SL Paper 1

The first term of a geometric sequence is 2 and the third term is 2.205.

a. Calculate the common ratio of the sequence;   [2]

b. Calculate the eleventh term of the sequence;   [2]

c. Calculate the sum of the first 23 terms of the sequence.   [2]

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a. **In this question give all answers correct to two decimal places.**   [3]

   Diogo deposited 8000 Argentine pesos, ARS, in a bank account which pays a nominal annual interest rate of 15%, **compounded monthly**.
   Find how much **interest** Diogo has earned after 2 years.

b. Carmen also deposited ARS in a bank account. Her account pays a nominal annual interest rate of 17%, **compounded yearly**. After three   [3]
   years, the total amount in Carmen's account is $10\,000\,\mathrm{ARS}$.

   Find the amount that Carmen deposited in the bank account.

The exchange rate between Indian rupees (INR) and Singapore dollars (S$) is $100\,\mathrm{INR} = \mathrm{S\$}\ 3.684$

a. Kwai Fan changes $\mathrm{S\$}\ 500$ to Indian rupees.   [2]

   Calculate the number of Indian rupees she will receive using this exchange rate. **Give your answer correct to the nearest rupee.**

b. On her return to Singapore, Kwai Fan has 2500 Indian rupees left from her trip. She wishes to exchange these rupees back to Singapore   [2]
   dollars. There is a 3% commission charge for this transaction and the exchange rate is $100\,\mathrm{INR} = \mathrm{S\$}3.672$.

   Calculate the commission in Indian rupees that she is charged for this exchange.

c. On her return to Singapore, Kwai Fan has 2500 Indian rupees left from her trip. She wishes to exchange these rupees back to Singapore   [2]
   dollars. There is a 3% commission charge for this transaction and the exchange rate is $100\,\mathrm{INR} = \mathrm{S\$}3.672$.

   Calculate the amount of money she receives in Singapore dollars, **correct to two decimal places**.

A store sells bread and milk. On Tuesday, 8 loaves of bread and 5 litres of milk were sold for $21.40. On Thursday, 6 loaves of bread and 9 litres of milk were sold for $23.40.

If b = the price of a loaf of bread and m = the price of one litre of milk, Tuesday's sales can be written as $8b + 5m = 21.40$.

a. Using simplest terms, write an equation in b and m for Thursday's sales.   [2]

b. Find b and m.   [2]

c. Draw a sketch, in the space provided, to show how the prices can be found graphically.   [2]
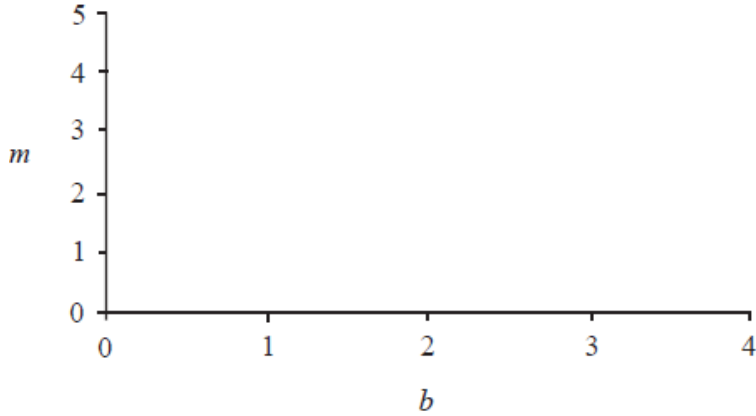
The annual fees paid to a school for the school years 2000, 2001 and 2002 increase as a geometric progression. The table below shows the fee structure.

Year	Fees (USD)
2000	8000.00
2001	8320.00
2002	8652.80

a. Calculate the common ratio for the increasing sequence of fees.   [2]

b. **Give your answer correct to 2 decimal places.**   [2]

   The fees continue to increase in the same ratio.

   Find the fees paid for 2006.

c. **Give your answer correct to 2 decimal places.**   [2]

   The fees continue to increase in the same ratio.

   A student attends the school for eight years, starting in 2000.

   Find the **total** fees paid for these eight years.

An amount, C, of Australian Dollars (AUD) is invested for 5 years at 2.5 % yearly simple interest. The interest earned on this investment is 446.25 AUD.

5000 AUD is invested at a nominal annual interest rate of 2.5 % **compounded half yearly**.

Calculate the length of time in years for the interest on this investment to exceed 446.25 AUD.

In this question give all answers correct to two decimal places.

Chiara is an Italian tourist visiting Sweden. The exchange rate for changing euros (€) into Swedish Krona (SEK) is 1€ = 10.275 SEK. She converts 350 euros into Swedish Krona at a bank which charges 2 % commission.

a. Calculate the amount of commission charged in **SEK**.   [3]

b. Write down the amount of money she receives from the bank after commission.   [1]

c. Chiara returns to Italy with 296 SEK. She changes this money back into euros at a bank and receives 32€. The bank does not charge   [2]

   commission.

   Calculate the value in SEK of 1€.

Consider the function $f(x) = ax^3 - 3x + 5$, where $a \neq 0$.

a. Find $f'(x)$.   [2]

b. Write down the value of $f'(0)$.   [1]

c. The function has a local maximum at $x = -2$.   [3]

   Calculate the value of a.

Given that $z = \frac{12\cos(A)}{4q+r}$ and that $A = 60°$, $q = 8$ and $r = 32$;

a. Find the **exact** value of z.   [2]

b.i.Write your answer to part (a) correct to 2 decimal places.   [1]

b.ii.Write your answer to part (a) correct to three significant figures.   [1]

b.iii.Write your answer to part (a) in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$.   [2]

a. When Bermuda (B), Puerto Rico (P), and Miami (M) are joined on a map using straight lines, a triangle is formed. This triangle is known as   [3]

the Bermuda triangle.

According to the map, the distance MB is $1650\,km$, the distance MP is $1500\,km$ and angle BMP is $57°$.
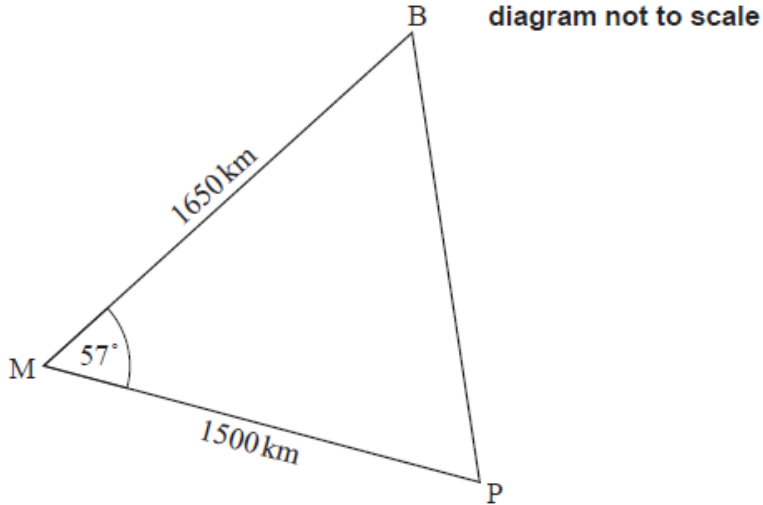
Calculate the distance from Bermuda to Puerto Rico, BP.

b. Calculate the area of the Bermuda triangle.   [3]

The fifth term of an arithmetic sequence is 20 and the twelfth term is 41.

a. (i) Find the common difference.   [3]

(ii) Find the first term of the sequence.

b. Calculate the eighty-fourth term.   [1]

c. Calculate the sum of the first 200 terms.   [2]

The second term of an arithmetic sequence is 30. The fifth term is 90.

a. Calculate   [3]

(i)   the common difference of the sequence;

(ii)   the first term of the sequence.

b. The first, second and fifth terms of this arithmetic sequence are the first three terms of a geometric sequence.   [3]

Calculate the seventh term of the **geometric** sequence.

The length of a square garden is $(x + 1)$ m. In one of the corners a square of 1 m length is used only for grass. The rest of the garden is only for planting roses and is shaded in the diagram below.


diagram not to scale

1 m

$(x+1)$ m
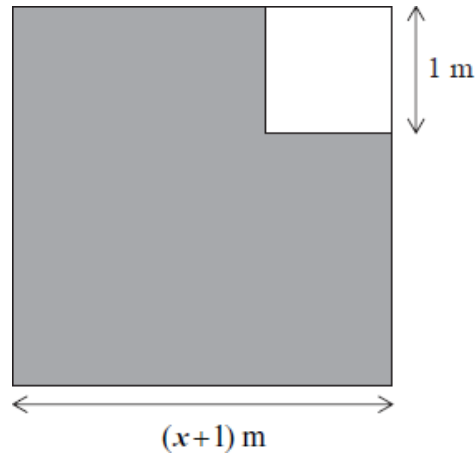
The area of the shaded region is A .

a. Write down an expression for A in terms of x. [1]

b. Find the value of x given that A = 109.25 m². [3]

c. The owner of the garden puts a fence around the shaded region. Find the length of this fence. [2]

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a. Factorise the expression $x^2 - kx$. [1]

b. Hence solve the equation $x^2 - kx = 0$. [1]

c. The diagram below shows the graph of the function $f(x) = x^2 - kx$ for a particular value of k. [1]
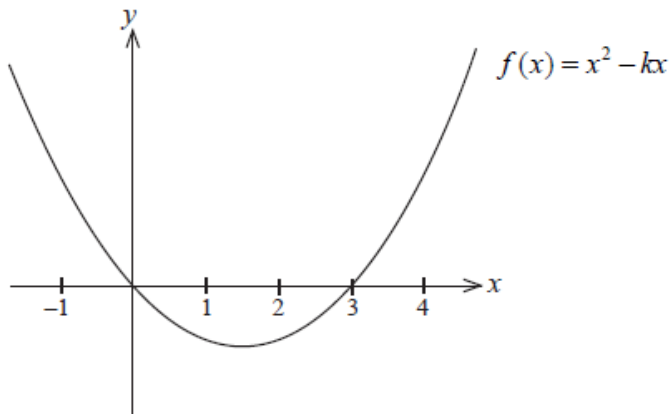
$f(x) = x^2 - kx$

Write down the value of k for this function.

d. The diagram below shows the graph of the function $f(x) = x^2 - kx$ for a particular value of k. [3]

$$f(x) = x^2 - kx$$
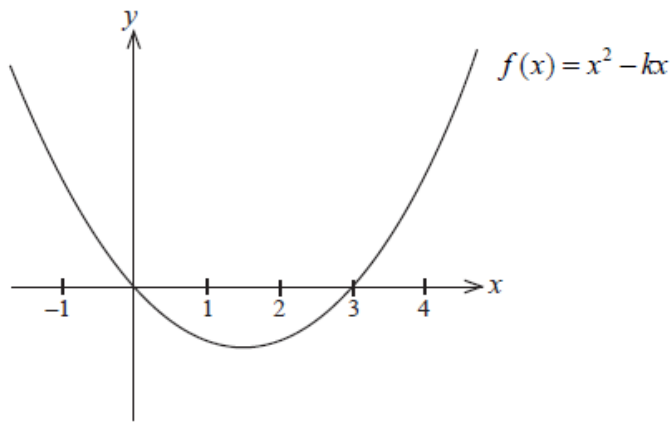
Find the minimum value of the function $y = f(x)$.

Minta deposits 1000 euros in a bank account. The bank pays a nominal annual interest rate of 5%, **compounded quarterly**.

a. Find the amount of money that Minta will have in the bank after 3 years. Give your answer correct to two decimal places. [3]

b. Minta will withdraw the money from her bank account when the interest earned is 300 euros. [3]

Find the time, in years, until Minta withdraws the money from her bank account.

The tenth term of an arithmetic sequence is 32 and the common difference is –6.

a. Find the first term of the sequence. [2]

b. Find the 21st term of the sequence. [2]

c. Find the sum of the first 30 terms of the sequence. [2]

The first three terms of a geometric sequence are $u_1 = 486$, $u_2 = 162$, $u_3 = 54$.

a. Find the value of r, the common ratio of the sequence. [2]

b. Find the value of n for which $u_n = 2$. [2]

c. Find the sum of the first 30 terms of the sequence. [2]

Javier starts training for a running race.

On the first day he runs 1.5 km. Every day he runs 10 % more than the day before.

a. Write down the distance he runs on the second day of training. [1]

b. Calculate the **total** distance Javier runs in the first seven days of training. [2]

c. Javier stops training on the day his total distance exceeds 100 km. [3]

   Calculate the number of days Javier has trained for the running race.

Claudia travels from Buenos Aires to Barcelona. She exchanges 8000 Argentine Pesos (ARS) into Euros (EUR).

The exchange rate is 1 ARS = 0.09819 EUR. The bank charges a 2% commission on the exchange.

When Claudia returns to Buenos Aires she has 85 EUR left and exchanges this money back into ARS. The exchange rate is 1 ARS = 0.08753 EUR.

The bank charges r% commission. The commission charged on this exchange is 14.57 ARS.

a. Find the amount of Euros that Claudia receives. Give your answer correct to two decimal places. [3]

b. Find the value of r. [3]

The first term of an arithmetic sequence is 3 and the sum of the first two terms is 11.

a. Write down the second term of this sequence. [1]

b. Write down the common difference of this sequence. [1]

c. Write down the fourth term of this sequence. [1]

d. The nth term is the first term in this sequence which is greater than 1000. Find the value of n. [3]

In a television show there is a transparent box completely filled with identical cubes. Participants have to estimate the number of cubes in the box.

The box is 50 cm wide, 100 cm long and 40 cm tall.

a. Find the volume of the box. [2]

b. Joaquin estimates the volume of one cube to be 500 cm³. He uses this value to estimate the number of cubes in the box. [2]

Find Joaquin's estimated number of cubes in the box.

c. The actual number of cubes in the box is 350. [2]

Find the percentage error in Joaquin's estimated number of cubes in the box.

Pietro arrives in Singapore and, at the airport, changes 800 euros (EUR) to Singapore dollars (SGD).

The bank rates quoted at the airport for exchanging EUR with SGD are given in the following table. Also given are the rates for exchanging SGD with British pounds (GBP) and US dollars (USD). There is no commission charged on exchanges.

Bank Buys	Bank Sells
1 EUR = 1.55 SGD	1 EUR = 1.75 SGD
1 GBP = 1.92 SGD	1 GBP = 2.05 SGD
1 USD = 1.15 SGD	1 USD = 1.28 SGD

a. Calculate the number of SGD Pietro receives. [2]

b. Pietro also has 100 GBP that he wishes to change to USD for a trip to Cambodia. [4]

To perform this transaction, the GBP must first be converted to SGD and then to USD.

Calculate the number of USD Pietro receives.

The number of apartments in a housing development has been increasing by a constant amount every year.

At the end of the first year the number of apartments was 150, and at the end of the sixth year the number of apartments was 600.

The number of apartments, y, can be determined by the equation $y = mt + n$, where t is the time, in years.

a. Find the value of m. [2]

b. State what m represents **in this context**. [1]

c. Find the value of n. [2]

d. State what n represents **in this context**. [1]

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a. Calculate exactly $\frac{(3 \times 2.1)^3}{7 \times 1.2}$. [1]

b. Write the answer to part (a) correct to 2 significant figures. [1]

c. Calculate the percentage error when the answer to part (a) is written correct to 2 significant figures. [2]

d. Write your answer to **part (c)** in the form $a \times 10^k$ where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [2]

For a study, a researcher collected 200 leaves from oak trees. After measuring the lengths of the leaves, in cm, she produced the following cumulative frequency graph.
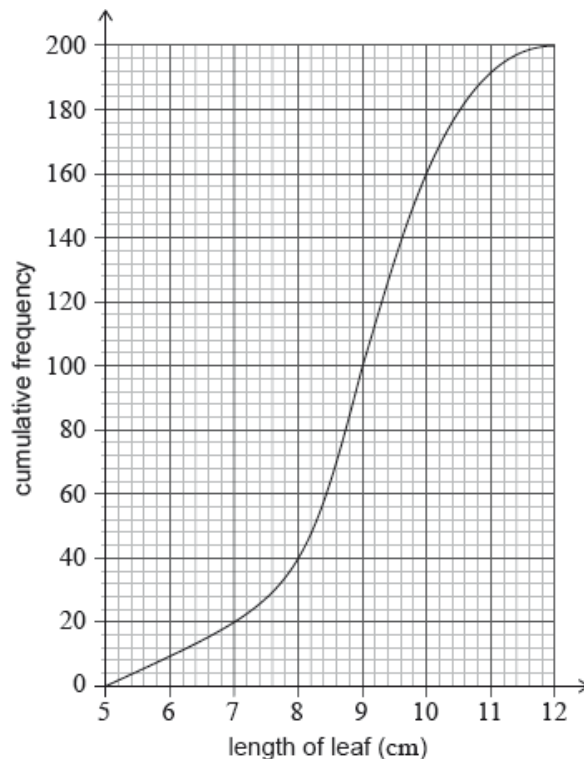
length of leaf (cm)

The researcher finds that 10% of the leaves have a length greater than k cm.

a. Write down the median length of these leaves. [1]

b. Write down the number of leaves with a length less than or equal to 8 cm. [1]

c.i. Use the graph to find the value of k. [2]

c.ii. Before measuring, the researcher estimated k to be approximately 9.5 cm. Find the percentage error in her estimate. [2]

Shiyun bought a car in 1999. The value of the car V , in USD, is depreciating according to the exponential model

$$V = 25000 \times 1.5^{-0.2t}, \ t \geqslant 0$$

where t is the time, in years, that Shiyun has owned the car.

a. Write down the value of the car when Shiyun bought it. [1]

b. Calculate the value of the car three years after Shiyun bought it. Give your answer correct to **two decimal places**. [2]

c. Calculate the time for the car to depreciate to half of its value since Shiyun bought it. [3]

The fourth term, u_4, of a geometric sequence is 135. The fifth term, u_5, is 101.25 .

a. Find the common ratio of the sequence. [2]

b. Find u_1, the first term of the sequence. [2]

c. Calculate the sum of the first 10 terms of the sequence. [2]

A quadratic function $f : x \mapsto ax^2 + b$, where a and $b \in \mathbb{R}$ and $x \geqslant 0$, is represented by the mapping diagram.
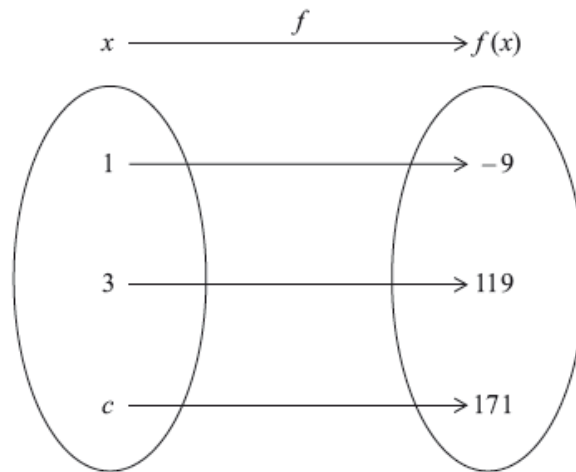
a. Using the mapping diagram, write down two equations in terms of a and b. [2]

b. Solve the equations to find the value of [2]

   (i) a;

   (ii) b.

c. Find the value of c. [2]

The planet Earth takes one year to revolve around the Sun. Assume that a year is 365 days and the path of the Earth around the Sun is the circumference of a circle of radius 150000000 km.

Earth

diagram not to scale

Sun
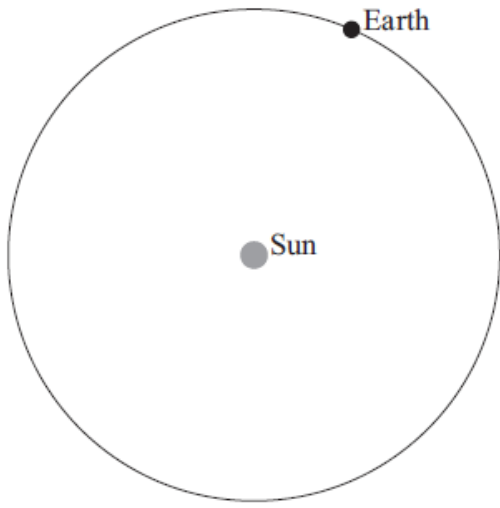
a. Calculate the distance travelled by the Earth in **one day**. [4]

b. Give your answer to part (a) in the form $a \times 10^k$ where $1 \leqslant a \leqslant 10$ and $k \in \mathbb{Z}$. [2]

Albena travels to Bulgaria on a business trip. She is paid 3550 Bulgarian levs (BGN) at the end of her trip. She converts all her BGN into euros (EUR), at an exchange bureau that sells 1 EUR for 1.95 BGN and charges 3 % commission.

a. Calculate the amount that Albena receives in EUR. [4]

b. At the airport shop, Albena buys chocolates that cost 34.50 BGN. She uses 20 EUR to pay for the chocolates but receives her change in BGN. [2]

The shop's exchange rate is 1 EUR = 1.90 BGN.

Find how many BGN she receives as change.

A concert choir is arranged, per row, according to an arithmetic sequence. There are 20 singers in the fourth row and 32 singers in the eighth row.

a. Find the common difference of this arithmetic sequence. [3]

b. There are 10 rows in the choir and 11 singers in the first row. [3]

Find the **total** number of singers in the choir.

A building company has many rectangular construction sites, of varying widths, along a road.

The area, A, of each site is given by the function

$$A(x) = x(200 - x)$$

where x is the **width** of the site in metres and $20 \leqslant x \leqslant 180$.

a. Site S has a width of 20 m. Write down the area of S.   [1]

b. Site T has the same area as site S, but a different width. Find the width of T.   [2]

c. When the width of the construction site is b metres, the site has a maximum area.   [2]

    (i)   Write down the value of b.

    (ii)   Write down the maximum area.

d. The range of $A(x)$ is $m \leqslant A(x) \leqslant n$.   [1]

    Hence write down the value of m and of n.

The exchange rates between the British pound (GBP) and the United States dollar (USD) and between the USD and the Euro (EUR) are given below.

1 GBP	2.034 USD
1 USD	0.632 EUR

a. Find the exchange rate between GBP and EUR in the form 1 GBP = k EUR, where k is a constant. Give your answer correct to **two decimal**   [2]

    places.

b. Isabella changes 400 USD into Euros and is charged 2 % commission.   [4]

    Calculate how many Euros she receives. Give your answer correct to **two decimal places**.

Consider $c = 5200$ and $d = 0.0000037$.

a. Write down the value of $r = c \times d$.   [1]

b. Write down your value of r in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$.   [2]

c. Consider the following statements about c, d and r. Only **three** of these statements are true.   [3]
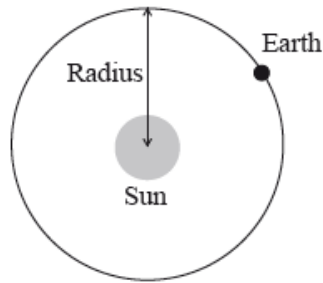
    Circle the true statements.

$c \in \mathbb{N}$
$d \in \mathbb{Z}$
$d \in \mathbb{Q}$
$r < d$
$c + d \in \mathbb{R}$
$\dfrac{1}{r} > c$

The average radius of the orbit of the Earth around the Sun is 150 million kilometres.
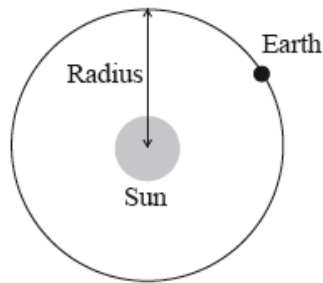
diagram not to scale

The average radius of the orbit of the Earth around the Sun is 150 million kilometres.

diagram not to scale

a. Write down this radius, in kilometres, in the form $a \times 10^k$, where $1 \leqslant a < 10$, $k \in \mathbb{Z}$.   [2]

b. The Earth travels around the Sun in one orbit. It takes one year for the Earth to complete one orbit.   [2]

   Calculate the distance, in kilometres, the Earth travels around the Sun in one orbit, assuming that the orbit is a circle.

c. Today is Anna's 17th birthday.   [2]

   Calculate the total distance that Anna has travelled around the Sun, since she was born.

A function $f(x) = p \times 2^x + q$ is defined by the mapping diagram below.
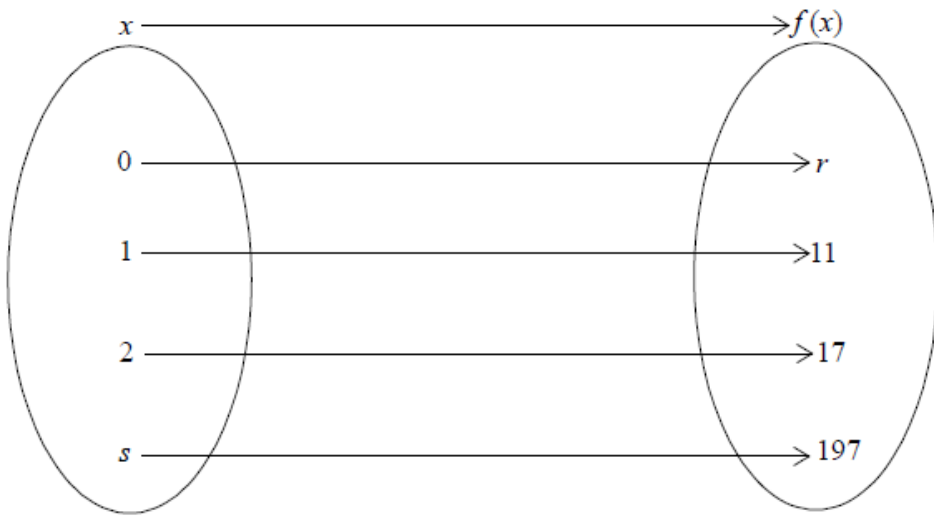
a. Find the value of [3]

(i) p ;

(ii) q .

b. Write down the value of r . [1]

c. Find the value of s . [2]

Given the arithmetic sequence: $u_1 = 124, u_2 = 117, u_3 = 110, u_4 = 103, \ldots$

a. Write down the common difference of the sequence. [1]

b. Calculate the sum of the first 50 terms of the sequence. [2]

c. u_k is the first term in the sequence which is negative. [3]

Find the value of k.

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a. A ladder is standing on horizontal ground and leaning against a vertical wall. The length of the ladder is 4.5 metres. The distance between the [1]

bottom of the ladder and the base of the wall is 2.2 metres.

Use the above information to sketch a labelled diagram showing the ground, the ladder and the wall.

b. Calculate the distance between the top of the ladder and the base of the wall. [2]

c. Calculate the **obtuse** angle made by the ladder with the ground. [3]

Gabriella purchases a new car.

The car's value in dollars, V, is modelled by the function

$$V(t) = 12870 - k(1.1)^t, \ t \geqslant 0$$

where t is the number of years since the car was purchased and k is a constant.

After two years, the car's value is $9143.20.

This model is defined for $0 \leqslant t \leqslant n$. At n years the car's value will be zero dollars.

a. Write down, and simplify, an expression for the car's value when Gabriella purchased it.   [2]

b. Find the value of k.   [2]

c. Find the value of n.   [2]

The following Venn diagram shows the relationship between the sets of numbers

$$\mathbb{N}, \ \mathbb{Z}, \ \mathbb{Q} \text{ and } \mathbb{R}.$$

The number -3 belongs to the set of $\mathbb{Z}$, $\mathbb{Q}$ and $\mathbb{R}$, but not $\mathbb{N}$, and is placed in the appropriate position on the Venn diagram as an example.
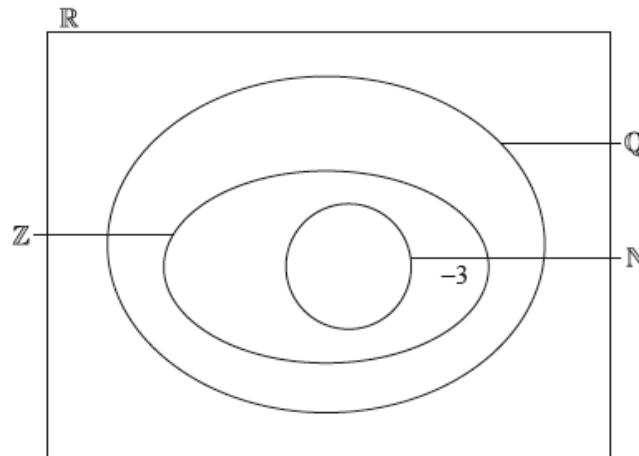
Write down the following numbers in the appropriate place in the Venn diagram.

a. 4   [1]

b. $\dfrac{1}{3}$ [1]

c. π [1]

d. 0.38   [1]

e. $\sqrt{5}$ [1]

f. -0.25 [1]

A satellite travels around the Earth in a circular orbit 500 kilometres above the Earth's surface. The radius of the Earth is taken as 6400 kilometres.

a. Write down the radius of the satellite's orbit. [1]

b. Calculate the distance travelled by the satellite in one orbit of the Earth. Give your answer correct to the nearest km. [3]

c. Write down your answer to (b) in the form $a \times 10^k$, where $1 \leqslant a < 10, k \in \mathbb{Z}$. [2]

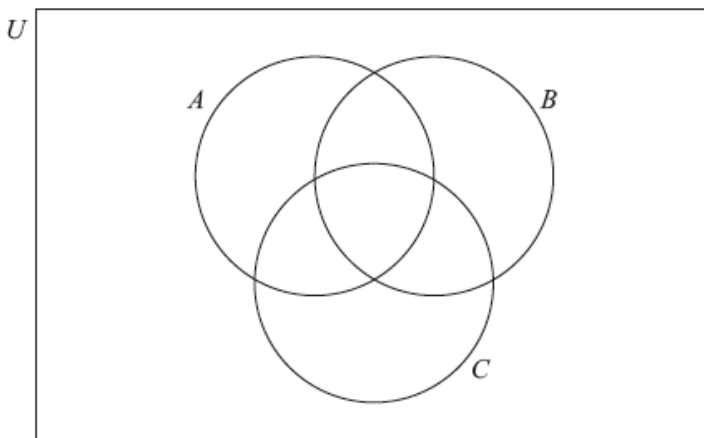U is the set of **positive** integers less than or equal to 10.

A, B and C are subsets of U.
  $A = \{\text{even integers}\}$
  $B = \{\text{multiples of 3}\}$
  $C = \{6, 7, 8, 9\}$

a. List the elements of A. [1]

b. List the elements of B. [1]

c. Complete the Venn diagram with **all** the elements of U. [4]

Consider the universal set $U = \{x \in \mathbb{N} | 3 < x < 13\}$, and the subsets $A = \{\text{multiples of 3}\}$ and $B = \{4, 6, 12\}$.

a.i. List the elements of the following set. [1]

A

a.ii.List the elements of the following set. [1]

$A \cap B'$

b. Write down one element of $(A \cup B)'$. [2]

c. One of the statements in the table below is false. Indicate with an **X** which statement is false. Give a reason for your answer. [2]

$n(A \cup B) = 4$	
$15 \in A'$	
$A \subset A \cup B$	

A manufacturer in England makes 16000 garden statues. 12% are defective and cannot be sold.

a. Find the number of statues that are non-defective. [2]

b. The manufacturer sells each non-defective statue for 5.25 British pounds (GBP) to an American company. The exchange rate from GBP to US [2] dollars (USD) is 1 GBP $= 1.6407$ USD.

Calculate the amount in USD paid by the American company for all the non-defective statues. Give your answer correct to **two decimal places**.

c. The American company sells one of the statues to an Australian customer for 12 USD. The exchange rate from Australian dollars (AUD) to USD [2] is 1 AUD $= 0.8739$ USD .

Calculate the amount that the Australian customer pays, in AUD, for this statue. Give your answer correct to **two decimal places**.

The diagram shows triangle ABC in which angle BAC $= 30°$, BC $= 6.7$ cm and AC $= 13.4$ cm.

diagram not to scale
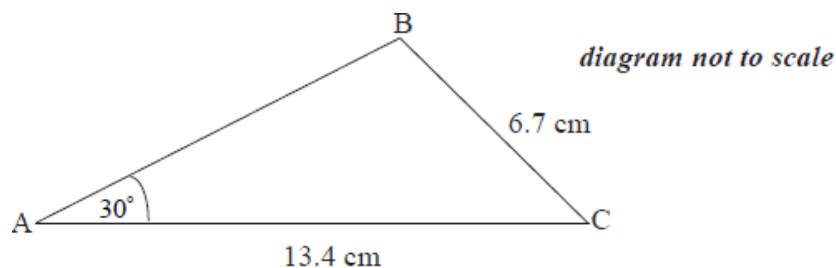
a. Calculate the size of angle ACB. [4]

b. Nadia makes an accurate drawing of triangle ABC. She measures angle BAC and finds it to be 29°. [2]

Calculate the percentage error in Nadia's measurement of angle BAC.

Passengers of Flyaway Airlines can purchase tickets for either Business Class or Economy Class.

On one particular flight there were 154 passengers.

Let x be the number of Business Class passengers and y be the number of Economy Class passengers on this flight.

On this flight, the cost of a ticket for each Business Class passenger was 320 euros and the cost of a ticket for each Economy Class passenger was 85 euros. The total amount that Flyaway Airlines received for these tickets was $14\,970$ euros.

The airline's finance officer wrote down the total amount received by the airline for these tickets as $14\,270$ euros.

a. Use the above information to write down an equation in x and y.   [1]

b. Use the information about the cost of tickets to write down a second equation in x and y.   [1]

c. Find the value of x and the value of y.   [2]

d. Find the percentage error.   [2]

Let $f(x) = x^2 - 6x + 8$.

a. Factorise $x^2 - 6x + 8$.   [2]

b. Hence, or otherwise, solve the equation $x^2 - 6x + 8 = 0$.   [2]

c. Let $g(x) = x + 3$.   [2]

    Write down the solutions to the equation $f(x) = g(x)$.

Given that $h = \sqrt{\ell^2 - \frac{d^2}{4}}$,

a. Calculate the **exact** value of h when $\ell = 0.03625$ and $d = 0.05$.   [2]

b. Write down the answer to part (a) correct to three decimal places.   [1]

c. Write down the answer to part (a) correct to three significant figures.   [1]

d. Write down the answer to part (a) in the form $a \times 10^k$, where $1 \leqslant a < 10, k \in \mathbb{Z}$.   [2]

The following table gives the exchange rate from US dollars to euros and from US dollars to Japanese Yen. **Give all answers in this question correct to two decimal places**.

1 USD	0.6337 EUROS
1 USD	99.7469 YEN

a, i Enrico has 475 USD. [2]

How many euros is this worth?

a, ii Enrico has 475 USD. [2]

Enrico goes to a bank to exchange his dollars. The bank charges 3 % commission.

How many euros does Enrico receive?

b. Find the exchange rate from euros to yen. [2]

Astrid invests 1200 Euros for five years at a nominal annual interest rate of 7.2 %, **compounded monthly**.

Find the interest Astrid has earned during the five years of her investment. **Give your answer correct to two decimal places.**

Neung is going home to Vietnam after working in Singapore.

She has 5000 Singapore dollars (SGD) and changes these into American dollars (USD) to take home.

The exchange rate between Singapore dollars (SGD) and American dollars (USD) is

1 USD = 1.2945 SGD.

There is also a 2.4 % commission on the exchange.

a. Calculate the amount of commission on the exchange **in SGD**. [2]

b. Calculate the number of American dollars (USD) Neung takes home. **Give your answer correct to 2 decimal places.** [2]

c. At the airport in Vietnam, Neung changes 150 USD into Vietnamese dong (VND) to pay for her transport home. [2]

The exchange rate between American dollars (USD) and Vietnamese dong (VND) is

1 USD = 19 495 VND.

There is no commission.

Calculate the number of Vietnamese dong that Neung receives. **Give your answer correct to the nearest thousand dong.**

Consider the sequence

$$512, 128, 32, 8, \ldots$$

a. Calculate the exact value of the ninth term of the sequence. [3]

b. Calculate the least number of terms required for the sum of the sequence to be greater than 682.6 [3]

A tree begins losing its leaves in October. The number of leaves that the tree loses each day increases by the same number on each successive day.

Date in October	1	2	3	4	....
Number of leaves lost	24	40	56	72	....

a. Calculate the number of leaves that the tree loses on the 21st October. [3]

b. Find the total number of leaves that the tree loses in the 31 days of the month of October. [3]

A cuboid has the following dimensions: length = 8.7 cm, width = 5.6 cm and height = 3.4 cm.

a. Calculate the **exact** value of the volume of the cuboid, in cm^3. [2]

b. Write your answer to part (a) correct to [2]

(i) one decimal place;

(ii) three significant figures.

c. Write your answer to **part (b)(ii)** in the form $a \times 10^k$, where $1 \leqslant a < 10, k \in \mathbb{Z}$. [2]

The first term of an arithmetic sequence is 0 and the common difference is 12.

a. Find the value of the 96th term of the sequence. [2]

b. The first term of a geometric sequence is 6. The 6th term of the geometric sequence is equal to the 17th term of the arithmetic sequence given [2]

above.

Write down an equation using this information.

c. The first term of a geometric sequence is 6. The \6$^{\text{th}}$ term of the geometric sequence is equal to the 17$^{\text{th}}$ term of the arithmetic sequence given [2] above.

Calculate the common ratio of the geometric sequence.

---

512 competitors enter round 1 of a tennis tournament, in which each competitor plays a match against one other competitor.

The winning competitor progresses to the next round (round 2); the losing competitor leaves the tournament.
The tournament continues in this manner until there is a winner.

a. Find the number of competitors who play in round 6 of the tournament. [3]

b. Find the total number of matches played in the tournament. [3]

---

a. Only one of the following four sequences is arithmetic and only one of them is geometric. [2]

$a_n = 1, \ 2, \ 3, \ 5, \ \ldots$

$b_n = 1, \ \frac{3}{2}, \ \frac{9}{4}, \ \frac{27}{8}, \ \ldots$

$c_n = 1, \ \frac{1}{2}, \ \frac{1}{3}, \ \frac{1}{4}, \ \ldots$

$d_n = 1, \ 0.95, \ 0.90, \ 0.85, \ \ldots$

State which sequence is

(i)   arithmetic;

(ii)   geometric.

b(i) For **another** geometric sequence $e_n = -6, \ -3, \ -\frac{3}{2}, \ -\frac{3}{4}, \ \ldots$ [1]

write down the common ratio;

b(ii) For **another** geometric sequence $e_n = -6, \ -3, \ -\frac{3}{2}, \ -\frac{3}{4}, \ \ldots$ [3]

find the **exact** value of the tenth term. Give your answer as a fraction.

---

80 matches were played in a football tournament. The following table shows the number of goals scored in all matches.

Number of goals	0	1	2	3	4	5
Number of matches	16	22	19	17	1	5

a. Find the mean number of goals scored per match. [2]

b. Find the median number of goals scored per match. [2]

c. A local newspaper claims that the mean number of goals scored per match is two. Calculate the percentage error in the local newspaper's [2]

claim.

---

a. Calculate $\frac{77.2\times3^3}{3.60\times2^2}$. [1]

b. Express your answer to part (a) in the form $a \times 10^k$, where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [2]

c. Juan estimates the length of a carpet to be 12 metres and the width to be 8 metres. He then estimates the area of the carpet. [3]

(i) Write down his estimated area of the carpet.

When the carpet is accurately measured it is found to have an area of 90 square metres.

(ii) Calculate the percentage error made by Juan.

The following diagram shows a rectangle with sides of length 9.5×10^2 m and 1.6×10^3 m.

diagram not to scale

9.5×10^2 m

1.6×10^3 m
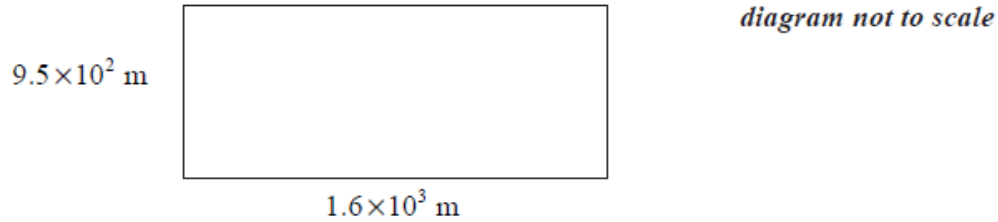
a. Write down the area of the rectangle in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. [3]

b. Helen's estimate of the area of the rectangle is $1\,600\,000$ m^2. [3]

Find the percentage error in Helen's estimate.

$z = \frac{17x^2}{a-b}$.

a. Find the value of z when $x = 12.5$, $a = 0.572$ and $b = 0.447$. Write down your full calculator display. [2]

b. Write down your answer to part (a) [2]

(i) correct to the nearest 1000 ;

(ii) correct to three significant figures.

c. Write your answer to **part (b)(ii)** in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. [2]

Water has a lower boiling point at higher altitudes. The relationship between the boiling point of water (T) and the height above sea level (h) can be described by the model $T = -0.0034h + 100$ where T is measured in degrees Celsius (°C) and h is measured in metres from sea level.

a. Write down the boiling point of water at sea level. [1]

b. Use the model to calculate the boiling point of water at a height of 1.37 km above sea level. [3]

c. Water boils at the top of Mt. Everest at 70 °C. [2]

   Use the model to calculate the height above sea level of Mt. Everest.

The length, in cm, of six baseball bats was measured. The lengths are given below.

$$104.5, 105.1, 104.8, 105.2, 104.9, 104.9$$

a. Calculate the **exact value** of the mean length. [2]

b. Write your answer to part (a) in the form $a \times 10^k$ where $1 \le a < 10$ and $k \in \mathbb{Z}$. [2]

c. Marian calculates the mean length and finds it to be 105 cm. [2]

   Calculate the percentage error made by Marian.

In the Canadian city of Ottawa:

97% of the population speak English,
38% of the population speak French,
36% of the population speak both English and French.

The total population of Ottawa is 985 000.

a. Calculate the percentage of the population of Ottawa that speak English but not French. [2]

b. Calculate the number of people in Ottawa that speak both English and French. [2]

c. Write down your answer to part (b) in the form $a \times 10^k$ where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [2]

In this question, give all answers correct to 2 decimal places.

Jose travelled from Buenos Aires to Sydney. He used Argentine pesos, ARS, to buy 350 Australian dollars, AUD, at a bank. The exchange rate was 1 ARS = 0.1559 AUD.

The bank charged Jose a commission of 2%.

Jose used his credit card to pay his hotel bill in Sydney. The bill was 585 AUD. The value the credit card company charged for this payment was 4228.38 ARS. The exchange rate used by the credit card company was 1 AUD = x ARS. No commission was charged.

a. Use this exchange rate to calculate the amount of ARS that is equal to 350 AUD. [2]

b. Calculate the **total** amount of ARS Jose paid to get 350 AUD. [2]

c. Find the value of x. [2]

U is the set of all the **positive** integers less than or equal to 12.

A , B and C are subsets of U .

$$A = \{1, 2, 3, 4, 6, 12\}$$
$$B = \{\text{odd integers}\}$$
$$C = \{5, 6, 8\}$$

a. Write down the number of elements in $A \cap C$. [1]

b. List the elements of B . [1]

c. Complete the following Venn diagram with **all** the elements of U . [4]
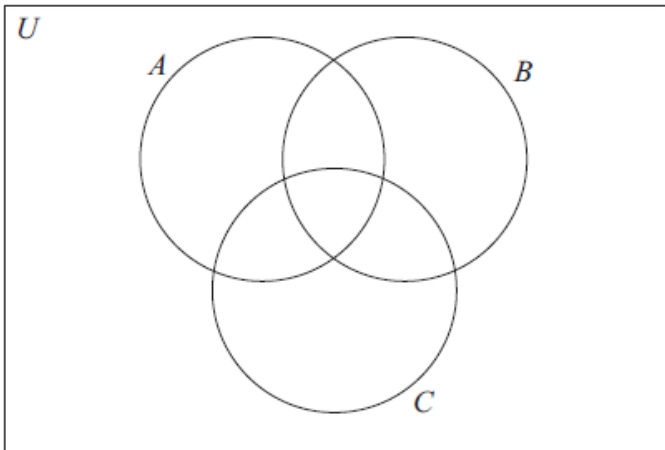
The diagram below represents a rectangular flag with dimensions 150 cm by 92 cm. The flag is divided into three regions A, B and C.

diagram not to scale

a. Write down the total area of the flag. [1]

b. Write down the value of y. [1]

c. The areas of regions A, B, and C are equal. [1]

Write down the area of region A.

d. Using your answers to **parts (b) and (c)**, find the value of x. [3]

---

a. A snack container has a cylindrical shape. The diameter of the base is $7.84\,\text{cm}$. The height of the container is $23.4\,\text{cm}$. This is shown in the following diagram. [1]
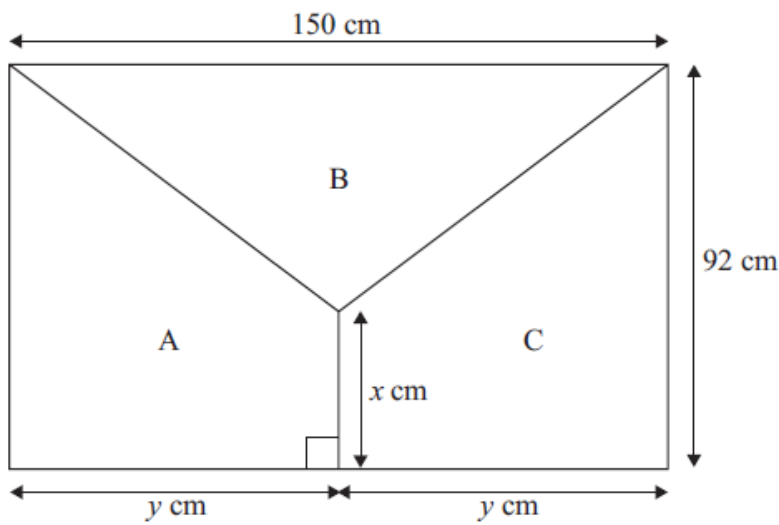
diagram not to scale
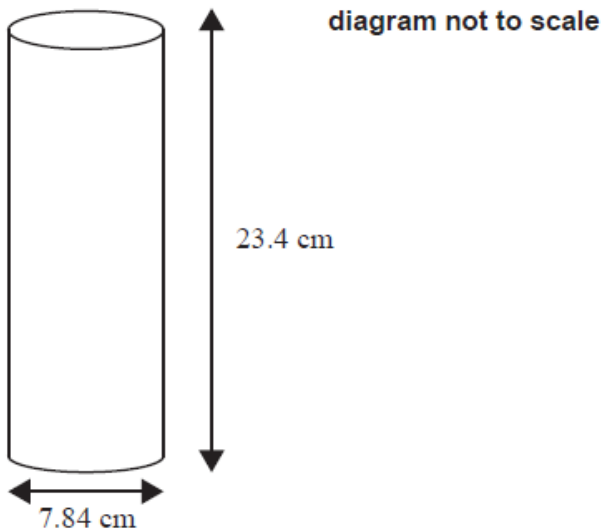
Write down the radius, in cm, of the base of the container.

b. Calculate the area of the base of the container. [2]

c. Dan is going to paint the curved surface and the base of the snack container. [3]

Calculate the area to be painted.

The first term of an arithmetic sequence is 7 and the sixth term is 22.

a. Find the common difference. [2]

b. Find the twelfth term. [2]

c. Find the sum of the first 100 terms. [2]

Consider the arithmetic sequence

$$326, \ 321, \ 316, \ 311, \ \dots, \ 191.$$

a. Find the value of the common difference of this sequence. [2]

b. Calculate the sum of the first 10 terms of this sequence. [2]

c. Find the number of terms in this sequence. [2]

a. Factorise the expression $x^2 - 3x - 10$. [2]

b. A function is defined as $f(x) = 1 + x^3$ for $x \in \mathbb{Z}, \ -3 \leqslant x \leqslant 3$. [4]

   (i)   List the elements of the domain of $f(x)$.

   (ii)   Write down the range of $f(x)$.

Daniela is going for a holiday to South America. She flies from the US to Argentina stopping in Peru on the way.

In Peru she exchanges 85 United States dollars (USD) for Peruvian nuevo sol (PEN). The exchange rate is 1 USD = 3.25 PEN and a flat fee of 5 USD commission is charged.

At the end of Daniela's holiday she has 370 Argentinean peso (ARS). She converts this back to USD at a bank that charges a 4% commission on the exchange. The exchange rate is 1 USD = 9.60 ARS.

a. Calculate the amount of PEN she receives. [3]

b. Calculate the amount of USD she receives. [3]

Assume the Earth is a perfect sphere with radius 6371 km.

a. Calculate the volume of the Earth in km^3. Give your answer in the form $a \times 10^k$, where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [3]

b. The volume of the Moon is 2.1958×10^{10} km^3. [3]

   Calculate how many times greater in volume the Earth is compared to the Moon.

   Give your answer correct to the nearest **integer**.

In this question, give all answers to two decimal places.

Karl invests 1000 US dollars (USD) in an account that pays a nominal annual interest of 3.5%, **compounded quarterly**. He leaves the money in the account for 5 years.

a.i. Calculate the amount of money he has in the account after 5 years. [3]

a.ii.Write down the amount of **interest** he earned after 5 years. [1]

b. Karl decides to donate this **interest** to a charity in France. The charity receives 170 euros (EUR). The exchange rate is 1 USD = t EUR. [2]

   Calculate the value of t.

Consider the following four numbers.

$$p = 0.00314 \; ; q = 0.00314 \times 10^2 \; ; r = \tfrac{\pi}{1000} \; ; s = 3.14 \times 10^{-2}$$

a. One of these numbers is written in the form $a \times 10^k$ where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. Write down this number. [1]

b. Write down the smallest of these numbers. [2]

c. Write down the value of **q + s**. [1]

d. Give your answer to part (c) in the form $a \times 10^k$ where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [2]

Susi travels from Singapore to Thailand and changes 1500 Singapore dollars (SGD) to Thai baht (THB). The exchange rate is 1 SGD buys 21.03464 THB.

Susi leaves Thailand and travels to Indonesia. She has 20 000 THB and uses these to buy Indonesian rupiah (IDR). The exchange rate is 3.28352 THB buys 1000 IDR.

Susi wants to find the approximate exchange rate between Singapore dollars and Indonesian rupiah and uses the exchange rates for Thai baht to do this.

a. Calculate the number of Thai baht Susi buys. Give your answer **correct to the nearest baht**. [2]

b. Calculate the **total** number of Indonesian rupiah Susi receives, **correct to the nearest thousand rupiah**. [2]

c. Calculate Susi's exchange rate between Singapore dollars and Indonesian rupiah. Give your answer in the form 1 SGD buys x IDR, where x is given correct to the nearest rupiah. [2]

$T = \frac{(\tan(2z)+1)(2\cos(z)-1)}{y^2-x^2}$, where $x = 9$, $y = 41$ and $z = 30°$.

a. Calculate the **exact** value of T. [2]

b. Give your answer to T correct to [2]

   (i)   two significant figures;

   (ii)   three decimal places.

c. Pyotr estimates the value of T to be 0.002. [2]

   Calculate the percentage error in Pyotr's estimate.

---

56 students were given a test out of 40 marks. The teacher used the following box and whisker plot to represent the marks of the students.
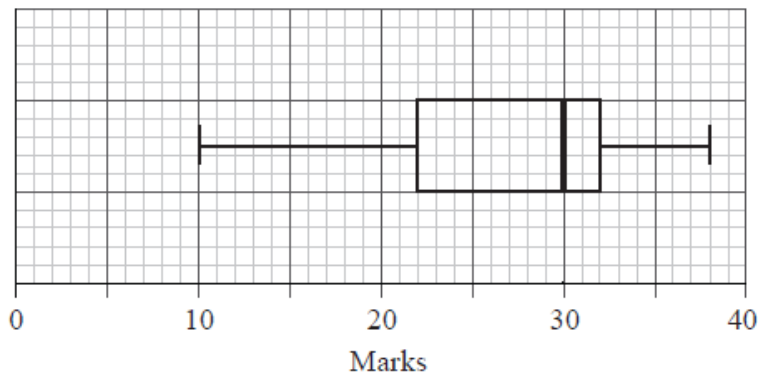
Marks

a.i. Write down the median mark. [1]

a.ii. Write down the 75th percentile mark. [1]

a.iii Write down the range of marks. [2]

b. Estimate the number of students who achieved a mark greater than 32. [2]

A comet orbits the Sun and is seen from Earth every 37 years. The comet was first seen from Earth in the year 1064.

a. Find the year in which the comet was seen from Earth for the fifth time.   [3]

b. Determine how many times the comet has been seen from Earth up to the year 2014.   [3]

Kunal borrows 200 000 Indian rupees (INR) from a money lender for 18 months at a nominal annual interest rate of 15%, **compounded monthly**.

Calculate the **total amount** that Kunal must repay at the end of the 18 months. Give your answer to the nearest rupee.

Sasha travelled from the USA to Mexico and converted 650 US dollars (USD) to Mexican pesos (MXN). Her bank offered an exchange rate of 1 USD = 12.50 MXN.

a. Find the number of MXN that Sasha received.   [2]

b. Before her return to the USA, Sasha exchanged 2300 MXN back into USD. The bank charged a commission of 1 %. The exchange rate was still [1]

    1 USD = 12.50 MXN.

    Write down the commission charged by the bank in MXN.

c. Before her return to the USA, Sasha exchanged 2300 MXN back into USD. The bank charged a commission of 1 %. The exchange rate was still [3]

    1 USD = 12.50 MXN.

    Calculate the amount of USD that Sasha received after commission. Give your answer correct to the nearest USD.
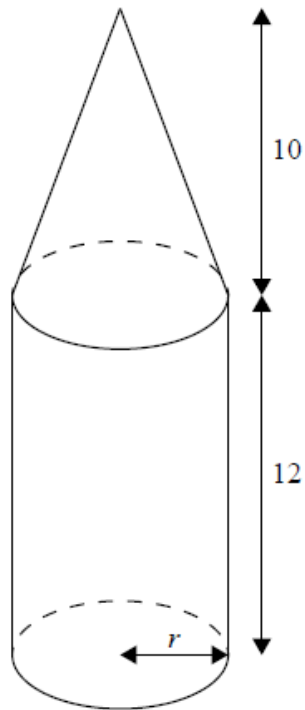

Julio is making a wooden pencil case in the shape of a large pencil. The pencil case consists of a cylinder attached to a cone, as shown.

The cylinder has a radius of r cm and a height of 12 cm.

The cone has a base radius of r cm and a height of 10 cm.

a. Find an expression for the slant height of the cone **in terms of r**. [2]

b. The total external surface area of the pencil case rounded to 3 significant figures is 570 cm². [4]

Using your graphic display calculator, calculate the value of r.

Matryoshka dolls, or Russian dolls, are similarly designed dolls which open up and fit inside each other.

The largest set of these type of dolls is a 51 piece set which was completed in 2003. The height of the largest piece in this set is 54 cm. The heights of successive smaller dolls are 94 % of the preceding larger doll, as shown.
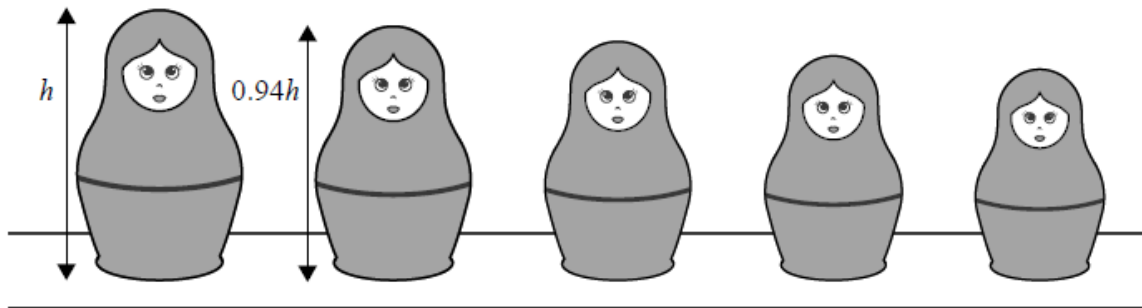
a. Find the height of the smallest doll in this set. [3]

b. Find the **total** height if all 51 dolls were placed one on top of another. [3]

---

a. Write down the following numbers in increasing order. [3]

$3.5, 1.6 \times 10^{-19}, 60730, 6.073 \times 10^5, 0.006073 \times 10^6, \pi, 9.8 \times 10^{-18}.$

b. Write down the median of the numbers in part (a). [1]

c. State which of the numbers in part (a) is irrational. [1]

Consider the function $f(x) = 1.25 - a^{-x}$, where a is a positive constant and $x \geqslant 0$. The diagram shows a sketch of the graph of f. The graph intersects the y-axis at point A and the line L is its horizontal asymptote.
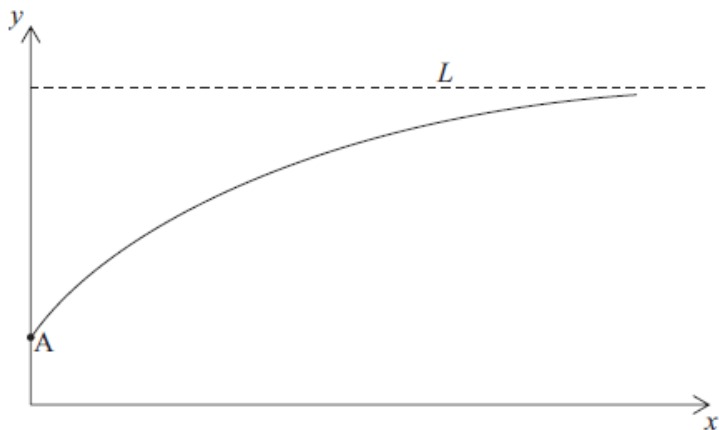
a. Find the y-coordinate of A . [2]

b. The point $(2, 1)$ lies on the graph of $y = f(x)$. Calculate the value of a . [2]

c. The point $(2, 1)$ lies on the graph of $y = f(x)$. Write down the equation of L . [2]

---

a. **In this question give all answers correct to the nearest whole number.** [2]

Loic travelled from China to Brazil. At the airport he exchanged 3100 Chinese Yuan, CNY, to Brazilian Real, BRL, at an exchange rate of $1 \ CNY = 0.3871 \ BRL$.

No commission was charged.

Calculate the amount of BRL he received.

b. When he returned to China, Loic changed his remaining BRL at a bank. The exchange rate at the bank was $1 \ CNY = 0.3756 \ BRL$ and a [4] commission of 5% was charged. He received $285 \ CNY$.

   i)   Calculate the amount of CNY Loic would have received if no commission was charged.

   ii) Calculate the amount of BRL Loic exchanged when he returned to China.

Consider the geometric sequence $16, 8, a, 2, b, \ldots$

a. Write down the common ratio. [1]

b.i. Write down the value of a. [1]

b.ii. Write down the value of b. [1]

c. The sum of the first n terms is 31.9375. Find the value of n. [3]

Mr Tan invested 5000 Swiss Francs (CHF) in Bank A at an annual simple interest rate of r %, for four years. The total interest he received was 568 CHF.

Mr Black invested 5000 CHF in Bank B at a nominal annual interest rate of 3.6 %, **compounded quarterly** for four years.

Calculate the total interest he received at the end of the four years. Give your answer correct to **two decimal places**.

Each year the soccer team, Peterson United, plays 25 games at their home stadium. The owner of Peterson United claimed that last year the mean attendance per game at their home stadium was 24500.

The actual total attendance last year was 617700.

a. Based on the owner's claim, calculate the total attendance for the games at Peterson United's home stadium last year. [2]

b. Calculate the percentage error in the owner's claim. [2]

c. Write down your answer to **part (b)** in the form $a \times 10^k$ where $1 \le a < 10$, $k \in \mathbb{Z}$. [2]

The population of big cats in Africa is increasing at a rate of 5 % per year. At the beginning of 2004 the population was 10 000.

a. Write down the population of big cats at the beginning of 2005. [1]

b. Find the population of big cats at the beginning of 2010. [2]

c. Find the number of years, from the beginning of 2004, it will take the population of big cats to exceed 50 000. [3]

Consider the numbers $p = 2.78 \times 10^{11}$ and $q = 3.12 \times 10^{-3}$.

a. Calculate $\sqrt[3]{\dfrac{p}{q}}$. Give your full calculator display. [2]

b.i.Write down your answer to part (a) correct to two decimal places; [1]

b.ii.Write down your answer to part (a) correct to three significant figures. [1]

c. Write your answer to **part (b)(ii)** in the form $a \times 10^k$, where $1 \leqslant a < 10$, $k \in \mathbb{Z}$. [2]

Veronica wants to make an investment and accumulate 25 000 EUR over a period of 18 years. She finds two investment options.

Option 2 offers a nominal annual interest rate of 4 %, **compounded monthly**.

Find the amount that Veronica has to invest with option 2 to have 25 000 EUR in her account after 18 years. Give your answer correct to **two decimal places**.

Consider the geometric sequence $u_1 = 18$, $u_2 = 9$, $u_3 = 4.5$, ….

a. Write down the common ratio of the sequence. [1]

b. Find the value of u_5. [2]

c. Find the smallest value of n for which u_n is less than 10^{-3}. [3]

Let $p = \dfrac{\cos x + \sin y}{\sqrt{w^2 - z}}$,

where $x = 36°$, $y = 18°$, $w = 29$ and $z = 21.8$.

a. Calculate the value of p. Write down your full calculator display. [2]

b. Write your answer to part (a) [2]

    (i)   correct to two decimal places;

    (ii)   correct to three significant figures.

c. Write your answer to **part (b)(ii)** in the form $a \times 10^k$, where $1 \leqslant a < 10$, $k \in \mathbb{Z}$. [2]

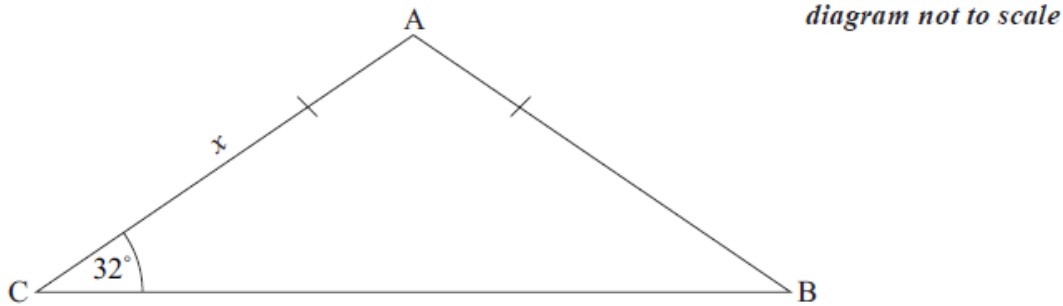The first term of an arithmetic sequence is 3 and the seventh term is 33.

a. Calculate the common difference; [2]

b. Calculate the 95th term of the sequence; [2]

c. Calculate the sum of the first 250 terms. [2]

Yun Bin invests 5000 euros in an account which pays a nominal annual interest rate of 6.25% , **compounded monthly**.

Give all answers correct to two decimal places.

a. Find the value of the investment after 3 years. [3]

b. Find the difference in the final value of the investment if the interest was compounded quarterly at the same nominal rate. [3]

In the diagram, triangle ABC is isosceles. AB = AC and angle ACB is 32° . The length of side AC is x cm.

diagram not to scale

a. Write down the size of angle CBA. [1]

b. Write down the size of angle CAB. [1]

c. The area of triangle ABC is 360 cm². Calculate the length of side AC. Express your answer in **millimetres**. [4]

The first term, u_1, of an arithmetic sequence is 145. The fifth term, u_5, of the sequence is 113.

a. Find the common difference of the sequence. [2]

b. The nth term, u_n, of the sequence is -7. [2]

   Find the value of n.

c. The nth term, u_n, of the sequence is -7. [2]

   Find S_{20}, the sum of the first twenty terms of the sequence.

A rumour spreads through a group of teenagers according to the exponential model

$$N = 2 \times (1.81)^{0.7t}$$

where N is the number of teenagers who have heard the rumour t hours after it is first started.

a. Find the number of teenagers who started the rumour.   [2]

b. Write down the number of teenagers who have heard the rumour five hours after it is first started.   [1]

c. Determine the length of time it would take for 150 teenagers to have heard the rumour. **Give your answer correct to the nearest minute.**   [3]

a. The golden ratio, r , was considered by the Ancient Greeks to be the perfect ratio between the lengths of two adjacent sides of a rectangle. The   [2]
exact value of r is $\frac{1+\sqrt{5}}{2}$.

Write down the value of r

i)   correct to 5 significant figures;

ii)   correct to 2 decimal places.

b. Phidias is designing rectangular windows with adjacent sides of length x metres and y metres. The area of each window is $1\,\mathrm{m}^2$.   [1]

Write down an equation to describe this information.

c. Phidias designs the windows so that the ratio between the longer side, y , and the shorter side, x , is the golden ratio, r.   [1]

Write down an equation in y , x and r to describe this information.

d. Find the value of x .   [2]

The surface of a red carpet is shown below. The dimensions of the carpet are in metres.

diagram not to scale

2x

x − 4
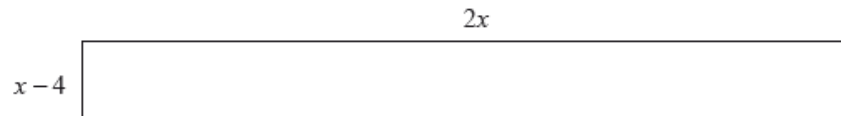
a. Write down an expression for the area, A, in m^2, of the carpet.   [1]

b. The area of the carpet is $10\,\mathrm{m}^2$.   [3]

Calculate the value of x.

c. The area of the carpet is $10\,\mathrm{m}^2$.   [2]

Hence, write down the value of the length and of the width of the carpet, in metres.

a. Solve the following equation for x [2]

$3(2x+1) - 2(3-x) = 13.$

b. Factorize the expression $x^2 + 2x - 3$. [2]

c. Find the **positive** solution of the equation [2]

$x^2 + 2x - 6 = 0.$

Yoshi is spending a year travelling from Japan to Italy and then to the United States of America.

Before Yoshi leaves Japan he changes 100 000 Japanese Yen (JPY) into euro (EUR). The exchange rate is 1 JPY = 0.006 EUR.

a. Calculate the amount Yoshi receives, in EUR. [2]

b. Yoshi spends 426.70 EUR in Italy. In an American bank he changes the remaining amount, into US dollars (USD), at an exchange rate of 1 USD [4]
= 0.673 EUR.

The bank charges 1.5 % commission.

Calculate the amount, in USD, Yoshi receives after commission. **Give your answer correct to the nearest USD.**

---

a. Consider the following statements [2]

z : x is an integer
q : x is a rational number
r : x is a real number.

i)   Write down, in words, $\neg q$.

ii) Write down a value for x such that the statement $\neg q$ is true.

b. Write the following argument in symbolic form: [3]

"If x is a real number and x is not a rational number, then x is not an integer".

c. Phoebe states that the argument in part (b) can be shown to be valid, without the need of a truth table. [1]

Justify Phoebe's statement.

The volume of a sphere is $V = \sqrt{\frac{S^3}{36\pi}}$, where S is its surface area.

The surface area of a sphere is 500 cm^2 .

a. Calculate the volume of the sphere. Give your answer correct to **two decimal places**. [3]

b. Write down your answer to (a) correct to the nearest integer. [1]

c. Write down your answer to (b) in the form $a \times 10^n$, where $1 \leqslant a < 10$ and $n \in \mathbb{Z}$. [2]

Five pipes labelled, "6 metres in length", were delivered to a building site. The contractor measured each pipe to check its length (in metres) and recorded the following;

   5.96, 5.95, 6.02, 5.95, 5.99.

a. (i) Find the mean of the contractor's measurements. [3]

   (ii) Calculate the percentage error between the mean and the stated, **approximate** length of 6 metres.

b. Calculate $\sqrt{3.87^5 - 8.73^{-0.5}}$, giving your answer [3]

   (i) correct to the nearest integer,

   (ii) in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$.

A rectangle is 2680 cm long and 1970 cm wide.

a. Find the perimeter of the rectangle, giving your answer in the form $a \times 10^k$, where $1 \leqslant a \leqslant 10$ and $k \in \mathbb{Z}$. [3]

b. Find the area of the rectangle, giving your answer correct to the nearest thousand square centimetres. [3]

Give all answers in this question correct to two decimal places.

Isabel is travelling from Geneva to Toronto via Amsterdam.

She changes 1240 Swiss francs (CHF) to Euros (EUR).
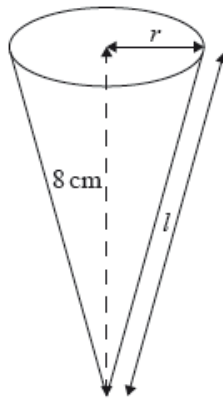
The exchange rate is 1 CHF = 0.7681 EUR.

a. Calculate the amount of Euros Isabel receives. [2]

b. Isabel then changes 750 EUR into Canadian dollars (CAD) and is charged 3.12 % commission. [4]

   The exchange rate is 1 CAD = 0.7470 EUR .

   Calculate the amount of Canadian dollars she receives.

A type of candy is packaged in a right circular cone that has volume 100 cm^3 and vertical height 8 cm.

a. Find the radius, r, of the circular base of the cone. [2]

b. Find the slant height, l, of the cone. [2]

c. Find the curved surface area of the cone. [2]

Sergei is training to be a weightlifter. Each day he trains at the local gym by lifting a metal bar that has heavy weights attached. He carries out successive lifts. After each lift, the same amount of weight is **added** to the bar to increase the weight to be lifted.

The weights of each of Sergei's lifts form an arithmetic sequence.

Sergei's friend, Yuri, records the weight of each lift. Unfortunately, last Monday, Yuri misplaced all but two of the recordings of Sergei's lifts.

On that day, Sergei lifted 21 kg on the third lift and 46 kg on the eighth lift.

a.i. For that day find how much weight was added after each lift. [2]

a.ii. For that day find the weight of Sergei's first lift. [2]

b. On that day, Sergei made 12 successive lifts. Find the total combined weight of these lifts. [2]

The table below shows the frequency distribution of the number of dental fillings for a group of 25 children.

Number of fillings	0	1	2	3	4	5
Frequency	4	3	8	q	4	1

a. Find the value of q . [2]

b. Use your graphic display calculator to find [4]

    (i)   the mean number of fillings;

    (ii)   the median number of fillings;

    (iii) the standard deviation of the number of fillings.

Jane plans to travel from Amsterdam to Chicago. She changes 1500 Euros (EUR) to US Dollars (USD) at an exchange rate of 1 EUR to 1.33 USD. Give all answers in this question **correct to two decimal places**.

a. Calculate the number of USD Jane receives. [1]

b. Jane spends 1350 USD and then decides to convert the remainder back to EUR at a rate of 1 EUR to 1.38 USD. [3]

    Calculate the amount of EUR Jane receives.

c. If Jane had waited until she returned to Amsterdam she could have changed her USD at a rate of 1 EUR to 1.36 USD but the bank would [2] have charged 0.8% commission.

    Calculate the amount of EUR Jane gained or lost by changing her money in Chicago.

---

a. One of the locations in the 2016 Olympic Games is an amphitheatre. The number of seats in the first row of the amphitheatre, u_1 , is 240. The [2] number of seats in each subsequent row forms an arithmetic sequence. The number of seats in the sixth row, u_6 , is 270.

    Calculate the value of the common difference, d.

b. There are 20 rows in the amphitheatre. [2]

    Find the **total** number of seats in the amphitheatre.

c. Anisha visits the amphitheatre. She estimates that the amphitheatre has 6500 seats. [2]

    Calculate the percentage error in Anisha's estimate.

The table below shows some exchange rates for the Japanese Yen (JPY).

Currency	1 JPY
Canadian Dollar	0.010406
Chinese Yuan	0.07127
Euro	0.0072591
Norwegian Kroner	0.057319

a. Minbin has 1250 Japanese Yen which she wishes to exchange for Chinese Yuan. [2]

   Calculate how many Yuan she will receive. Give your answer to the nearest Yuan.

b. Rupert has 855 Canadian Dollars which he wishes to exchange for Japanese Yen. [2]

   Calculate how many Yen he will receive. Give your answer to the nearest Yen.

c. Find how many Norwegian Kroner there are to the Euro. Give your answer correct to 2 decimal places. [2]

Pierre invests 5000 euros in a fixed deposit that pays a nominal annual interest rate of 4.5%, compounded **monthly**, for seven years.

a. Calculate the value of Pierre's investment at the end of this time. Give your answer correct to two decimal places. [3]

b. Carla has 7000 dollars to invest in a fixed deposit which is compounded **annually**. [3]

   She aims to double her money after 10 years.

   Calculate the minimum annual interest rate needed for Carla to achieve her aim.

Juan buys a bicycle in a sale. He gets a discount of 30% off the original price and pays 560 US dollars (USD).

To buy the bicycle, Juan takes a loan of 560 USD for 6 months at a nominal annual interest rate of 75%, **compounded monthly**. Juan believes that

the total amount he will pay will be less than the original price of the bicycle.

a. Calculate the original price of the bicycle. [2]

b. Calculate the difference between the original price of the bicycle and the total amount Juan will pay. [4]

The distance d from a point $P(x, \ y)$ to the point $A(1, \ -2)$ is given by $d = \sqrt{(x-1)^2 + (y+2)^2}$

a. Find the distance from $P(100, \ 200)$ to A. Give your answer correct to two decimal places. [3]

b. Write down your answer to **part (a)** correct to three significant figures. [1]

c. Write down your answer to **part (b)** in the form $a \times 10^k$, where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$. [2]

---

a. Expand the expression $x(2x^3 - 1)$. [2]

b. Differentiate $f(x) = x(2x^3 - 1)$. [2]

c. Find the x-coordinate of the local minimum of the curve $y = f(x)$. [2]

Marcus has been given 500 Australian dollars (AUD) by his grandmother for his 18th birthday.

He plans to deposit it in a bank which offers a nominal annual interest rate of 6.0 %, **compounded quarterly**, for three years.

a. Calculate the total amount of interest Marcus would earn, in AUD, over the three years. **Give your answer correct to two decimal places.** [3]

b. Marcus would earn the same amount of interest, **compounded annually**, for three years if he deposits the 500 AUD in a second bank. [3]

   Calculate the interest rate the second bank offers.

Charles invests 3000 USD in a bank that offers compound interest at a rate of 3.5% per annum, compounded half-yearly.

Calculate the number of years that it takes for Charles's money to double.

In the diagram, $\hat{BAC} = 90°$. The length of the three sides are x cm, $(x + 7)$ cm and $(x + 8)$ cm.

diagram not to scale
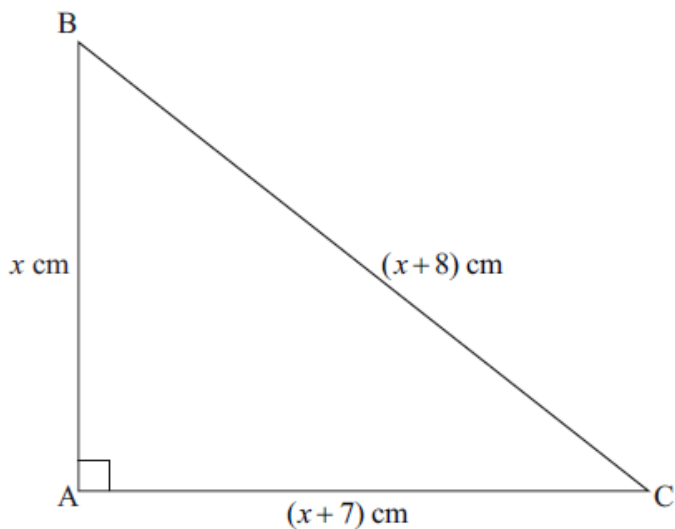
a. Write down and **simplify** a quadratic equation in x which links the three sides of the triangle. [3]

b. Solve the quadratic equation found in part (a). [2]

c. Write down the value of the perimeter of the triangle. [1]

A teacher earns an annual salary of 45000 USD for the first year of her employment. Her annual salary increases by 1750 USD each year.

a. Calculate the annual salary for the fifth year of her employment.   [3]

b. She remains in this employment for 10 years. Calculate the **total** salary she earns in this employment during these 10 years.   [3]

In this question give all answers correct to 2 decimal places.

George travelled from the USA to Europe and changed 1200 dollars (USD) into Euros (EUR). The exchange rate was $1 \text{ USD} = 0.8154 \text{ EUR}$.

a. Calculate the number of EUR George received.   [2]

b. On his return, George had 160 EUR to change back into USD. There was 4.5% commission charged on the exchange. The exchange rate was   [2]

    1 USD = 0.8202 EUR.

    Calculate the value, in EUR, of the commission that George paid.

c. On his return, George had 160 EUR to change back into USD. There was 4.5% commission charged on the exchange. The exchange rate was   [2]

    1 USD = 0.8202 EUR.

    Calculate the number of dollars George received.

Ludmila takes a loan of 320 000 Brazilian Real (BRL) from a bank for two years at a nominal annual interest rate of 10%, **compounded half yearly**.

a. Write down the number of times interest is added to the loan in the two years.   [1]

b. Calculate the **exact** amount of money that Ludmila must repay at the end of the two years.   [3]

c. Ludmila estimates that she will have to repay 360 000 BRL at the end of the two years.   [2]

    Calculate the percentage error in her estimate.

A cuboid has a rectangular base of width x cm and length $2x$ cm . The height of the cuboid is h cm . The total length of the edges of the cuboid is 72
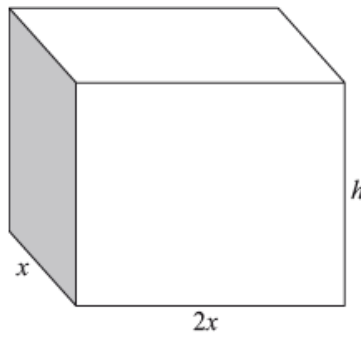
cm.

diagram not to scale

The volume, V, of the cuboid can be expressed as $V = ax^2 - 6x^3$.

a. Find the value of a. [3]

b. Find the value of x that makes the volume a maximum. [3]

Emma places €8000 in a bank account that pays a nominal interest rate of 5% per annum, compounded quarterly.

a. Calculate the amount of money that Emma would have in her account after 15 years. Give your answer correct to the nearest Euro. [3]

b. After a period of time she decides to withdraw the money from this bank. There is €9058.17 in her account. Find the number of months that [3]

Emma had left her money in the account.

A liquid is heated so that after 20 seconds of heating its temperature, T , is $25°C$ and after 50 seconds of heating its temperature is $37°C$.

The temperature of the liquid at time t can be modelled by $T = at + b$, where t is the time in seconds after the start of heating.
Using this model one equation that can be formed is $20a + b = 25$.

a. Using the model, write down a second equation in a and b . [2]

b. Using your graphic display calculator or otherwise, find the value of a and of b . [2]

c. Use the model to predict the temperature of the liquid 60 seconds after the start of heating. [2]

The seventh term, u_7 , of a geometric sequence is 108. The eighth term, u_8 , of the sequence is 36 .

a. Write down the common ratio of the sequence. [1]

b. Find u_1 . [2]

c. The sum of the first k terms in the sequence is 118096 . Find the value of k . [3]

A shipping container is a cuboid with dimensions 16 m, $1\frac{3}{4}$ m and $2\frac{2}{3}$ m.

a. Calculate the **exact** volume of the container. Give your answer as a fraction. [3]

b. Jim estimates the dimensions of the container as 15 m, 2 m and 3 m and uses these to estimate the volume of the container. [3]

   Calculate the percentage error in Jim's estimated volume of the container.

10000 people attended a sports match. Let x be the number of adults attending the sports match and y be the number of children attending the sports match.

a. Write down an equation in x and y . [1]

b. The cost of an adult ticket was 12 Australian dollars (AUD). The cost of a child ticket was 5 Australian dollars (AUD). [2]

   Find the total cost for a family of 2 adults and 3 children.

c. The total cost of tickets sold for the sports match was 108800 AUD. [1]

   Write down a second equation in x and y .

d. Write down the value of x and the value of y . [2]

$f(x) = 5x^3 - 4x^2 + x$

a. Find $f'(x)$. [3]

b. Find using your answer to part (a) the x-coordinate of [3]

   (i) the local maximum point;
   (ii) the local minimum point.

José stands 1.38 kilometres from a vertical cliff.

a. Express this distance in metres. [1]

b. José estimates the angle between the horizontal and the top of the cliff as 28.3° and uses it to find the height of the cliff. [3]
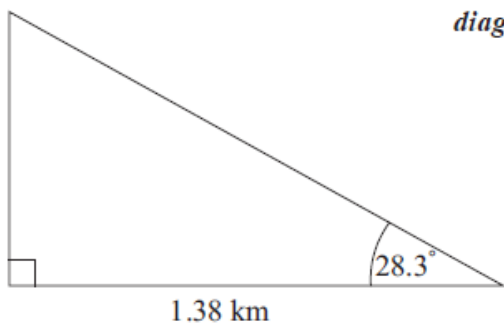
diagram not to scale

28.3°

1.38 km
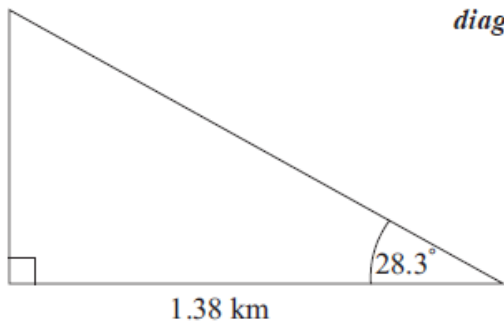
Find the height of the cliff according to José's calculation. **Express your answer in metres, to the nearest whole metre.**

c. José estimates the angle between the horizontal and the top of the cliff as 28.3° and uses it to find the height of the cliff. [2]

diagram not to scale

28.3°

1.38 km

The actual height of the cliff is 718 metres. Calculate the percentage error made by José when calculating the height of the cliff.

Ross is a star that is 82 414 080 000 000 km away from Earth. A spacecraft, launched from Earth, travels at 48 000 kmh^{-1} towards Ross.

a. Calculate the **exact** time, in hours, for the spacecraft to reach the star Ross. [2]

b. Give your answer to part (a) in years. (Assume 1 year = 365 days) [2]

c. Give your answer to part (b) in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

Dumisani has received a scholarship of 5000 US dollars (USD) to study in Singapore.

He has to travel from South Africa and must change USD for his air fare of 6600 South African rand (ZAR).

The exchange rate is 1USD = 8.2421 ZAR.
In this question give all answers correct to two decimal places.

a. Calculate the number of USD that Dumisani must change to pay for his air fare. [2]

b. On arrival in Singapore, Dumisani changes 3000 USD to Singapore dollars (SGD) to pay for his school fees. There is a 2.8% commission [2]

charged on the exchange.

Calculate the value, **in USD**, of the commission that Dumisani has to pay.

c. The exchange rate is 1 USD = 1.29903 SGD. [2]

Calculate the number of SGD Dumisani receives.

The sets P, Q and U are defined as

U = {Real Numbers} , P = {Positive Numbers} and Q = {Rational Numbers}.
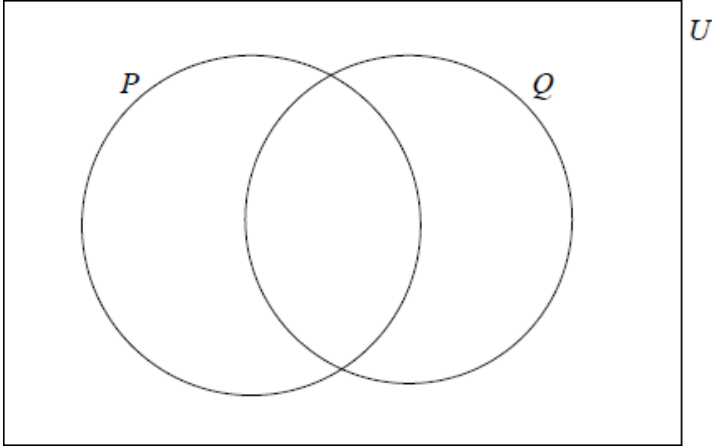
Write down in the correct region on the Venn diagram the numbers

$\frac{22}{7}$, 5×10^{-2} , $\sin(60°)$, 0 , $\sqrt[3]{-8}$, $-\pi$.

In this question give all answers correct to two decimal places.

Javier takes 5000 US dollars (USD) on a business trip to Venezuela. He exchanges 3000 USD into Venezuelan bolívars (VEF).

The exchange rate is 1 USD $=$ 6.3021 VEF.

During his time in Venezuela, Javier spends 1250 USD and 12 000 VEF. On his return home, Javier exchanges his remaining VEF into USD.

The exchange rate is 1 USD $=$ 8.7268 VEF.

a. Calculate the amount of VEF that Javier receives. [2]

b. Calculate the total amount, in USD, that Javier has remaining from his 5000 USD after his trip to Venezuela. [4]

---

a. The length of one side of a rectangle is 2 cm longer than its width. [1]

   If the smaller side is x cm, find the perimeter of the rectangle in terms of x.

b. The length of one side of a rectangle is 2 cm longer than its width. [1]

   The perimeter of a square is equal to the perimeter of the rectangle in part (a).

   Determine the length of each side of the square in terms of x.

c. The length of one side of a rectangle is 2 cm longer than its width. [4]

   The perimeter of a square is equal to the perimeter of the rectangle in part (a).

The sum of the areas of the rectangle and the square is $2x^2 + 4x + 1$ (cm²).

(i) Given that this sum is 49 cm², find x.

(ii) Find the area of the square.

A hydraulic hammer drives a metal post vertically into the ground by striking the top of the post. The distance that the post is driven into the ground, by the nth strike of the hammer, is d_n.

The distances d_1, d_2, d_3 ..., d_n form a geometric sequence.

The distance that the post is driven into the ground by the first strike of the hammer, d_1, is 64 cm.

The distance that the post is driven into the ground by the second strike of the hammer, d_2, is 48 cm.

a. Find the value of the common ratio for this sequence. [2]

b. Find the distance that the post is driven into the ground by the eighth strike of the hammer. [2]

c. Find the **total depth** that the post has been driven into the ground after 10 strikes of the hammer. [2]

In an arithmetic sequence, the fifth term, u_5, is greater than the first term, u_1. The difference between these terms is 36.

a. Find the common difference, d. [2]

b. The tenth term of the sequence is double the seventh term. [4]

(i) Write down an equation in u_1 and d to show this information.

(ii) Find u_1.

---

a. Obi travels from Dubai to Pretoria and changes 2000 United Arab Emirates Dirham (AED) at a bank. He receives 6160 South African Rand (ZAR). [2]

The exchange rate is $1\ \mathrm{AED} = x\ \mathrm{ZAR}$.

Calculate the value of x .

b. Obi decides to invest half of the money he receives, $3080\ \mathrm{ZAR}$, in an account which pays a nominal interest rate of $9\,\%$, **compounded monthly**. [4]

The amount of money in the account will have doubled before the end of the nth year of the investment.

Calculate the minimum value of n .

Consider the following sequence:

$$57, 55, 53 \ldots, 5, 3$$

a. Find the number of terms of the sequence. [3]

b. Find the sum of the sequence. [3]

Given $p = x - \dfrac{\sqrt{y}}{z}$, $x = 1.775$, $y = 1.44$ and $z = 48$.

a. Calculate the value of p. [2]

b. Barry **first** writes x , y and z correct to one significant figure and **then** uses these values to estimate the value of p . [2]

   (i) Write down x , y and z each correct to one significant figure.

   (ii) Write down Barry's estimate of the value of p .

c. Calculate the percentage error in Barry's estimate of the value of p . [2]

The x-coordinate of the minimum point of the quadratic function $f(x) = 2x^2 + kx + 4$ is $x = 1.25$.

a. (i) Find the value of k . [4]

   (ii) Calculate the y-coordinate of this minimum point.

b. Sketch the graph of $y = f(x)$ for the domain $-1 \leqslant x \leqslant 3$. [2]
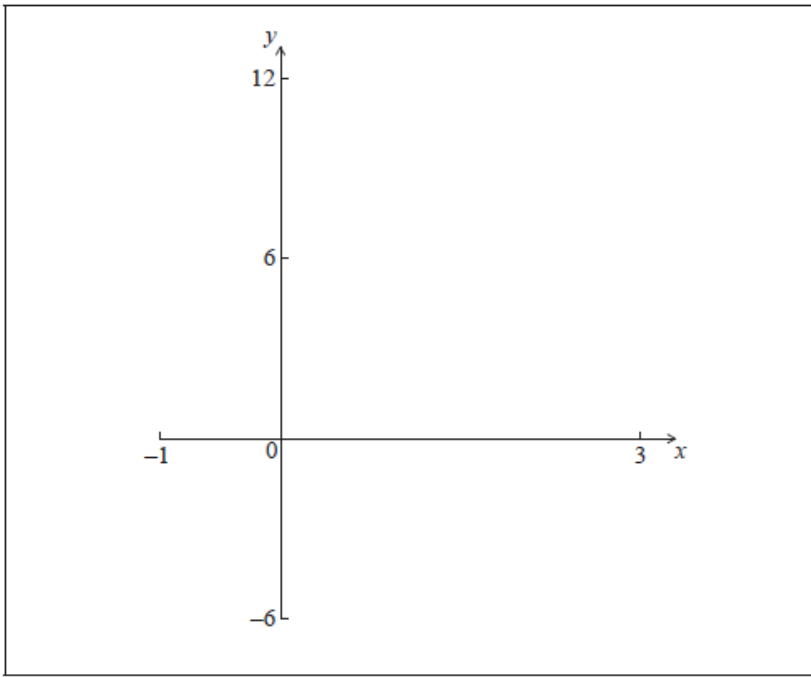
Tomás is playing with sticks and he forms the first three diagrams of a pattern. These diagrams are shown below.

Diagram 1   Diagram 2   Diagram 3
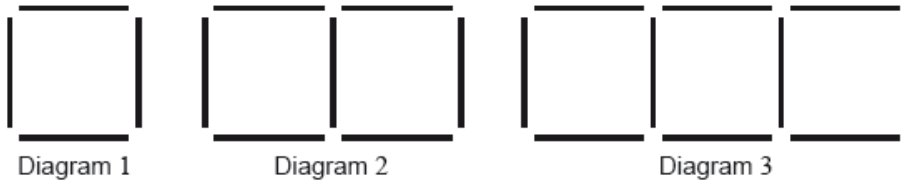
Tomás continues forming diagrams following this pattern.

Tomás forms a total of 24 diagrams.

a. Diagram n is formed with 52 sticks. Find the value of n.   [3]

b. Find the total number of sticks used by Tomás for all 24 diagrams.   [3]

The company Snakezen's Ladders makes ladders of different lengths. All the ladders that the company makes have the same design such that:

       the first rung is 30 cm from the base of the ladder,

       the second rung is 57 cm from the base of the ladder,

       the distance between the first and second rung is equal to the distance between all adjacent rungs on the ladder.

The ladder in the diagram was made by this company and has eleven equally spaced rungs.

diagram not to scale

30 cm

57 cm
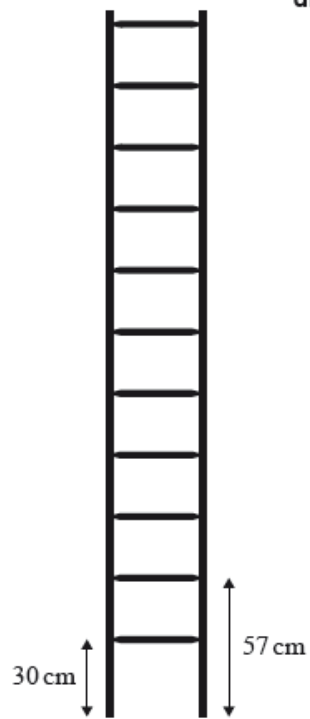
a. Find the distance from the base of this ladder to the top rung. [3]

b. The company also makes a ladder that is 1050 cm long. [3]

   Find the maximum number of rungs in this 1050 cm long ladder.

Inge borrows € 4500 for 2 years.

Bank 1 charges compound interest at a rate of 15 % per annum, compounded quarterly.

Calculate the **total** amount to be repaid at the end of the 2 years. **Give your answer correct to two decimal places**.


Mandzur, a farmer, takes out a loan to buy a buffalo. He borrows 900 000 Cambodian riels (KHR) for 2 years. The nominal annual interest rate is 15%, compounded **monthly**.

a. Find the amount of the **interest** that Mandzur must pay. Give your answer correct to the nearest 100 KHR. [4]

b. Write down your answer to part (a) in the form $a \times 10^k$, where $1 \leqslant a < 10, \ k \in \mathbb{Z}$. [2]

Consider the numbers $\sqrt{3}$, 6, $2\frac{1}{2}$, π, -5, and the sets $\mathbb{N}$, $\mathbb{Z}$, and $\mathbb{Q}$. Complete the following table by placing a tick in the appropriate box if the number is an element of the set.

	$\sqrt{3}$	6	$2\frac{1}{2}$	π	-5
$\mathbb{N}$					
$\mathbb{Z}$					
$\mathbb{Q}$					

A quadratic function, $f(x) = ax^2 + bx$, is represented by the mapping diagram below.
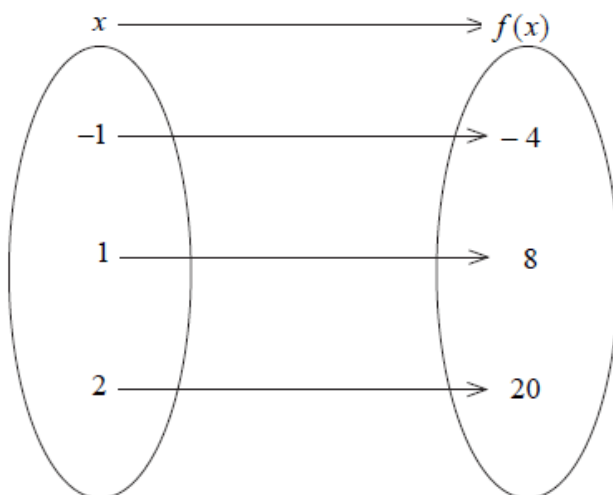
a. Use the mapping diagram to write down **two** equations in terms of a and b. [2]

b.i. Find the value of a. [1]

b.ii. Find the value of b. [1]

c. Calculate the x-coordinate of the vertex of the graph of f (x). [2]

The number of cells, C, in a culture is given by the equation $C = p \times 2^{0.5t} + q$, where t is the time in hours measured from 12:00 on Monday and p and q are constants.

The number of cells in the culture at 12:00 on Monday is 47.

The number of cells in the culture at 16:00 on Monday is 53.

a. Use the above information to write down two equations in p and q ;   [2]

b. Use the above information to calculate the value of p and of q ;   [2]

c. Use the above information to find the number of cells in the culture at 22:00 on Monday.   [2]

The speed of light is $300\,000$ kilometres per second. The average distance from the Sun to the Earth is 149.6 million km.

A light-year is the distance light travels in one year and is equal to $9\,467\,280$ million km. Polaris is a bright star, visible from the Northern Hemisphere.

The distance from the Earth to Polaris is 323 light-years.

a. Calculate the time, **in minutes**, it takes for light from the Sun to reach the Earth.   [3]

b. Find the distance from the Earth to Polaris in millions of km. Give your answer in the form $a \times 10^k$ with $1 \leqslant a < 10$ and $k \in \mathbb{Z}$.   [3]

In this question give all answers correct to the nearest whole number.

a. Fumie is going for a holiday to Great Britain. She changes $100\,000$ Japanese Yen (JPY) into British Pounds (GBP) with no commission charged.   [2]

The exchange rate between GBP and JPY is

1 GBP = 129 JPY.

Calculate the value of $100\,000$ JPY in GBP.

b. At the end of Fumie's holiday in Great Britain she has 239 GBP. She converts this back to JPY at a bank, which does not charge commission,   [4]

and receives 30 200 JPY

(i)   Find the exchange rate of this second transaction.

(ii)   Determine, when changing GBP back to JPY, whether the exchange rate found in part (b)(i) is better value for Fumie than the exchange rate in part (a). Justify your answer.

Arthur and Jacob dream of owning a speedboat that costs $35\,300$ euros (EUR).

Arthur invested x EUR in an account that pays a nominal annual interest rate of 3.6%, compounded **monthly**. After 18 years he will have $35\,300$ EUR in the account.

Jacob invested 9000 EUR for n years. The investment has a nominal annual interest rate of 3.2% and is compounded **quarterly**. After n years, the investment will be worth $35\,300$ EUR.
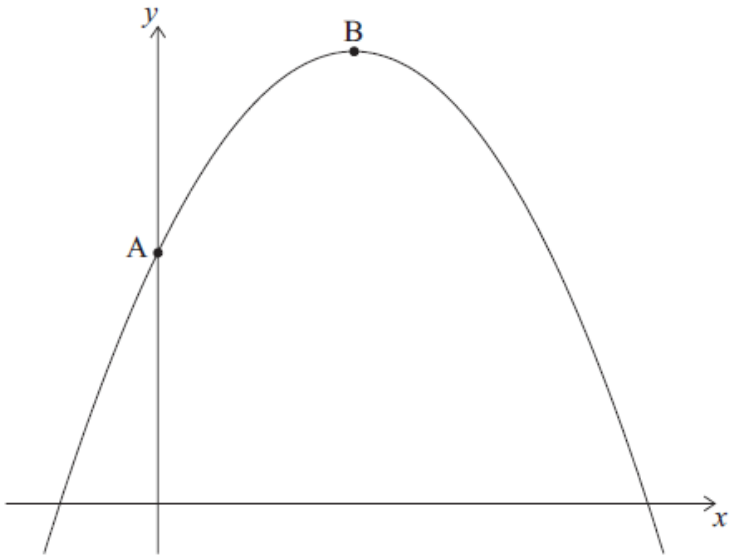
a. Calculate the value of Arthur's initial investment, x. Give your answer to two decimal places. [3]

b. Find the value of n. [3]

The graph of the quadratic function $f(x) = c + bx - x^2$ intersects the y-axis at point A(0, 5) and has its vertex at point B(2, 9).

a. Write down the value of c. [1]

b. Find the value of b. [2]
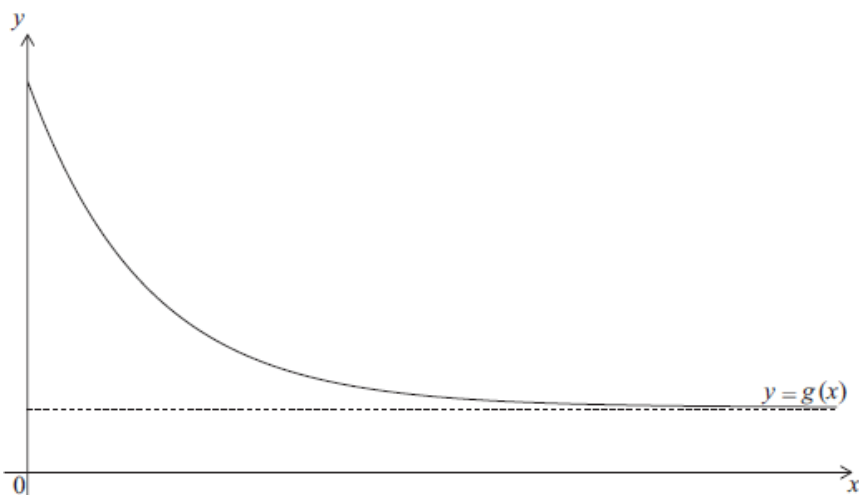
c. Find the x-intercepts of the graph of f. [2]

d. Write down $f(x)$ in the form $f(x) = -(x - p)(x + q)$. [1]

The function $g(x)$ is defined as $g(x) = 16 + k(c^{-x})$ where $c > 0$.

The graph of the function g is drawn below on the domain $x \geqslant 0$.

The graph of g intersects the y-axis at $(0, 80)$.

a. Find the value of k .   [2]

b. The graph passes through the point $(2, 48)$.   [2]

    Find the value of c .

c. The graph passes through the point $(2, 48)$.   [2]

    Write down the equation of the horizontal asymptote to the graph of $y = g(x)$.

Let $p = \dfrac{2\cos x - \tan x}{\sqrt{y} - z}$.

a. Calculate the value of p when $x = 45°$, $y = 8192$ and $z = 64$. Write down your full calculator display.   [2]

b. Write down your answer to part (a)   [4]

    (i)   correct to two decimal places;

    (ii)   correct to four significant figures;

    (iii)   in the form $a \times 10^k$, where $1 \leqslant a < 10$, $k \in \mathbb{Z}$.

Jackson invested 12 000 Australian dollars (AUD) in a bank that offered simple interest at an annual interest rate of r %. The value of Jackson's

investment doubled after 20 years.

Maddison invests 15 000 AUD in a bank that offers compound interest at a nominal annual interest rate of 4.44 %, **compounded quarterly**.

Calculate the number of years that it will take for Maddison's investment to triple in value.

The equation of a line L_1 is $2x + 5y = -4$.

a. Write down the gradient of the line L_1.   [1]

b. A second line L_2 is perpendicular to L_1.   [1]

    Write down the gradient of L_2.

c. The point $(5, 3)$ is on L_2.   [2]
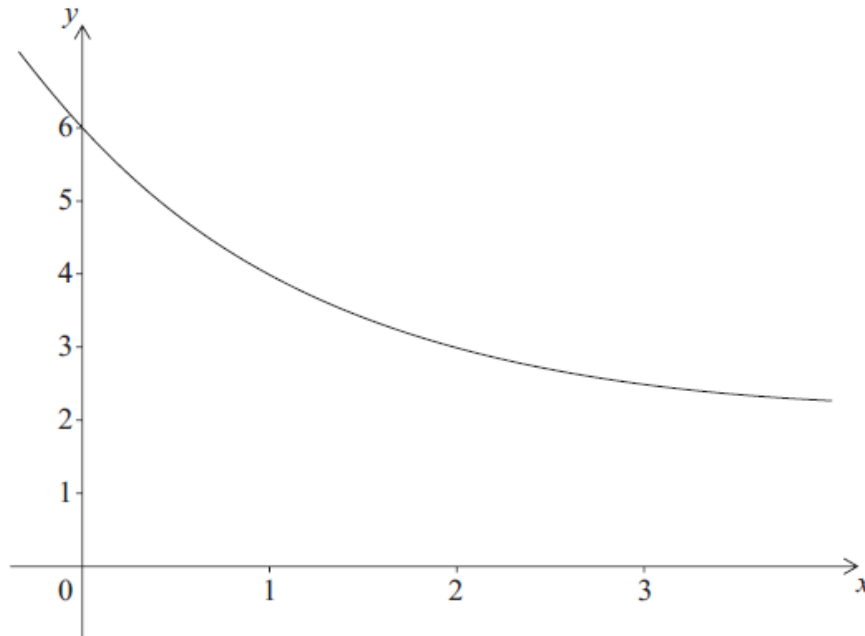
    Determine the equation of L_2.

d. Lines L_1 and L_2 intersect at point P.   [2]

Using your graphic display calculator or otherwise, find the coordinates of P.

Consider the function $f(x) = p(0.5)^x + q$ where p and q are constants. The graph of $f(x)$ passes through the points $(0, 6)$ and $(1, 4)$ and is shown below.

a. Write down two equations relating p and q. [2]

b. Find the value of p and of q. [2]

c. Write down the equation of the horizontal asymptote to the graph of $f(x)$. [2]

---

a. Eva invests USD2000 at a nominal annual interest rate of 8% **compounded half-yearly**. [3]

   Calculate the value of her investment after 5 years, correct to the nearest dollar.

b. Toni invests USD1500 at an annual interest rate of 7.8% **compounded yearly**. [3]

   Find the number of **complete** years it will take for his investment to double in value.

---

1 Brazilian Real (BRL) = 2.607 South African Rand (ZAR). Giving answers **correct to two decimal places**,

(i) convert 300 BRL to ZAR,

(ii) find how many Real it costs to purchase 300 Rand.

Consider the numbers 3, –5 , $\sqrt{7}$, 2^{-3} and 1.75.

Complete the table below, placing a tick ($\checkmark$) to show which of the number sets, $\mathbb{N}, \mathbb{Q}$ and $\mathbb{R}$ these numbers belong to. The first row has been completed as an example.

	$\mathbb{N}$	$\mathbb{Q}$	$\mathbb{R}$
3	$\checkmark$	$\checkmark$	$\checkmark$
–5			
$\sqrt{7}$			
2^{-3}			
1.75			

Ben inherits $6500. Ben invests his money in a bank that pays compound interest at a rate of 4.5% per annum.

Calculate the value of **Ben's** investment at the end of 6 years. Give your answer **correct to 2 decimal places**.

Jenny invested $20 000 in a bank account that paid 3.5 % annual simple interest. She withdrew her investment from the account when its value was $31 200.

Ramón invests $18 000 in a bank account that pays 3.4 % nominal annual interest, **compounded quarterly**.

Find the minimum number of years that Ramón must invest the money for his investment to be worth $27 000.

A hotel has a rectangular swimming pool. Its length is x metres, its width is y metres and its perimeter is 44 metres.

a. Write down an equation for x and y.   [1]

b. The area of the swimming pool is 112m^2.   [1]

   Write down a second equation for x and y.

c. Use your graphic display calculator to find the value of x and the value of y.   [2]

d. An Olympic sized swimming pool is 50 m long and 25 m wide.   [2]

   Determine the area of the hotel swimming pool as a percentage of the area of an Olympic sized swimming pool.

The graph of the quadratic function $f(x) = ax^2 + bx + c$ intersects the y-axis at point A $(0, 5)$ and has its vertex at point B $(4, 13)$.
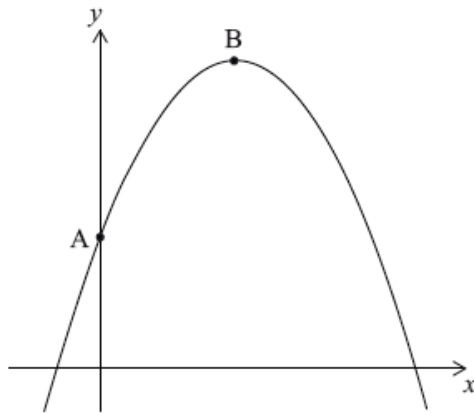
a. Write down the value of c. [1]

b. By using the coordinates of the vertex, B, or otherwise, write down **two** equations in a and b. [3]

c. Find the value of a and of b. [2]

A race track is made up of a rectangular shape 750 m by 500 m with semi-circles at each end as shown in the diagram.
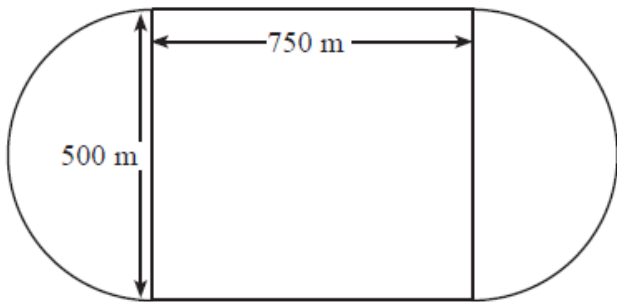
Michael drives around the track once at an average speed of 140 kmh^{-1}.

a. Calculate the distance that Michael travels. [2]

b. Calculate how long Michael takes in **seconds**. [4]

Chocolates in the shape of spheres are sold in boxes of 20.

Each chocolate has a radius of 1 cm.

a. Find the volume of 1 chocolate. [2]

b. Write down the volume of 20 chocolates. [1]

c. The diagram shows the chocolate box from above. The 20 chocolates fit perfectly in the box with each chocolate touching the ones around it or [2]

the sides of the box.
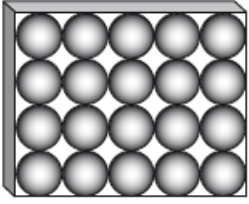
Calculate the volume of the box.

d. The diagram shows the chocolate box from above. The 20 chocolates fit perfectly in the box with each chocolate touching the ones around it or [1]

the sides of the box.
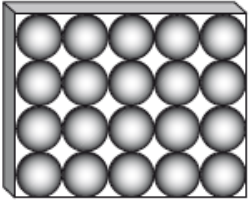
Calculate the volume of empty space in the box.

An iron bar is heated. Its length, L, in millimetres can be modelled by a linear function, $L = mT + c$, where T is the temperature measured in

degrees Celsius (°C).

a. At 150°C the length of the iron bar is 180 mm. [1]

Write down an equation that shows this information.

b. At 210°C the length of the iron bar is 181.5 mm. [1]

Write down an equation that shows this second piece of information.

c. At 210°C the length of the iron bar is 181.5 mm. [4]

Hence, find the length of the iron bar at 40°C.

a. Complete the truth table. [2]

p	q	$\neg p$	$\neg p \vee q$
T	T		
T	F		
F	T		
F	F		

b. Consider the propositions p and q: [2]

  p: x is a number less than 10.

  q: x2 is a number greater than 100.

  Write in words the compound proposition $\neg p \vee q$.

c. Using part (a), determine whether $\neg p \vee q$ is true or false, for the case where x is a number less than 10 and x^2 is a number greater than 100. [1]
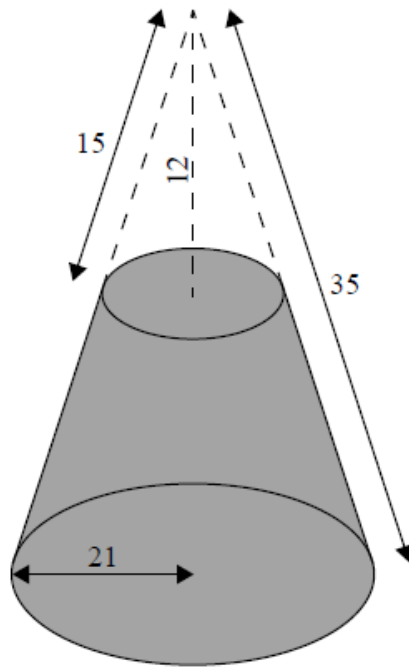
d. Write down a value of x for which $\neg p \vee q$ is false. [1]

A solid right circular cone has a base radius of 21 cm and a slant height of 35 cm.

A smaller right circular cone has a height of 12 cm and a slant height of 15 cm, and is removed from the top of the larger cone, as shown in the diagram.

diagram not to scale

a. Calculate the radius of the base of the cone which has been removed. [2]

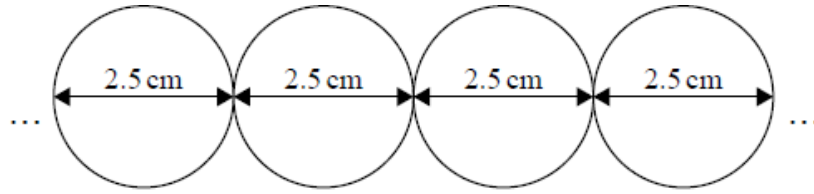b. Calculate the curved surface area of the cone which has been removed. [2]

c. Calculate the curved surface area of the remaining solid. [2]

Last year a South American candy factory sold 4.8×10^8 spherical sweets. Each sweet has a diameter of 2.5 cm.

The factory is producing an advertisement showing all of these sweets placed in a straight line.


The advertisement claims that the length of this line is x times the length of the Amazon River. The length of the Amazon River is 6400km.

a. Find the length, in cm, of this line. Give your answer in the form $a \times 10^k$, where $1 \le a < 10$ and $k \in \mathbb{Z}$. [3]

b.i. Write down the length of the Amazon River in cm. [1]

b.ii Find the value of x. [2]

A park in the form of a triangle, ABC, is shown in the following diagram. AB is 79km and BC is 62km. Angle $A\hat{B}C$ is 52°.

diagram not to scale
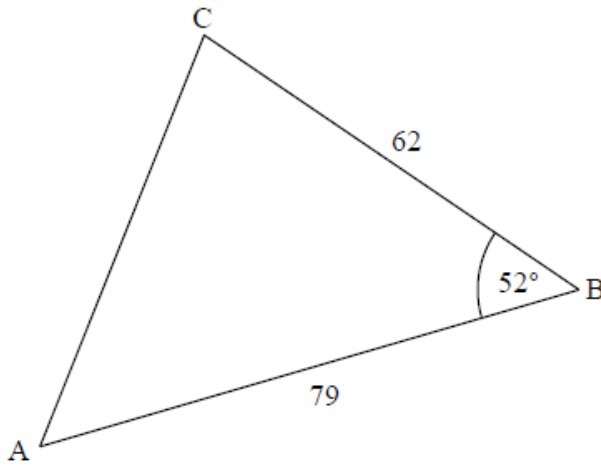
a. Calculate the length of side AC in km. [3]

b. Calculate the area of the park. [3]

a. Consider the numbers 2, $\sqrt{3}$, $-\frac{2}{3}$ and the sets $\mathbb{N}$, $\mathbb{Z}$, $\mathbb{Q}$ and $\mathbb{R}$. [3]

Complete the table below by placing a tick in the appropriate box if the number is an element of the set, and a cross if it is not.

		$\mathbb{N}$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{R}$
(i)	2				
(ii)	$\sqrt{3}$				
(iii)	$-\dfrac{2}{3}$				

b. A function f is given by $f(x) = 2x^2 - 3x,\ x \in \{-2, 2, 3\}$. [1]

Write down the range of function f.

Fabián stands on top of a building, T, which is on a horizontal street.

He observes a car, C, on the street, at an angle of depression of 30°. The base of the building is at B. The height of the building is 80 metres.

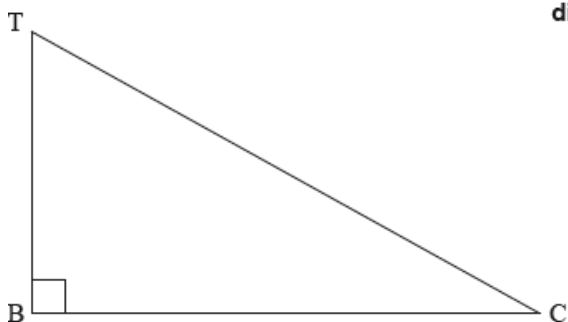The following diagram indicates the positions of T, B and C.

diagram not to scale

a. Show, in the appropriate place on the diagram, **the values** of [2]

   (i)   the height of the building;

   (ii)   the angle of depression.

b. Find the distance, BC, from the base of the building to the car. [2]
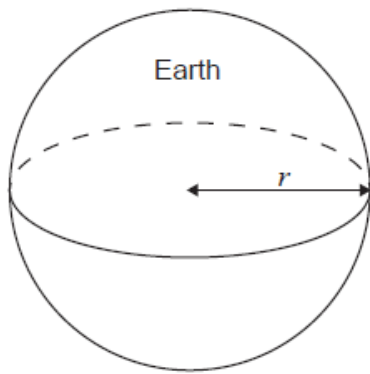
c. Fabián estimates that the distance from the base of the building to the car is 150 metres. Calculate the percentage error of Fabián's estimate. [2]

---

a. Assume that the Earth is a sphere with a radius, r, of 6.38×10^3 km . [4]

Earth

i) Calculate the surface area of the Earth in km^2.

ii) Write down your answer to part (a)(i) in the form $a \times 10^k$, where $1 \leqslant a < 10$ and $k \in \mathbb{Z}$.

b. The surface area of the Earth that is covered by water is approximately $3.61 \times 10^8 \text{km}^2$.

[2]

Calculate the percentage of the surface area of the Earth that is covered by water.

Consider the numbers -1, 4, $\frac{2}{3}$, $\sqrt{2}$, 0.35 and -2^2.

Complete the following table by placing a tick (✓) to indicate if the number is an element of the number set. The first row has been completed as an example.

	$\mathbb{N}$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{R}$
-1		✓	✓	✓
4				
$\frac{2}{3}$				
$\sqrt{2}$				
0.35				
-2^2				

$U = \{x|x \text{ is an integer}, 2 < x < 10\}$

A and B are subsets of U such that $A = \{\text{multiples of } 3\}$, $B = \{\text{factors of } 24\}$.

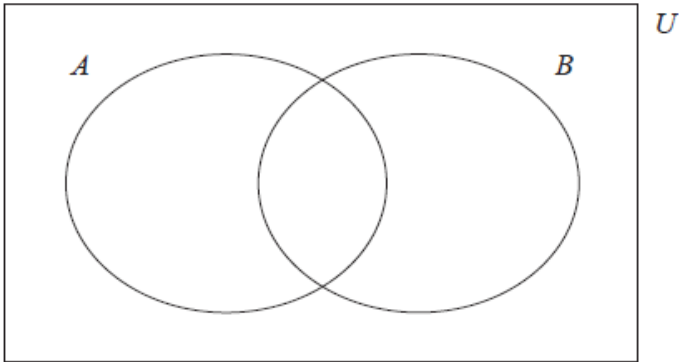a. List the elements of   [2]

(i) U ;

(ii) B .

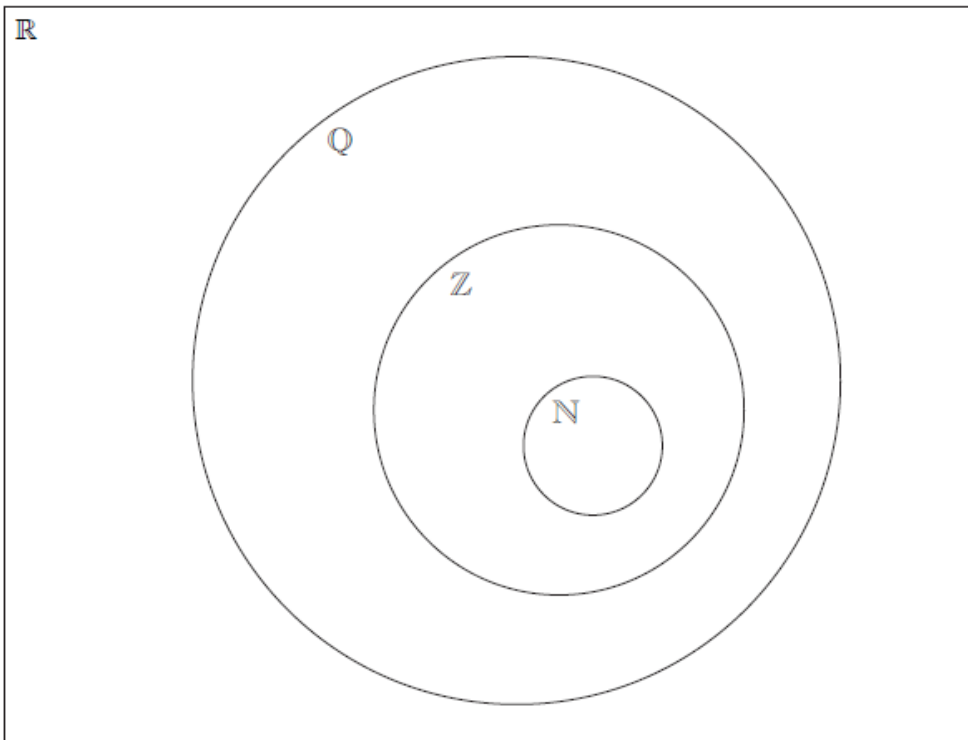b. Write down the elements of U on the Venn diagram.   [3]

c. Write down $n(A \cap B)$.   [1]

The Venn diagram shows the number sets $\mathbb{N}$, $\mathbb{Z}$, $\mathbb{Q}$ and $\mathbb{R}$. Place each of the following numbers in the appropriate region of the Venn diagram.

$\frac{1}{4}$, −3, π, cos 120°, 2.7 × 10³, 3.4 × 10⁻²

The following table shows four different sets of numbers: $\mathbb{N}$, $\mathbb{Z}$, $\mathbb{Q}$ and $\mathbb{R}$.

Set	Example of a number in the set
$\mathbb{N}$	
$\mathbb{Z}$	
$\mathbb{Q}$	
$\mathbb{R}$	

a. Complete the second column of the table by giving **one** example of a number from each set. [4]
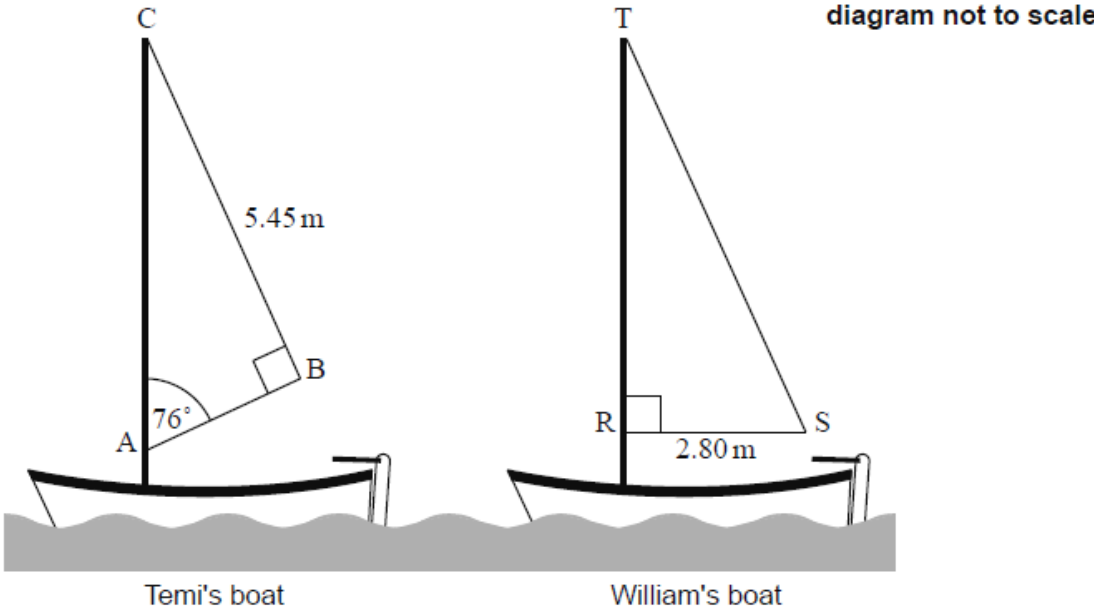
b. Josh states: "Every integer is a natural number". [2]

   Write down whether Josh's statement is correct. Justify your answer.

---

a. Temi's sailing boat has a sail in the shape of a right-angled triangle, ABC. $BC = 5.45$m, [2]

   angle $CAB = 76^o$ and angle $ABC = 90^o$.

   Calculate AC, the height of Temi's sail.

b.   **diagram not to scale** [2]

Temi's boat

William's boat

William also has a sailing boat with a sail in the shape of a right-angled triangle, TRS.
$RS = 2.80$m. The area of William's sail is $10.7\,\text{m}^2$.

Calculate RT, the height of William's sail.

---

a. Each day a supermarket records the midday temperature and how many cold drinks are sold on that day. The following table shows the [2]

   supermarket's data for the last 6 days. This data is also shown on a scatter diagram.

Midday temperature, °C (x)	7	12	14	15	16	20
Number of cold drinks sold (y)	280	350	380	420	400	450
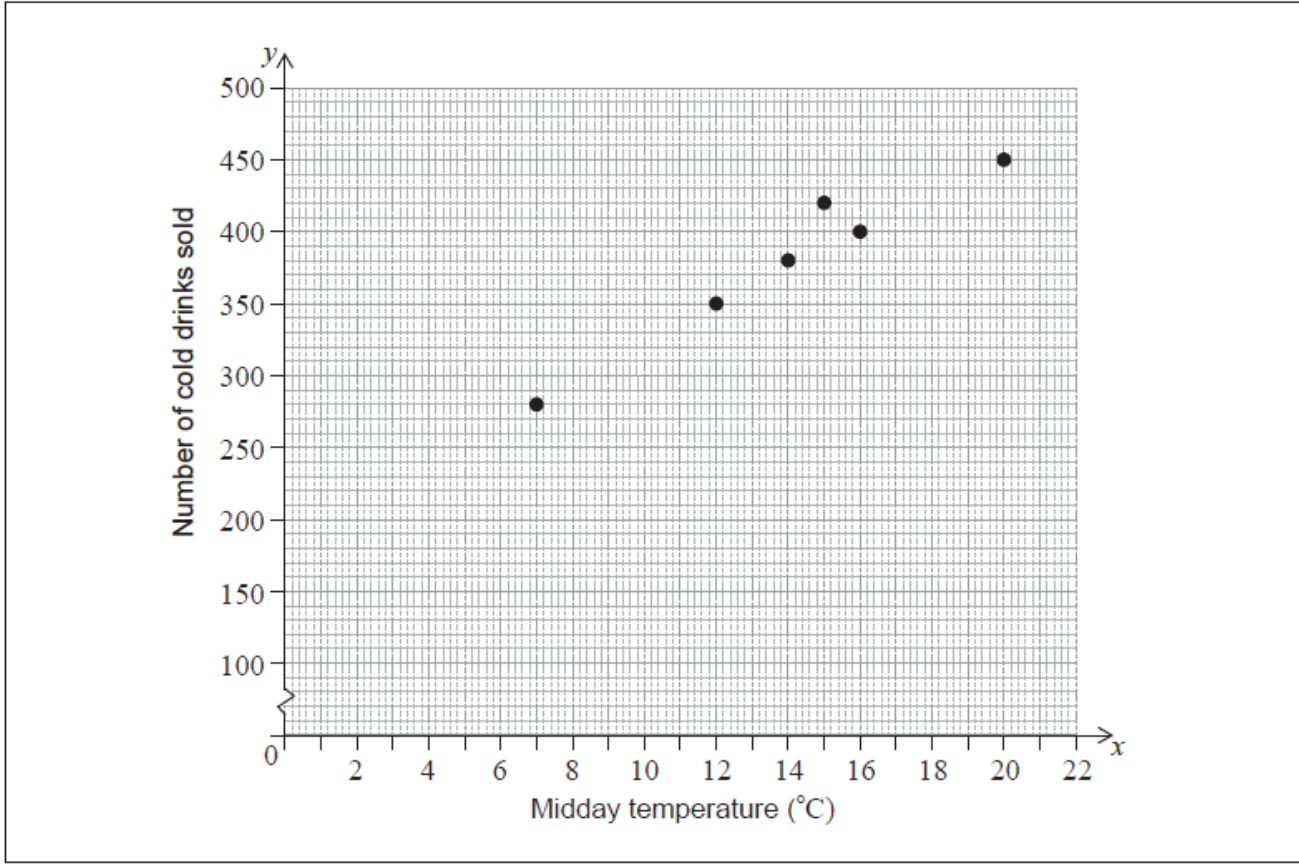
Write down

i)   the mean temperature, $\bar{x}$;

ii) the mean number of cold drinks sold, $\bar{y}$.

b. Draw the line of best fit on the scatter diagram.   [2]

c. Use the line of best fit to estimate the number of cold drinks that are sold on a day when the midday temperature is $10\,°C$.   [2]