Please paste the barcoded label here	TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2024

MATHEMATICS: PAPER I

EXAMINATION NUMBER													

Time: 3 hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 30 pages and an Information Sheet of 2 pages (i–ii). Please check that your question paper is complete.
2. Read the questions carefully.
3. **Answer all the questions on the question paper and hand this in at the end of the examination. Remember to write your examination number in the space provided.**
4. Write your answers in the spaces provided.
5. You may use an approved non-programmable and non-graphical calculator unless otherwise stated.
6. Clearly show **ALL** calculations, diagrams, graphs, etc. that you have used to determine your answers. **Answers only will NOT necessarily be awarded full marks.**
7. Diagrams are not necessarily drawn to scale.
8. If necessary, round off answers to **TWO** decimal places, unless otherwise stated.
9. It is in your own interest to write legibly and to present your work neatly.
10. Two blank pages (page 28 and 29) and an extra graph (page 30) are included at the end of the paper. If you run out of space for a question, use these pages. Clearly indicate the number of your answer should you use this extra space.

FOR OFFICE USE ONLY: MARKER TO ENTER MARKS

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	TOTAL
13	14	20	6	10	12	8	18	19	9	7	14	/150

SECTION A

QUESTION 1

(a) Solve for x.

(1) $\left(\frac{x}{4}-1\right)(x+2)=0$

(2)

(2) Use the formula $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$, to solve for x if $2x^2-x=12$.
Show all working.

(4)

(3) Solve for x if: $x^2 + 2x \leq 0$.

(3)

(b) Determine the value(s) of k for which the roots of $x\left(\frac{1}{2}x + 2\right) = -k^2$ are equal.

(4)
[13]

QUESTION 2

(a) Solve for x, in terms of y, if $3^{x+2y} = \frac{9^{3y}}{27}$.

(3)

(b) Solve for x if $\sqrt{x+8} - x = 2$.

(5)

(c) If $\log 6 = x$ and $\log 3 = y$ determine the value of each of the following in terms of x and y.

(1) $\log 18$ (2)

(2) $\log \sqrt{3}$ (2)

(3) $\log 2$ (2)

[14]

QUESTION 3

(a) Using first principles, find $f'(x)$ if $f(x) = x^2 + 1$.

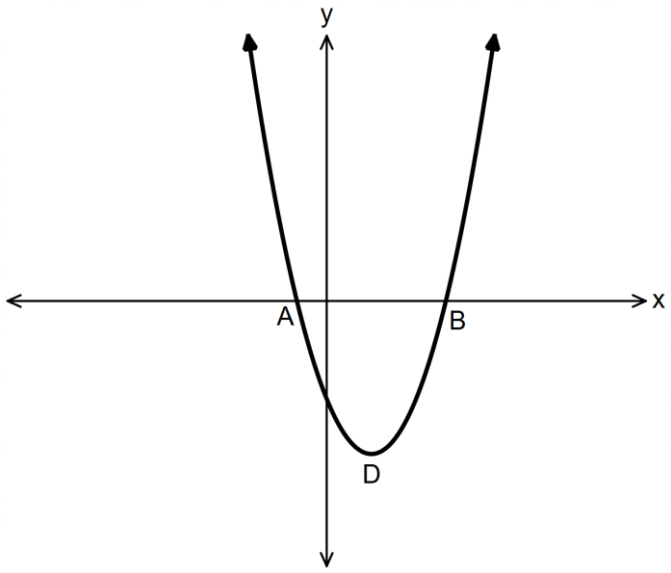
(5)

(b) Find $f'(x)$, if $f(x) = 2x^4 + \frac{1}{\sqrt[4]{x}} - 4$.

(4)

(c) In the diagram below:

- $f(x) = x^2 - 3x - 4$
- A and B are *x*-intercepts of *f.*
- D is the turning point of *f.*



(1) Determine the coordinates of A and B.

(3)

(2) Determine the coordinates of D.

(3)

(3) For which values of x will the gradient of the tangent to f be negative?

(1)

(4) Find all the values of x for which the gradient of the tangent to f will be parallel to the line $y = -4x + 4$.

(4)
[20]

QUESTION 4

(a) Given that $5x-1$, $3x+1$ and $2x$ are the first three terms of an arithmetic sequence.

Find the numerical values of the first three terms of the sequence.

(4)

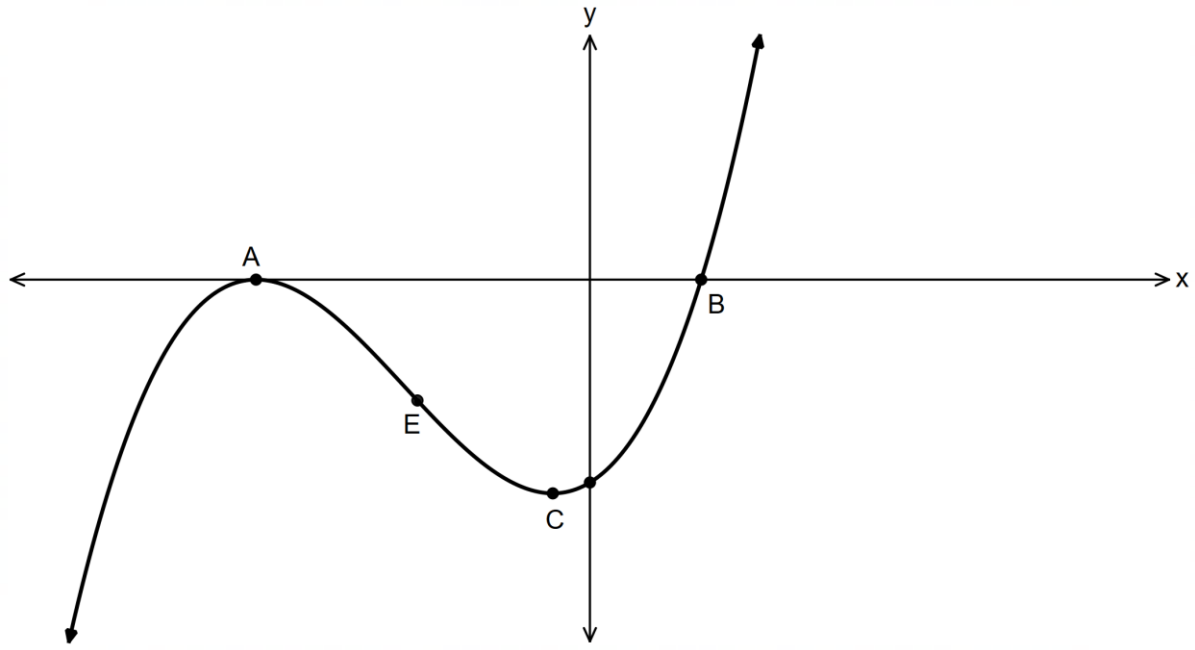
(b) Write down the n^{th} term of the sequence.

(2)
[6]

QUESTION 5

In the diagram below:

- $f(x) = x^3 + px^2 + 3x - 9$.
- A and C are the turning points of f.
- A and B are the x-intercepts.
- $\mathrm{E}\left(-\frac{5}{3};\ y\right)$ is the point of inflection.



(a) Determine the value of p.

(4)

(b) If $p = 5$ then:

(1) Calculate the coordinates of the turning point at C.

(4)

(2) Calculate the x-coordinate of B.

(2)
[10]

QUESTION 6

Give your answer correct to two decimal places.

(a) An amount of money was invested, at a rate of 6% p.a. compounded quarterly. Calculate the effective interest rate % per annum of the investment.

(3)

(b) Masego buys a flat for R940 000. She pays a 25% deposit and secures a loan for the balance, to be repaid in equal monthly instalments over a period of 20 years.

(1) If interest is calculated at 11,25% p.a. compounded monthly, what will her monthly instalment be, if payments start 1 month after the loan is granted and continue for the full 20 years?

(4)

(2) After 11 years, Masego has some financial problems and is unable to continue to pay her original instalments. Calculate the balance outstanding on Masego's loan immediately after she has made her payment at the end of the 11^{th} year.

(5)
[12]

75 marks

SECTION B

QUESTION 7

The first five terms of a quadratic sequence are given:

$$3 ; 9 ; 17 ; 27 ; 39 ; \ldots$$

(a) Determine the n^{th} term of the sequence.

(4)

(b) Tlhogi claims that 161 is a term of the sequence. Show if Tlhogi is correct or not.

(4)
[8]

QUESTION 8

(a) Given: $\sum_{n=0}^{\infty}\left(\frac{x+2}{2}\right)^n$

(1) Write down an expression for the sum of the first three terms.

(2)

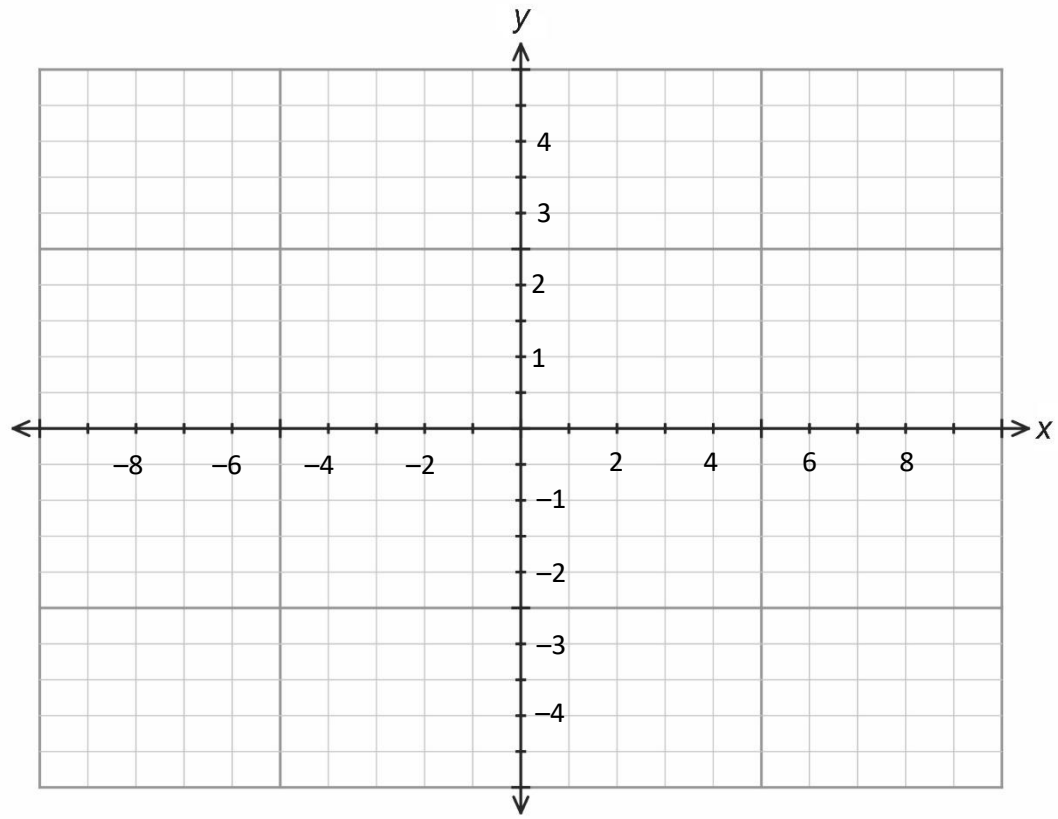
(2) For which values of x will the given sum to infinity converge?

(3)

(3) If the sum converges find $\sum_{n=0}^{\infty}\left(\frac{x+2}{2}\right)^n$ in terms of x.
Simplify your answer.

(3)

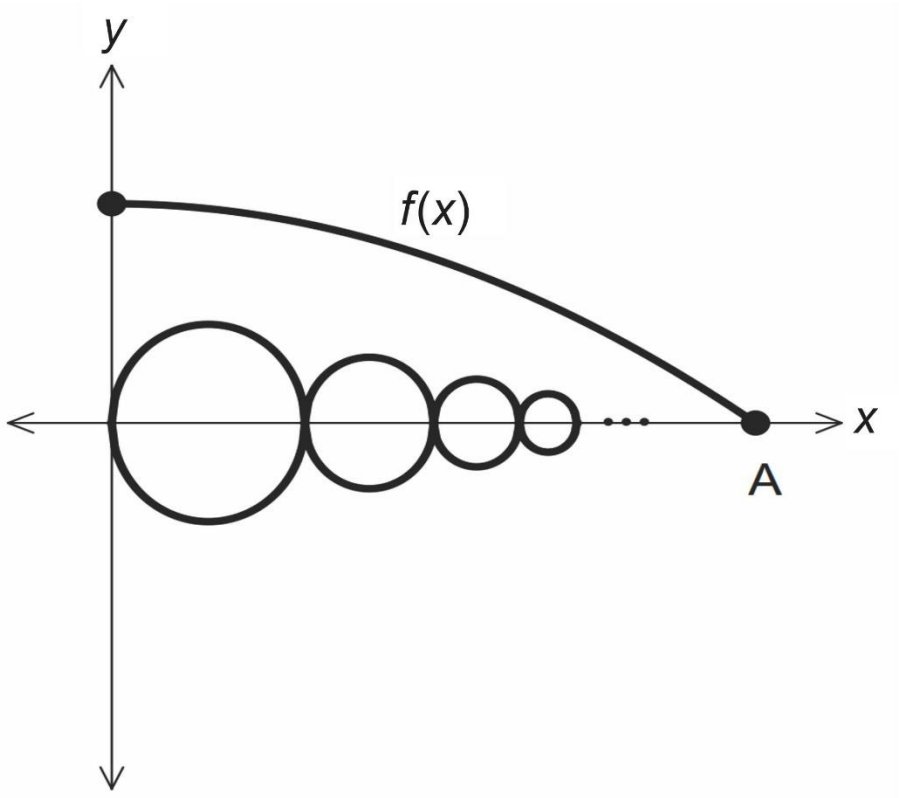
(4) If $f(x)=\sum_{n=0}^{\infty}\left(\frac{x+2}{2}\right)^n$, sketch the graph of $y = f(x)$.



(3)

(b) In the diagram below, a number of touching circles, with their centres placed along the *x*-axis are drawn.

- The left-most circle, with an area of 324π, touches the *y*-axis at the origin.
- The radius of the second circle is two-thirds of the radius of the first circle, the third circle's radius is two-thirds of the second circle, and so on, forming a sequence of circles.
- $f(x) = -\frac{20}{11449}x^2 + 20$ is drawn for $0 \leq x \leq a$ where $A(a; 0)$ is a point on the *x*-axis.



(1) Determine *a.*

(2)

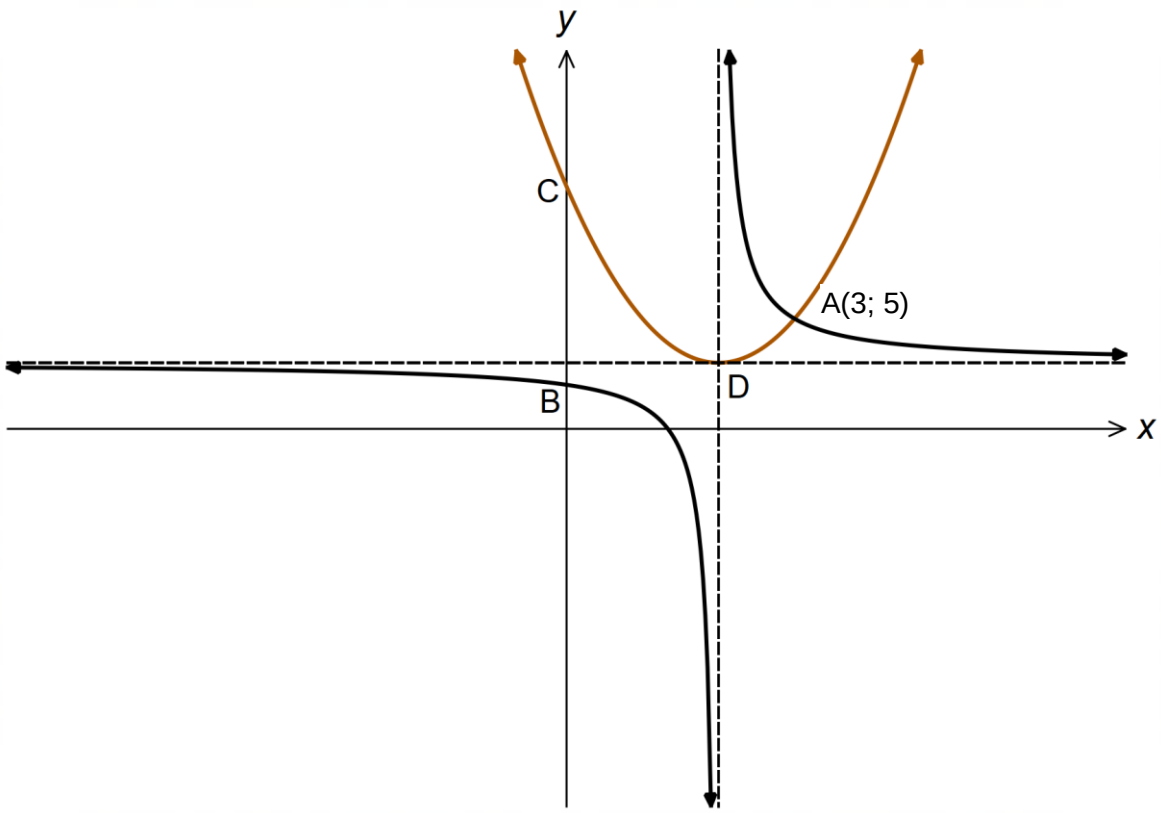
(2) If circles are drawn touching each other as shown above, determine the maximum number of circles that can be drawn if the row of circles does not go beyond point A.

(5)
[18]

QUESTION 9

(a) In the diagram below:

- $f(x)=a(x-p)^2+q$ and $g(x)=\frac{k}{x-2}+m$.
- The range of g is $y\in\mathbb{R}: y\neq 3$.
- D is the turning point of f and lies on both asymptotes of g.
- A(3; 5) is a point of intersection of f and g.
- B and C are y-intercepts.



(1) State the domain of g.

(1)

(2) Determine the values of a, p and q.

(3)

(3) Find the numerical length of BC.

(6)

(4) State the values of x for which $f(x).g(x) > 0$.

(4)

(b) Given that $h(x) = \log_k (x + m)$

- $h(4) = 0$
- $h^{-1}(-1) = \frac{31}{10}$

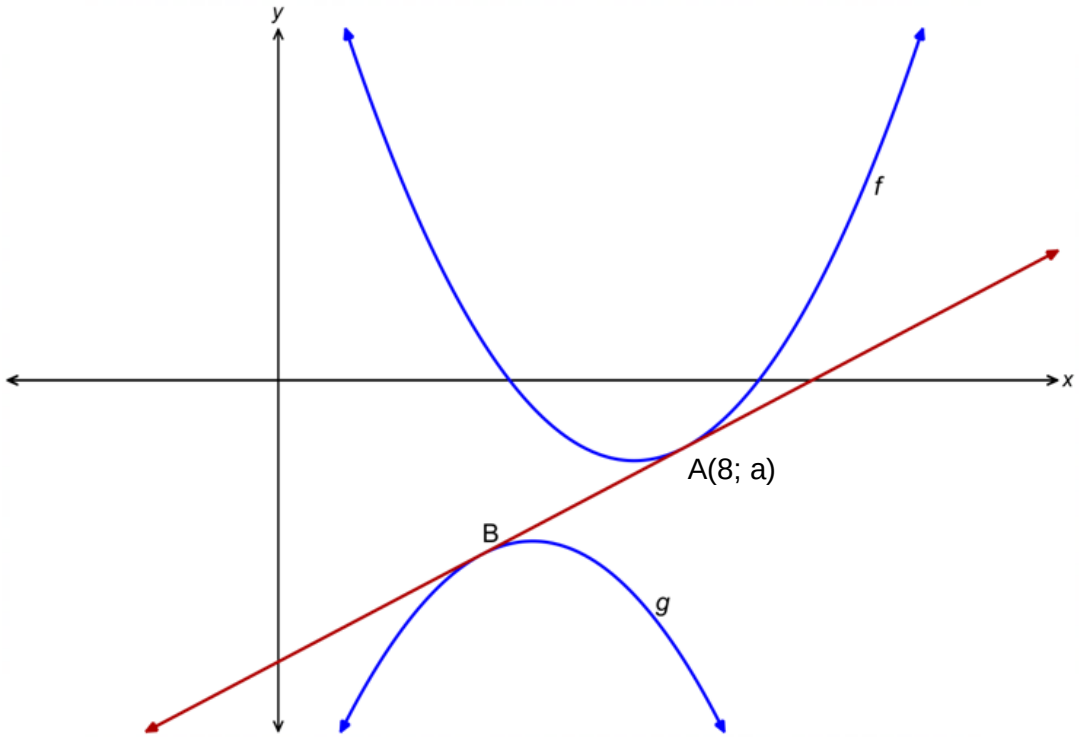
Determine the values(s) of m and k.

(5)
[19]

QUESTION 10

There are two functions represented by *f* and *g* with a common tangent at A(8; *a*) and B respectively in the diagram below.

- $f(x)=x^2-14x+43$
- $g(x)=-x^2+10x-19+k$



(a) Determine the equation of the common tangent.

(5)

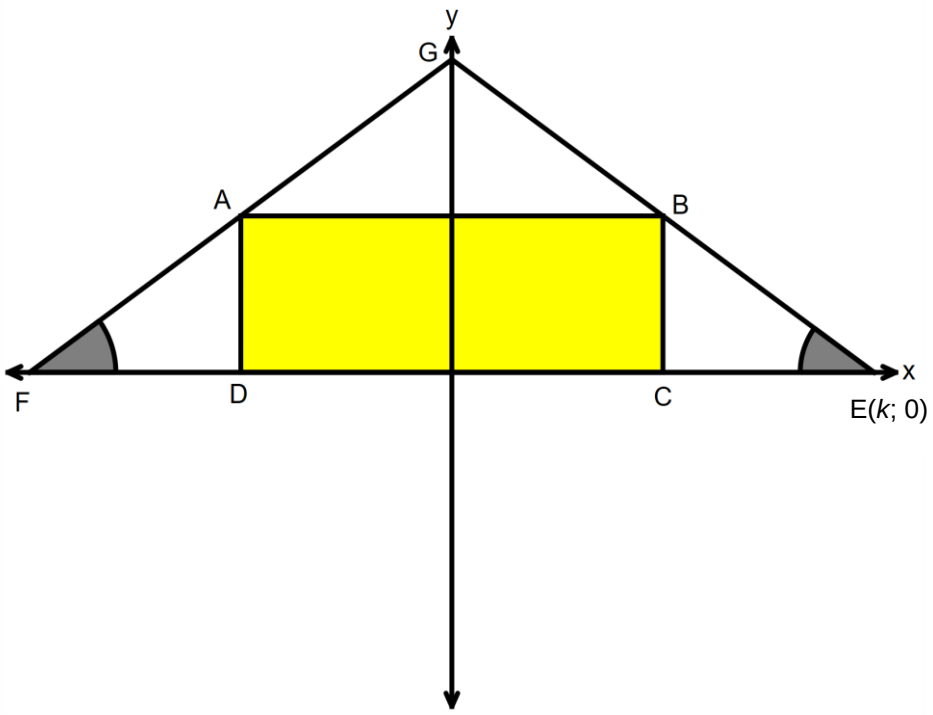
(b) Determine the value of k.

(4)
[9]

QUESTION 11

Given: Rectangle ABCD is placed inside an isosceles triangle GEF.

- A and B lie on the equal sides GF and GE of the triangle respectively.
- F, D, C and E(k; 0) lie on the x-axis.
- The height of the triangle GEF is a third of the length of its base FE.



Calculate the area of the largest possible rectangle ABCD in terms of k.

[7]

QUESTION 12

Every client of a certain bank has a personal identification number (PIN) which consists of four randomly chosen digits from 0 to 9.

(a) (1) How many unique four-digit PINs can be created, if repetition is **not** allowed?

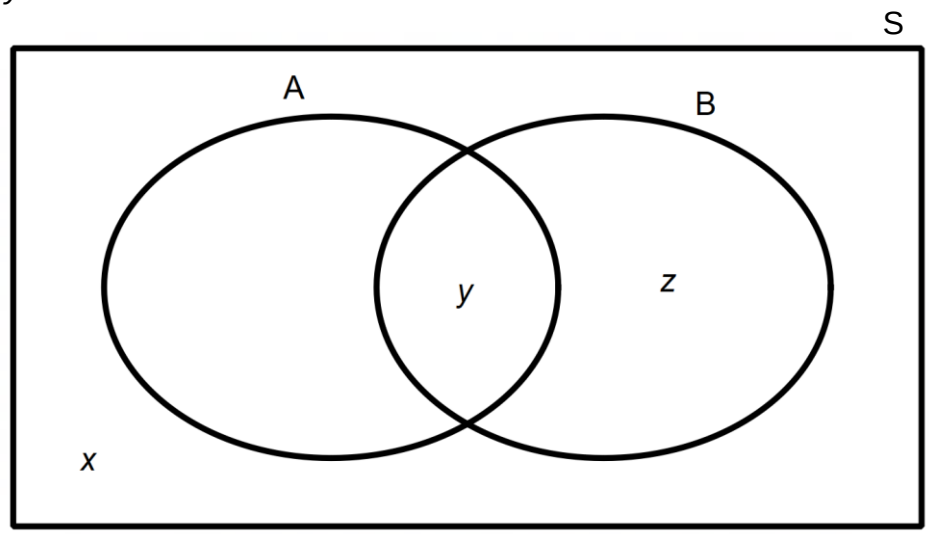
(2)

(2) If a PIN is made by selecting four digits at random, and repetition is allowed, what is the probability that the PINs include exactly two 9s?

(5)

(b) In the following Venn diagram below, A and B are two sets within a sample space S.

- $n(S) = 80$
- $n(B) = 20$ and $P(A) = \frac{1}{2}$
- $4P(B) = 5P(A \cap B)$
- x, y and z are the number of elements in each set.



Find the values of x, y and z.

(7)
[14]

75 marks

Total: 150 marks

ADDITIONAL SPACE (ALL QUESTIONS)

REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED.

EXTRA GRAPH

QUESTION 8 (a)(4)