

Surname	Centre Number	Candidate Number
Other Names		0



GCSE

3300U50-1



MATHEMATICS
**UNIT 1: NON-CALCULATOR *
HIGHER TIER**

FRIDAY, 10 NOVEMBER 2017 – MORNING

1 hour 45 minutes

ADDITIONAL MATERIALS

The use of a calculator is not permitted in this examination.
A ruler, a protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

If you run out of space use the continuation page at the back of the booklet. Question numbers must be given for all work written on the continuation page.

Take π as 3.14.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

In question 4, the assessment will take into account the quality of your linguistic and mathematical organisation and communication.

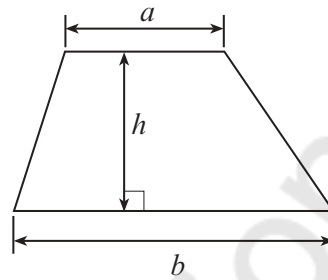
For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	3	
2.	5	
3.	4	
4.	7	
5.	4	
6.	3	
7.	5	
8.	3	
9.	4	
10.	4	
11.	3	
12.	9	
13.	5	
14.	2	
15.	4	
16.	3	
17.	4	
18.	1	
19.	7	
Total	80	



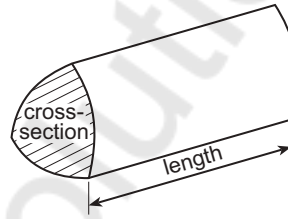
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Formula List - Higher Tier

$$\text{Area of trapezium} = \frac{1}{2}(a + b)h$$

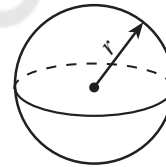


$$\text{Volume of prism} = \text{area of cross-section} \times \text{length}$$



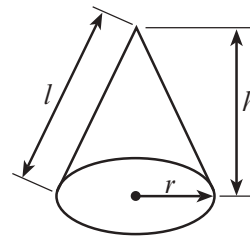
$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

$$\text{Surface area of sphere} = 4\pi r^2$$



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

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

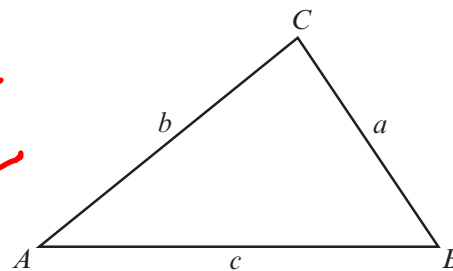


In any triangle ABC

$$\text{Sine rule} \quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{Cosine rule} \quad a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area of triangle} = \frac{1}{2}ab \sin C$$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Annual Equivalent Rate (AER)

AER, as a decimal, is calculated using the formula $\left(1 + \frac{i}{n}\right)^n - 1$, where i is the nominal interest rate per annum as a decimal and n is the number of compounding periods per annum.



1. Look at the following descriptions of special quadrilateral shapes. Circle the correct name for each one.

[Plane shape with 4 sides]

(a) Its diagonals intersect at 90° .
Only one diagonal is a line of symmetry.

[1]

- Kite Rhombus Square Trapezium Rectangle

(b) Only one pair of sides are parallel.

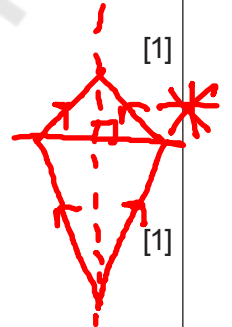
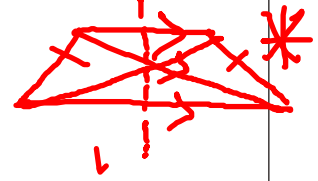
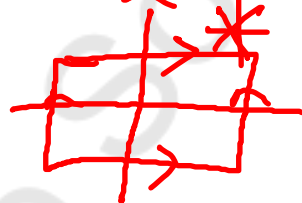
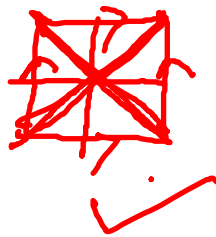
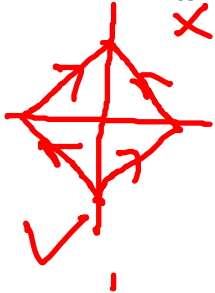
[1]

- Kite Rhombus Square Trapezium Rectangle

(c) All four sides are equal.
Its diagonals are not equal in length.

[1]

- Kite Rhombus Square Trapezium Rectangle



Mathsvault.io Solutions



2. (a) Complete the table below.
 Draw the graph of $y = 2x^2 - 5$ for values of x between -2 and 3 .
 Use the graph paper below.
 Choose a suitable scale for the y -axis.

x	-2	-1	0	1	2	3
$y = 2x^2 - 5$	3	-3	-5	-3	3	13

$$(-1)^2$$

$$-1 \times -1$$

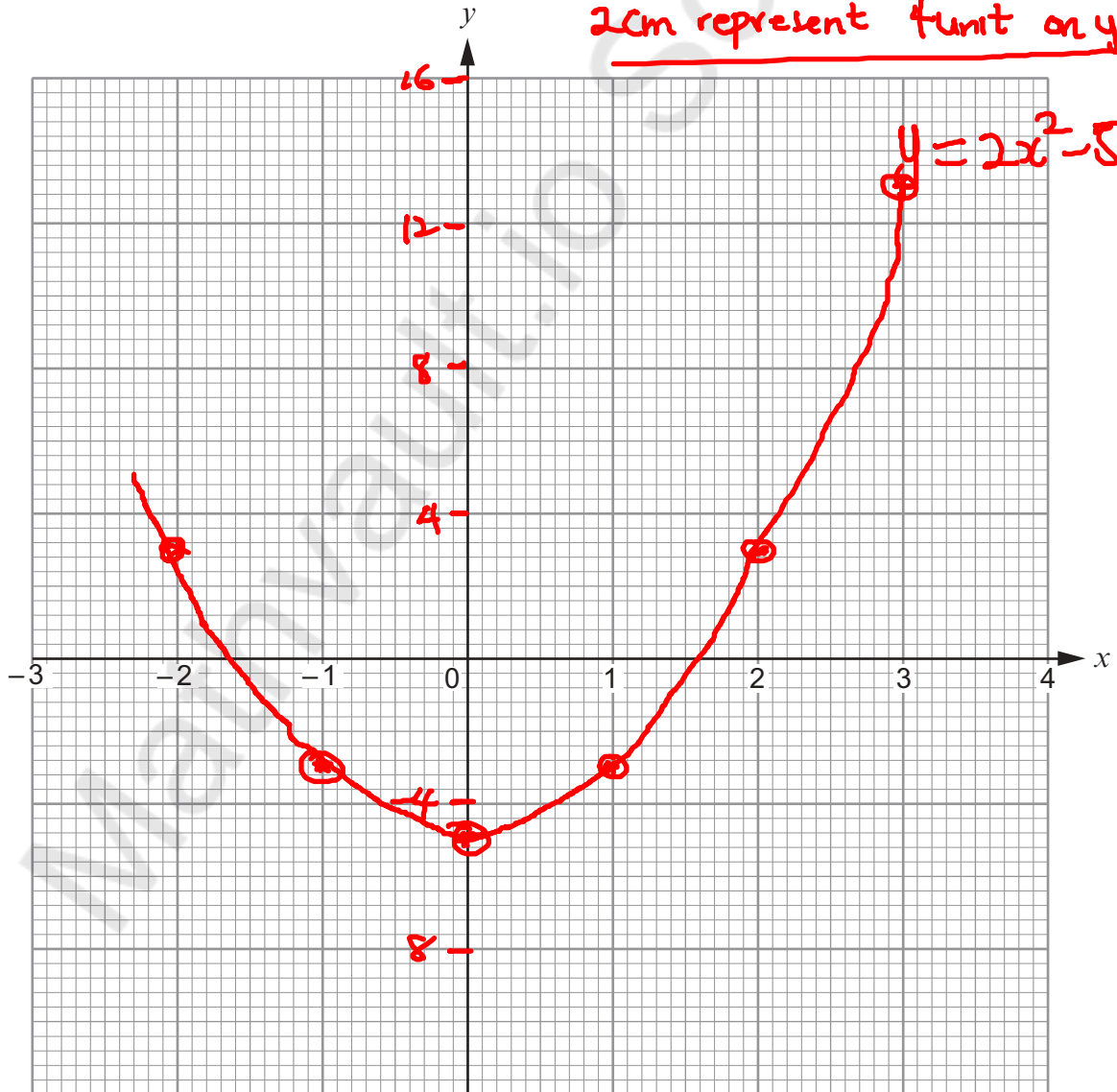
$$+1$$

$$y = 2x^2 - 5 \quad \text{when } x = -1$$

$$y = 2 \times (-1)^2 - 5 = 2 \times 1 - 5 = 2 - 5$$

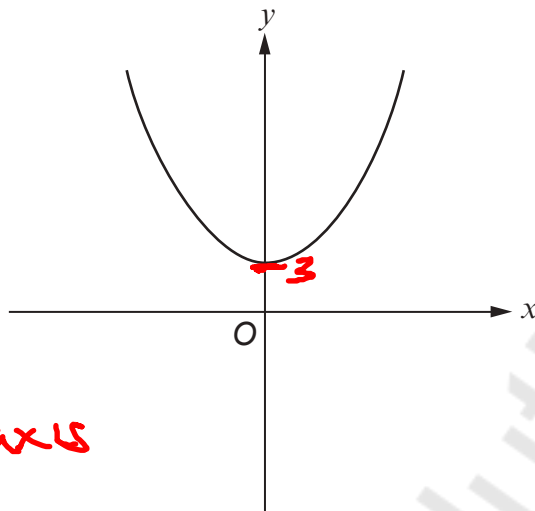
$$y = -3$$

2cm represent 1 unit on y axis



(b)

$y = -x^2$
reflection
over x-axis



$y = x^2 + k$

The sketch above can represent only one of the equations given below.
Circle this equation.

[1]

$y = x^2$
X

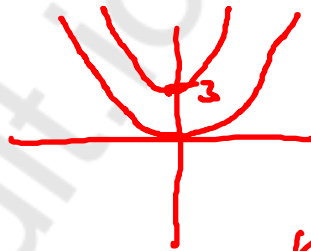
$y = x^2 - 3$
X

$y = -x^2$
X

$y = x^2 + 3$

$y = 3x$

$y = x^2$



$y = x^2 + k$

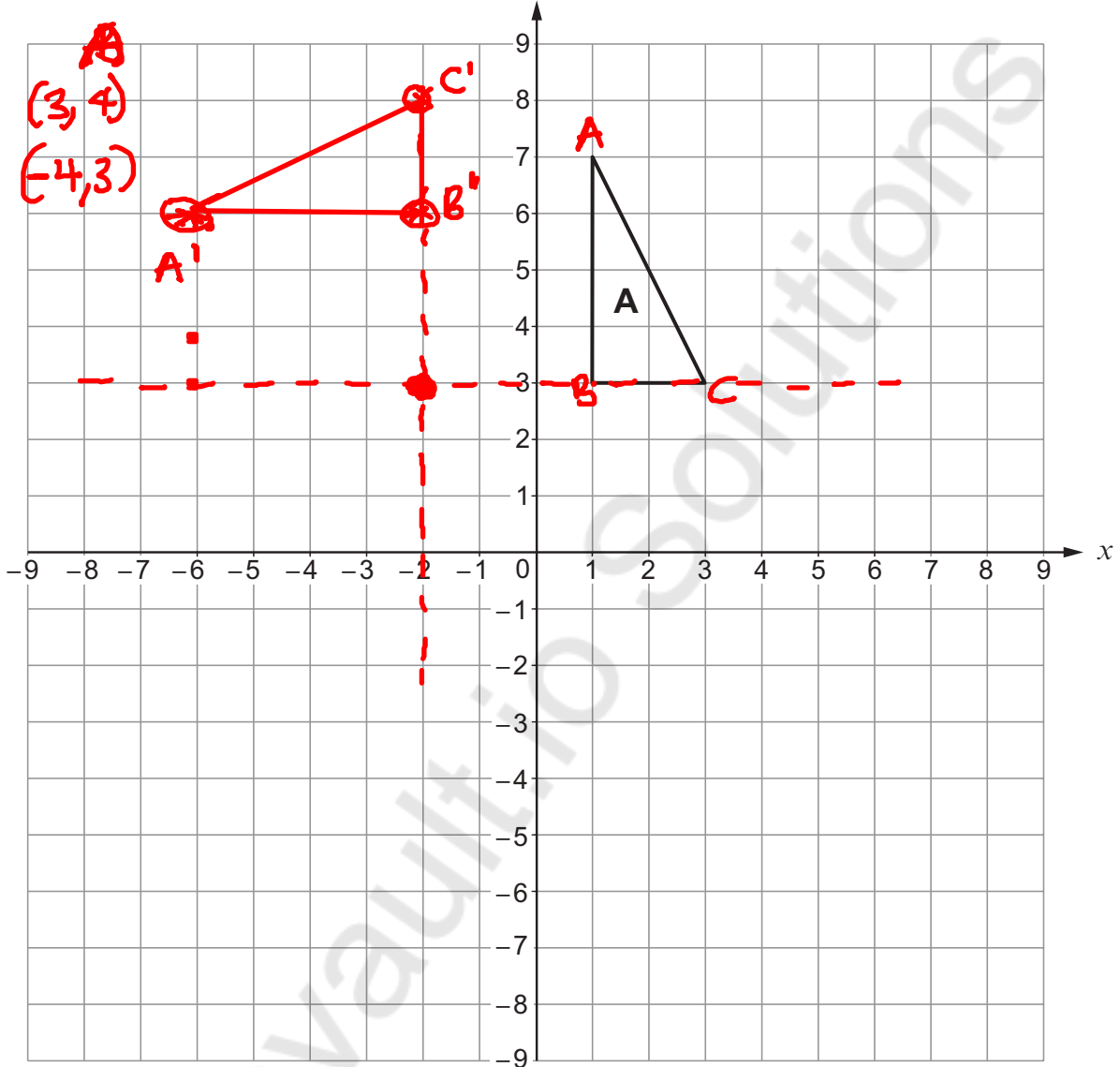
$k > 0$ Shifted up
by k unit

$k < 0$ Shifted down
by k unit

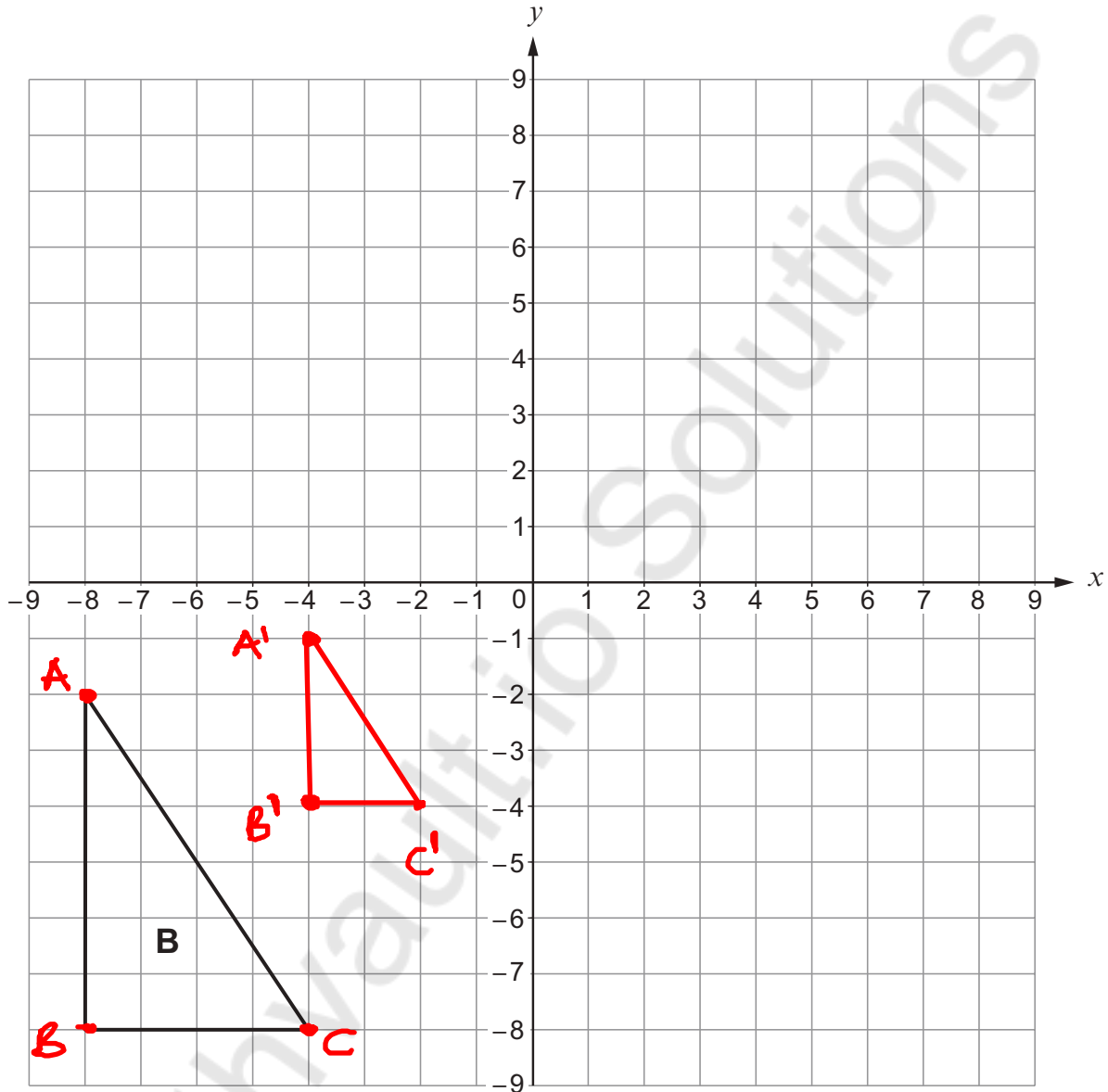


3. (a) Rotate triangle A through 90° anticlockwise, about the point $(-2, 3)$. [2]

$$(x, y) \longrightarrow (-y, x) \text{ anticlockwise rotation } 90^\circ$$



- (b) Enlarge triangle B by a scale factor of $\frac{1}{2}$, using (0, 0) as the centre of enlargement. [2]



Scale factor $\frac{1}{2}$

Transformation K

$$(x, y) \longrightarrow K(x, y)$$

$$A = (-8, -2) \longrightarrow \frac{1}{2}(-8, -2) = (-4, -1) \quad A'$$

$$B = (-8, -8) \longrightarrow \frac{1}{2}(-8, -8) = (-4, -4)$$

$$C = (-4, -8) \longrightarrow \frac{1}{2}(-4, -8) = (-2, -4)$$



4. In this question you will be assessed on the quality of your organisation, communication and accuracy in writing.

PQ and PR are tangents to a circle with centre O .

$$\hat{RPQ} = 30^\circ$$

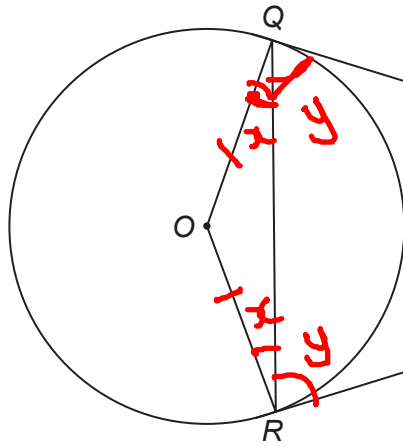


Diagram not drawn to scale

$$\text{Let } \hat{OQR} = x$$

Find the size of \hat{OQR} .

You must indicate any angles you calculate.

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

[5 + 2 OCW]

$$OR = OQ \text{ [The radius of the circle]}$$

Therefore, $\triangle OQR$ is isosceles triangle

$$\text{Then, } \hat{ROQ} = \hat{OQR} = x$$

$$\hat{OQP} = \hat{ORP} = 90^\circ \text{ [Angle from centre of a circle to the tangent]}$$

$$PQ = QR \text{ [equidistance from the circumference]}$$

So, $\triangle PQR$ is isosceles triangle

$$\text{So, } y + y + 30 = 180 \text{ [sum of angle in a triangle]}$$

$$2y = 180 - 30$$

$$2y = 150$$

$$y = 75^\circ$$

Since $\triangle OQP$ is right-angled

$$\text{So, } x + y = 90$$

$$x = 90 - y$$

$$x = 90 - 75$$

$$x = 15^\circ$$

$$\hat{OQR} = \underline{\underline{15^\circ}}$$



5. (a) Express 0.00042 in standard form. [1]

0.00042 $n = -4$ $A \times 10^n$ n integer $1 < A < 10$

$A = 4.2$ 4.2×10^{-4}

- (b) Calculate the value of $\frac{7.2 \times 10^6}{2 \times 10^{-2}}$. [1]

Give your answer in standard form. $\frac{a^m}{a^n} = a^{m-n}$

$\frac{7.2 \times 10^6}{2 \times 10^{-2}} = 3.6 \times 10^{6-(-2)} = 3.6 \times 10^8$

- (c) Calculate the value of $(4.7 \times 10^5) - (6.2 \times 10^4)$. [2]
- Give your answer in standard form.

$4.7 \times 10^5 - 6.2 \times 10^4$

$4.7 \times 10^5 - 6.2 \times 10^4 \times \frac{10}{10}$

$4.7 \times 10^5 - \frac{6.2}{10} \times 10^4 \times 10$

$4.7 \times 10^5 - 0.62 \times 10^5$

$10^5 [4.7 - 0.62]$

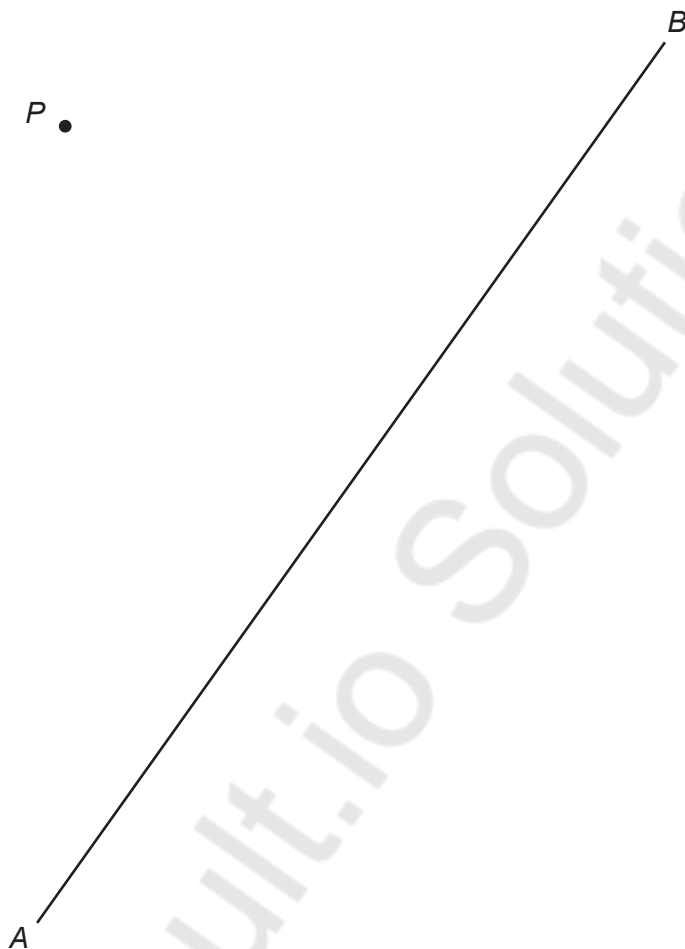
$10^5 [4.08]$

4.08×10^5

$\begin{array}{r} 4.70 \\ -0.62 \\ \hline 4.08 \end{array}$



6. Using only a ruler and a pair of compasses, construct a perpendicular line from the point P to the line AB . [3]

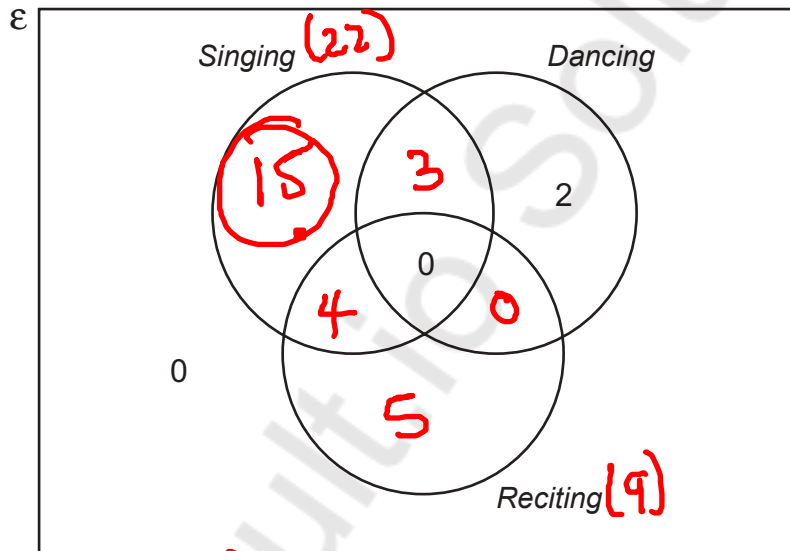


7. A group of pupils from a school took part in The Urdd National Eisteddfod. All of them competed in at least one of the following competitions: *Singing*, *Dancing* or *Reciting*.

- 2 of them only took part in a *Dancing* competition.
- 5 only took part in a *Reciting* competition.
- No one took part in both a *Reciting* and a *Dancing* competition.
- 3 took part in both a *Singing* and a *Dancing* competition.
- 9 took part in a *Reciting* competition.
- 22 took part in a *Singing* competition.

The Venn diagram below shows some of the above information. The universal set, ϵ , contains all of the pupils in the group.

One of the pupils in the group is chosen at random. What is the probability that this person **only** took part in a *Singing* competition? [5]



$$\frac{22}{29} = \frac{22 - 7}{29} = \frac{15}{29}$$

$Pr(\text{only singing}) = \frac{\text{number of only singing}}{\text{Universal set}}$

Universal set = 5 + 4 + 15 + 3 + 2 = 29

$Pr(\text{only singing}) = \frac{15}{29}$



8. Factorise $x^2 - 7x - 18$, and hence solve $x^2 - 7x - 18 = 0$. [3]

$$\underline{x^2 - 7x - 18}$$

$$1x - 18 = -18$$

Factors of -18

Add the factors

$1 \times -18 = -18$	$1 + (-18) = -17$
$-1 \times 18 = -18$	$-1 + 18 = 17$
* $2 \times -9 = -18$	$2 + (-9) = -7$
$-2 \times 9 = -18$	$-2 + 9 = 7$
$6 \times -3 = -18$	$6 + (-3) = 3$
$-6 \times 3 = -18$	$-6 + 3 = -3$

$$x^2 + 2x - 9x - 18$$

$$x(x+2) - 9(x+2)$$

$$(x+2)(x-9)$$

$$x^2 - 7x - 18 = \underline{\underline{(x+2)(x-9)}}$$

$$x^2 - 7x - 18 = 0$$

Since $x^2 - 7x - 18 = (x+2)(x-9)$

$$(x+2)(x-9) = 0$$

$$x+2 = 0 \quad \text{OR} \quad x-9 = 0$$

$$x = 0 - 2 \quad \text{OR} \quad x = 0 + 9$$

$$\underline{\underline{x = -2 \quad \text{OR} \quad x = 9}}$$



9. Solve the following simultaneous equations using an algebraic (not graphical) method. [4]

$$4x - 3y = 2 \quad \text{---}$$

$$6x - 5y = 1 \quad \text{---}$$

Using elimination method 3 and 5
15

$$4x - 3y = 2 \quad \times 5 \quad \text{---} \textcircled{1}$$

$$6x - 5y = 1 \quad \times 3 \quad \text{---} \textcircled{2}$$

$$\begin{array}{r} 20x - 15y = 10 \\ - 18x - 15y = 3 \\ \hline 2x = 7 \end{array}$$

$$x = \frac{7}{2} = \underline{\underline{3.5}}$$

Using equation (1)

$$4x - 3y = 2$$

$$24 \times \frac{7}{2} - 3y = 2$$

$$14 - 3y = 2$$

$$-3y = 2 - 14$$

$$-3y = -12$$

$$y = \frac{-12}{-3} = 4$$

$$\boxed{x = \frac{7}{2} \quad y = 4} \quad *$$



10. A cylinder just fits inside a hollow cube with sides of length m cm.

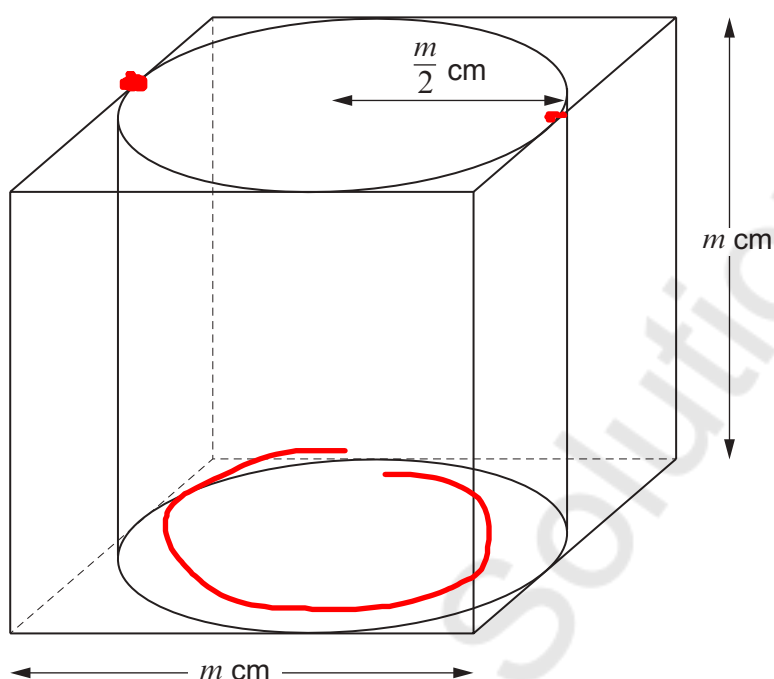


Diagram not drawn to scale

The radius of the cylinder is $\frac{m}{2}$ cm.

The height of the cylinder is m cm.

The ratio of the volume of the cube to the volume of the cylinder is given by

volume of cube : volume of cylinder

$$= k : \pi,$$

where k is a number.

Find the value of k .

You must show all your working.

[4]

$$\text{Volume of cube} = \text{Base Area} \times \text{height}$$

$$= m \times m \times m$$

$$V_{\text{cube}} = m^3$$

$$\text{Volume of cylinder} = \text{Base Area} \times \text{height}$$

$$\pi r^2 \times h$$



$$V_{\text{cylinder}} = \pi \times \left(\frac{m}{2}\right)^2 \times m$$

$$= \pi \times \frac{m^2}{4} \times m = \frac{m^3}{4} \pi$$

$$\text{Ratio} = \frac{\text{Volume of cube}}{\text{Volume of cylinder}} = \frac{m^3}{\frac{\pi m^3}{4}}$$

$$\text{Ratio} = m^3 \div \frac{m^3 \pi}{4} = m^3 \times \frac{4}{m^3 \pi}$$

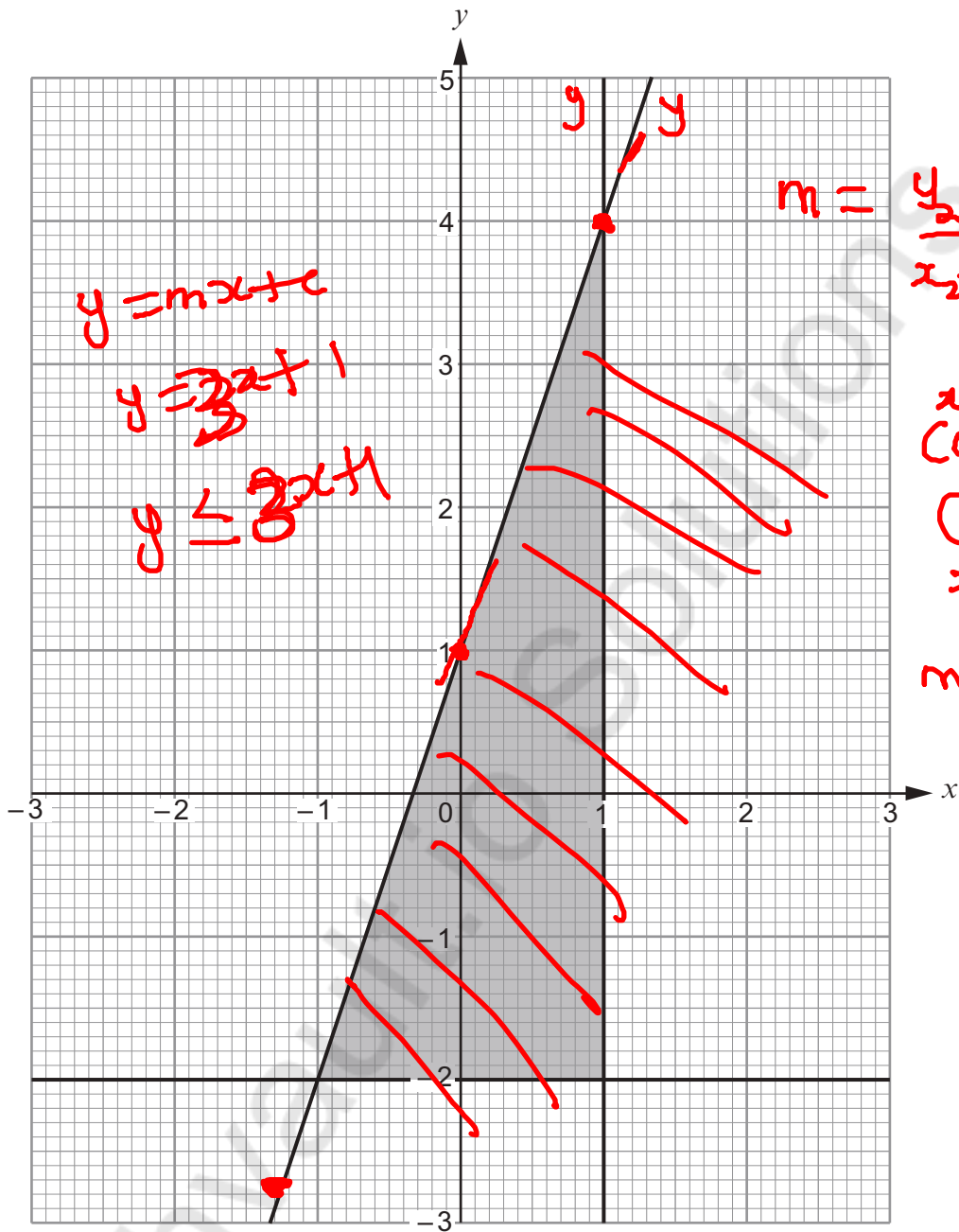
$$\text{Ratio} = \frac{4}{\pi} = \frac{4}{\pi} \pi$$

$$\text{Ratio} = 4 : \pi$$

$$K = \underline{\underline{4}}$$



11.



Complete the following table to give the set of inequalities that describes the shaded region shown above. [3]

.....

$x \leq 1$
$y \geq -2$
$y \leq 3x + 1$



12. Two different squares are constructed. $\square x$ $\square x+3$
 The side length of the smaller square is x cm.
 The side length of the larger square is 3 cm longer than the side length of the smaller square.
 The combined area of the two squares is 22.5 cm^2 .

(a) Show that $4x^2 + 12x - 27 = 0$. [4]

22.5
x2

45.0

3x5
-18

27

Area of square = s^2
 $A_1 + A_2 = 22.5$
 $x^2 + (x+3)^2 = 22.5$
 $x^2 + x^2 + 3x + 3x + 9 = 22.5$
 $2x^2 + 6x + 9 = 22.5$
 multiply all by 2

$4x^2 + 12x + 18 - 45 = 0$
 $4x^2 + 12x - 27 = 0$
 proved //
 $4x^2 + 12x - 27 = 0$

(b) Find the dimensions of each of the squares. [5]

Do not use a trial and improvement method *

you must show all your working and justify any decision that you make.

164
27

112

32

432

144

576

123
82

82

$4x^2 + 12x - 27 = 0$ $ax^2 + bx + c = 0$
 $a = 4$ $b = 12$ $c = -27$
 $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-12 \pm \sqrt{12^2 - 4 \times 4 \times -27}}{2 \times 4}$
 $x = \frac{-12 \pm \sqrt{144 + 432}}{8} = \frac{-12 \pm \sqrt{576}}{8}$
 $x = \frac{-12 \pm 24}{8} = \frac{-12 + 24}{8} \text{ OR } \frac{-12 - 24}{8}$
 $x = \frac{12}{8} \text{ OR } \frac{-36}{8}$ *

Smaller $x = 1.5 \text{ cm}$
 bigger $x + 3 = 1.5 + 3 = 4.5 \text{ cm}$

Side length of smaller square = 1.5 cm

Side length of larger square = 4.5 cm



13. Given that y is inversely proportional to x³ and that y = 120 when x = 2,

(a) find an expression for y in terms of x, [3]

$$y \propto \frac{1}{x^3}$$

$$y = \frac{k}{x^3}$$

$$120 = \frac{k}{2^3}$$

$$120 = \frac{k}{8}$$

$$k = 120 \times 8$$

$$k = 960$$

$$y = \frac{960}{x^3}$$

$$\begin{array}{r} 120 \\ \times 8 \\ \hline 960 \end{array}$$

(b) use the expression you found in part (a) to complete the following table. [2]

x	2	10	4
y	120	0.96	15

$$y = \frac{960}{x^3}$$

$$x = 10$$

$$10 \times 10 \times 10 = 1000$$

$$y = \frac{960}{10^3} = \frac{960}{1000} = 0.96$$

$$\begin{array}{r} 15 \\ 9 \overline{) 135} \\ \underline{90} \\ 45 \\ \underline{45} \\ 0 \end{array}$$

$$y = 15 \quad x = ?$$

$$\begin{array}{r} 64 \\ 15 \overline{) 960} \\ \underline{90} \\ 60 \\ \underline{60} \\ 0 \end{array}$$

$$y = \frac{960}{x^3}$$

$$15 = \frac{960}{x^3}$$

$$15x^3 = 960$$

$$x^3 = \frac{960}{15} = 64$$

$$x^3 = 64$$

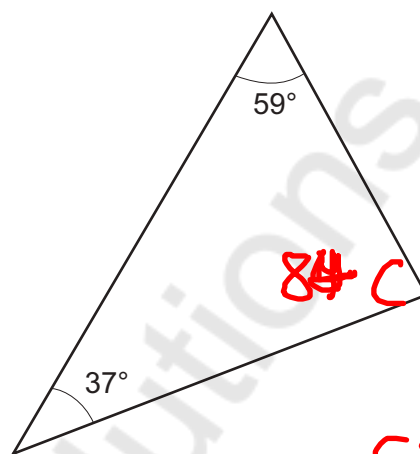
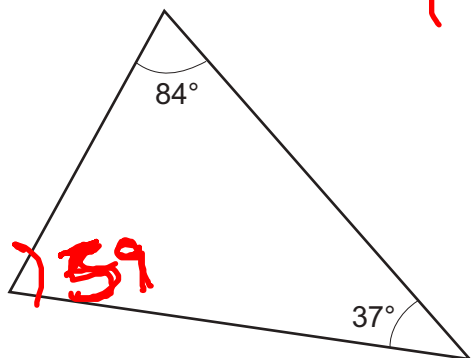
$$x = \sqrt[3]{64}$$

$$x = \sqrt[3]{4 \times 4 \times 4}$$

$$x = 4$$



14. The two triangles shown below are not drawn to scale.



84
+ 37

121
180
- 121

59

59
37

96

Which one of the following statements is correct?
Give full reasons for your answer.

- A: the triangles **must** be congruent ✓
- B**: the triangles **could** be congruent
- C: the triangles **cannot** be congruent *

SSS
AAA [2]
SAS

sum of angle
in a triangle
is 180

180
- 96

84

$$x + 84 + 37 = 180$$

$$x + 121 = 180$$

$$x = 180 - 121$$

$$x = 59$$

$$y + 37 + 59 = 180$$

$$y + 96 = 180$$

$$y = 180 - 96$$

$$y = 84$$

The correct statement is **B**

This is because

The triangles could be congruent because the three angles of the triangles being equal is not a sufficient condition for congruency because they may have different sides.

*
SSS
SAS
ASA
AAS
RHS

AAA [is not a sufficient condition]



$$\sqrt[1]{212}$$

$$\frac{106}{2}$$

15. (a) Express 0.642 as a fraction. [2]

0.642 as a fraction

$$0.6\overline{42} = 0.6424242\dots$$

$$\text{Let } x = 0.6424242\dots \times 100$$

$$100x = 64.242424\dots$$

$$-x = 0.642424\dots$$

$$99x = 63.600000$$

$$99x = 63.6$$

$$x = \frac{63.6 \times 10}{99 \times 10}$$

$$x = \frac{636}{990} = \frac{212}{330}$$

$$x = \frac{106}{165}$$

- (b) Evaluate $\left(\frac{1}{36}\right)^{-\frac{1}{2}}$. [2]

$$\left(\frac{1}{36}\right)^{-\frac{1}{2}}$$

$$\left(\frac{36}{1}\right)^{\frac{1}{2}}$$

$$36^{\frac{1}{2}}$$

$$6^{2 \times \frac{1}{2}}$$

$$= 6^1 = \underline{\underline{6}}$$

$$\left(\frac{x}{y}\right)^{-a} = \left(\frac{y}{x}\right)^a$$

$$36 = 6^2$$



16. You are given that $p = \sqrt{40}$ and $q = \sqrt{10}$.
Circle the correct answer in each of the following:

(a) p is equal to

[1]

$10\sqrt{4}$

$4\sqrt{10}$

$10\sqrt{2}$

$2\sqrt{10}$

20

$$p = \sqrt{40} = \sqrt{4 \times 10} = \sqrt{4} \times \sqrt{10} = \underline{\underline{2\sqrt{10}}}$$

(b) pq is equal to

[1]

$10\sqrt{40}$

$40\sqrt{10}$

400

200

20

$$pq = p \times q = \sqrt{40} \times \sqrt{10} = \sqrt{40 \times 10} = \sqrt{400}$$

$$pq = \sqrt{400} = 20$$

(c) q^5 is equal to

[1]

$100\sqrt{10}$

$5\sqrt{10}$

$\sqrt{50}$

625

$10\sqrt{100}$

$$q^5 = (\sqrt{10})^5$$

$$\sqrt{10^5} = \sqrt{10 \times 10 \times 10 \times 10 \times 10}$$

$$\sqrt{10 \times 10} \times \sqrt{10 \times 10} \times \sqrt{10}$$

$\sqrt{100}$

$$10 \times 10 \times \sqrt{10}$$

$$\underline{\underline{100\sqrt{10}}}$$



17. Simplify $\frac{12x+16}{9x^2-16}$.

[4]

$$\frac{12x+16}{9x^2-16}$$

$$\frac{4(\cancel{3x+4})}{(\cancel{3x+4})(3x-4)}$$

$$= \frac{4}{\underline{3x-4}}$$

$$9x^2-16$$

$$(3x)^2-(4)^2$$

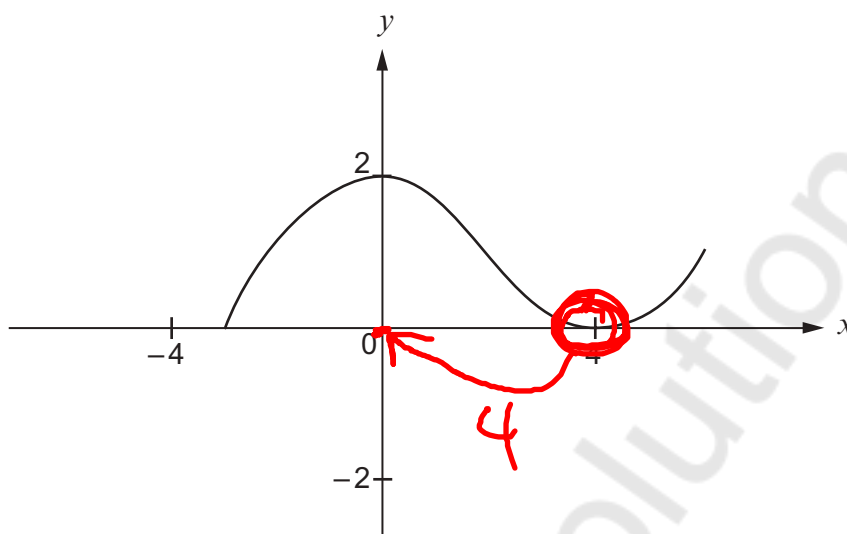
Difference of two
square

$$x^2-y^2 = (x+y)(x-y)$$

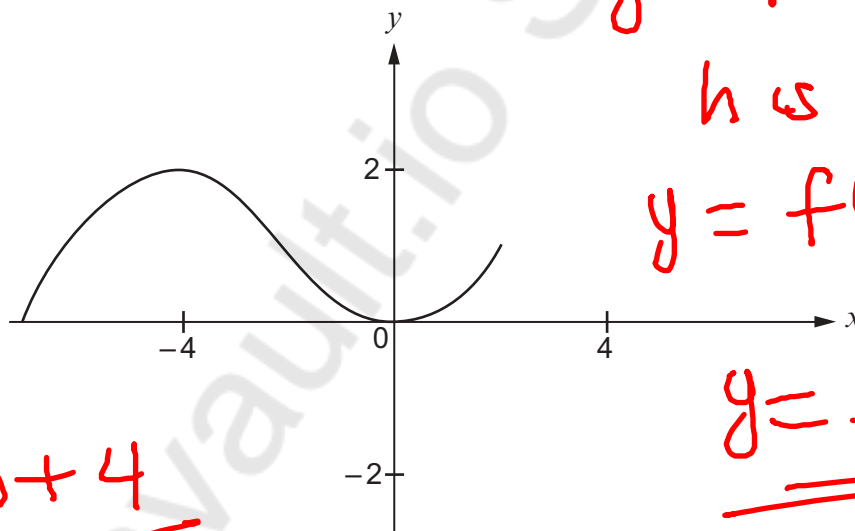
$$(3x)^2-(4)^2 = (\underline{3x+4})(\underline{3x-4})$$



18. The following diagram shows a sketch of the curve $y = f(x)$.



The curve is transformed, as shown below.



$y = f(x - h)$

h is negative

$y = f(x + h)$

$y = f(x + 4)$

$f(x) + 4$

Using function notation, complete the following to give the equation of the transformed curve. [1]

The equation of the transformed curve is

$y = f(x + 4)$

$k > 0$

$k < 0$

$y = a f(bx - h) + k$

a, b, h, k

$h > 0$, the graph will shift to the right hand side

$h < 0$, the graph will shift to the left hand side

Turn over.



19.



Two of the cards shown above are selected at random, without being replaced.

Find the probability that

(a) the product of the two numbers selected is 12, [3]

Two card selected

$2 \times 3 = 6$

$3 \times 2 = 6$

$3 \times 2 = 6$

$2 \times 2 = 6$

$2 \times 3 = 6$

$3 \times 3 = 9$

$3 \times 3 = 9$

$4 \times 3 = 12$

$3 \times 4 = 12$

$2 \times 4 = 8$

$3 \times 4 = 12$

$3 \times 4 = 12$

$4 \times 3 = 12$

$3 \times 4 = 12$

$2 \times 4 = 8$

$3 \times 4 = 12$

$3 \times 4 = 12$

$4 \times 4 = 16$

$2 \times 4 = 8$

$3 \times 4 = 12$

$3 \times 4 = 12$

$4 \times 4 = 16$

$$\text{Pr}(\text{product of } 12) = \frac{12}{30} = \frac{2}{5}$$

(b) the sum of the two numbers selected is even. [4]

$$\text{Pr}(\text{sum of two number is even}) = \frac{14}{30}$$

$$= \frac{7}{15}$$

$$\frac{7}{15}$$

END OF PAPER



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