



Here are the first six terms of a Fibonacci sequence.

1 1 2 3 5 8

The rule to continue a Fibonacci sequence is,

the next term in the sequence is the sum of the two previous terms.

(a) Find the 9th term of this sequence.

.....
(1)

The first three terms of a different Fibonacci sequence are

a b $a + b$

(b) Show that the 6th term of this sequence is $3a + 5b$

(2)

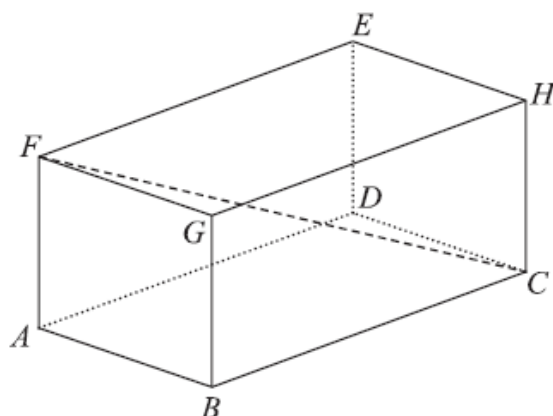
Given that the 3rd term is 7 and the 6th term is 29,

(c) find the value of a and the value of b .

.....
(3)

(Total for Question 3 is 6 marks)

The diagram shows a cuboid $ABCDEFGH$.



$AB = 7$ cm, $AF = 5$ cm and $FC = 15$ cm.

Calculate the volume of the cuboid.

Give your answer correct to 3 significant figures.

..... cm^3

(Total for Question 12 is 4 marks)

Write

$$4 - \left[(x + 3) \div \frac{x^2 + 5x + 6}{x - 2} \right]$$

as a single fraction in its simplest form.
You must show your working.

The graph of $y = f(x)$ is transformed to give the graph of $y = -f(x + 3)$
The point A on the graph of $y = f(x)$ is mapped to the point P on the
graph of $y = -f(x + 3)$

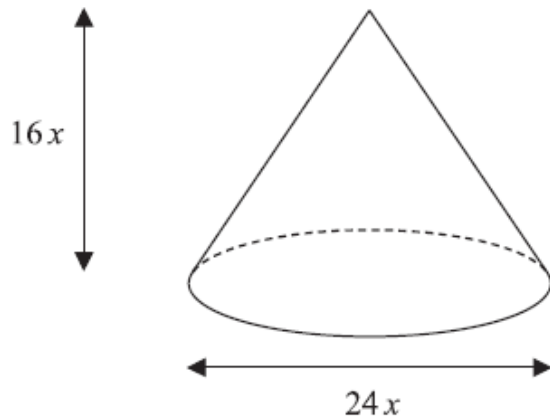
The coordinates of point A are $(9, 1)$
Find the coordinates of point P .

(..... ,)

(Total for Question 16 is 2 marks)

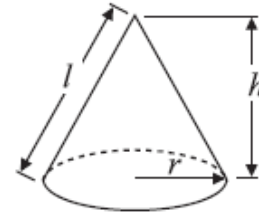


The diagram shows a solid cone.



$$\text{Volume of cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Curved surface area of cone} = \pi r l$$



The diameter of the base of the cone is $24x$ cm.
The height of the cone is $16x$ cm.

The curved surface area of the cone is 2160π cm².
The volume of the cone is $V\pi$ cm³, where V is an integer.

Find the value of V .

Mark has made a clay model.
He will now make a clay statue that is mathematically similar to the clay model.

The model has a base area of 6 cm^2
The statue will have a base area of 253.5 cm^2

Mark used 2 kg of clay to make the model.

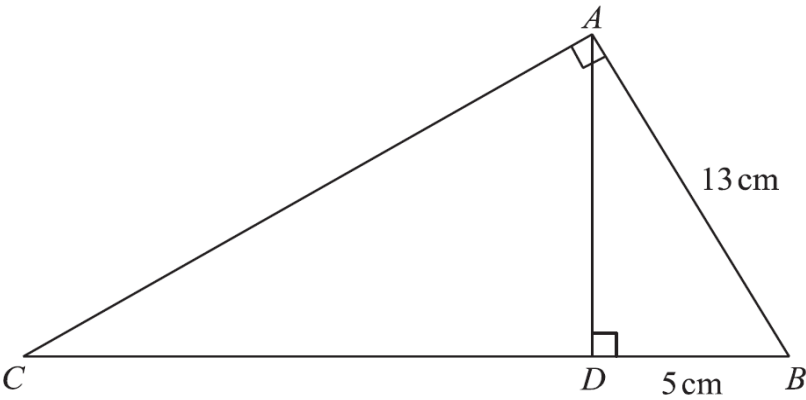
Clay is sold in 10 kg bags.
Mark has to buy all the clay he needs to make the statue.

How many bags of clay will Mark need to buy?

(Total for Question 20 is 3 marks)



ABC and ABD are two right-angled triangles.



Angle $BAC = \text{angle } ADB = 90^\circ$

$AB = 13 \text{ cm}$

$DB = 5 \text{ cm}$

Work out the length of CB .



A pendulum of length L cm has time period T seconds.
 T is directly proportional to the square root of L .

The length of the pendulum is increased by 40%.

Work out the percentage increase in the time period.

.....%



Here are the first 5 terms of a quadratic sequence.

1 3 7 13 21

Find an expression, in terms of n , for the n th term of this quadratic sequence.

.....



$f(x) = 3x^2 - 2x - 8$

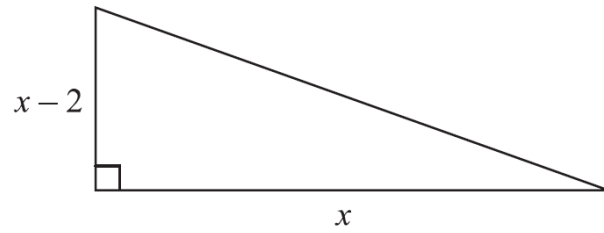
Express $f(x + 2)$ in the form $ax^2 + bx$

.....

(Total for Question 18 is 3 marks)



Here is a right-angled triangle.



All measurements are in centimetres.

The area of the triangle is 2.5 cm^2 .

Find the perimeter of the triangle.

Give your answer correct to 3 significant figures.

You must show all of your working.



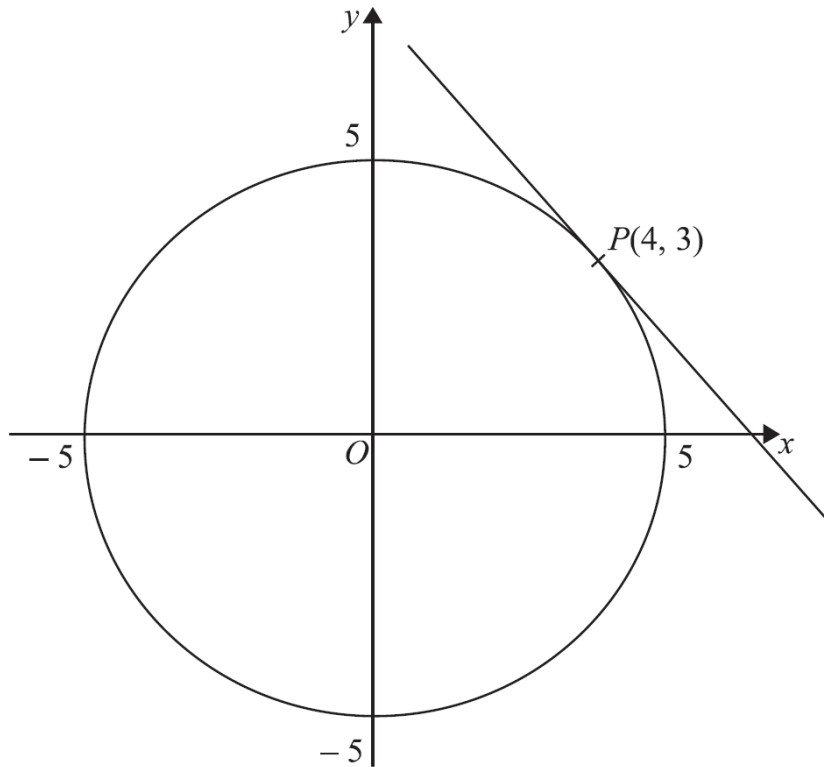
Here are the first five terms of an arithmetic sequence.

7 13 19 25 31

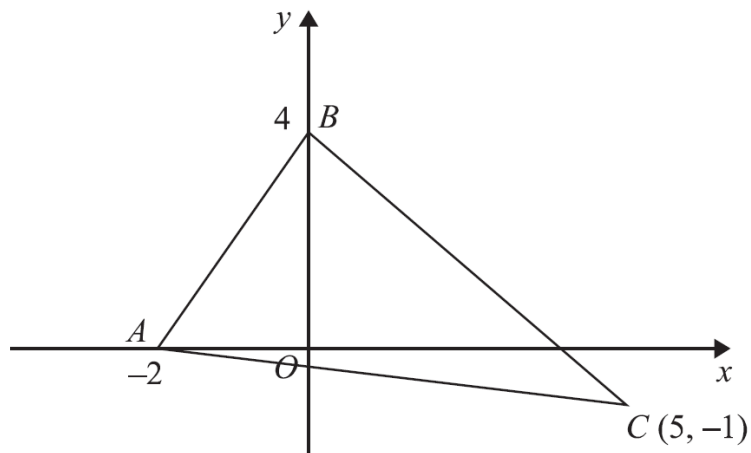
Prove that the difference between the squares of any two terms of the sequence is always a multiple of 24

(Total for Question 22 is 6 marks)

Here is a circle, centre O , and the tangent to the circle at the point $P(4, 3)$ on the circle.



Find an equation of the tangent at the point P .



Find an equation of the line that passes through C and is perpendicular to AB .

Louis and Robert are investigating the growth in the population of a type of bacteria. They have two flasks A and B.

At the start of day 1, there are 1000 bacteria in flask A.

The population of bacteria grows exponentially at the rate of 50% per day.

- (a) Show that the population of bacteria in flask A at the start of each day forms a geometric progression.

(2)

The population of bacteria in flask A at the start of the 10th day is k times the population of bacteria in flask A at the start of the 6th day.

- (b) Find the value of k .

.....
(2)

At the start of day 1 there are 1000 bacteria in flask B.

The population of bacteria in flask B grows exponentially at the rate of 30% per day.

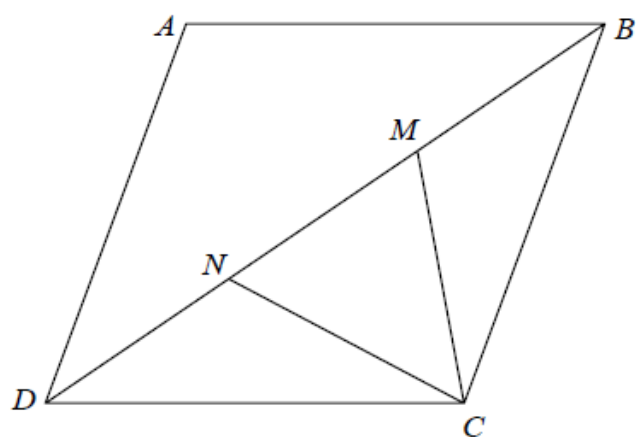
- (c) Sketch a graph to compare the size of the population of bacteria in flask A and in flask B.

(1)

(Total for Question 17 is 5 marks)



$ABCD$ is a rhombus.



M and N are points on BD such that $DN = MB$.

Prove that triangle DNC is congruent to triangle BMC .

(Total for Question 13 is 3 marks)



Sami asked 50 people which drinks they liked from tea, coffee and milk.

- All 50 people like at least one of the drinks
- 19 people like all three drinks.
- 16 people like tea and coffee but do **not** like milk.
- 21 people like coffee and milk.
- 24 people like tea and milk.
- 40 people like coffee.
- 1 person likes only milk.

Sami selects at random one of the 50 people.

(a) Work out the probability that this person likes tea.

.....
(4)

(b) Given that the person selected at random from the 50 people likes tea,
find the probability that this person also likes exactly one other drink.

.....
(2)

(Total for Question 12 is 6 marks)



The function f is such that

$$f(x) = 4x - 1$$

(a) Find $f^{-1}(x)$

$$f^{-1}(x) = \dots\dots\dots (2)$$

The function g is such that

$$g(x) = kx^2 \text{ where } k \text{ is a constant.}$$

Given that $fg(2) = 12$

(b) work out the value of k

$$k = \dots\dots\dots (2)$$

(Total for Question 10 is 4 marks)



Solve $x^2 - 5x + 3 = 0$

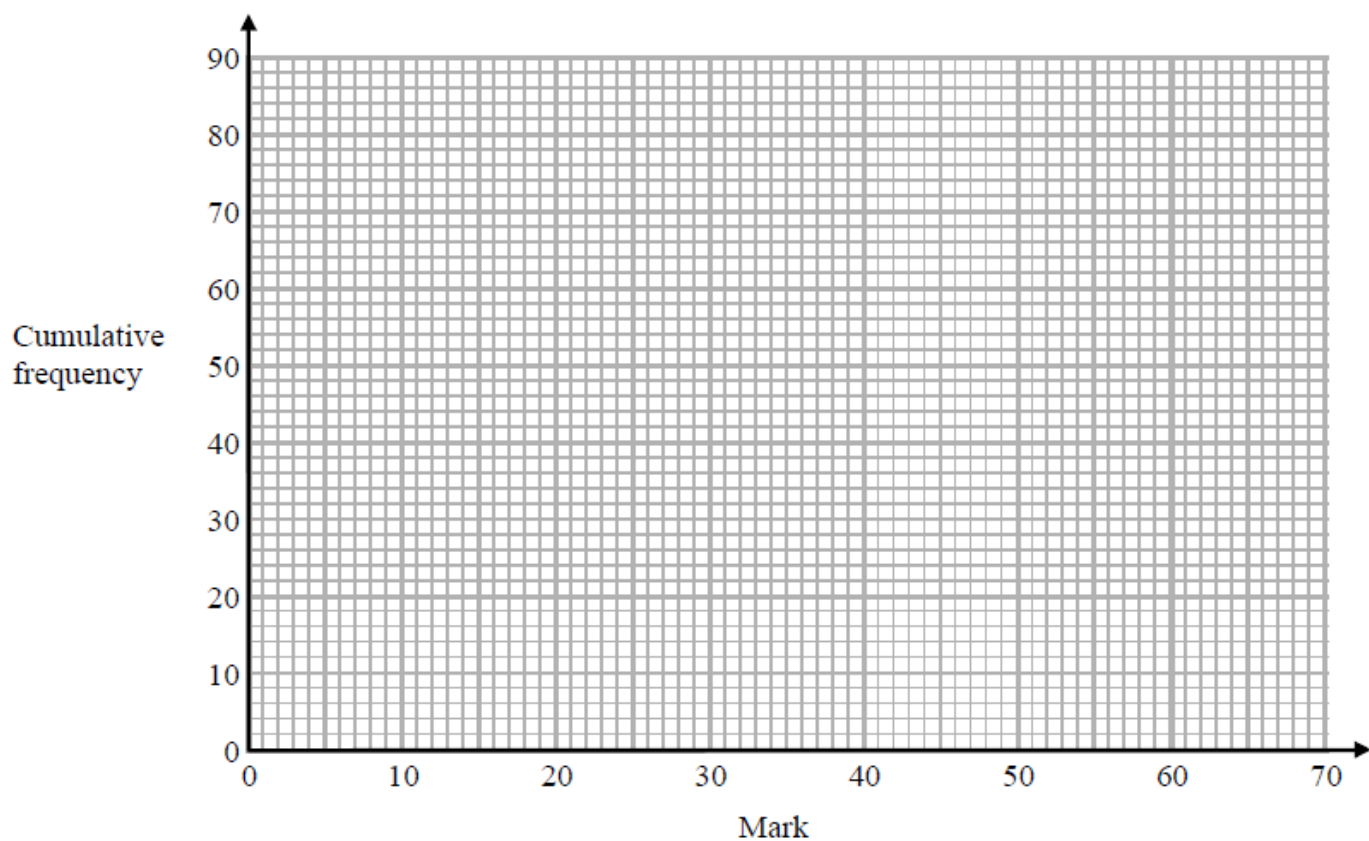
Give your solutions correct to 3 significant figures.

(Total for Question 11 is 3 marks)

The cumulative frequency table shows the marks some students got in a test.

Mark (m)	Cumulative frequency
$0 < m \leq 10$	8
$0 < m \leq 20$	23
$0 < m \leq 30$	48
$0 < m \leq 40$	65
$0 < m \leq 50$	74
$0 < m \leq 60$	80

(a) On the grid, plot a cumulative frequency graph for this information.



(2)

(b) Find the median mark.

(1)

Students either pass the test or fail the test.

The pass mark is set so that 3 times as many students fail the test as pass the test.

(c) Find an estimate for the lowest possible pass mark.

.....
(3)

(Total for Question 7 is 6 marks)

In triangle RPQ ,

$$RP = 8.7 \text{ cm}$$

$$PQ = 5.2 \text{ cm}$$

$$\text{Angle } PRQ = 32^\circ$$

- (a) Assuming that angle PQR is an acute angle, calculate the area of triangle RPQ .
Give your answer correct to 3 significant figures.

..... cm^2
(4)

- (b) If you did not know that angle PQR is an acute angle, what effect would this have on your calculation of the area of triangle RPQ ?

.....
(1)

(Total for Question 21 is 5 marks)



$$m = \frac{\sqrt{s}}{t}$$

$s = 3.47$ correct to 3 significant figures

$t = 8.132$ correct to 4 significant figures

By considering bounds, work out the value of m to a suitable degree of accuracy.
Give a reason for your answer.

(Total for Question 18 is 5 marks)

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DO NOT WRITE IN THIS AREA

DO NOT WRITE



Katy invests £2000 in a savings account for 3 years.

The account pays compound interest at an annual rate of

2.5% for the first year

$x\%$ for the second year

$x\%$ for the third year

There is a total amount of £2124.46 in the savings account at the end of 3 years.

(a) Work out the rate of interest in the second year.

.....
(4)

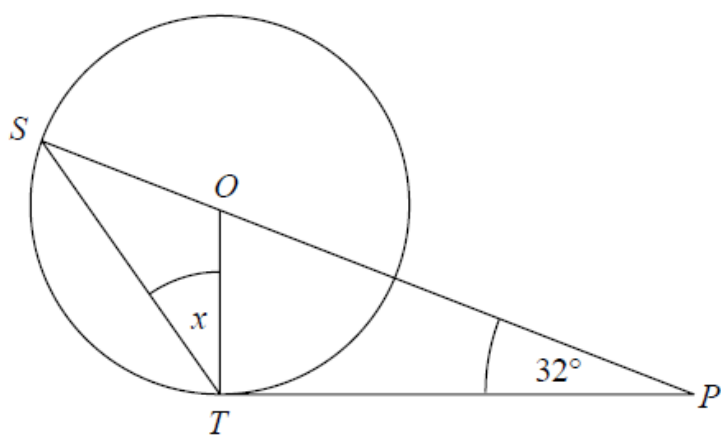
Katy goes to work by train.

The cost of her weekly train ticket increases by 12.5% to £225

(b) Work out the cost of her weekly train ticket before this increase.

£.....
(2)

(Total for Question 10 is 6 marks)



S and *T* are points on the circumference of a circle, centre *O*.

PT is a tangent to the circle.

SOP is a straight line.

Angle $OPT = 32^\circ$

Work out the size of the angle marked *x*.

You must give a reason for each stage of your working.

(Total for Question 11 is 4 marks)

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Sami selects at random one of the 50 people.

(a) Work out the probability that this person likes tea.

.....
(4)

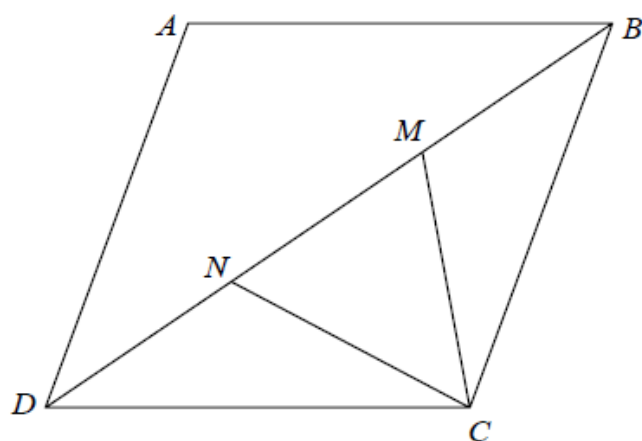
(b) Given that the person selected at random from the 50 people likes tea,
find the probability that this person also likes exactly one other drink.

.....
(2)

(Total for Question 12 is 6 marks)



$ABCD$ is a rhombus.



M and N are points on BD such that $DN = MB$.

Prove that triangle DNC is congruent to triangle BMC .

(Total for Question 13 is 3 marks)

d is inversely proportional to c

When $c = 280$, $d = 25$

Find the value of d when $c = 350$

$d = \dots\dots\dots$

(Total for Question 13 is 3 marks)

Prove algebraically that

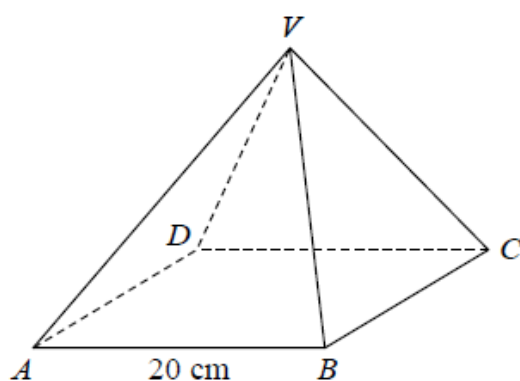
$(2n + 1)^2 - (2n + 1)$ is an even number

for all positive integer values of n .

(Total for Question 14 is 3 marks)



$VABCD$ is a solid pyramid.



$ABCD$ is a square of side 20 cm.

The angle between any sloping edge and the plane $ABCD$ is 55°

Calculate the surface area of the pyramid.

Give your answer correct to 2 significant figures.

..... cm^2

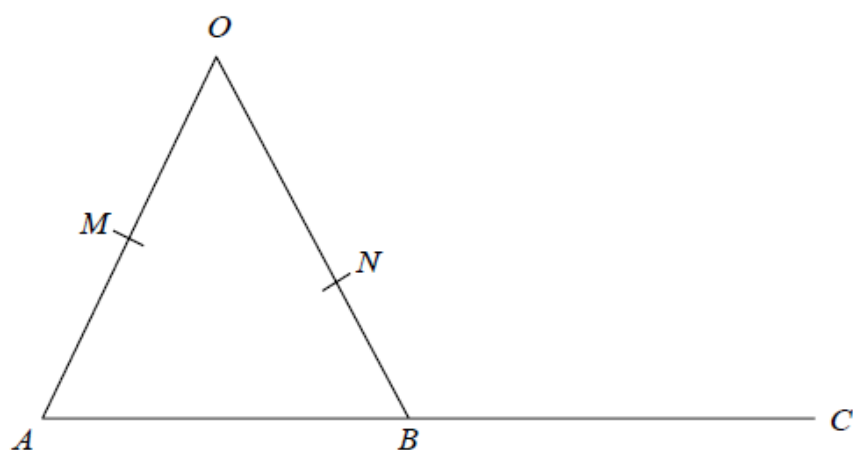
(Total for Question 16 is 5 marks)

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Show that $\frac{1}{6x^2 + 7x - 5} \div \frac{1}{4x^2 - 1}$ simplifies to $\frac{ax + b}{cx + d}$ where a , b , c and d are integers.

(Total for Question 16 is 3 marks)



OMA , ONB and ABC are straight lines.

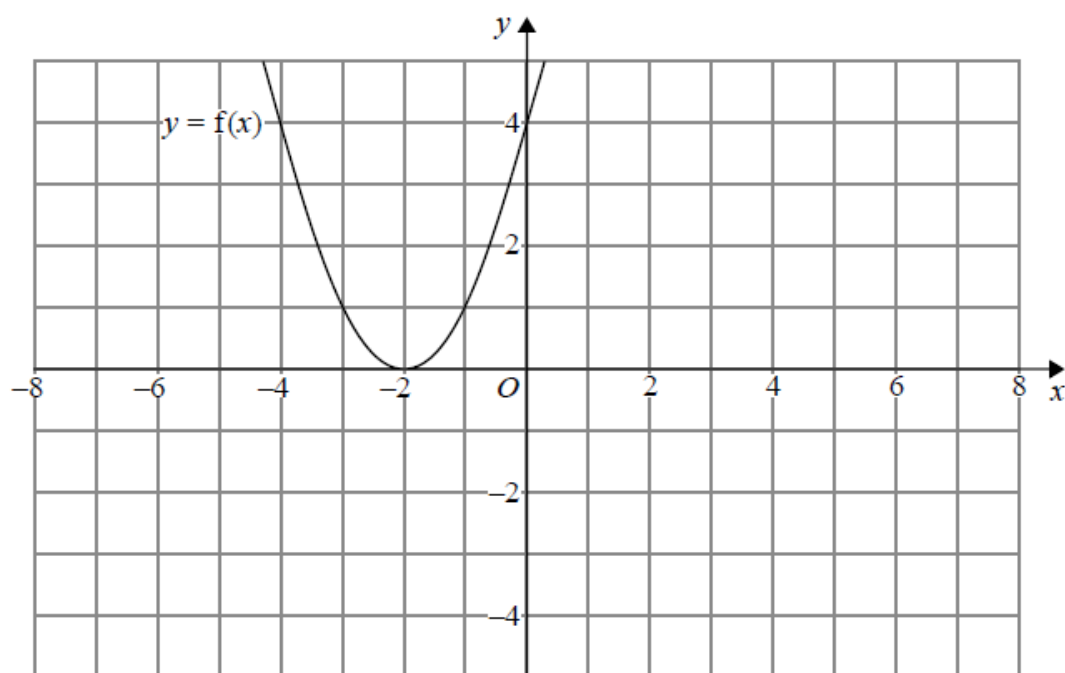
M is the midpoint of OA .

B is the midpoint of AC .

$\vec{OA} = 6\mathbf{a}$ $\vec{OB} = 6\mathbf{b}$ $\vec{ON} = k\mathbf{b}$ where k is a scalar quantity.

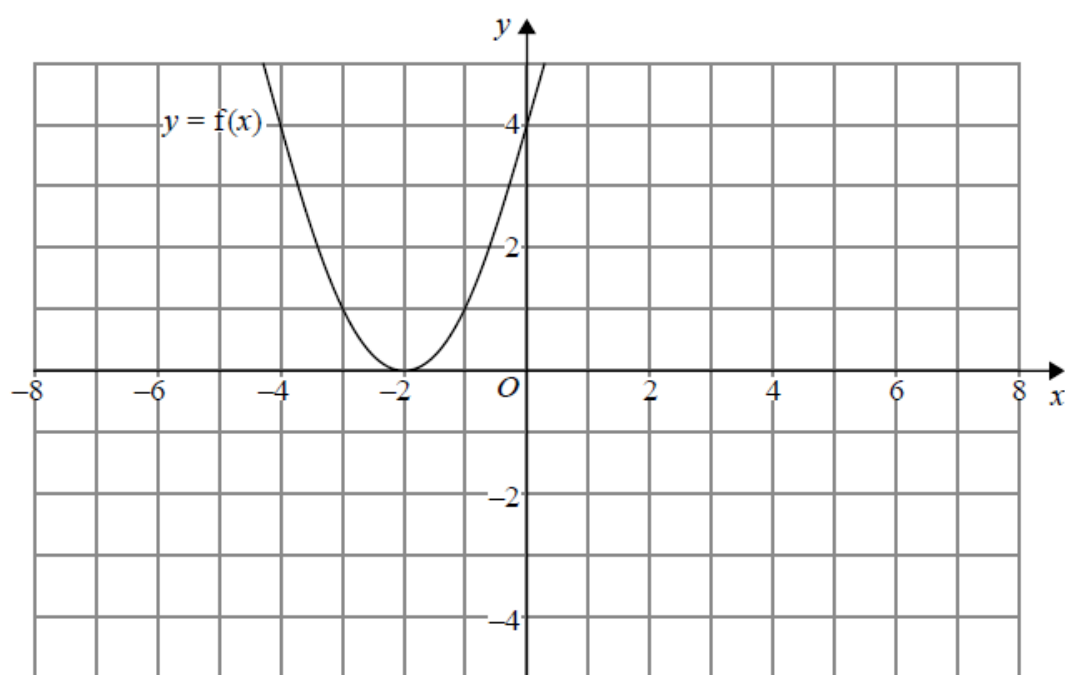
Given that MNC is a straight line, find the value of k .

The graph of $y = f(x)$ is shown on both grids below.



(a) On the grid above, sketch the graph of $y = f(-x)$

(1)



(b) On this grid, sketch the graph of $y = -f(x) + 3$

(1)

(Total for Question 19 is 2 marks)



Solve algebraically the simultaneous equations

$$x^2 + y^2 = 25$$

$$y - 2x = 5$$

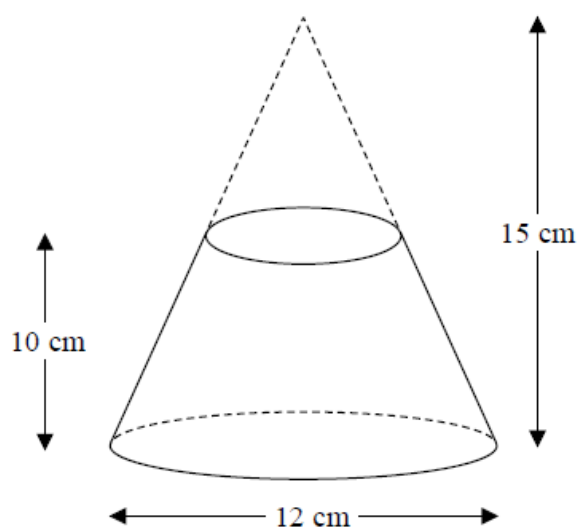
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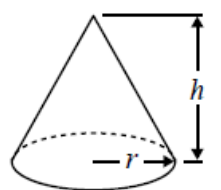
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(Total for Question 20 is 5 marks)

A frustum is made by removing a small cone from a large cone as shown in the diagram.



$$\text{Volume of cone} = \frac{1}{3}\pi r^2 h$$



The frustum is made from glass.

The glass has a density of 2.5 g/cm^3

Work out the mass of the frustum.

Give your answer to an appropriate degree of accuracy.

(Total for Question 22 is 5 marks)

● Show that $\frac{1}{1 + \frac{1}{\sqrt{2}}}$ can be written as $2 - \sqrt{2}$

● John has an empty box.
He puts some red counters and some blue counters into the box.

The ratio of the number of red counters to the number of blue counters is 1 : 4

Linda takes at random 2 counters from the box.

The probability that she takes 2 red counters is $\frac{6}{155}$

How many red counters did John put into the box?

 $A(-2, 1)$, $B(6, 5)$ and $C(4, k)$ are the vertices of a right-angled triangle ABC .
Angle ABC is the right angle.

Find an equation of the line that passes through A and C .

Give your answer in the form $ay + bx = c$ where a , b and c are integers.