

Grade 12 Mathematics

Paper 1 Revision Workshop

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NAME: _____

ALGEBRA – expressions, equations, inequalities and nature of roots

1. Simplify, giving answers with positive exponents and rational denominators where applicable.

A calculator may **not** be used.

a.
$$\frac{(a^2b^3)^{-1} \times ab^4}{a^{-4}b}$$

b.
$$\left(\frac{1}{2}\right)^{x-1} (\sqrt{2})^{2x-1}$$

c.
$$\frac{9^x - 3^{2x+1}}{3^{2x-1}}$$

d.
$$\frac{12^{x+1} \times 18^x}{8^{x+1} \times 27^{x-1}}$$



2. Solve for x without using a calculator (other than to evaluate logs):

a. $8^{2x+3} = 32^{x+1}$

b. $3^{x+2} - 3^x = 72$

c. $ax^{\frac{p}{c}} + b = g$

d. $\frac{a}{x} + b = c$

e. $x^2 - x < 12$

f. $\log_2(x+6) = 3$

g. $2x^2 - 3x - 5 = 0$ by completing the square



h. $\sqrt{x-2} + 4 = x$

i. $3(2^x) - 17 + 10(2^{1-x}) = 0$

j. $2x^4 + 5x^3 - x^2 - 6x = 0$

k. $3x - 2y = 17$ and $4x + 5y = -8$

3. Without solving discuss the nature of the roots of:

a. $2x^2 + 5x = 3$

b. $x(x + 2) = 7$



4. Find k if:

a. $x^2 + kx + 9 = 0$ has equal roots

b. $kx^2 + 2x + 5 = 0$ has real, unequal roots

c. $x^2 + kx + \frac{k}{2} = -2$ has no real roots

5. Prove that the equation $x^2 + kx + k - 3 = 0$ has real roots for all values of k



Sequences and Series

1. Determine, showing working:

a. T_{20} of $2 ; 6 ; 10 ; 14 ; \dots$

b. S_{30} of $3 ; 4\frac{1}{2} ; 6 ; 7\frac{1}{2} ; \dots$

2. Determine k if $\sum_{i=4}^{23} (ki-2) = 1\,310$ showing all working details.

3. Which is the first term to exceed 20 000 000 in the sequence:

$6 ; 9 ; 13\frac{1}{2} ; 20\frac{1}{4} ; \dots$



4. An arithmetic sequence has $T_9 = 13$ and $S_{10} = 60$. Find the first three terms.
5. Which term in the sequence $-1 ; 6 ; 17 ; 32 ; \dots$ is equal to 899?
6. Find p if:
- $2p + 3 ; 4p + 2$ and $5p + 3$ are consecutive terms of an arithmetic sequence.
 - $3p + 1 ; 2p + 4$ and $p + 8$ are consecutive terms of a geometric sequence.
 - $p - 1 ; 2p - 1 ; 4p - 2$ and $5p$ are consecutive terms of a quadratic progression.

7. A radioactive substance weighing 8 kg loses 9% of its mass each week. After how many weeks will it first weigh less than a kilogram?

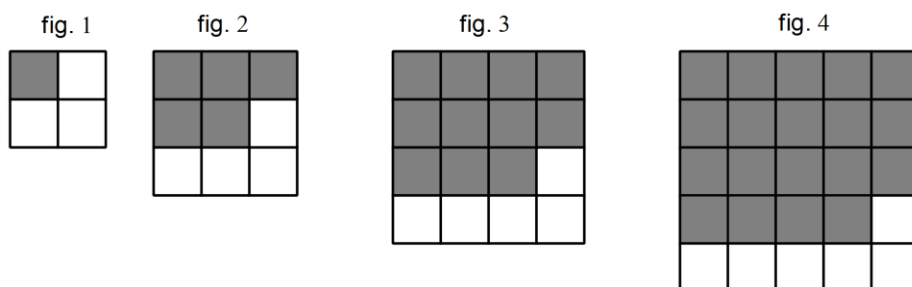


8. A tree grows 2 m in its first year. Each year thereafter it grows by 20% of the amount it grew the year before. What is the maximum height it will ever reach?



9. For what value(s) of k will $\sum_{i=1}^{\infty} (2k + 3)^i$ converge?

10. How many shaded squares are there in figure 25?



Financial Mathematics

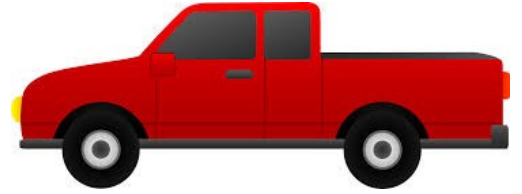
1. Convert a rate of 10% p.a. compounded monthly to an effective annual rate. Express your answer as a percentage to 2 d.p. e.g., 10,15%
2. What annual rate compounded quarterly will achieve the same return as 10% p.a.? Express your answer as a percentage to 2 d.p. e.g. 9,45%
3. If inflation is 6% p.a. then calculate, to the nearest year, how long it will take for an item to double in price.
4. A man deposits x . Two years later he deposits a further x . A year later he withdraws x . Five years after his initial deposit he has R10 000. Find x to the nearest cent if interest was paid at 10% p.a. compounded monthly for the first year and then at 12% p.a. compounded quarterly thereafter.



5. Dali deposits R300 per month into an account paying 10% p.a. compounded monthly. He makes 60 payments. How much money does he have in the account 4 months after making his last payment?
6. Jason borrows R200 000. He repays it monthly over 4 years starting 1 month from the date of the loan. Interest is charged at 12% p.a. compounded monthly. Calculate his monthly repayment.
7. Jordyn borrows R1 000 000 to buy a house. He repays it with monthly payments of R15 000 per month starting one month from the date of the loan. Interest is charged at 10% p.a. compounded monthly.
- a. How long will it take him to repay the loan?
- b. How much does he still owe after his 30th payment?



8. George buys a new bakkie for his company. It costs R750 000. He plans to keep it for 5 years after which he will trade it in for its depreciated value. The bakkie will depreciate at 15% p.a. while inflation is expected to average 5,7% over the next 5 years. George plans to set up a sinking fund paying 9% p.a. compounded monthly. How much should he invest each month to be able to replace his bakkie at the end of the five-year period?



Calculus

1. Determine the following derivatives by first principles. Pay careful attention to notation:

a. $f(x) = -x^2 + 3x$

b. $f(x) = (x + 1)^2$

2. Determine the following derivatives paying careful attention to notation:

a. $y = \left(x - \frac{1}{x}\right)^2$

b. $f(x) = \frac{x^3 - 8}{2x - 4}$

c. $\frac{d}{dx} \left[\frac{5}{x^2} + \sqrt[3]{x^4} + \sqrt{5} \right]$

d. $D_x \left[\frac{x^3 + 6x}{3x^2} \right]$

3. Determine whether the given function is increasing, decreasing or stationary at the given value:

a. $f(x) = 2x^3 + x^2 - 8x - 4$ at $x = 1$

b. $f(x) = 2x^3 + 7x^2 - 9$ at $x = -1$



4. For what value(s) of x is:

a. $y = x^3 + 4x^2 - 11x - 30$ increasing?

b. $f(x) = 3x^3 + 16x^2 + 23x + 6$?
concave down

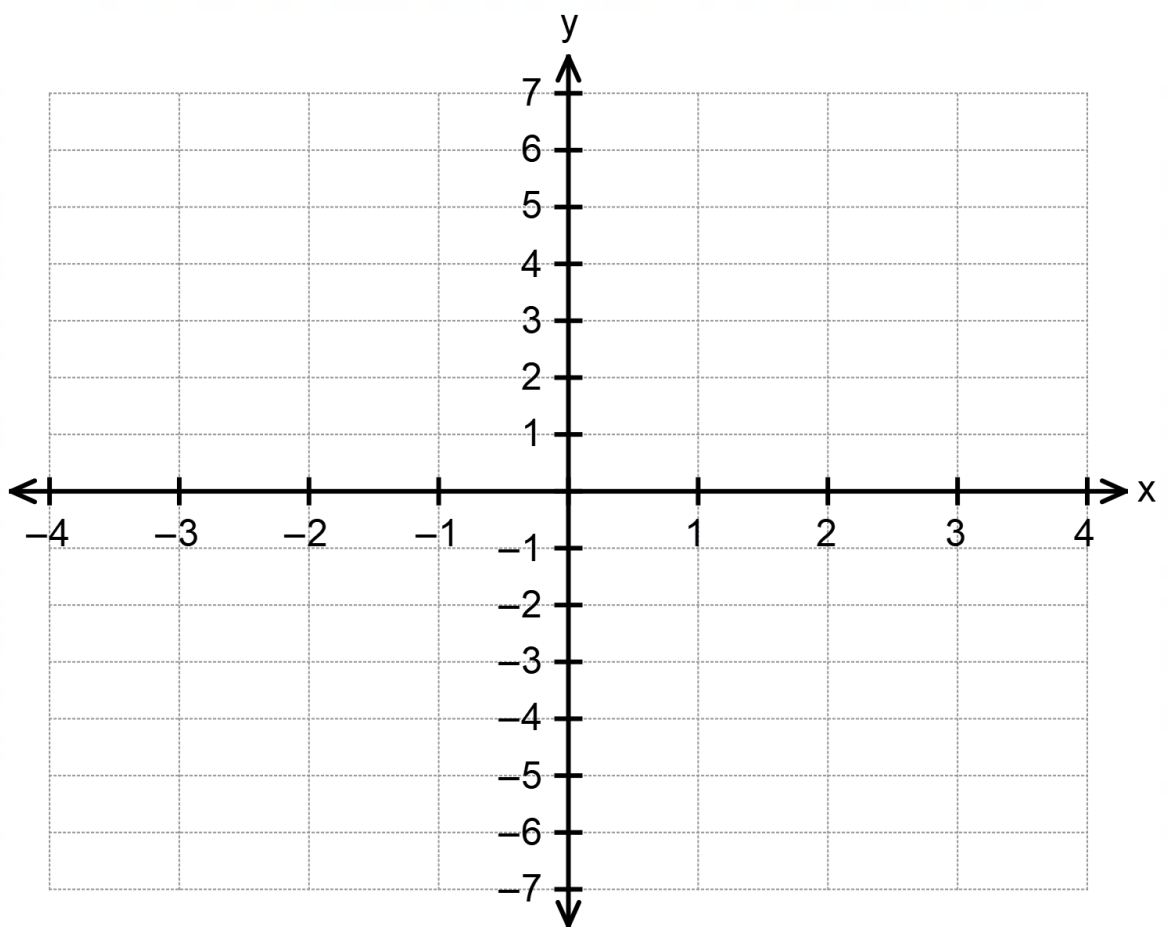
5. Find the equation of the tangent to:

a. $y = x^2 + 5x - 3$ at the point where $x = 2$

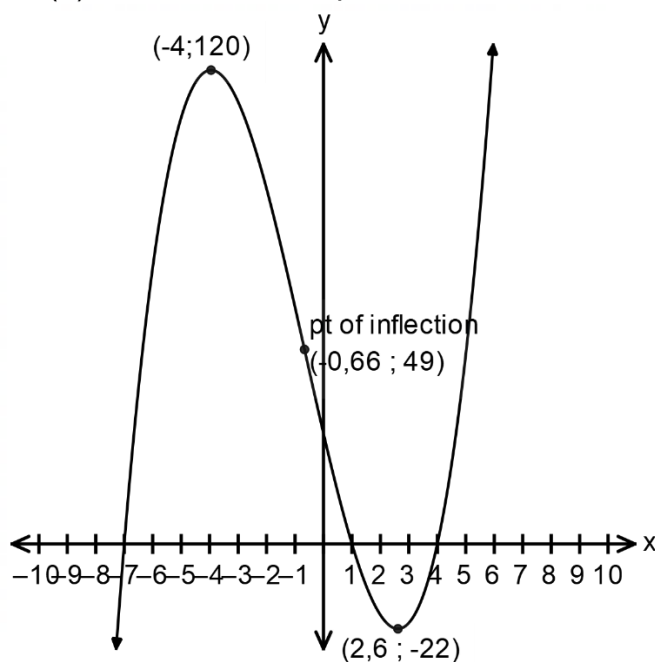
b. $y = x^2 - 5$ which is perpendicular to the line $4y + x = 8$



6. Sketch $y = 6x^3 + 5x^2 - 8x - 3$ on the axes provided, showing all points of interest.



7. Find the point of inflection of $y = x^3 + 6x^2 - 8x + 13$
8. The function $y = ax^2 + bx - 2$ has a gradient of 9 at the point (3;7). Find a and b .
9. Consider the function $f(x)$ and answer the questions which follow:



Give all value(s) of x for which:

- a. $f(x) < 0$
- b. $f'(x) \geq 0$
- c. $f(x) \cdot f'(x) \geq 0$
- d. $f'(x)f''(x) \leq 0$

10. A fruit farmer has 300 apple trees each of which has 70 apples. Presently each apple can sell for 50c, but the price will increase by 10c per apple per week. Each week each tree loses 2 apples.



- a. What is the crop presently worth?
- b. What will the crop be worth in t weeks' time?
- c. At what point should the farmer harvest his crop to maximise his profit?
- d. What is the maximum profit?

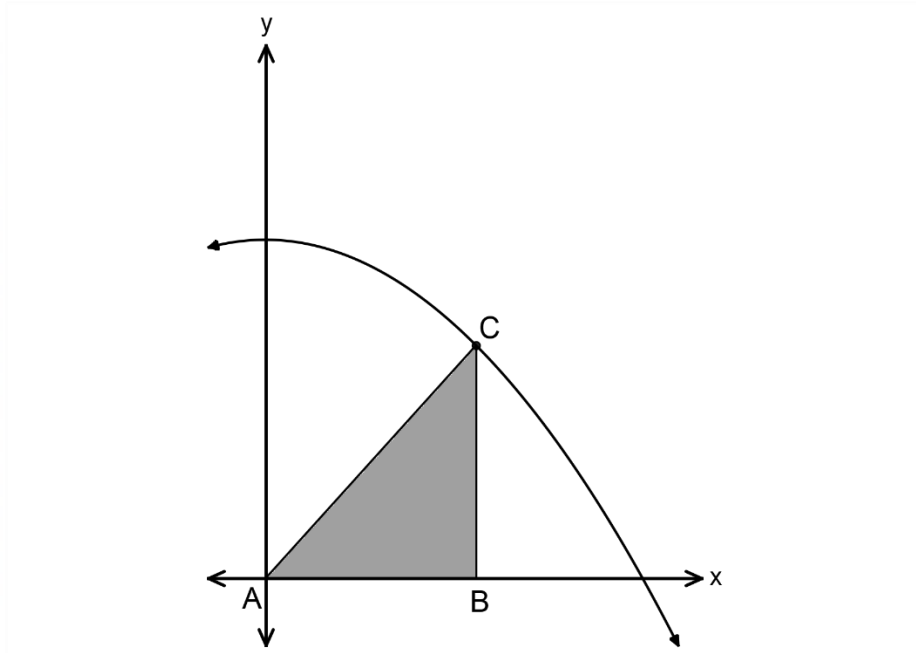
11. A boy has a 100 cm piece of rope. He cuts it into two pieces and forms a square and a circle.



- a. Suppose the sides of the square are x . Find the area of both shapes in terms of x
- b. Find the value of x that will **minimize** the total area enclosed by the two shapes. Give your answer to the nearest cm.



12. A right-angled triangle has one vertex on the origin and the other on the function $f(x) = -0,1x^2 + 8$ as shown.



- If B has coordinates $(x;0)$ then give the coordinates of C in terms of x .
- Hence, or otherwise, find the area of $\triangle ABC$ in terms of x .
- Find the value of x which will give the maximum area.
- Give the maximum area.

Functions and Inverses

1. For each of the following say, with justification, whether we have a function.

a. $(-2;5) (1;3) (7;8) (1;5) (9;11)$

b. $g(x) = \pm\sqrt{x+4}$

c. $(-3;1) (2;5) (4;1) (5;6) (7;9)$

d. $y = \sin x$

2. Give the domain and range of each of the following functions:

a. $y = \frac{12}{x-4} + 3$

b. $y = \log_2(x+4)$

c. $y = 0,5^x - 9$

d. $y = -(x+4)^2 + 9$

3. Find the turning point and the range of the following functions by completing the square:

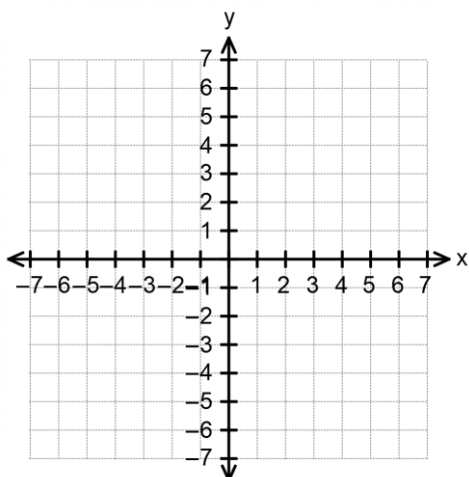
a. $y = x^2 + 6x + 11$

b. $y = x^2 + 5x - 6$

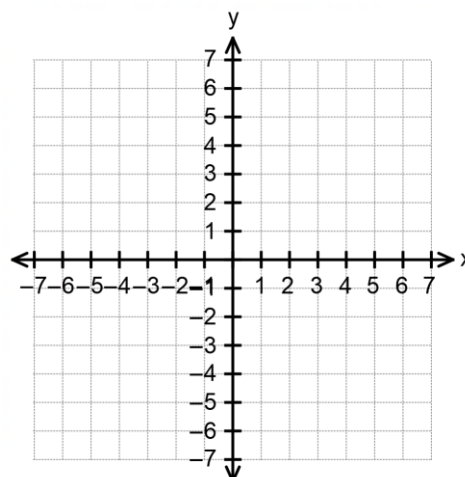


4. Draw graphs of the following functions showing all points of interest. Where there are asymptotes, they should be drawn (with dotted lines) and labelled.

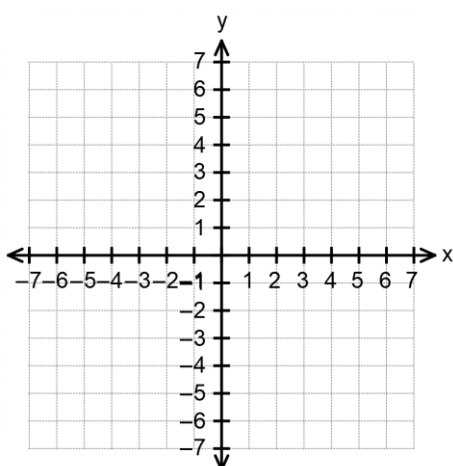
a. $y = -2x + 4$



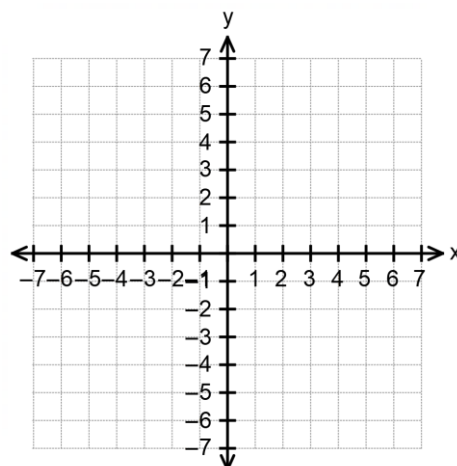
b. $y = 0,5^x - 4$



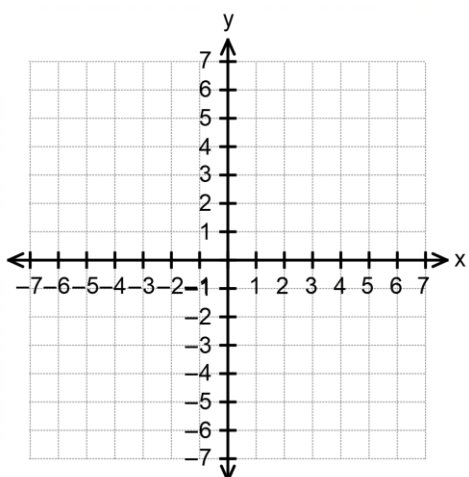
c. $y = \log_2(x + 4)$



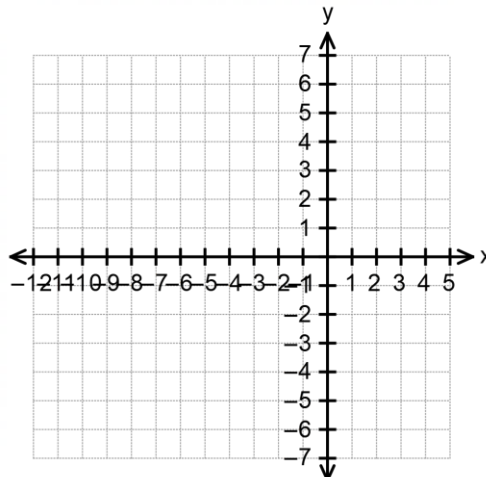
d. $y = x^2 - 5x + 6$



e. $y = -2 \times \left(\frac{1}{3}\right)^x + 6$



f. $y = \frac{-9}{x + 4} - 2$



5. Give, in standard form, the equation of the function which results when:

a. $y = x^2 + 3x - 5$
is shifted 3 left and 2 up

b. $y = 3^x + 5$
is reflected in the x-axis

c. $y = \frac{7}{x+3} - 2$
is reflected in the y-axis

d. $y = 3^x - 5$
is reflected in the line $y = x$

6. Find the inverses of the following functions in the form:

a. $f(x) = 3x - 5$

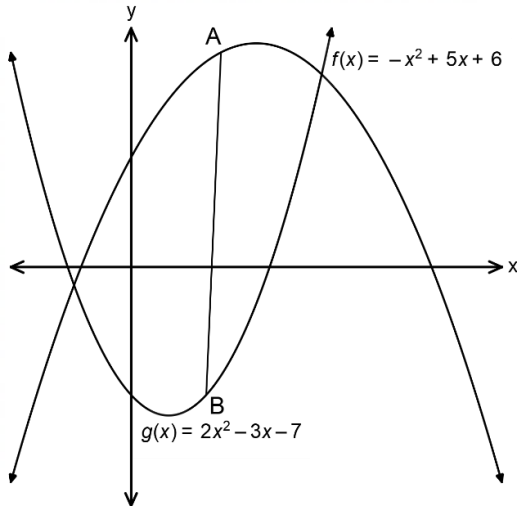
b. $f(x) = 2 \times 3^x + 6$

c. $f(x) = -\frac{3}{x-4} + 5$

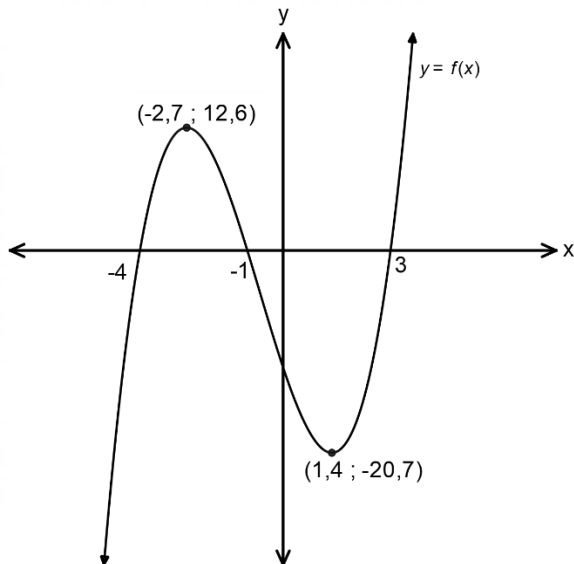
d. $f(x) = \log_2(x+3) - 5$



7. Consider the sketch below. AB is a vertical line with A on g and B on f . Find the maximum length of AB if it is on the interval where g exceeds f .



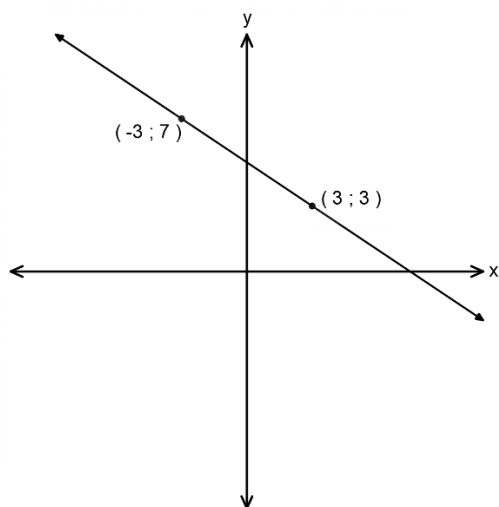
8. Consider the diagram below:



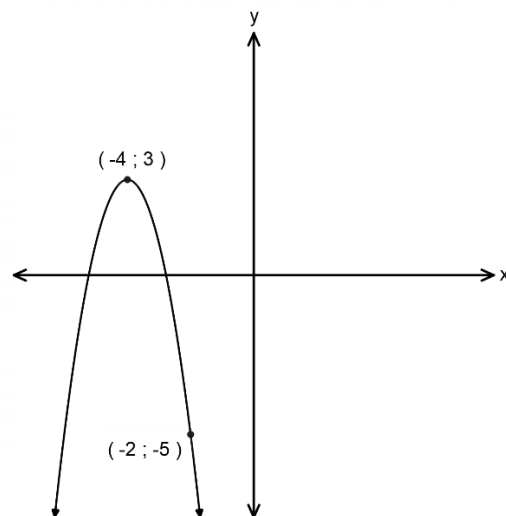
- For what value(s) of t will $f(x) + t = 0$ have exactly one root?
- For what value(s) of k if will $f(x + k) = 0$ have only positive roots?
- For what value(s) of t will $f(x) + t = 0$ have three distinct roots?
- For what value(s) of k if will $f(x + k) = 0$ have 3 roots of the same sign?

9. Find the equations of the following functions:

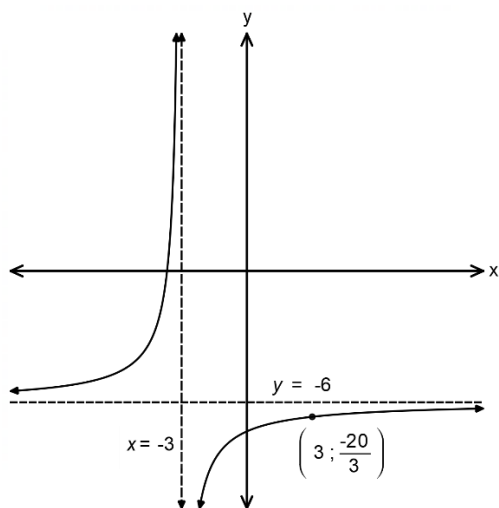
a.



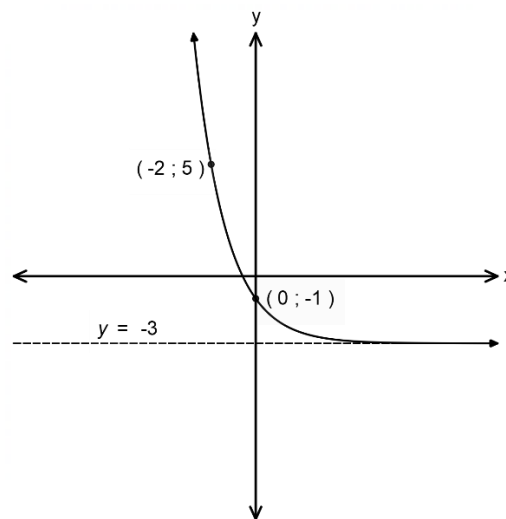
b.



c.



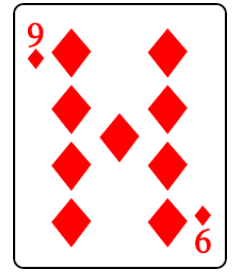
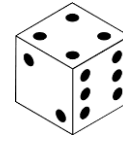
d.



Probability and Counting Techniques

1. I toss a die and I draw a card from a well shuffled pack. Determine of:

a. $P(\text{even on die and a spade})$



b. $P(<3 \text{ on die and a black card})$

c. $P(\text{even on die or a red card})$

d. $P(<3 \text{ on die or a diamond})$

2. Events A and B are such that $P(A) = 0,4$ and $P(B) = 0,5$ and $P(A \cap B) = 0,25$

a. Are A and B independent? Justify your answer.

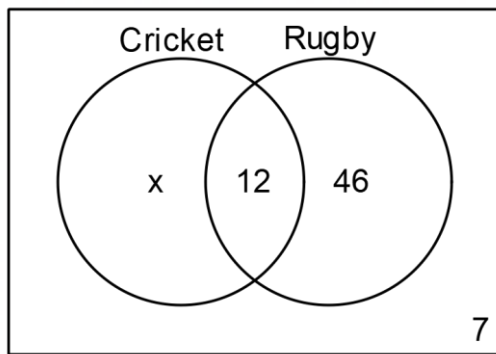
b. Are A and B mutually exclusive? Justify your answer.

c. Draw a venn diagram

d. Determine $P(A \cup B)$

e. Determine $P(A \cap \overline{B})$

3. Consider the venn diagram below:



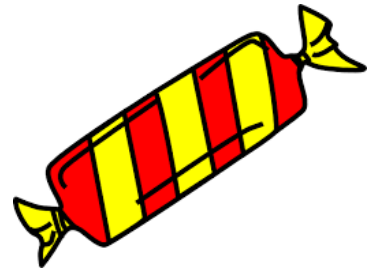
If $P(\text{cricket} \cap \overline{\text{rugby}}) = \frac{3}{16}$ then find x .

4. Complete the following table and then use it to determine whether “drinking coca cola” is dependent on gender. You must justify your answer with a calculation.

	Drink coke	Don't drink coke	Total
Male	45		
Female			45
Total	72		120



5. A bag contains 11 sweets, some of which are fizzers, and the rest are toffees. I eat two at random. If the probability that at least one is a fizzer is $\frac{52}{55}$ then how many fizzers were there?



6. Cameron and Abdul are playing a game with two dice. They take turns throwing the dice with Cameron starting. Whoever throws a double first is the winner. What is the probability that Cameron wins? Hint: draw a tree diagram.

Express your answer as a percentage to 1 d.p.

7. How many different number plates can I make with the following format:

3 alphabetic letters followed by 4 numeric digits.

- To prevent the occurrence of rude words, the five vowels are excluded.
- Letters may be repeated
- The numeric digits may not be repeated.

An example number plate is GRG 9341

How many different number plates are possible?



8. Consider the digits 5 , 7 , 2 , 6 and 3. Numbers are formed using some or all of the digits. There is only one of each digit – in other words digits cannot be repeated.

How many 3-digit numbers are possible?

How many numbers are possible altogether?

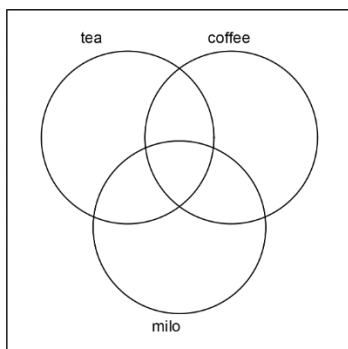
What is the probability that a randomly selected number is bigger than 4000?

9. Thirty people are asked about their preference of hot drinks (tea, coffee and milo). The results are as follows:

- 3 like all of the drinks
- 7 people like tea and coffee
- 5 people like coffee and milo
- 4 people like tea and milo
- 14 people like tea
- 14 people like coffee
- 13 people like milo



Draw a venn diagram and use it to answer the following questions:



- a. How many people drink none of the hot drinks?
- b. Calculate the following probabilities:
- $P(\text{tea} \cap \overline{\text{coffee}})$
 - $P(\text{coffee} \cup \text{milo})$

10. Three boys and five girls go to watch a soccer game. They are seated randomly in 8 adjacent seats. What is the probability that:
- a. The 3 boys are seated together?
 - b. The 5 girls are seated together?
 - c. The 3 boys are seated together, and the 5 girls are seated together?
11. How many different 8 letter “words” can be made using the letters NEEDLESS?

If one is chosen at random then what is the probability that it starts and ends with the same letter?



12. A bag contains 4 apples, 3 bananas and 2 pears. I randomly select two items and eat them.

Draw a tree diagram and use it to answer the questions which follow:



- a. $P(\text{at least one apple})$
- b. $P(\text{an apple and a banana in any order})$

13. I have 10 shirts. Three have short sleeves and are identical. Two others have short sleeves but are different from one another and different to the other two. The remaining five shirts have long sleeves.



- a. In how many different ways can the shirts be arranged?
- b. What is the probability that the short-sleeved shirts end up together?