905 min

4. Express the following hours as minutes
   (i) 1¾ hours (ii) 4.75 hrs (iii) $3\frac{3}{5}$hrs (iv) 6 hours

5. How many hours are there in:
   (i) 7200 sec (ii) 6400 sec (iii) 2900 sec (iv) 4800 sec

6. Work out the following

(i)

	hr	min	sec
	4	20	15
	2	80	75
+	1	14	30

(ii)

	hr	min	sec
	3	75	45
	7	95	68
+	4	16	27

(iii)

hr	min	sec
8	50	38
	x	5

(iv)

hr	min	sec
7	35	40
	x	8

(v)

	hr	min	sec
	9	48	15
-	5	59	57

(vi)

	hr	min	sec
	12	16	21
-	9	49	36

(vii) 9)13 hr 7 min 5 sec (viii) 7)16 hr 1 min 2 sec

7. An examination started at 8:30 a.m and ended at 10:45 a.m. How long was the examination?

8. After being in a meeting for 3½ hours, the participants took a break of 30 min. After the break the meeting continued until 1:30 p.m. What time did the meeting start?

2.6 (b) Average Speed

$$\text{Speed} = \frac{\text{Distance travelled}}{\text{Time taken}}$$

Example 1

Deng walks 6 kilometres from home to school in 2 hours. What is his average speed?

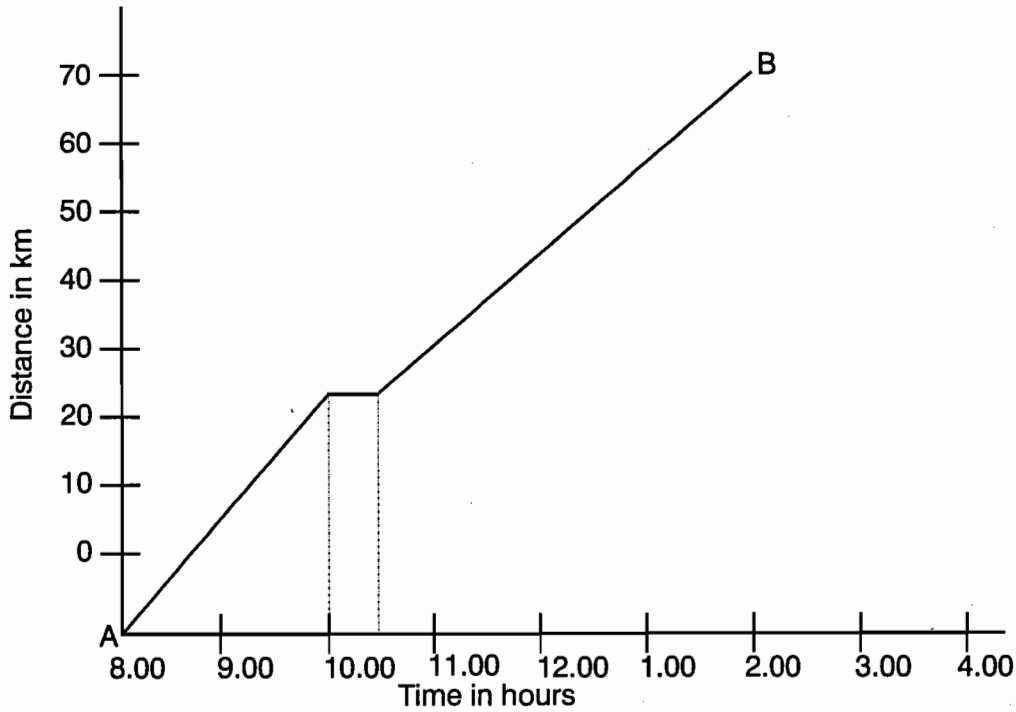
Solution

Distance = 6 kilometres
Time taken = 2 hours

Therefore speed $= \frac{D}{T} = \frac{\cancel{6}^{3}}{\cancel{2}} = 3\text{km/h}$

Example II

The graph below shows journey of a cyclist between two stations A & B.



(a) At what speed was she travelling before resting?
(b) How long was the rest?
(c) At what speed was she travelling after resting?
(d) What was her average speed for the whole journey?

Solution

(a) Distance travelled before resting is = 30 km
Time taken to travel 30km = 2 hrs

$$\text{Therefore speed} = \frac{\text{Distance}}{\text{Time}} = \frac{30}{2} = 15\text{km/h}$$

(b) Time of rest from 10.00am - 10.30am
Therefore time of rest = 10.30 - 10.00am = 30 mins

(c) Speed after resting:
Distance traveled after resting = 70 - 30 = 40 km
Time taken after resting = 10.30 to 2.00pm
Therefore time taken = 2.00pm - 10.30am = 3½ hrs

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \frac{40\text{km}}{3\tfrac{1}{2}\text{hrs}} = \frac{40}{3.5} = 11\frac{3}{7}\text{ km/hr}$$

$$\text{(d) Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

$$= \frac{70\text{km}}{6\text{hrs}} = 11\frac{2}{3}\text{km/hr}$$

Exercise 38 b

1. A bullet was fired at 600m/s and traveled 2 sec before hitting the target. How far away was the target?

2. Nyang and Alice set off from home to the show ground. Nyang cycled at 20km/h and took 30min while Alice walked and took 2½hrs.

   (a) How far was it from home to the show ground?
   (b) What was Alice's walking speed?

3. A motorist set out to travel between town A & B. After travelling for 1½hrs, he had a tyre punch which took him 20 min to repair. He continued for 4 hrs before he reached town B. If his average speed for the whole journey was 72km/h.
   (a) How far is town B from A?
   (b) What would have been his average speed if he had not got a tyre punch.

4. An athlete runs 400m in 40second.
   (a) Find his average speed in m/s.
   (b) Find his average speed in km/h.

5. An aircraft flew from Lokichoggio in Kenya to Akot in Sudan, a distance of 900km. The plane took 4½ hrs to cover the distance. Calculate
   (a) Its speed in km/h.
   (b) Its speed in m/s.

6. A cyclist takes 30 minutes to cover 9 km. What is his speed in m/s?

7. A truck travels at 10m/s. Calculate its speed in km/h

8. The distance from Akello's home to the market is 16km. It took her $2\frac{2}{3}$ hrs to reach the market. Calculate her speed in m/s.

9. A cyclist traveled at a speed of 10m/s. If he covered a distance of 54000m,
   (a) Calculate the time taken for the whole trip.
   (b) Express the speed in km/h.

10. A motorist left Maridi at 6.30 am and arrived at Akot at 8.30 pm. If he was traveling at a speed of 72km/h, calculate the distance covered.

11. An athlete runs at a speed of 10m/s. If he runs at a consistent speed for 2 hrs, what distance does he cover in km?

2.6 (c) Converting speed in km/h to m/s and vice versa

Example

(i) A motorist traveled at a speed of 45 km/hr. Express this speed in m/s.

Solution

Change the distance traveled in km to m.

1km = 1000 m

∴ 45 km = (45 x 1000)m = 450000m

Change the time in hours to seconds

1hr = 60 min

1 min= 60 sec

∴ 1hr = 60 min = 60 sec x 60 = 3600 sec

$$\text{Speed} = \frac{\text{Distance}}{\text{time taken}} = \frac{45{,}000}{3{,}600}$$

= 12½ m/s

(ii) A motorcyclist traveled at a speed of 40m/s. Express this speed in km/h.

Solution

Distance covered in 1 sec = 40 m. Express this distance in kilometres.

1000m = 1 km

$\therefore$ 40 m = $\left(\frac{40}{1000}\right)$ km = distance covered

Time taken is 1 sec. Express this time in hours

60 sec = 1 min

60 min -= 1 hr

∴ 3600 sec = 1 hr

$\therefore$ 1 sec = $\frac{1}{3600}$ hr

$\therefore$ Time taken in hours $= \frac{1}{3600}$

$\therefore$ Speed $= \frac{\text{Distance}}{\text{time taken}}$

$= \frac{40}{1000} \div \frac{1}{3600} = \frac{40}{1000} \times \frac{3600}{1}$

$= 144$ km/hr

Finding Time

Example

Lado covered a 400 metres race at a speed of 10m/s.

(a) How long did Lado take to finish the race?

(b) Calculate the speed in km/h

Solution

(a) Time $= \frac{\text{Distance}}{\text{speed}} = \frac{400}{10} = 40$ sec

(b) Distance = 400m, speed = 10 m/s

Therefore speed in km/h $= \frac{\text{Distance}}{\text{time}}$

$= \frac{400}{1000} \div \frac{40}{3600} = \frac{400}{1000} \times \frac{3600}{40}$

$= 36$ km/hr

Finding Distance

Example

Gofolo drove from his home to the air-strip at a speed of 50km/h. If he took 30 min to reach the air-strip, how far is the air-strip from his home?

Solution

Distance = Speed x Time taken

= speed 50km/h

Time taken = 30 min

$$\text{Distance} = \overset{25}{\cancel{50}} \times \frac{\overset{1}{\cancel{30}}}{\underset{2}{\cancel{60}}} = 25 \text{ km}$$

Exercise 38 (c)

1. Express the following km/h in m/s

   (a) 27km/h (b) 63km/h (c) 72km/h (d) 90km/h (e) 300km/h

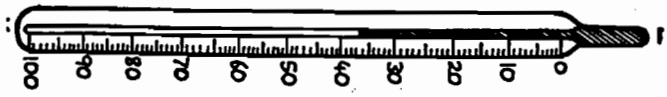
2. Express the following m/s in km/h

   (a) 8mls (b) 60m/s (c) 30m/s (d) 75 m/s (e) 150m/s

2.7 Temperature

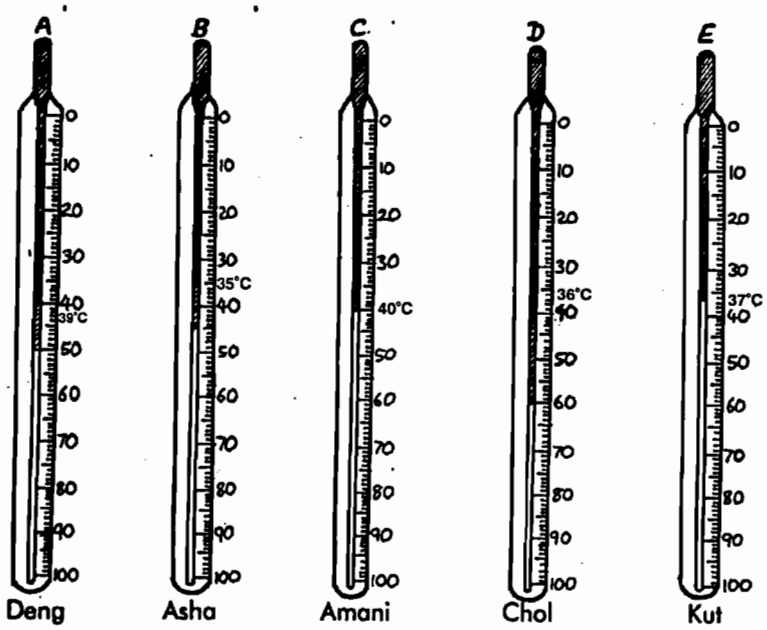
2.7 (a) Degree as a unit of measure for Temperature

Temperature is the hotness or coldness of a body, object or a place. The instrument used to measure temperature is a thermometer.



The unit of measure is the degree Celsius (°C).
At sea level (for example, at Mombasa) water boils at 100°C and freezes at 0°C.

2.7 (a) Reading temperature in degrees celsius from a thermometer



Exercise 39

1. The following therrnometers show the temperatures of different patients recorded by a doctor. Read and record the correct temperature for each patient.

2. Using the above thermometer, answer the following questions

   (a) Which patient had the highest temperature?

   (b) Which patient had the lowest temperature?

   (c) What is the difference between the temperatures of Asha and Kut?

3. The temperature of water in a container was 18c. The container was placed on the fire until the water boiled. What was the rise in temperature?

4. At 8:00 am on Monday the temperature was 15c. At 2:00 pm the temperature was 24c. How many degrees did the temperature rise?

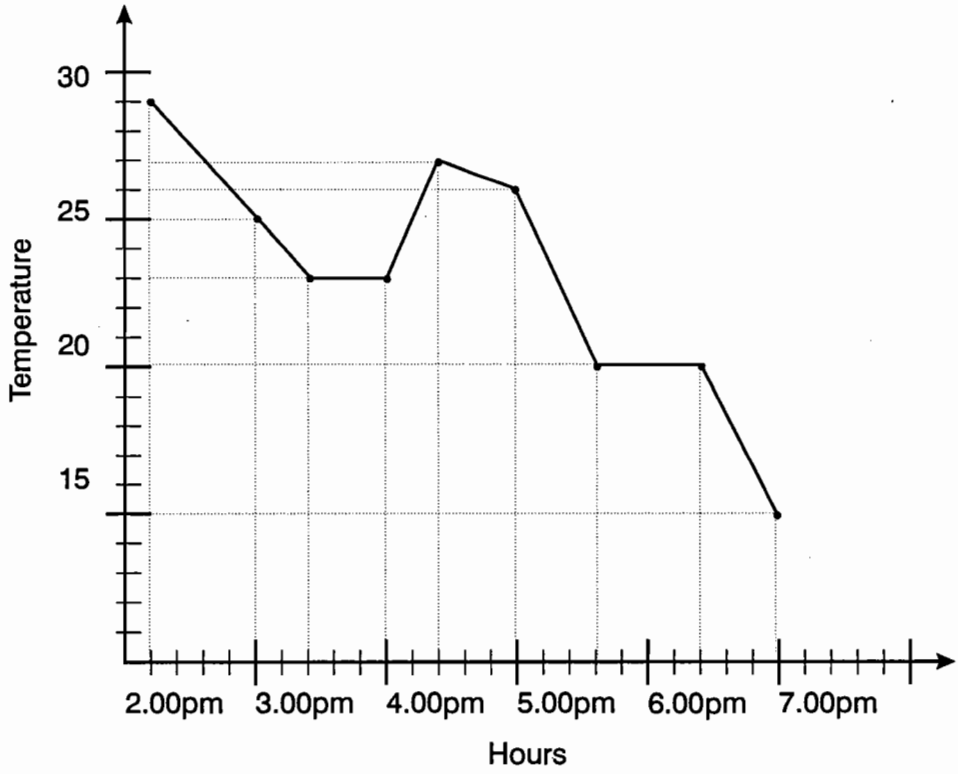
2.7 (c) Solving problems involving temperature

1. At 7.00am on Tuesday the temperature was 32°C. At 2.00pm the temperature was 39°C. What was the rise in temperature?

2. The temperature of water in a container was 20°C. The container was placed on a fire until the water boiled. What was the rise in temp?

3. The temperature of frozen mass of ice was 18°C below the zero mark. The ice was warmed until there was rise of 32°C. What was the reading on the thermometer?

Graph showing temperature during the day



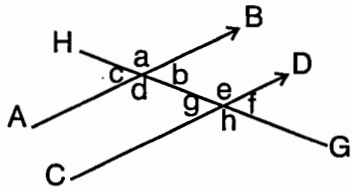
(a) At what time did the temperature dropped to the lowest?
(b) What was the drop in temperature between 2.00pm and 4.00pm.
(c) What was the temperature reading at 4.24pm?
(d) At what hours of the day was the temperature constant?

UNIT 3 Geometry

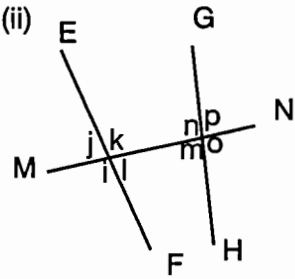
3.1 (a) (i) Transversal lines

A line that crosses any two or more lines is called a transversal line.

(i)

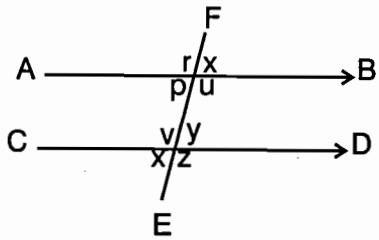


(ii)



In the figures above HG and MN are transversals

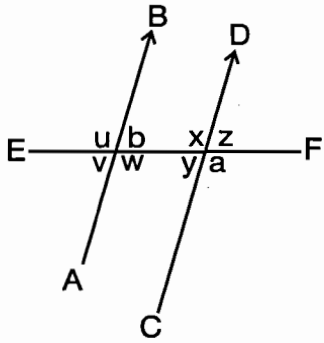
3.1 (a) (ii) Parallel lines:



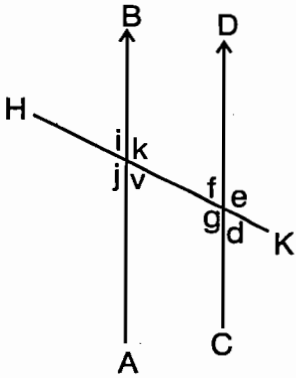
The lines AB and CD are parallel lines.

3.1 (b) Corresponding alternate and co-interior angles

(i)



(ii)



(I) In the diagram, AB is parallel to CD and EF is a transversal.

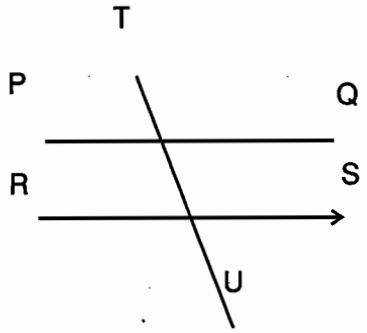
(ii) In the diagram what agnles correspond? What angles are equal?

Angle i corresponds with angle v. They are equal
Angle j corresponds with angle k. They are equal
Angle f corresponds with angle d. They are equal
Angle e corresponds with angle g. They are equal

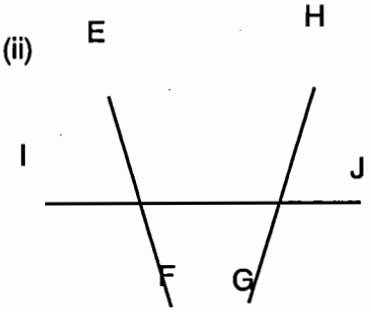
Exercise 40 (a)

Name the transversal lines in the figure below.

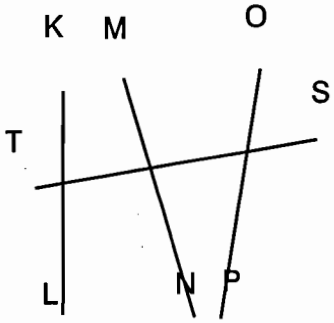
(i)



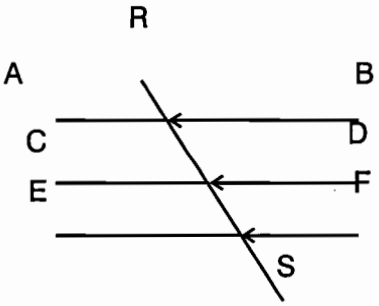
(ii)



(iii)

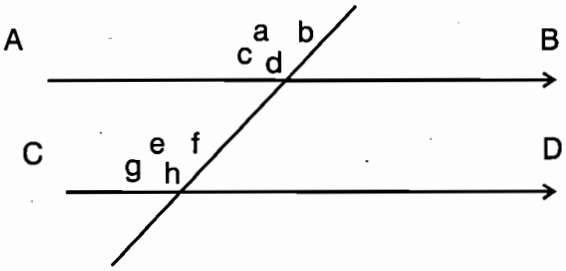


(iv)



Exercise 40 (b)

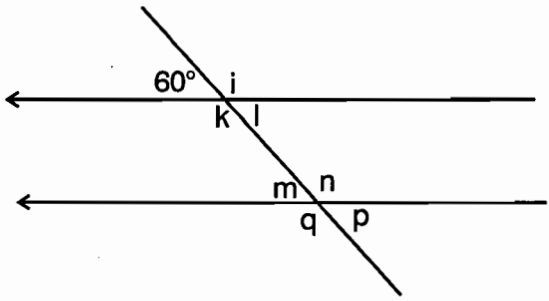
1. Use the diagram below to complete the statements that follow.



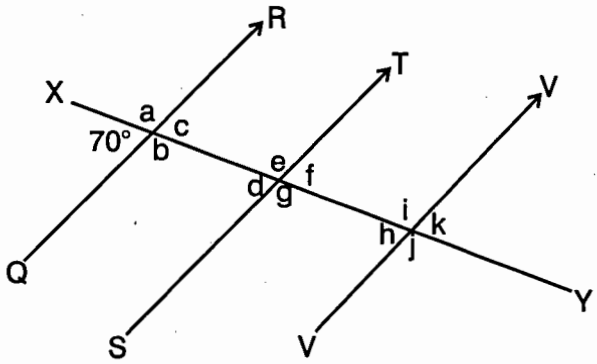
(i) Angle a corresponds with angle .....
(ii) Angle c corresponds with angle .....
(iii) Angle b corresponds with angle.....
(iv) Angle d corresponds with angle .....

2. In the diagram below, find the values of angles j, k, l, m, n, q and p

(v) Angle j corresponds with angle n and r ..... and .....
(Vi)Angle k corresponds with angle .....and .....
(iii) Angle j corresponds with angle ..... and .....
(iv) Angle l corresponds with angle .....and .....

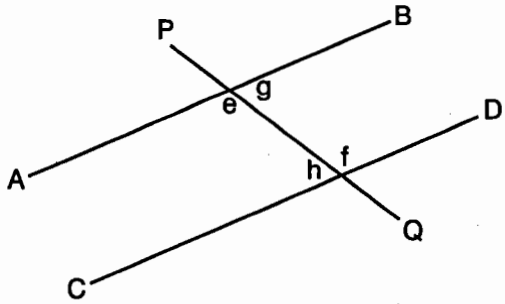


3. In the diagram below QR, ST and UV are parallel lines. XY is a transversal. Find the values of the angle marked with letters from a to k



3.1(c) Problems involving alternate co-interior angles and corresponding angles.

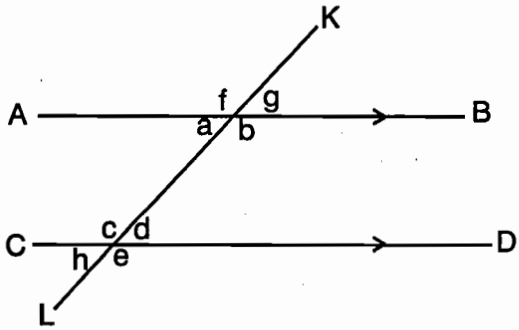
In the diagram below AB and CD are parallel lines. PQ is a transversal. Trace out angle e and place it on angle f. What do you notice about the size of angles e and f? The two angles are equal. They are alternate angles.



Angle g and angle h are alternate angles. They are equal.

Exercise 40(c)

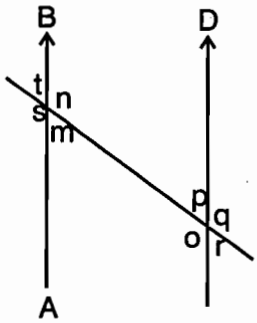
1 a) Complete the statements below the diagram



(i) Angle a is alternate to angle .....
(ii) Angle b is alternate to angles .....

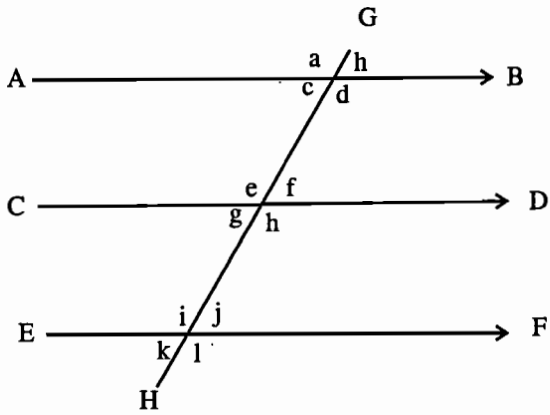
b) Complete the statements alongside the diagram.

(i) Angle ..... is alternate to angle O
(ii) Angle .... is alternate to angle P
(iii) Angle n = angle .....
(iv) Angle m = angle .....



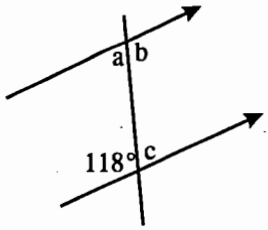
2. Complete the statements about the figure below.

(i) Angle d = angle ..... = angle i
(ii) List all the angles equal to angle C

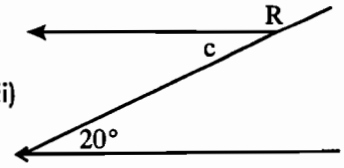


3. Find the value of the angles marked with letters.

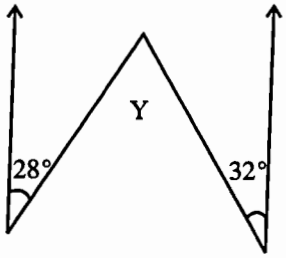
(i)



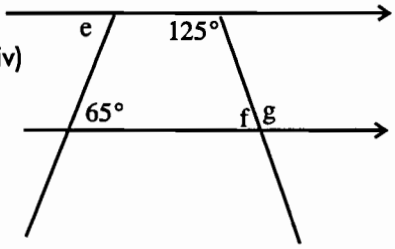
(ii)



(iii)



(iv)

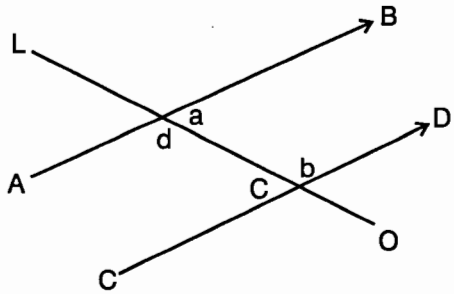


Co-interior angles

Co-interior angles are angles enclosed between a pair of parallel lines and on the same side of a transversal line.

Calculate the sizes of the angles marked by letters. In the diagram below, co-interior angles are a and b, c and d.

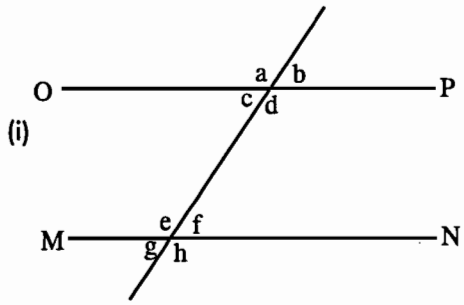
1. Measure angles a and b.
2. Find their sum.
3. measure angles d and c
4. find their sum
5. What do you notice about the sum of each set of angles?

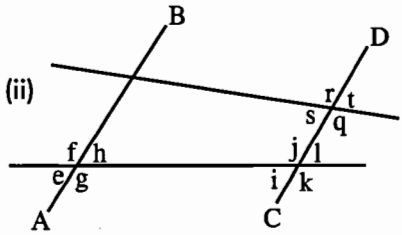


Above a + b = 180°. They are supplementary angles.

Exercise 40 (d)

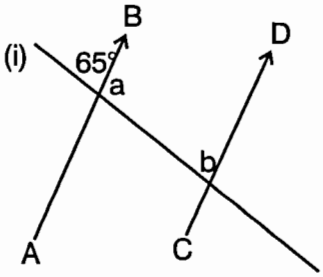
1. Name pairs of co-interior angles in the following diagrams.



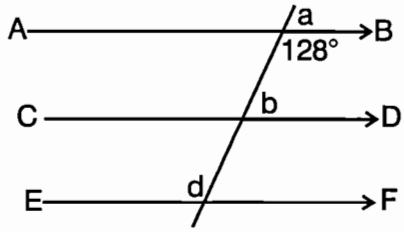


2. Calculate the size of the angles marked with letters.

(i)

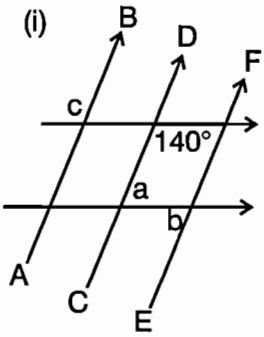


(ii)

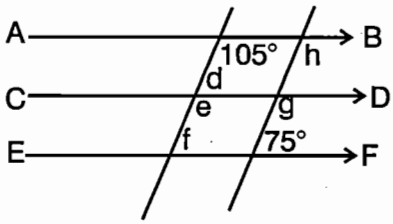


3 Find the sizes of the angles marked with letters.

(i)



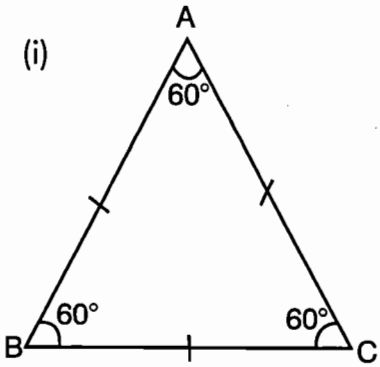
(ii)



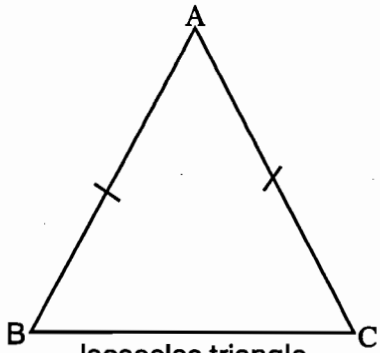
3.1 (d) Constructing right angled, equilateral and isosceles triangles

In an equilateral triangle, all three sides are equal and all three angles are equal. Note that all of the angles in a triangle add up to 180°.

(i)



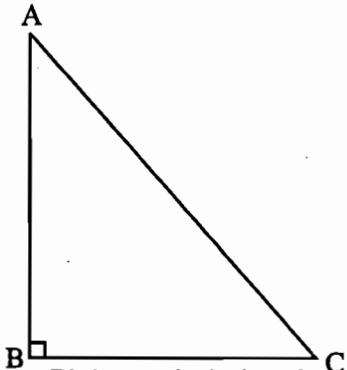
(ii)



Isosceles triangle

In an isosceles triangle, two sides are equal. The angles formed by the two equal sides at the base are equal, so we say that the base angles of an isosceles triangle are equal.

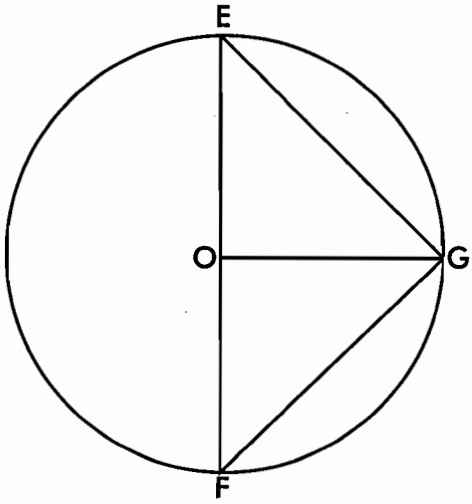
(iii)



Right angled triangle

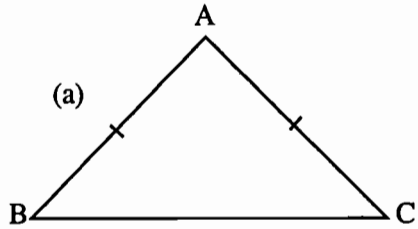
In a right angled triangle, one of the angles is 90°. The longest side is called the hypotenuse. The hypotenuse is opposite the right angle. In this case the hypotenuse is AC.

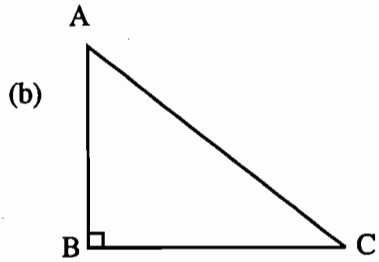
(iv) O is the centre of the circle. EF is the diameter. EFG is a triangle. When an angle is bisected at the circumference by the diameter, the angle formed is a right angled triangle. Angle EGF is a right angle.

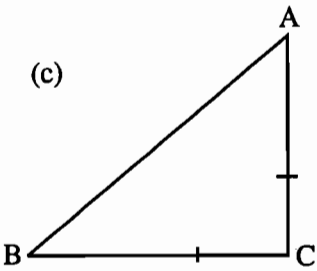


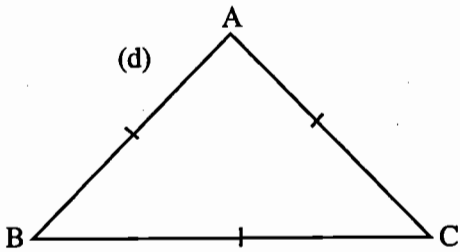
Exercise 41

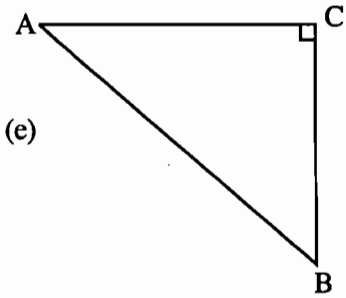
1. Which of the following triangles are:
   (i) equilateral (ii) isosceles (iii) right angled

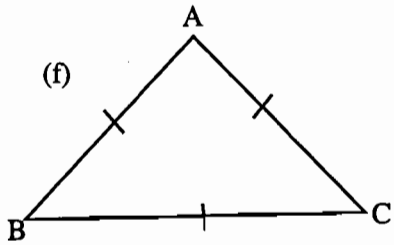


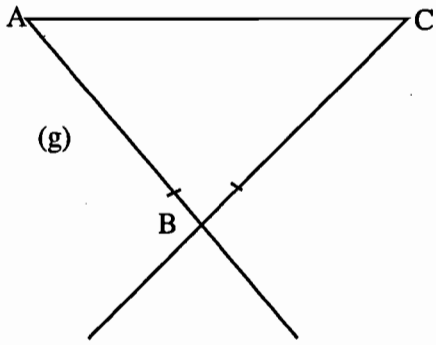


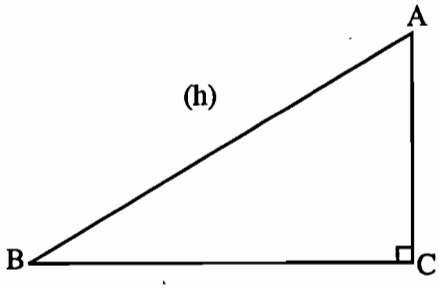






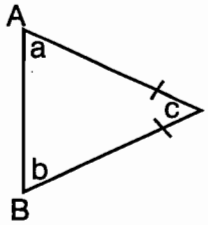




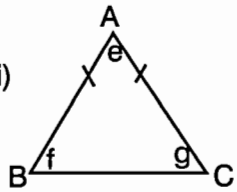


2. In the diagrams below name the two angles which are equal

(i)

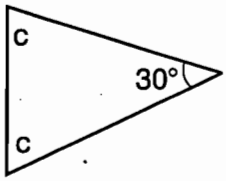


(ii)

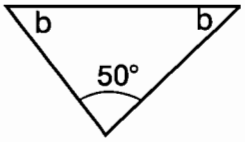


3. In the figure below, find the value of the angles marked with letters.

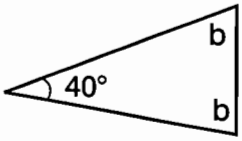
(i)



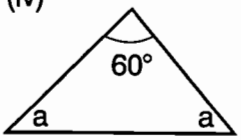
(ii)



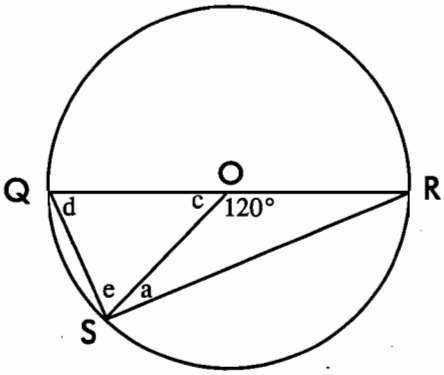
(iii)



(iv)



4. In the diagram, O is the centre of the circle, Q,O,R, is the diameter QO = OS =QS and OS = OR.



(i) What are the names given to the following triangles QOS, SOR, and QRS?
(ii) Find the value of the angles marked with letters.
(iii) What is the size of angle QSR

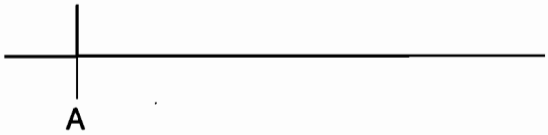
3.1 (e) Construction of triangles with given sides and angles

Equilateral triangle

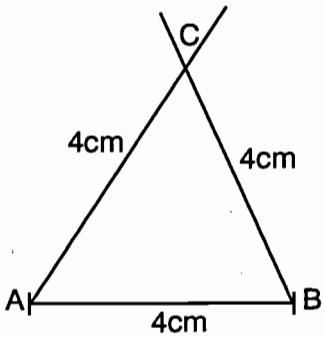
Using a ruler and a pair of compasses construct a triangle ABC with equal sides of 4cm each

Step 1

Take a ruler and a pencil, draw a line and mark a point on it. Name the point A



Step 2



Using a ruler and a pair of compasses, measure 4 cm. Place the sharp tip of the compass at A and rnark a point on the line. Name it B. with the same radius place your compass at A and mark an arc above A move your compass to B and with the same radius mark an arc to cross the one you had drawn above and name the intersection point C. Join AC and BC. The three sides are equal. The three angles are equal.

Step 3

Measure angles CAB, ABC and BCA, you will find that the three angles are each 60°.

- Triangles ABC, BCA and CAB are equal and all the sides equal.

Exercise 42

1. Using a ruler and a pair of compasses only, construct the following triangles and measure the angles of each triangle.

   (i) CDE where CD = DE =CE= 4.5 cm
   (ii) XYZ where XY =YZ =XZ =3.5 cm.
   (iii) QRS where QR =RS =SQ =6 cm

2. Draw a triangle DEF where DE is 6cm. Angle DEF =FDE = 60°

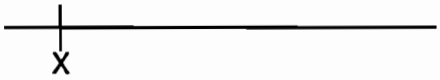
   (i) Measure the length of lines DF and EF.
   (ii) Measure the size of angle EFD.
   (iii) What do you notice about angles EFD and DEF?
   (iv) What do you notice about the length of lines DE, EF and FD?
   (v) What is the name given to this type of triangle?

Isosceles triangles

Construct an isosceles triangle ABC, where AB = 4 cm and Angle CAB =ABC = 60°. Measure lines AC and BC. What do you notice about the lines?

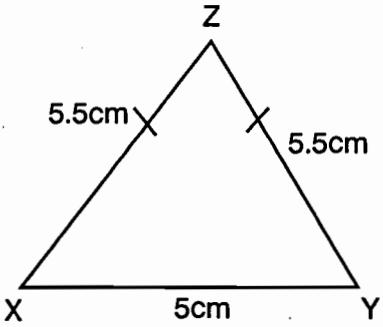
Step1

Draw a line and mark a point on it. Name the point X.



Step 2

Using a ruler and a pair of compasses, measure 5.5 cm. Place the sharp tip of a compass at x and mark a point on the line. Name it y with the same radius. Place your compass at x and mark an arc above x. Move your compass to y and with the same radius mark an arc to cross the first one above x. Name the intersection point z. Join xz and yz. The two sides are equal. The two angles are equal.



Step3

Measure angles zxy, xyz and yzx. You will find that the two sides zx and zy are equal. The two angles zxy and xyz are 60° each.

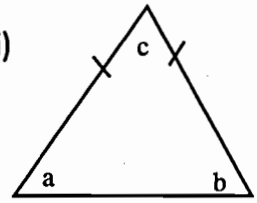
Exercise 43

1. With your ruler and a pair of compasses only, construct the following triangles and measure their angles.

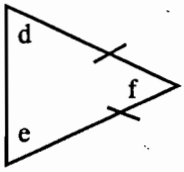
   (i) ABC where CA =BC =5cm and AB = 3 cm
   (ii) DEF where EF =FD =6.5 cm and DE = 4cm
   (iii) XYZ where YZ=ZX =4.5 cm and XY = 3.5 cm

2. In the diagram below name the two angles which are equal.

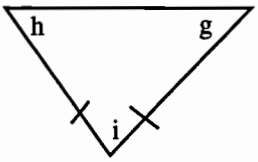
(i)



(ii)

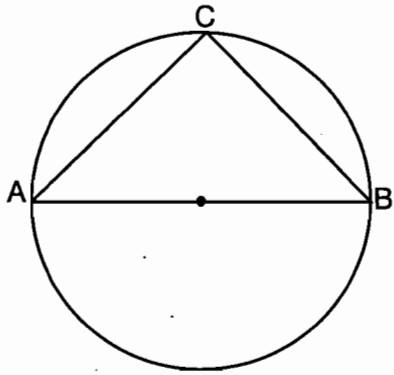


(iii)



3.1 (f) Inscribing and circumscribing triangles

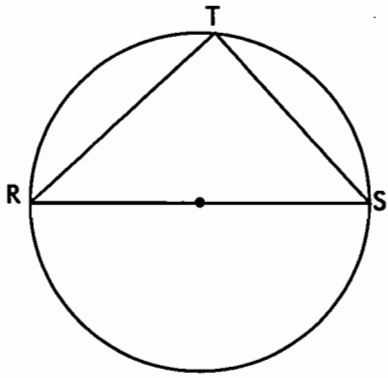
1. Draw a circle with a radius of 3 cm. With AB as the diameter draw two lines from A and B to meet at the circumference. Name that point C. Measure angle ABC. What type of triangle have you drawn?



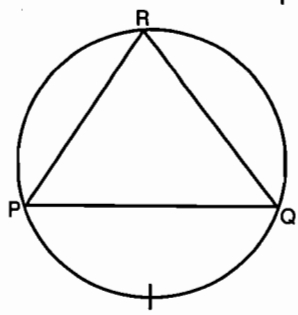
You will find that angle ACB is 90°. You have drawn a right angled triangle.

2. Draw a circle of radius 2.5 cm. In the circle construct a triangle RST where RS = 5 cm and angle TSR = SRT = 45°

(i) Measure sides TR and TS.
(ii) What type of triangle is this?



3. Draw a circle of radius 2 cm. In the circle construct an equilateral triangle PQR.



Step 1

Draw a circle with radius 2.5cm.

Step 2

With the same radius, mark arcs on the circle as shown.

Step 3

Name alternate arcs as shown in the figure.

Step 4

(i) Join PQ, QR and PR. Measure the sides and the angles.
(ii) What do you notice?

Exercise 43

1. Draw a circle of radius 3.6 cm with RT as the diameter. Construct triangle RST where RS = 4.5 cm.

   (i) Which angle is 90°?
   (ii) Measure angles SRT and STR.
   (iii) What is the measurement of ST?

2. Draw a circle of radius 2.7 cm. Construct a triangle EFG such that points EFG are on the circumference. EF = 3 cm and FG = 3 cm. Find the measurement of

   (i) Line EG.
   (ii) Angle GEF
   (iii) Angle FGE
   (iv) What type of triangle is this?

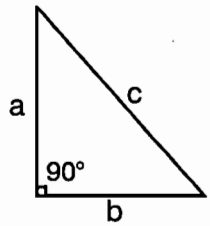
3. (a) Draw a triangle ABC where AB = 6 cm, AC = 6.5 and angle ABC = 80°.
   (b) Draw perpendicular bisectors from any two sides of triangle ABC. Name the intersecting point R.
   (c) With any of the radius RA, RB or RC. Draw a circle which passes through the three vertices of the angles.

4. Draw a triangle EFG where EF = 6cm, FG = 4 cm and EG =5. Draw a circle touching the three vertices EFG.

5. Draw a triangle XYZ where angle XYZ =YXZ =YZX =60° and line XY = 6 cm. Draw a circle such that points X, Y and Z are on the circumference. What is the length of the radius?

3.2 (g) Application of the Pythagorean relationship of 3-4-5 and 5-12-13 to calculate length and area of a triangle

The Pythagorean Relationship states that



$a^2 + b^2 = c^2$

In a right angled triangle when C is the side opposite the right angle (called the hypotenuse)

Example1

(a) Find the base of a right angled triangle whose height is 8 cm and hypotenuse = 10 cm.

(b) Calculate its area.

Solutions

(a) $\text{Base}^2 + \text{height}^2 = \text{hypotenuse}^2$

$\text{Base}^2 + 8^2 = 10^2\,\text{cm}^2$

$\text{Base}^2 = (10^2 - 2^2)\,\text{cm}^2$

$\text{Base}^2 = (100 - 64)\,\text{cm}^2$

$\text{Base}^2 = 36\,\text{cm}$

$\text{Base} = \sqrt{36}$

$\text{Base} = \underline{6\text{cm}}$

(b) Area = ½bh

$= (\tfrac{1}{2} \times 6 \times 8)\text{cm}^2 = 24\text{cm}^2$

Example 2

A triangle has an area of 54 cm^2. If its base is 12 cm. Calculate its

(a) Height

$\frac{1}{2}bh = \text{Area}$

$\frac{1}{2} \times 12 \times h = 54\ cm^2$

$6h = 54\ cm^2$

$\therefore h = \frac{54}{6} = 9cm$

(b) Hypotenuse

$Hyp^2 = (b^2 + h^2)\ cm^2$

$hyp^2 = (12^2 + 9^2)\ cm^2$

$hyp^2 = (144 + 81)\ cm^2$

$= 225cm^2$

$= \sqrt{225}$

$= \underline{15\ cm}$

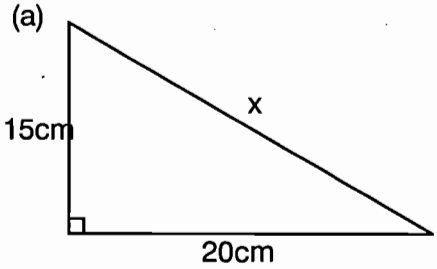
Exercise 44(a)

1. Using the Pythagorean relationship find out which of the following triangles are right-angled triangles

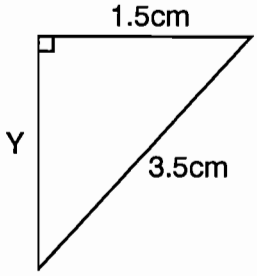
(a) 7cm by 12 cm by 5 cm
(b) 1.5 cm by 2 cm by 2.5 cm
(c) 6cm by 8cm by 10 cm
(d) 3.2 cm by 4.2 cm by 5.2 cm
(e) 0.5 cm by 1.2 cm by 9.3 cm
(f) 2.5 cm by 6cm by 6.5 cm

2. Find the length of the side whose dimension is not given.

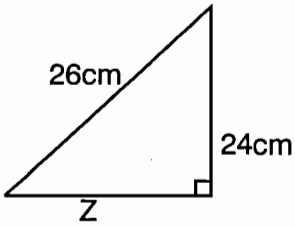
(a)



(b)

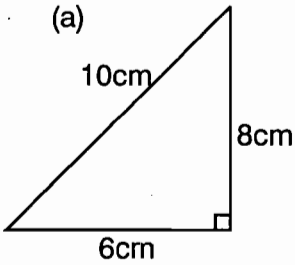


(c)

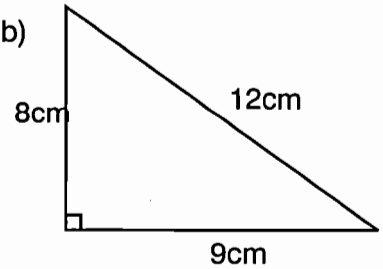


3. Find which of the following right angled triangles are 3 - 4 - 5 triangles.

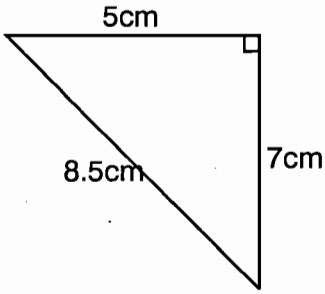
(a)



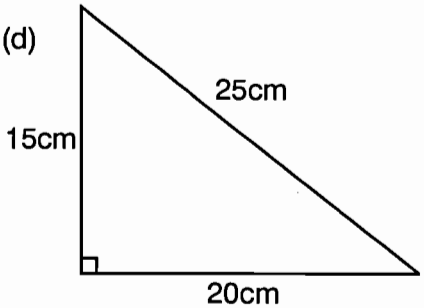
(b)



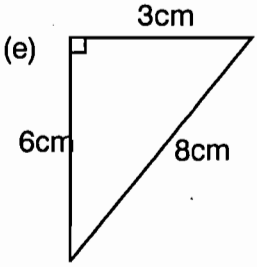
(c)



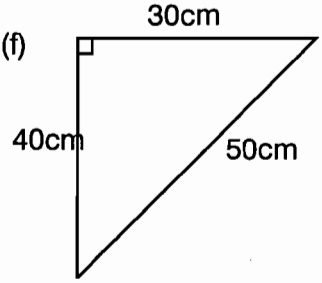
(d)



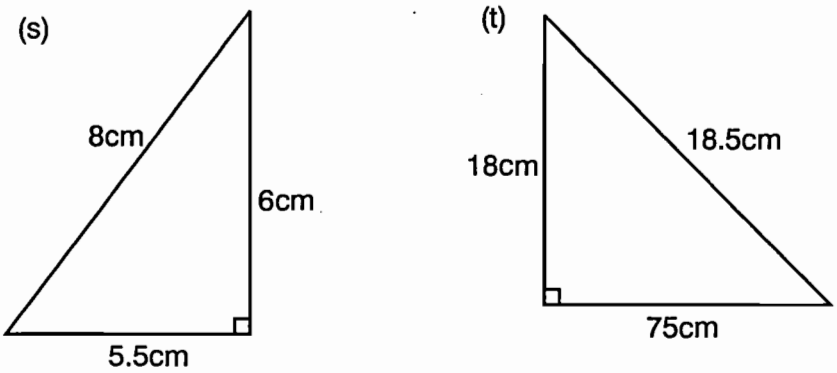
(e)



(f)

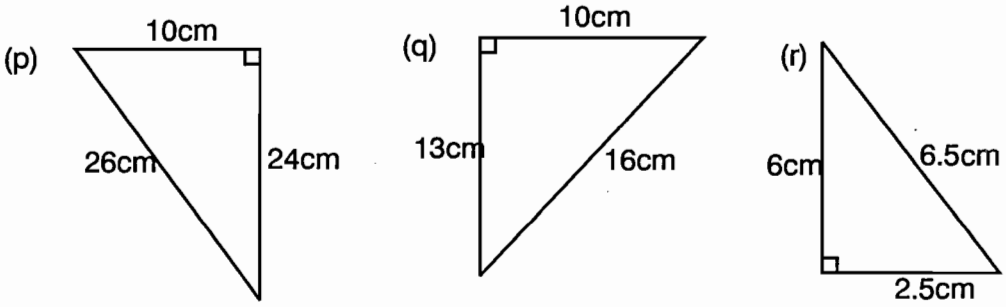


4. Find out from the following triangles which ones are 5-12-13-triangles



5. A right angled triangle has a base of 12 cm and a height of 16cm. Calculate
   (a) The length of its hypotenuses
   (b) The area of the triangle

Applying Pythagorean relationship or 3 - 4 - 5 and 5- 12 - 13



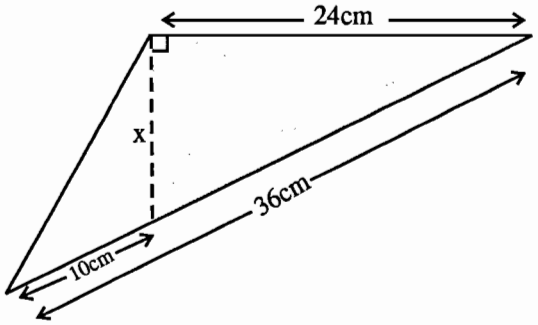
Exercise 44(b)

1. A rectangular garden has a length of 12 cm and a width of 9 cm. A foot path passes across the garden diagonally
   (a) Calculate the length of the foot path.
   (b) Calculate the area of the garden.

2. A carpenter used a ladder 20 metres long to climb to the top of a house 16 cm from the ground. At what distance from the house should he place the ladder?

3. The following diagram represents a triangular piece of cardboard. Find

(a) The length of x
(b) The area of the shade part.



4. An isosceles triangle has a base length of 6.4 cm and each of its sides 4 cm. Calculate

(a) The height of the triangle
(b) The area of the triangle

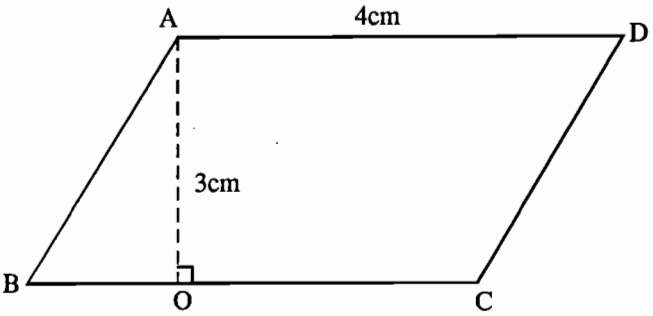
5. Njofo placed a ladder at a distance of 3.9 cm from the foot of a tree in order to get his ball which got stuck on top. If the height of the tree was 5.2m, find the length of the ladder. (Answer to one decimal place).

3.2 (h) Constructing of parallelogram and rhombus of given sides and angels.

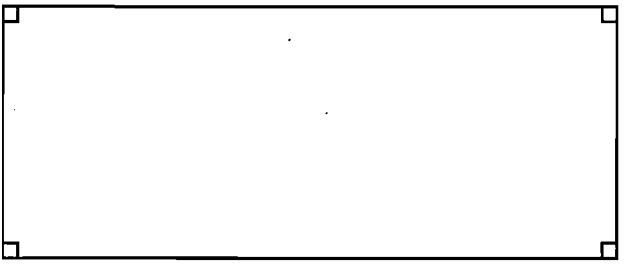
Properties of Parallelograms

(a) Opposite sides are equal
(b) Opposite sides are parallel
(C) Opposite angles are equal

Example (i)



ABCD is a parallelogram. If we trace and cut off the shaded right angled triangle ABO and fit it on the other side of DC, a rectangle with the same area as the parallelogram will be formed.



The length of a parallelogram = the length of the rectangle = 4 cm.
The height of the parallelogram = the width of the rectangle = 3 cm
Area of the parallelogram = Area of the rectangle = $(4 \times 3)cm^2 = 12cm^2$

Example 2

Construct a parallelogram ABCD. Where AB = 6cm, BC = 5cm and angle ABC = 110° and DAB = 70°

Solution:

Steps

1. Draw the line AB 6cm
2. Using a protractor and at point B measure and mark 110°
3. Draw the line marking angle 110°
4. Using a protractor and at point A mark and draw and 70°
5. Mark AD 5cm and BC 5cm. Join DC.

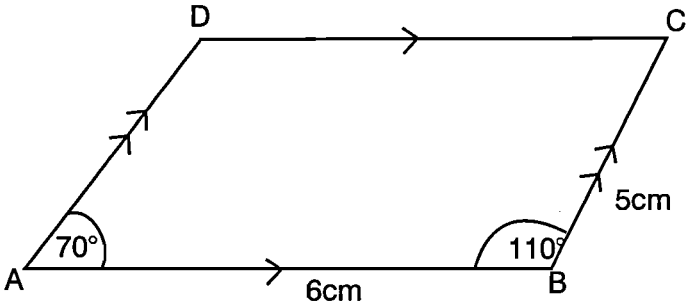
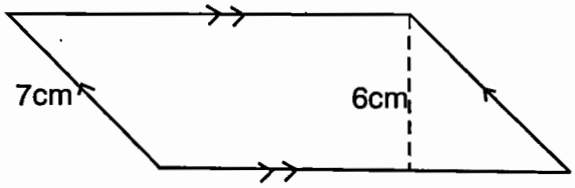


Figure ABCD is a parallelogram

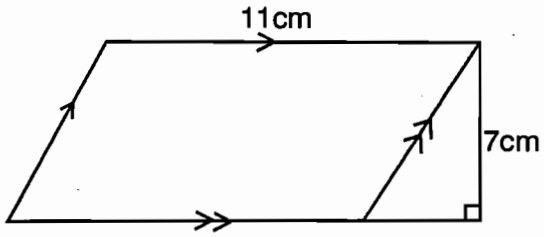
Exercise 45

1. Find the area of the shaded parts of the following figures

(a)



(b)



2. A parallelogram whose base length is 5 cm has a height of 3 cm. Calculate its area.

3. (a) Draw a parallelogram PQRS where PQ = 4-5 cm, PS = 5.5cm angles PQR = 130° and SPQ =50°

   (b) Measure angles:
   (i) PSR (ii) QRS

   (c) Line:
   (i) SR (ii) PS

4. (a) Draw a parallelogram KLMN where KL = 5cm , KN = 4cm and angle NKL 140°

   (b) Measure angles:
   (i) LMN (ii) KNM (iii) KLM

   (c) Lines:
   (i) ML (ii) MN

5. a) draw a parallelogram WXYZ where WX = 6cm, XY = 7 cm and WXY =105°
   Find the measurements of:

   (b) Angles :
   (i) WZY (ii) ZWX

   (c) Lines
   (i) XY (ii) YZ

3.2 (i) Construction of a Rhombus using corresponding properties

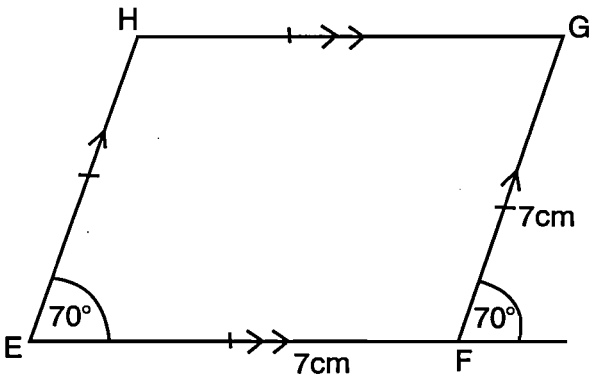
Constructing Rhombuses:

Properties of a rhombus:

a) All sides are equal
b) Opposite sides are parallel
c) Opposite angles are equal

Example:

Construct a rhombus whose sides measure 7cm. The corresponding angles at E and F should measure 70°. Mark EH and FG 7cm each. Join GH as shown.



Exercise 46

1. Draw a rhombus QRST whose sides measure 5.5 cm and angle TQR = 50°.

2. Construct a rhombus ABCD whose sides measure 6.5 cm and the supplementary angles at A and B measure 50° and 130°.

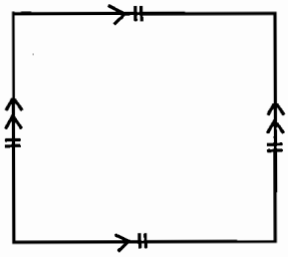
3. Draw a rhombus WXYZ whose sides measure 4.5 cm and angle XYZ measures 80°. Measure the following:

   (i) angle XWZ (ii) angle WXY (iii) angle WZY

3.2 (j) Properties of a square, parallelogram, rhombus and trapezium

Quadrilaterals

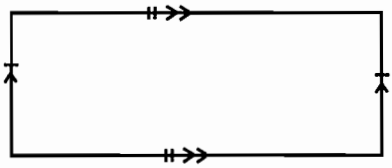
A quadrilateral is a figure with four sides. The following are common quadrilaterals and their properties.



A square

A Square

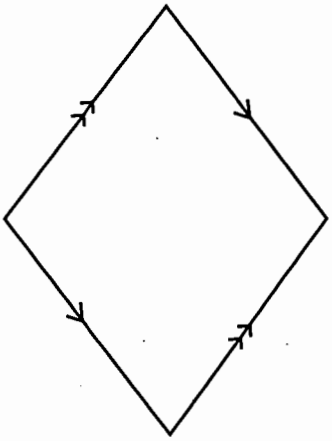
All sides are equal. All angles are right angles. Opposite sides are parallel. Total number of degrees is 360°.



A rectangle

A Rectangle

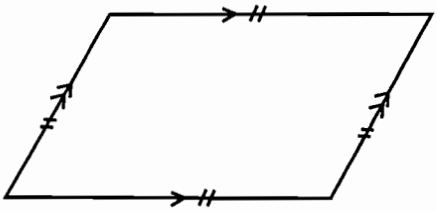
Opposite sides are equal and parallel. All angles are right angles. Total number of angles 360°.



A Rhombus

A Rhombus

All sides are equal, opposite sides are parallel, opposite angles are equal. Total number of angles is 360.



A Parallelogram

A Parallelogram

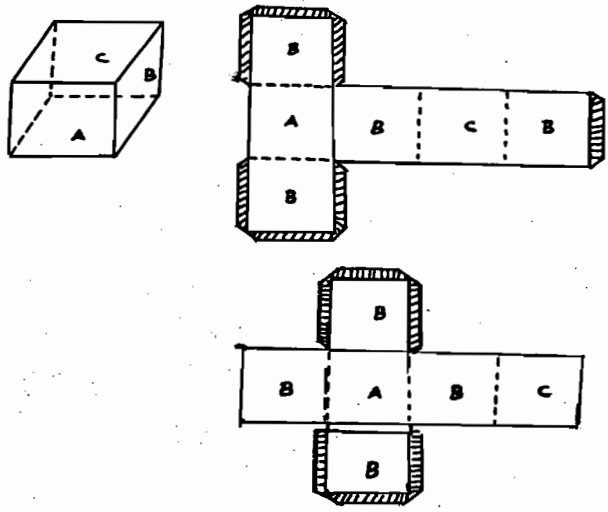
All sides are not equal. Opposite sides are parallel. Opposite angles are equal. Total angles in a Parallelogram are 360°.

3.2 (k) Models of Cubs, Cuboids, Prisms and triangular and square base pyramids

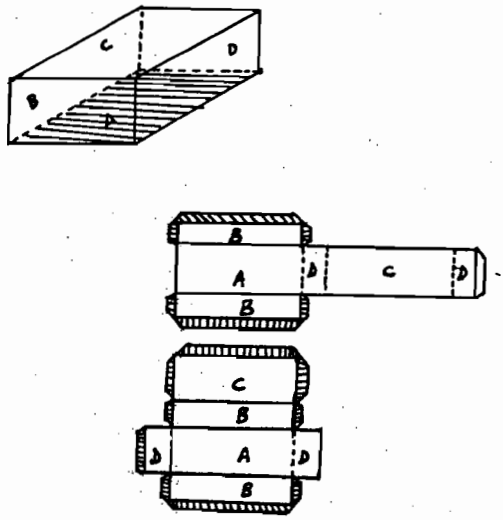
Nets of Solids

If a solid such as a Cuboid or a prism is cut open along the edges in such a way that we get a single plane shape, then that plane shape is called a net of that solid. Since a solid may be cut in more than one way, we may have more than one net of the solid. Nets are very useful in constructing solids.

A) The Cube
   A. is the bottom
   B. is one of the sides
   C is the top

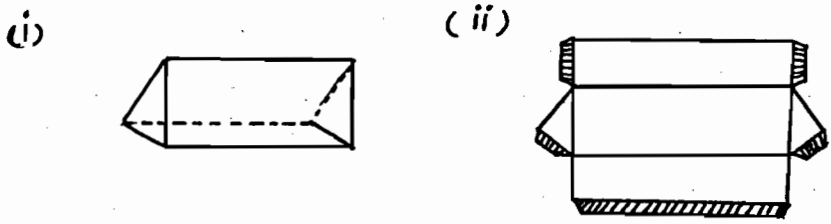


B) A Cuboid (A rectangular box or prism)
   A. Is the bottom
   B. Is the front side
   D. Is other side
   C. Is the top



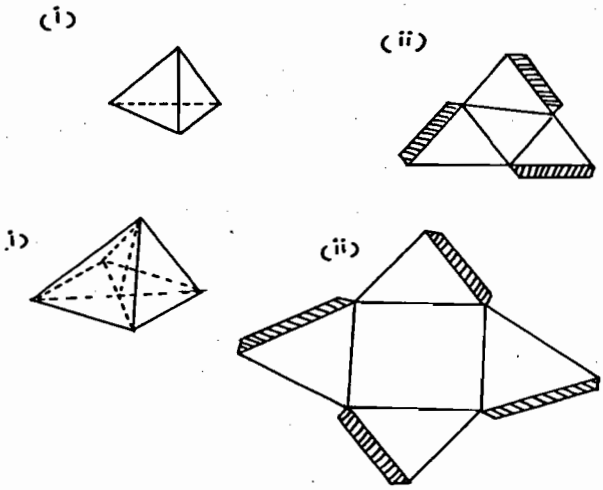
C. Triangular Prism

Its uniform crosssection is a triangle; two faces are triangles, the others are squares or rectangles.



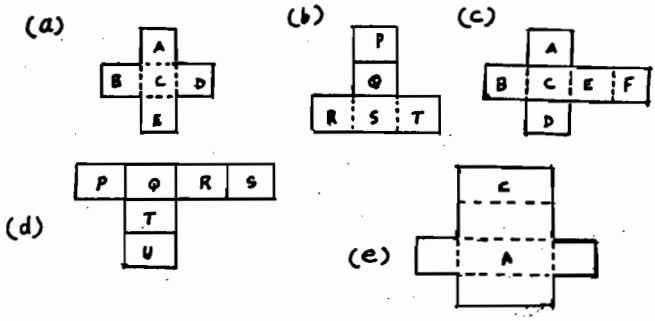
D) Pyramids

Net of a triangular pyramid consists of four triangles. Base is a square (tetrahedron) or a triangle.



Exercise 47

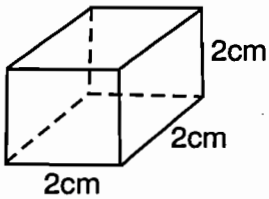
1. Which of the following nets when folded represent a cube?



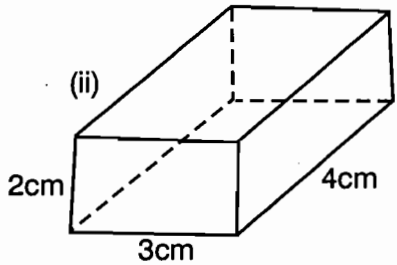
2. Sketch nets for
   (a) A hexagon prism
   (b) A cylinder
   (c) A cone with a circular base.
   (d) A pyramid with a square base

3. Describe the following solid figures. In each case state the number of vertices (V) edges (E) and faces (F).

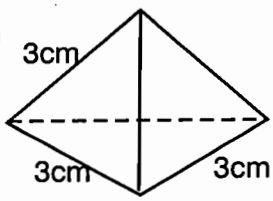
(i)



(ii)



(iii)



UNIT 4 Algebra

4.1 (c) Simplifying Algebraic Expressions

Examples

(i) $3(6a + 5b + 2c) + 5(2a + 7b + 6c)$

Remove the brackets by multiplying each item within the first bracket by 3 and within the second bracket by 5.

$= 18a + 15b + 6c + 10a + 35b + 30c$

Collect the like terms together

$= 28a + 50b + 36c$

(ii) $\frac{1}{4}(16 + 8a) + 6\left(\frac{5a}{6} - 3b\right)$

$= 4 + 2a + 5a - 18b$

$= 4 + 7a - 18b$

(iii) $\frac{1}{7}(14a + 21b) + \frac{1}{5}(10a - 20b)$

$= 2a + 3b + 2a - 4b$

$= 4a - b$

(iv) $6\left(\frac{1}{3}x + \frac{1}{3}y\right) + \frac{1}{3}(9x - 6y)$

$= 2x + 3y + 3x - 2y$

$= 5x + y$

Exercise 49 (a)

Simplify the following algebraic expressions:

1. $3(a + 3) + 2(a - 2)$
2. $9(x + 3y) - 3(2x - 7y)$
3. $5(x + y + 3z)$
4. $5(p + \frac{1}{5}) + \frac{1}{3}(9 - 6p)$
5. $5(3a + 2b + 3c) + 4(6a + b + 2c)$
6. $6(\frac{5}{6}m + \frac{2}{3}n) - \frac{1}{2}(4m + 8n)$
7. $\frac{1}{2}(8a - 2b) + \frac{3}{4}(4a + 8b)$
8. $5x(2 + 3y) + 6y(5 - 2x)$
9. $\frac{3}{5}(5a - 10b + 15c)$
10. $3(3p + 2q) - 2(4p + 3q)$
11. $3(9w + 4s - 5t) - 4(6w - 2s + 2t)$
12. $y + 7(3 + y) + 2$
13. $\frac{2}{3}(12x + + 6y - 9z)$
14. $7g + (9h - 3g) + 2(2g - 4h)$
15. $\frac{2}{3}(12x + 18y) + \frac{1}{6}(12x - 18y)$

4.1 (a) Finding the value of algebraic expressions through substitution

Example

If a = 5, b = 8, c = 3, x = 9, y = 7

Find the value of the following:

(i) $3(a + b) = 3(5 + 8) = 3 \times 13 = \underline{39}$

(ii) $\dfrac{2a + 3b - 8c}{x - y} = \dfrac{2 \times 5 + 3 \times 8 - 8 \times 3}{9 - 7}$

$= \dfrac{10 + 24 - 24}{2}$

$= \dfrac{10}{2} = 5$

Exercise 49 (b)

If a = 6, b =2, c =4. x=8, y=7

Find the value of:

(a) $2(a + b)$ (b) $3\dfrac{(x - y)}{2(a + b)}$ (c) $(4a + 3b)(4x - 3y)$

(d) $a(3 - 2) + c(4 + 2)$ (e) $6(2a - 3b + 3c)$ (f) $(b + c - a)(2y - x)$

(e) $\dfrac{3x - 2y}{a + b - c}$

2 If h = 5, e = 9, f = 8. Find the values of the following

(a) $h(e + f) + f(e + h)$ (b) $h \times e \times f$

(c) $\dfrac{h \times e \times f}{e}$ (d) $\dfrac{2e + 8f}{5h}$ (e) $\dfrac{4h - 5e + 2f}{5f - 2e}$

3. If a = 4, b = 3, c = 0 find the value of

(a) a^2b (b) ab^2c (c) $3a^2b - 2b^2$

(d) $\frac{5ab^2 + 6b^3c}{10b}$ (e) $\sqrt{a^2 + b^2}$ (f) $\frac{1}{3}b^2(a^2 - c)$

(g) $\frac{2ab}{3a} + \frac{a^2b}{4}$ (h) $\frac{1}{2}a + \frac{2}{3}b$

4. If a = 5, b = 12, c = 4, f = 7, g = 6, p = 3, t = 10, y =1 q =2 find the value of

(a) b x c (b) f x g x p (c) 10 x t x y

(d) 8y x 3q x p (e) 5 x 3q (f) 26 x 2c

4.1 (d) Evaluating Algebraic expressions

Example

Find the value of the following if x = 2, y = 1 and z = 3
(4x + 3y) (4z - 3x)

Solution

$$\begin{aligned}(4x + 3y)(4z - 3x) &= (4 \times 2 + 3 \times 1)(4 \times 3 - 3 \times 2)\\ &= (8 + 3)(12 - 6)\\ &= 11 \times 6\\ &= 66\end{aligned}$$

Exercise

Given x = 2, y = 1 and z = 3 Find the value of

(a) $4\frac{(4x - 2y)}{7x - z}$ (b) $4\frac{(2x - y)}{3y - x}$ (c) $\frac{2z}{z - x} + \frac{2x + 4y}{z - y}$

(d) $2\frac{(2x^2 - y^2)}{7(2y^2 - z)}$ (e) $\frac{2x}{3y^2} - \frac{1}{y^2}$ (f) $\frac{2yz}{3x} + \frac{9x^2y}{4z^2}$

4.1 (b) Forming Algebraic Expressions

The statements below can be expressed in algebraic expressions.

(i) q is added to twice p can be expressed as $2p + q$

(ii) Price of c chicken at £d each can be expressed as £d x c or £dc

(iii) The average weight of 3 children weighing akg, bkg and ckg can be expressed as $\frac{a + b + c}{3}$ kg

(Iv) d subtracted from twice b and the result multiplied by 4 can be expressed as $(2b - d) \times 4$ or $4(2b - d)$

Exercise 49(c)

1. Add x to 3y.

2. Subtract c from a quarter b.

3. X multiplied by 7 by y.

4. Eight multiplied by m added to six

5. The sum of a and b multiplied by 4.

6. The difference between twice n and four times m divided by r.

7. 3 parcels weigh xkg, ykg and zkg respectively. What is their average weight?

8. N girls shared m marbles equally. How many marbles did each girl get?

9. Rose has 6 beads and Rebecca has y beads. How many beads do they have altogether?

10. A boy gets £s x as pocket money every week. He spends £sy on drinks and spent the rest on sweets. Calculate the money he will spend on sweets in 4 weeks.

11. Find the perimeter of a rectangle whose length is 2x and breadth is 3y cm.

12. Beatrice is x years old now. How old will she be after z years?

4.1 (e) Forming and Solving Equations

Examples

(i) The length of a rectangle is 5cm more than its width. Calculate its length and width if the perimeter is 62cm

Solution

Let the width be x

$\therefore$length = x +5

Perimeter = 2(x + 5 + x) = 62

= 2(2x + 5) = 62

$\therefore$4x + 10 = 62

= 4x = 52

$\therefore$x = 13

$\therefore$perimeter of a rectangle = 62

$\therefore$width = <u>13cm</u>

$\therefore$length =<u>18cm</u>

(ii) I think of a number, double it and then add 3 to it. The result is 49, what is the number?

Solution

Let the number be x

Double it i.e. 2x

Add 3 to it i.e. 2x+3

The result is 49 i.e.

2x +3 =49

2x = 49-3

2x =46

$\therefore$x = <u>23</u>

(iii) Ayaga is 4 years older than Uchan. If the sum of their ages is 14 years, what is each child's age?

Solution

Let Ayaga's age be x

Then Uchan's age will be x-4

Sum of their ages = x + x -4 = 14

2x - 4 =14

2x = 18

$\therefore$ x = 9

$\therefore$ Ayaga's age = 9 years

Uchan's age = 5 years

Exercise 49 (d)

1. James's weight is twice that of his son. If their total weight is 216kg, what is his son's weight?

2. The angles of triangle are a°, (3a +5)° and (2a-5)°. What is the value of each angle?

3. I thought of a number, doubled it and added 3 to it. If my answer was 17, what number did I think of?

4. A woman is 25 years older than her son. If the sum of their ages is 39 years, how old is the son?

5. A right-angled triangle has sides 2a cm, (2a +2)cm and (4a -2)cm long. If the perimeter of the triangle is 24 cm
   (a) Find the length of each side
   (b) Find the area of the triangle

6. The difference between two numbers is 44. If one of the numbers is three times larger than the other one find
   (i) The smaller number
   (ii) The bigger number

7. Lado thought of a number, added 5 to it, and the result was 69. Find the number.

8. John is 4 years older than his sister Mary. In 10 years time their total age will be 36 years. How old is Mary?

9. £s 330 is shared between A, B, C and D. A gets £s40 less than B, C gets twice as much as A, and D gets half as much as B. How much does D receive?

10. Wani had twice as many cows as he had goats. If the total number of the animals which Wani had was 156, how many
    (a) Goats did he have?
    (b) Cows did he have?

11. Solve the following equations:
    (a) $5a + 5 = 15$ (b) $6b = 18$ (c) $18x)9 = 6$ (d) $3\frac{4}{5}x - \frac{3x}{5} = 32$

    (e) $3\frac{4}{5}x - \frac{3}{5} = 3\frac{1}{5}$ (f) $7 + \frac{1}{5}b = 11$ (g) $4x - 2 = 3\frac{1}{2}x + 3 = 11$

4.1 (f) Solving simultaneous equations

Different methods of solving simultaneous equations

(a) Method of substitution

Example 1

Solve the simultaneous equation

$x + y = 8$ .....(i)

$3x - 4y = 10$ .....(ii)

Solution

From equation (i) $x = 8-y$

Substitute this value for x in equation (ii)

Thus $3(8-y)-4y = 10$

$24 - 3y - 4y = 10$

$-7y = 10-24$

$-7y = -14$

$y = 2$

Substituting for $y = 2$ in equation (i)

$x + 2 = 8$

$x = 6$

(b) Method of Elimination

This is a common method used for solving simultaneous equations. One of the two unknowns x and y is eliminated (got rid of).

Example 2

Solve the simultaneous equations

$x + 2y = 6$ ..... (i)

$3x - 2y = 10$ ..... (ii)

Solution

Add the equations together, thus eliminate y

we get $4x = 16$

$X = 4$

Substituting $x = 4$ in the equation (i) we get

$4 + 2y = 6$

$2y = 2$

$y = 1$

Thus $x = 4, y = 1$

Example 3

Solve the simultaneous equations

$3x - 4y = 8$ .....(i)
$x + 5y = 9$ .....(ii)

Solution

Multiply equation (ii) by 3

i.e $3x - 4y = 8$
$3x + 15y = 27$

Introduce negative sign in (i) to eliminate x

i.e $-3x + 4y = -8$ .....(i)
$3x + 15y = 27$
$19y = 19$
$y = 1$

Substitute y in equation (i)

i.e. $3x - 4 = 8$
$3x = 12$
$x = 4$

Thus $x = 4$, $y = 1$

Example 4

solve the simultaneous equations

$\frac{a}{4} - \frac{b}{3} = 0$..... (i)

$a - b = 2$ ..... (ii)

Multiply (i) by 12

$\therefore 3a - 4b = 0$ .....(i)
$a - b = 2$ .....(ii)

Multiply (ii) by 4

$\therefore 3a - 4b = 0$
$4a - 4b = 8v$

Introduce negative sign to eliminate b

$-3a + 4b = 0$
$4a - 4b = 8$
$\therefore a = 8$

Substitute the value of $a = 8$ in (ii)

i.e. $a - b = 2$

$8 - b = 2$

$-b = -6$

$b = 6$

Thus $a = 8$, $b = 6$

Exercise 49 (e)

Solve the following simultaneous equations

1. $3x\ y = 11$
   $x + 2y = -1$

2. $x + 8 = 3y$
   $3x + 2y = 9$

3. $3y - 5x = 4$
   $5x - y = 2$

4. $4x\ y = 5$
   $5y - 4x = 7$

5. $q + r = 7$
   $q - r = 3$

6. $s + t = 11$
   $s - t = 5$

7 $2a + 4b = 24$
   $2a + 2b = 8$

8. $6x - 2y = 30$
   $6x - 2y = 18$

9. $2w + 4x = 12$
   $2w + x = 6$

10. $3c + m = 16$
    $2c + m = 12$

11. $3f + 4g = 10$
    $3f + g = 7$

12. $3x + 3y = 27$
    $2x + 3y = 24$

13. $\frac{m}{4} - \frac{n}{3} = 0$
    $m + 2n = 5$

14. $2\frac{1}{2}p - q = 3\frac{1}{2}$
    $2p + 2q = 7$

15. $\frac{a}{7} - \frac{b}{7} = 2$
    $5a - 2b = 26$

16. The sum of two numbers is 15. The difference between five times the first and three times the second is 19. Find the two numbers.

17. The difference between two numbers is 3 and the sum of one third of each is 5. Find the numbers.

18. The weight of Andrew and his son Dominic together is 70kg. Dominic weighs one-sixth that of his father. Find their weights.

19. The price of tea is 7 times the price of sugar. If the total of 6kg of sugar and 2kg of tea is £120, find the price of tea and sugar per kg.

20. The ages of Anna and Beatrice add up to 40 years. 5 years ago Anna was twice as old as Beatrice was then. Find their present ages.

4.2 Sets

4.2 (a)

A set is a collection of similar things. Items in a set are called members or elements. Elements/members in a set are enclosed by brace brackets "{}"
A = {3, 6, 9, 12} read as "A" is a set whose members are 3,6, 9,12. Members in a set are separated by commas. The order in which elements in a set occur does not affect the set.

4.2 (b)) Two Ways of Describing Sets

By listing all the elements in the set, e.g. "A" = {2,4,6,8} can be described as a set of even numbers up to 8 or "A" is a set of multiples of two up to eight.

Example

Using the set notation, list the elements of set "A" whose members are even numbers greater then 8 and less than 20.
A = {10,12,14,16,18}

Exercise 50 (a)

Describe the following sets in two ways

1. B = {*v,w,x,y,z*}
2. M= {*2,3,5,7,11,13*}
3. X = {*Nairobi, Khartoum, Addis Ababa, Kigali*}
4. Y = {*Sudan, Uganda, Zaire, Burundi, Kenya*}
5. A= {*a,b,c,e,f*}
6. C= {*guitar, dram, piano, flute*}
7. L = {hammer, chisel, pliers, saw}

8. List in set notations the elements of each of the following sets:
   (i) P = A set of odd numbers greater than 10 and less than 24.
   (ii) Q =A set of the months with 31 days.
   (iii) R = A set of the last six letters of the English alphabet
   (iv) C = A set of the first four months of the year
   (v) L = A set of multiples of 3 not exceeding 19

9. Using descriptive titles identify the following sets
   (i) A = {*5,10,15,20,25,30*}
   (ii) B = {*orange, yellow, indigo, red, violet, green, blue*}
   (iii) D = {*mars, Jupiter, Plato, Neptune*}
   (iv) F = {*April, June, September, November*}

4.2 (c) Empty sets

A set with no elements is known as an empty set. An empty set is represented by a pair of brace brackets with nothing.{} Empty set.

Exercise 50 (b)

1. From the following sets, which ones represents an empty set?
   (a) A set of multiples of 5 between 21 and 24
   (b) A set of vowels in the word "dry"
   (c) A set of even numbers less than 2
   (d) A set of vowels in the word "Maridi"

2. How many elements are in the following set?
   (a) X = {*indigo, violet, red, blue, yellow, orange, green*}
   (b) Y = {7,14,21,28,35}
   (c) M= {}
   (d) K = {0}

4.2 (d) Unequal sets

Consider the following sets

X = {1,2,3,4} Y= {a,b,c,d,e}

Set X = 4 elements

Set Y = 5 elements

∴Set X ≠Y (≠means not equal)

Set Y has more elements than X

Y>X or X<Y

The symbol (sign)

= means "is equal to"

≠ means "is not equal to"

> means "is greater than"

< means "is less than"

Exercise 50(c)

1. Use the symbols = to complete the statements below
   (a) X = {1,2,3,4} Y = {a,b,c,d,e}
   X.....Y

   (b) M = {orange, pawpaw, guava}
   N = {Knife, Fork, Spoon}
   M.....N

   (c) P = {3,6,9,12,15} Q = {9,6,15,12,3}
   P.....Q

   (d) R = {red, blue, yellow, green} S = {2,4,6,8}
   R.....S

2. Use =, < and> to make the following statements true
   (a) 3 +2 .....2x3
   (d) 10-6 .....2x2
   (c) 19+4 .....20 x1
   (d) 30+40 .....20x4
   (e) 100-11 .....70 +9

4.2 (e) Union and intersection of sets

4.2 (e) (i) Union of Sets

Two or more sets can be put together to form one set. This can be done by listing all members contained in the sets without repeating elements which appear in both sets.

Example

1. Consider the following two sets:
   X = is a set of all counting numbers 1-9.
   Y = is a set of all multiples of 2 up to 10.

List all the elements of X and Y
   X = {1,2,3,4,5,6,7,8,9} Y = {2,4,6,8,10}

We can put together x and y to form one set.

We can do this by listing all the members in X and Y but elements which appear in both sets should be written once only. When we put together elements of two or more sets, the new set formed is called a "Union set". Union of a set is represented by the sign U. Therefore,
XUY = {1,2,3,4,5,6,7,8,910}

Note that 2, 4, 6 and 8 appear in both sets. In the union they appear only once.

2. A = a set of boys who play football
   B = a set of boys who play volleyball
   A = {*Samuel, Elijah, John, Andrew*}
   B = {*Thomas, Elijah, James, Andrew*}

List the names of boys who play either football or volleyball. They will be Samuel, Elijah, John, Andrew, Thomas and James.

You realize that boys who play both games have their names appearing only once. Therefore

AUB = {*Samuel, Elijah, John, Andrew, Thomas, James*}

3. Write the Union of the following three sets
   A= {2,4,6,8,10} B = {3,6,9,12,15}= C = {4,8,12,16,20}

Solution

List all the elements of sets A, B and C without repeating any number 2,3,4,6,8,9, 10, 12, 15, 16, 20

Therefore AUBUC = {2,3,4,6,8,9,10,12,15,16,20}

Exercise 50(d)

1. If A ={*5, 10, 15, 20, 25, 30, 35, 40*}
   B = {*6, 12, 18, 24, 30, 36, 42*}
   Find AUB=

2. If X = {*P, Q, R, S, T*} *Y* = {*R, S, T, U, V*}
   Find XUY=

3. Use he following sets to answer the questions below
   M = {*1,2,3,4,5,6,7,8,9*} *N* = {*3,6,9,12*}*Q* = {*4,8,12,16*}
   (a) List elements of set M which are also in set N
   (b) List elements of set M which are also found in set Q
   (c) List elements of N which are also found in set Q
   (d) MUN
   (e) MUQ
   (f) NUQ
   (g) MUNUQ

4. X = {*set of even numbers less than 11*}
   Y = {*set of multiples of 3 less than 13*}
   (a) List the elements of set X
   (b) List the elements of a set Y
   (c) Find XUY

5. P is a set of the first 8 letters of the English alphabet.
   Q is a set of the English vowels.
   (a) List the element of set P.
   (b) List the elements of set Q.
   (c) Find PUQ.

6. Find the following: if

R= {1,3,5,7,9,11,13,15}

S= {1,2,3,5,7,11,13,17}

T = {2,4,6,8,10}

(a) RUS (b) RUT (c) SUT (d) RUSUT

4.2 (e) (ii) Intersection sets

(i) Consider the following sets

A = {1,2,3,4,5,6,7,8,9} B = {2,4,6,8,10,12,14,16}

1. The elements of set A are whole numbers up to 9.
2. The elements in set B are multiples of 2 less than 17.
3. Which elements in set A can be found in set B? They are 2,4,6,8.
4. The common members of set A and set B form an intersection set.
5. The intersection set is represented by the symbol ∩ therefore intersection of a and B can be written as (i) A∩B = {2,4,6,8}

(ii) Consider the following sets

P = {a,b,c,d,e,f} R= {a,b,d,o,m,e,n}

Find the intersection set

∴P∩R = {a,b,d,e}

(iii) Consider the following three sets

S= {10,20,30,40,50,60}

R = {5,10,15,20,25,30,35,40,45}

T = {4,8,12,16,20,28,32,36,40}

(a) Which elements are common in sets S,R, and T

(b) State the intersection of the three sets

Solution

The common elements in sets S,R and T are 20, 40

The intersection of S,R and T can be written as S∩R∩T = {20,40}

Exercise 50(e)

1. If X = {2,3,6,8,10,12,14,16,18,20}
   Y = {3,6,7,9,10,12,15,18,20}
   (a) List the common elements of X and Y
   (b) Write the intersection set of X and Y

2. A = {*Mary, Martha, Rebecca, Joan, Elizabeth*}
   B = {*Martha, Jane, Judy, Joan, Margaret*} find $A \cap B$

3. M= {mangoes, guavas, oranges, pawpaws}
   N = {pineapples, apples, bananas} find $M \cap N$

4. Write the intersection sets for the following pairs of sets.
   (a) F = {6,12,18,24,30,36}

   E = {4,8,12,16,20,24,28,32,36}
   $F \cap E$

   (b) K = {*John, James, Jacob, Joan, Jude*}

   L = {*Jane, James, Joan, Jesse, Jennifer*}
   $K \cap L = \{\}$

5. Find the intersection of the following sets

   (a) Q = {2,4,6,10,12,14,16,18,20}

   R = {3,6,01,12,14,16,18,20}

   S = {6,12,15,18,21,24}

   $Q \cap R \cap S$

   (b) M = {a,c,d,h,i,j}

   P= {g,h,e,d,m}

   R= {k,i,d,e,b,h}

   $\therefore M \cap P \cap R$

6. Find the intersection of the following pair of sets

(a) H = {9,18,27,36}, J = {8,16,24,32}

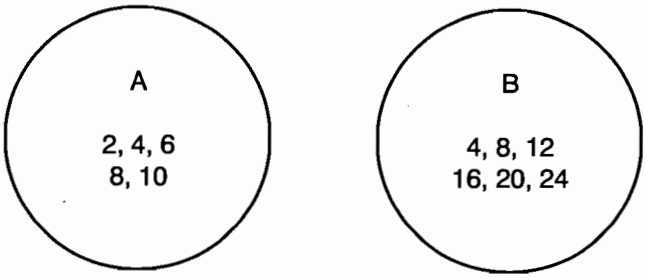
(b) D = {5,10,15,20,25,30}, E = {7,14,21,28}

4.2 (f) Venn Diagrams

Sets can be represented by diagrams. Diagrams used to represent sets are called Venn diagrams.

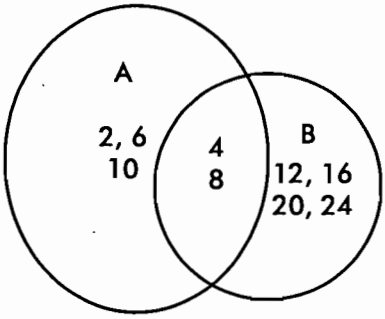
Example

Set A = {2,4,6,8,10} B ={4,8,12,16,20,24}



$A \cap B = \{4,8\}$

The intersection of A and B can be represented by a Venn diagram as shown below.

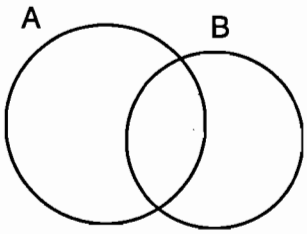


Do you remember what the union of two sets is? Given two sets X and Y, the union of the sets is the set made up of all the members in X or in Y or in both.

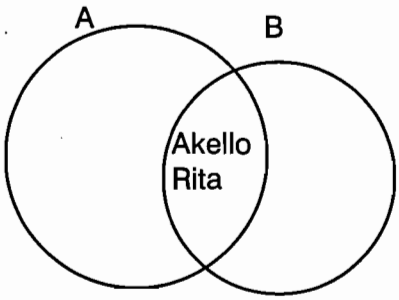
We can show the union of two sets using a Venn diagram.
Suppose that we have two sets of pupils:

A = {*pupils who write with their left hand*
Rita, Akelo, Kato, Raphael, Simon}
B = {*pupils who write with their right hand*
Atima, Leon, Akello, Peter, Rita}

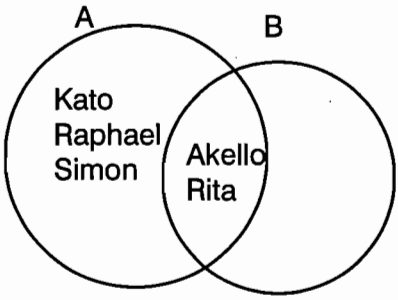
Step 1 Draw an empty Venn diagram



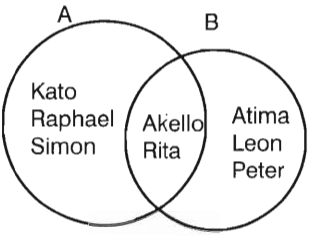
Step 2 Write in the members of the intersection.



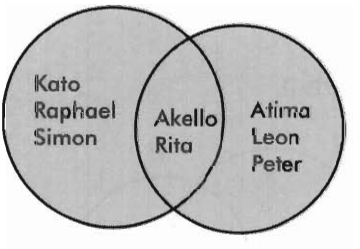
Step 3 Fill in the remaining members of A.



Step 4 Fill in the remaining members of B.



Each member has been put into its correct position, and each member appears only once. Now we can shade the whole region. This shaded region is the Union of A and B.



Now we can list the set AUB =
{Kato, Raphael, Siomon, Akello, Ritta, Atima, Leon, Peter}

Exercise 50 (f)

Use Venn diagrams to find the Union of each pair of sets. List the union sets using curly brackets

1. M={even numbers less than 11}
   N= {counting numbers less than 11}
2. P = {3,6,9,12,15,18,21}
   Q = {1,3,5,7,9,11}

3. K= {21,22,23,24,25}
   L= {21,24,27,30}

4. X = {4,8,12,16,20,24}
   Y = {3,6,9,12,15,18,21,24}
   (a) List the common elements of X and Y
   (b) Write the intersection of X and Y i.e. X ∩Y =
   (c) Draw Venn diagram to show the intersection of X and Y

5. Q = *{F,G,H,T,J,K,L,M}*
   R = *{K,L,M,N,O,P}*
   Draw a Venn diagram to illustrate the relationship of the sets Q and R

UNIT 5 Statistics

Statistics is the collection, organization and analysis of information (data).

5.2 (a) Mean

Arithmetic mean (or average)

$$\text{Mean} = \frac{\textit{Total number of items}}{\textit{Total number of sets}}$$

Examples

(i) If a given set of numbers are x_1, x_2, x_3, x_4

Arithmetic mean = $\frac{X_1 + x_2 + x_3 + x_4}{4}$

(ii) The weight of 5 boys was recorded as follows.
15kg, 20kg, 36kg, 18kg, 27kg. Find arithmetic mean

Solution

$$\frac{15 + 20 + 36 + 18 + 27}{5}$$

Arithmetic mean = $\frac{116}{5}$ = *23.2kg*

(iii) The average mark for Lado in 7 tests was 54. In six tests he scored the following marks 53, 48, 55, 59, 52, 50. Find the score for the seventh test.

Solution

Total marks for 7 tests = 7x54 =378
Total mark for 6 tests = 6 x54 =324
Score for the seventh test = 54 marks

Exercise 51 (a)

1. Find the mean of the following numbers:

   (a) 12, 16, 17, 21, 9, 10, 13

   (b) 33, 47, 79, 65

   (c) $\frac{1}{2}, \frac{1}{6}, \frac{1}{4}, \frac{1}{12}$

2. The average age of 8 girls and women is 26 years. The age of seven of the girls are as follow: 15yr, 20yrs, 18yr, 25yrs, 19yrs, 23yrs, 21yrs, find the age of the eighth girl.

3. The ages of the people working in an office were 38,22,45,44,58. What was the rnean age of the people in that office?

4. A pickup carried a load of 460 kg which included 5 people whose mean weight was 75.4 kg and cabbages. What was the weight of the cabbages?

5. In a small business the director earns £120,000 a mouth. His two assistants each earn £55,000 a month. Ten workers earn£ 5,000 each. Find the total wage bill and use this to work out the mean wage for the thirteen people.

6. Work to construct a road started in January and ended in April the same year. The attendance of workers was as follow: Jan. 39, Feb. 48, March 41, and April 48. What was the mean daily attendance?

7. The ages of the people working in a factory were 35, 45, 37, 29, 28 and 42. What was the mean age? (give your answer correct to 1 decimal place)

5.2 (d) Median

This is a value that lies in the middle after the data is arranged in order of magnitude i.e. either in ascending or descending order

(a) If a given set of data is <u>odd</u> then one value must lie in the middle which divides the set into two equal parts.

(b) If a given set of data is <u>even</u> then median will be equal to the arithmetic mean of the two values that lie in the middle, after it has been arranged in order of magnitude.

Examples

Find the median from the following set of data

(i) 16, 20, 13, 35, 8, 12, 28

Solution

First arrange it in an array

i.e. 8, 12, 13, $\boxed{16}$ 20, 28, 35

∴Median = <u>16</u>

(ii) 15, 3, 9, 20, 5, 6, 13, 2

Solution

2, 3, 5, $\boxed{6, 9,}$ 13, 15, 20

Median = $\frac{6 + 9}{2}$

= $\frac{15}{2}$

<u>7.5</u>

Exercise 51 (b)

1. A boy got the following scores from several examinations given by the teacher
   (a) 90, 86, 39, 69, 40,
   (b) 86, 72, 43, 50, 60, 70

Find the median in each set.

2. The ages of pupils in a class are 13, 14, 12, 15, 13, 11, 18. Find the median age of these pupils.

3. The number of absentees in a certain school in one week was recorded as follows 9, 3, 5, 15, 13. Find the median.

4. Find the median attendance of P4 pupils in a certain school in one week, if they came as follows: 41,42,38, 46, 40.

5. In a hospital, the temperature of patients a - c is given below. Find their median.

   (a) 35.9°C, 36.3°C, 40°C, 36.8°C,
   (b) 36.9°C, 38.8°C, 34.6°C, 36.8°C
   (c) 38.9°C, 36.5°C, 41°C, 39.4° C, 37.5°C

6. Find median of the following:

   (a) 160, 130, 92, 58, 130
   (b) 90, 98, 98, 71, 23, 40
   (c) 16, 26, 30, 22, 16

7. A shopkeeper sold several sizes of shoes to customers one day as follows:
   7, 8, 9, 10, 9, 10, 7, 7, 5. Find the median.

5.2 (e) Mode

This is the value with the highest occurrence (with the most frequency)

Examples

(i) Find the mode from the data below
   2, 5, 3, 7, 2, 3, 2, 6, 2, 9, 2

Solution

   Mode = 2

(ii) Find mode from the data below
   9, 5, 11, 5, 10, 8, 11, 13, 7, 11, 5

Solution

Mode = *5 and 11*

(iii) Find the mode of the following ages
   20, 15, 39, 23, 27, 31, 19, 17

Solution

Here mode = 0
This implies that there is no mode because every age is occurring once

Exercise 51 (c)

Solving problems involving mean, mode and median

1. Find the mode, mean and median of the following numbers
   (i) 7, 8, 4, 6, 7, 9 (ii) 21, 32, 12, 32, 34, 15, 32.

2. What is the mode of the following quantities?
   340, 240, 540, 340, 240, 440, 240

3. The weight of nine bags of beans is as shown below.
   91kg, 90kg, 92kg, 93kg, 90kg, 91kg, 92kg, 89kg
   Find the mode, mean and median

4. Find (i) the mode and (ii) the mean of the following numbers
   (a) 3, 2, 4, 3, 6, 2, 3, 5, 4, 8,
   (b) 12, 11, 9, 8, 13, 10, 12, 17, 16
   (c) 30, 20, 50, 60, 30, 50, 70, 10, 50, 40

5. 12 teams were involved in a competition and their scores were as follows:
   20, 12, 15, 15, 13, 20, 14, 7, 20 , 15, 8 and 9. What was the modal score?

6. A pick-up carried bags of maize in five trips in the following order:
   450kg, 350kg, 500kg, 450kg and 400kg. What was its modal weight?

7. Find the mode, mean and median of the following numbers:
   (a) 12, 13, 16, 17, 18, 12, 15, 12
   (b) 29, 30, 42, 43, 42, 40, 29
   (c) 4.6, 4.9, 5.8, 7.9, 3.6, 7.9
   (d) 2, 3, 4, 9, 11, 6, 3, 4 ,3,
   (e) 23, 7, 24, 10, 23, 21, 23, 30, 60

5.2 (b) (i) Bar Graph

Important points to remember when choosing a suitable scale

- Drawing of graphs involves choice of a suitable scale
- the scale chosen should be such that the values in the table can be represented to fit the size of the graph paper.

Examples

Batali obtained the following marks in 5 subjects as shown in the table below

	Subjects	Marks
1.	English	64%
2.	Mathematics	54%
3.	History	78%
4.	Geography	64%
5.	Science	80%

Before you draw the graph

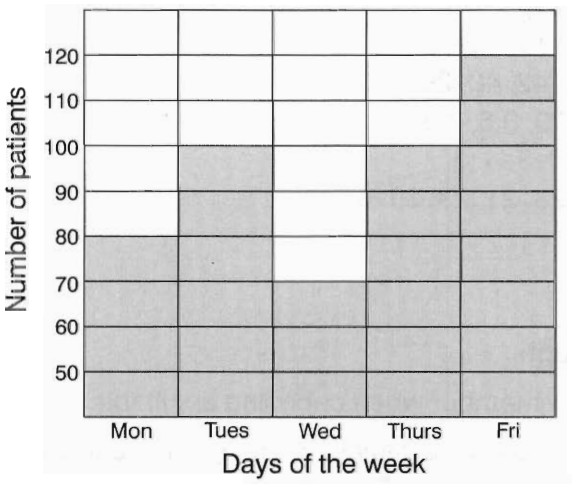
(i) Decide on which axis to put the subject and which one to put the marks
(ii) Choose a suitable scale for each axis

Solution

- The subject should be put along the horizontal axis and the marks on the vertical axis.
- Let 1 cm represent one subject on the horizontal axis and 1 cm to represent 10 marks on the vertical axis

Now draw the bar graph for the table

ii) The graph below shows the number of patients who attended hospital in one week. Study it and use it to answer questions (a) to (h) below



a) Which day of the week had the least number of patients?
b) How many patients attended on Thursday?
c) How many more patients attended on Tuesday than on Monday?
d) How many patience attended the hospital in the first three days of the week?

e) Which day of the week had the most number of patients?
f) On which days were the numbers of patients the same?
g) What is the total number of patients who attended in the whole week?
h) What is the difference in the number of patients between the day with the least number of patients and the day with the most number of patients.

Answers:

a) Wednesday
b) 100 patients
c) 20 more patients
d) 250 patients (i.e M + T + W)
e) Friday
f) Tuesdays and Thursday
g) 470 patients (i.e M + T + W +TH +F)
h) 50 patients (ie. 120 -70 = 50)

Exercise 51(d)

1. The table below shows records of clinic attendants of expectant mothers in a certain hospital in South Sudan

Day	Mon	Tue	Wed	Thur	Fri
Number of attendants	45	35	70	45	30

(I) Using a suitable scale, draw a bar graph to represent this information.
(ii) How many mothers attended clinic for the whole week?
(iii) What is the mode in this date?
(iv) Calculate arithmetic mean from this information

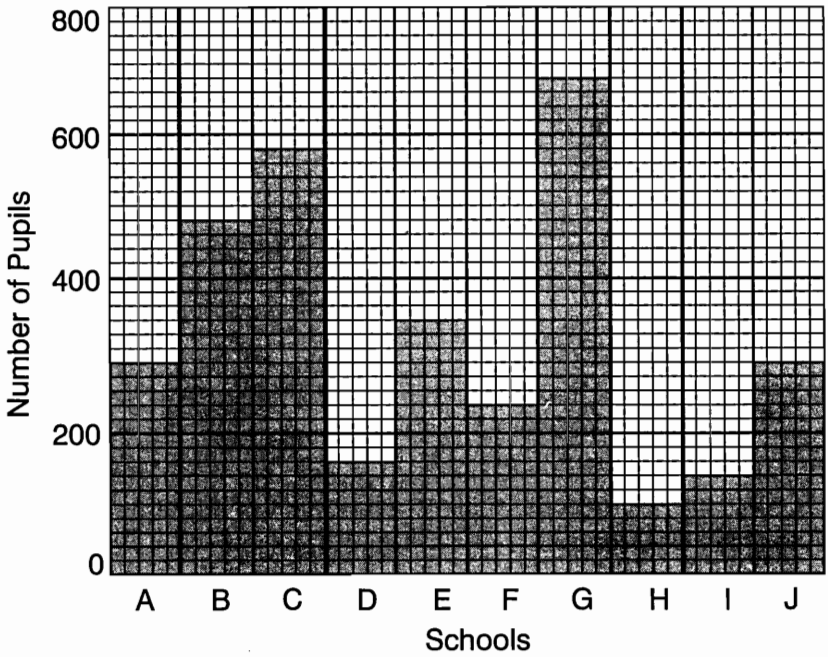
2. The following table shows mathematics marks for 6 pupils in P7 in a certain school. Use the information in the table to answer the questions below.

Name	James	Rita	Andrew	Judith	Simon	Mark
Marks	75	65	40	80	90	85

(a) Draw a bar graph
(b) Answer the following questions
    (i) Who among the six pupils needs to try harder.
    (ii) Calculate the mean average mark for the six pupils
    (iii) Arrange the marks for the six pupils in ascending order.

5.2 (c) Reading and interpreting data in a given table

1. The graph below shows a number of pupils in 10 schools namely A -J. Use the graph to answer the questions below.



a) What is the scale on the horizontal axis?
b) What is the scale on the vertical axis?
c) Which school has the highest number of pupils?
d) Which two schools have the same number of pupils?
e) Which school has the lowest enrolment?
f) Find the total number of pupils in the ten schools
g) Find the mean average for the ten schools

2. The table below shows the number of new children admitted in a school in 2004. Use the table to answer the questions below.

Class	1	2	3	4	5	6	7	8
No. of pupils	140	110	80	55	55	38	29	-

(i) In which class were the most pupils admitted?
(ii) Which class admitted the lowest number of pupils?
(iii) Which class had no new admission?

(iv) What was the total number of new pupils that year?
(v) Which classes admitted the same number of pupils?

3. In a class of 60 pupils were asked by their teacher to vote for their favorite fruit. Since some of the pupils did not have favorite fruit, they did not vote. Use the table below to answer questions that follow:

Name of fruit	Orange	Mangoes	Banana	Paw-paw	Lemon
Number of pupils	8	12	16	4	-

(i) Which fruit was not liked?
(ii) Which fruit was liked most?
(iii) How many children voted?
(iv) How many children did not vote?
(v) What percentage of the class voted? Give your answer correct to 2 decimal places.

5.2 (b) (ii) Pie Chart

A pie chart shows how something is divided up. The area of the sector represents the number of items.

Examples

(a) In Jokondo's fruit farm 20% are oranges, 30% are pineapples, 40% are mangoes and 10% are guavas. Represent this information on a pie chart.

Solution

(i) Express all percentages into fractions

Oranges $= \frac{20}{100} = \frac{1}{5}$

Pineapples $= \frac{30}{100} = \frac{3}{10}$

Mangoes $= \frac{40}{100} = \frac{2}{5}$

Guavas $= \frac{10}{100} = \frac{1}{10}$

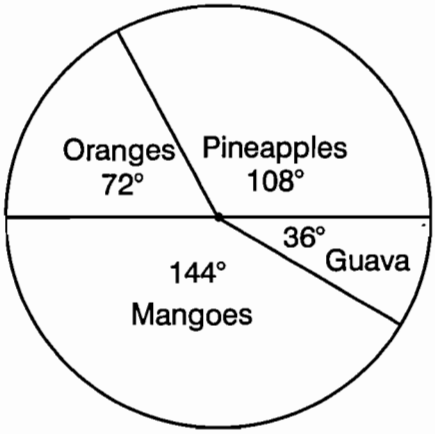
(iii) Express these fractions on a circle of 360°

Orange $= \frac{1}{5} \times 360 = 75°$

Pineapples $= \frac{3}{10} \times 360 = 108°$

Mangoes $= \frac{2}{5} \times 360 = 144°$

Guava $= \frac{1}{10} \times 360 = 36°$



(b) Nimaya has the following types of marbles: 8 green, 6 red, 7 blue and 9 yellow Represent this information on a pie chart.

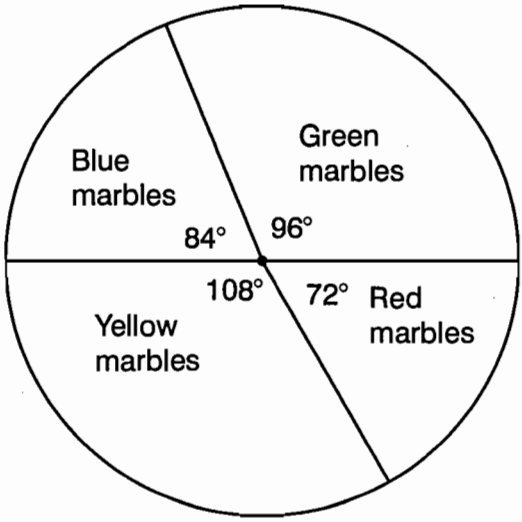
Solution

Total number of marbles is 8 +6 + 7 + 9 =30. The number of degrees in a circle is 360°. Then number of degrees representing each marble is $= \frac{\cancel{360}^{12}}{30} = 12°$

∴The angles representing

Green Marbles	$= 8 \times 12° = 96°$
Red Marbles	$= 6 \times 12° = 72°$
Blue Marbles	$= 7 \times 12° = 84°$
Yellow Marbles	$= 9 \times 12° = 108°$

Draw these angles in a circle as shown below,
Draw a circle of any reasonable radius. From the centre draw the angles above.



Exercise 52

1. Poni harvested 3 bags of groundnuts, 7 bags of dura, 4 bags of maize and 6 bags of beans. Represent this information in a pie chart.

2. 45% of Garang's livestock are cows, 25% are goats, and 30% are sheep.

   (a) What fraction of Garang's livestock are

   (i) cows (ii) goats (iii) sheep

   (b) What angle in a pie chart will represent:

   (i) cows (ii) goats (iii) sheep

   (c) Draw a pie chart to represent the information above.

3. A housewife spends 30% of her time in a day working in the garden, 15% cooking for the family, 30% on social activities, and 25% resting.

   (a) What fraction represents

   (i) Time spent in the garden?

   (ii) Time spent cooking?

   (iii) Time spent on social activities?

   (iv) Time spent resting?

(b) Find the angle which will represent time spend
   (i) Working in the garden
   (ii) cooking for the family
   (iii) On social activities
   (iv) Resting

(c) Draw a pie chart to represent this information.

4. The following information shows how Victoria used her garden. $\frac{1}{8}$ of the garden she has planted simsim. $\frac{3}{8}$ of the garden she has planted groundnuts. ½ of the garden she has planted sorghum.

   (a) What percentage is the portion for
      (i) simsim (ii) groundnuts (iii) sorghum

   (b) What angle in the pie chart represent
      (i) simsim (ii) groundnuts (iii) sorghum

   (c) Draw a pie chart to represent the information above.

5. In a primary school in Tonj, the deputy head teacher counted all the text books in the store. The result were as follows:

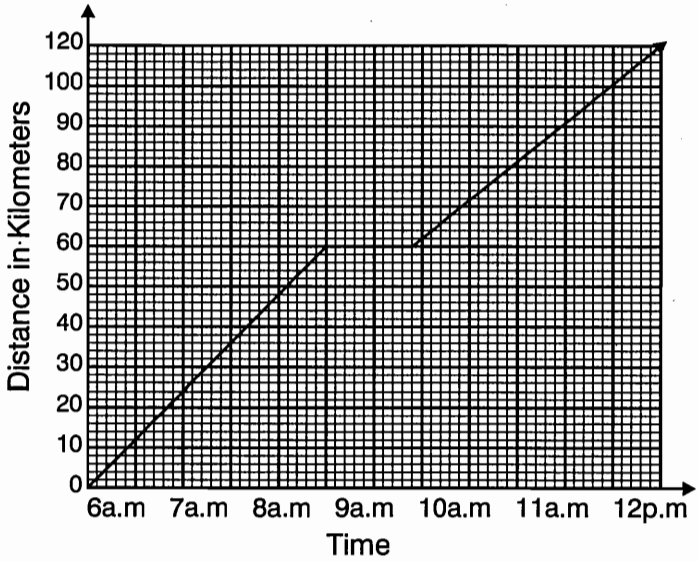
Mathematics	300 books
English	360 books
Social Studies	120 books
Science	180 books
Home science	180 books
Agriculture	60 books

(A) On a pie chart what angle represents
   (i) Mathematics
   (ii) English
   (iii) Social studies
   (iv) Science
   (v) Agriculture

(b) Draw a pie chart to represent the information above.

5.2 (b) (iii) Travel graph

Use this graph to answer the questions in the example below.



Example

The above graph shows how Peter traveled from town A to town B. His motor bike developed problems after he had traveled a distance of 60 km. He took some time to repair it and then he continued with his journey to the end. Using the graph to answer the following questions.

(a) What was his speed before he developed a problem?

(b) How long did he take to repair his motor-bike?

(c) At what speed did he travel from 9:30 am to 12:00 noon?

(d) Calculate his average speed for the above journey. (include of time of rest in your calculation)

Solution

(a) Speed $= \frac{60}{2\frac{1}{2}} = 60 \div \frac{5}{2} = 60 \times \frac{2}{5} = 24$ km/h

(b) He took = 9:30 - 8:30 = 1 hour

(c) Time taken
$$\begin{array}{r} 12{:}00 \\ -\underline{9{:}30} \\ \underline{2.30} \end{array} = 2\text{hr } 30\text{min}$$

Distance covered = (120 - 60)km = 60 km

Speed $= \frac{D}{T} = 60 \div 2\frac{1}{2} = 24$ km/hr

(d) Average speed $= \frac{\text{Total distance covered}}{\text{Total time taken}}$

$$\left(\frac{120}{6}\right) = 20 \text{ km/hr}$$

Exercise 53

1. Kiden walked from her home to the hospital, a distance of 24km. She left home at 8:00am and arrived at the hospital at 11:30 am.

   (a) (i) How long did she take from her home to the hospital?
   (ii) Calculate her average speed.
   (iii) Using a suitable scale for both vertical and horizontal axis, draw a travel graph for her journey.

   (b) From the graph answer the following questions:
   (i) How far had she walked by 9:30 am?
   (ii) At what time had she covered 18 km?

2. A cyclist started his journey at 7:30am. After riding for 4 hours at a speed of 36 km/h, he rested for 30 minutes. He then rode again at a speed of 12km/h arriving at the destination at 1:00pm

   (a) Draw a graph to show the cyclist journey
   (b)From the graph
   (i) Calculate the total distance covered in the whole journey.
   (ii) Calculate time taken cycling for the whole journey
   (iii) Calculate average speed for the whole journey.

3. A tourist started his journey from town A at 7:00am. He drove to town B for 2hrs at a speed of 60km/h. At town B he rested for 30 minutes. From town B he drove at a speed of 70 km/h for 3 hours to town C .

   (i) Calculate the distance between town A and B
   (ii) What time did the tourist arrive at town B?
   (iii) At what time did he start his second journey from B?
   (iv) Find the distance covered between B and C.
   (v) At what time did the tourist arrive at town C
   (vi) Calculate his average speed for the whole journey.
   (vii)Draw a travel graph to illustrate the tourists journey.

4. Below is a description of Modut's journey
   From 10: am to 11:00 am he traveled 90km.
   From 11:00 am to 11:15 am he stopped for petrol and minor repairs.

From 11:15 am to 12:00 noon he traveled 60km.
From 12:00 noon to 1:00pm he travelled at an average speed of 70km/h.
From 1:00pm to 2:00pm he stopped for lunch.

(a) Draw a graph to illustrate the journey.
(b) Use your graph to answer the following questions.

(i) How far had he gone by 12:00 noon? By 1:30 pm?
(ii) At what time had he covered a distance of 100km? 200km?
(Iii) What was the total distance of the journey?
(iv) At what speed did he travel between 11:15 am and 12:00 noon?

5.2 (g) Games of chance (probability)

The term "probabilities "arose from games of chance and the first theorists were gamblers. This theory originated from them.

Suppose that a particular event or occurrence can happen in h ways and fail to happen in f ways and that each of these (h+f) possibilities is equally likely to happen, then the probability, p that the event does occur is

$$= \frac{\text{Number of ways event can occur}}{\text{Total number of possibilities}} = \frac{h}{h+f}$$

And the possibility, q that the event does not occur is similarly $\frac{f}{h+f}$

$$\text{Now } p + q = \frac{h}{h+f} + \frac{f}{h+f} = \frac{h+f}{h+f} = 1$$

$$\therefore p + q = 1$$

It therefore follows that q = 1-p
ie if the probability that an event occurs is p, the probability that it does not occur is 1-p.

N.B when an event is certain to happen q = 0 and so p =1. Likewise when an event is certain not to happen p = 0 and so q = 1.

Example

Suppose we have coloured beads as follows

- 8 red
- 5 blue
- 3 green
- 4 yellow

Find the probability of selecting red, blue, green and yellow beads.

Solution

Sample space = 20

(i) P(red beads) $= \frac{8}{20} = \frac{2}{5}$

(ii) P(blue beads) $= \frac{5}{20} = \frac{1}{4}$

(iii) P(green beads) $= \frac{3}{20}$

(iv) P(yellow beads) $= \frac{4}{20} = \frac{1}{5}$

5.2 (g) Games of chance involving coins and dice

Examples

(i) Find the probably of getting a head in a single throw of a fair coin.

Solution

Number of heads in coin = 1

Number of sides of a head and not tail i.e. sample space = 2

$\therefore$probability of a head = $\frac{\text{Number of times ahead occurs}}{\text{Total possible outcomes}}$

$\therefore$ P(h) = ½

It follows that p(tail) = ½ i.e 1 - p - ½ = ½

(ii) Find the probability of getting 5 out of single throw of a fair die.

Solution

Sample space = 6 i.e. die has six faces

$$\therefore \text{probability of getting 5} = \frac{\text{Ways of getting 5}}{\text{sample space}} = \frac{1}{6}$$

Exercise 54

Pupils work in groups to experiment with coins and dice.

1. Toss a coin in the air, it will fall head or tail. Toss one coin eight times and record your outcome. Remember to tie the tally marks when they reach four.

e.g

	Tally marks	No of times
Head		
Tail		

2. Experiment with six coins

	Tally marks	No of times
Head		
Tail		

3. Experiment with dice

	Tally marks	**No of times**
1		
2		
3		
4		
5		
6		

4. A fair coin is tossed twice, what is the probability of a head?

5 A fair die is thrown up once. What is the probability of getting 2, 5, or 6?

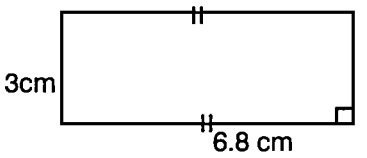
6. In a box there are 7 red balls, 5 green balls, 8 yellow balls and 4 brown balls. What is the probability of getting a red, green, yellow and brown balls?

UNIT 6 Scale Drawing

6(a) Reading and drawing to scale

In scale drawing, given 1 cm for 10m means that when drawing, 1cm represents an actual length of 10m. eg. If the real length is 68m, the drawing length is

$$\frac{68}{10} = \underline{6.8\text{cm}}$$

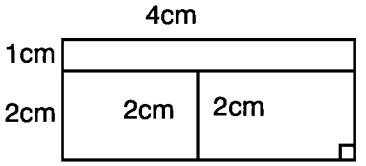


6(b) Interpreting linear scale:

1:100 means 1cm on the drawing represents 100 cm on the actual measurement. What does 5 cm represent?

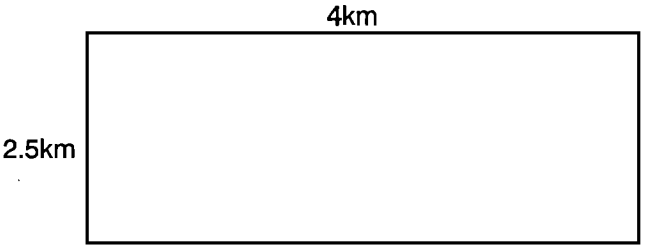
6(c) Interpreting scale drawing.

Scale: 1 cm represents 10 m. Find the actual measurements.



6(d) Drawing appropriate scale

Choose a scale drawing for the diagram below.



Solution

1 km = 100,000cm
4km = 400,000cm
(a) The scale 1:100,000

$$\text{Therefore } 4\text{km} = \frac{400{,}000}{100{,}000} = 4\text{cm}$$

$$2.5\text{km} = \frac{250{,}000^{25}}{100{,}000} = 2.5\text{cm}$$

Drawing

(b) The scale 1: 50000 will be

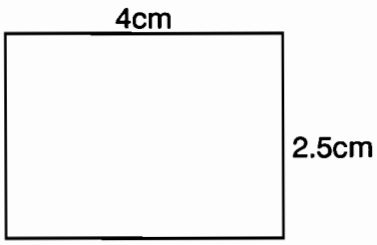
$$4 \text{ cm} = \frac{400000}{50000} = 8 \text{ cm}$$

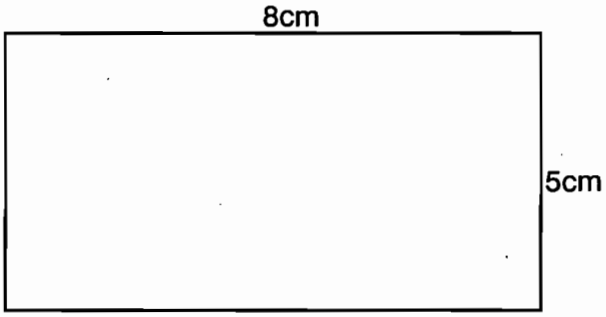
$$2.5 \text{ cm} = \frac{250000}{50000} = 5 \text{ cm}$$

(c) The scale 1: 10000 will be

$$4 \text{ km} = \frac{400000}{10000} = 40 \text{ cm}$$

$$2.5 \text{ km} = \frac{250000}{10000} = 25 \text{ cm}$$





Exercise: 55(a)

1. Complete the following statements:

(a) 1 cm represents 3 m can be written as 1 cm represents ____cm.
(b) 1 cm represents 7m can be written as 1 cm represents ___cm.
(c) 1 cm represents 500m can be written as 1 cm represents __cm.
(d) 1 cm represents 1.5 km can be written as represents _____cm.
(e) 1 cm represents 20 km can be written as 1 cm represents __cm.

2. Write each of the following scales as a ratio.

   a) 1 cm represents 6 metres.
   b) 1 cm represents 80 metres.
   c) 1 cm represents 25 km.
   d) 1 cm represents 100 metres.
   e) 1 cm represents 50 km.

3. What are the drawing lengths of the following given the scale of 1:10000?

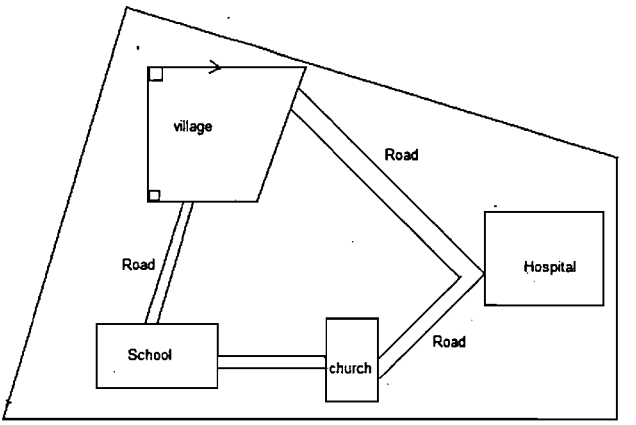
   a) 200m b) 500m c) 850m d) 1.3km e) 950m

4. Using the scale: 1:10000, what would be the real length of the following in metres?.

   a) 2.5cm b) 13cm c) 3.8cm d) 8.9cm

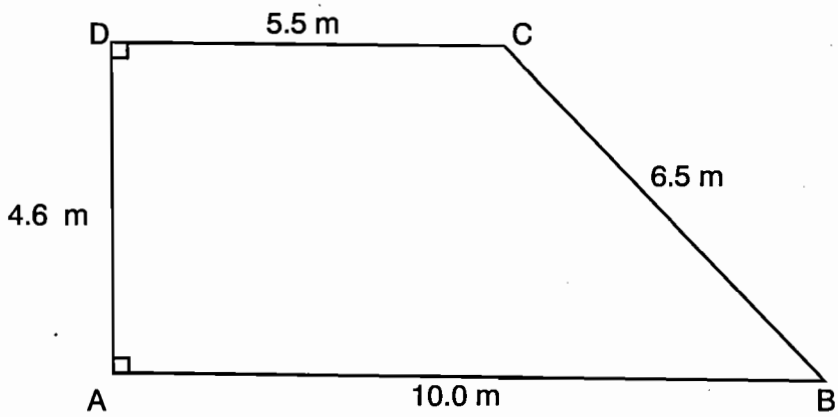
6(d) (i) Determining to appropriate scale

1. Below is the map of a centre drawn to the scale of 1:1000. Use a ruler to answer the questions that follow.



a) What is the distance around the centre in metres?
b) What is the length of the road from the village to the hospital in metres?
c) Calculate the area covered by the village in m^2.

2. In the figure below draw the ABCD to scale of 1:1000 or 1 cm : 1 m



Exercise 55 (b)

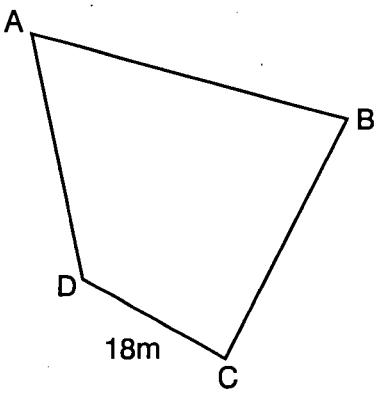
1. Complete the following table:

	Drawing length	**Real length**
A to B	10 cm	1000 m
B to C	6 cm	m
C to D	4.3 cm	m
D to E	cm	200 m
E to F	cm	300 m
F to G	5 cm	m
G to A	cm	600 m
Perimeter	cm	m

2. A rectangular ranch measures 1.5km by 800 metres.
   (a) Using a 1 cm scale, represent 200 metres, and calculate the drawing dimensions of the land.
   (b) Make a scale drawing of the ranch.

3. Measure the length and width of your classroom. Make a scale drawing of it using the scale 1:100.

4. The diagram below represents a piece of ground whose real measurement for one side is shown.



a) Measure DC in centimeters.
b) What is the real length of AB in meters?
c) Write the scale used in the ratio form.

6.1 (f) Making a Scale Drawing

Example

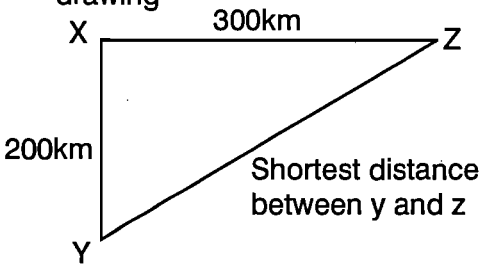
Town x is 200km North of town Y and town Z is 300km East of town x.

(a) Using the scale 1cm represents 50km, make a scale drawing showing the position of towns x, y and z.

(b) What is the shortest distance between town y and z?

Solution

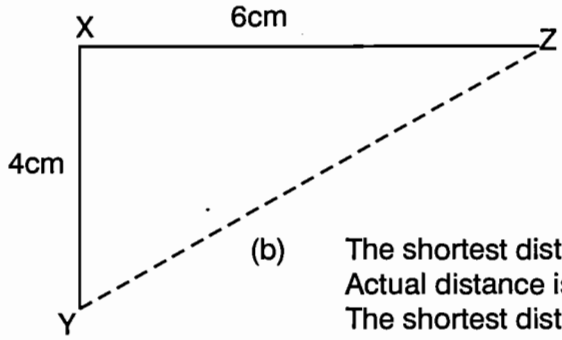
(a) It is always important to make a rough sketch diagram of the expected scale drawing



Since 1cm represents 50km or 50km is represented by 1cm, 1km is represented by $\frac{1}{50}$ cm

200km is represented by $\frac{1}{50}$ x 200cm = 4cm

300km is represent by $\frac{1}{50}$ x 300cm = 6cm

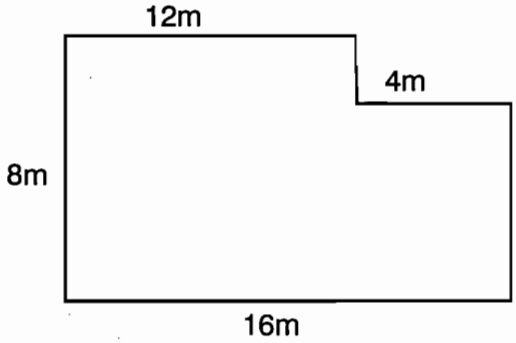


(b) The shortest distance is YZ = 7.2cm
Actual distance is 7.2cm x 50km = 360km
The shortest distance between y and z is 360km

Exercise

1. A rectangular field measures 30m by 90m
   (a) Using a scale 1cm represents 10m, calculate the drawing dimensions of the field.
   (b) Make a scale drawing of the field.

2. Below is a sketch of a building plan



Using a scale of 1cm to represent 2m, draw the building plan to scale.

3. The width of a door is 1.5m and its height is 1½ times its width. Using a scale of 1cm represent 1m, draw the door to scale.

4. A rectangular field measuring 450m by 600m is to be represented on a scale drawing using 1:5000
   (a) What will be the measurements of the rectangle drawn?
   (b) What is the perimeter of the scale drawing?
   (c) What is the area of the scale drawing?

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