BAULKHAM HILLS HS

PERSEVERE

2025 **PRELIMINARY HALF-YEARLY EXAMINATION**

Mathematics Extension 1

General Instructions	• Reading time – 10 minutes • Working time – 1 hour 30 minutes • Write using black pen • Calculators approved by NESA may be used • A reference sheet is provided at the back of this paper • For Questions 11 – 14, show relevant mathematical reasoning and/or calculations • Marks may be deducted for careless or poorly arranged work
Total marks: 55	**Section I – 10 marks** (pages 2 – 6) • Attempt Questions 1 – 10 • Allow about 15 minutes for this section **Section II – 45 marks** (pages 7 – 10) • Attempt Questions 11 – 14 • Allow about 1 hour and 15 minutes for this section

Section I

10 marks
Attempt Questions 1 – 10
Allow about 15 minutes for this section

Use the multiple-choice answer page in the writing booklet for Questions 1 – 10.

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1 A particular zoo looks after 15 giraffes and 8 elephants. For an upcoming guest attraction, the zoo wishes to put 6 giraffes and 3 elephants into an outdoor enclosure to be on display for their guests. If the animals are randomly chosen, in how many ways can this attraction be put together?

A. ${}^{23}C_9$

B. ${}^{23}P_9$

C. ${}^{15}C_6 \times {}^{8}C_3$

D. ${}^{15}C_6 + {}^{8}C_3$

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2 What is the domain of $y = \sqrt{x^2 - x - 2}$?

A. $x \le -1,\ x \ge 2$

B. $x \le -2,\ x \ge 1$

C. $-1 \le x \le 2$

D. $-2 \le x \le 1$

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3 From a group of n students, 3 students are randomly selected to answer a survey. It is known that there are somewhere between 100 and 150 different possible ways this random selection of students can be made. What is the value of n?

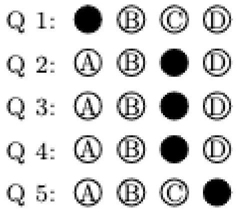
A. 5

B. 6

C. 9

D. 10

4 A particular test consists of 5 multiple-choice questions, each with 4 possible options. Every student who completed the test answered all 5 questions, each with 1 of the 4 possible options selected. The following shows one such response.



Which one of the following calculations gives the minimum number of students in the class if it is guaranteed that two students have given the same response for this particular test?

A. $4\times5+1$

B. 4^5+1

C. 5^4+1

D. $5!+1$

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5 Students from two different schools attend a prefect afternoon tea. Each of the two schools sent 5 student representatives. To facilitate conversation, these 10 students will be seated around a circular table so that no two students from the same school are seated next to one another. How many possible seating arrangements are there?

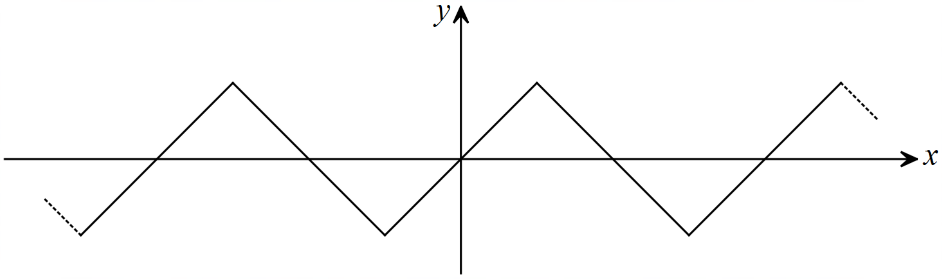
A. $5!\times5!$

B. $2\times5!\times5!$

C. $4!\times5!$

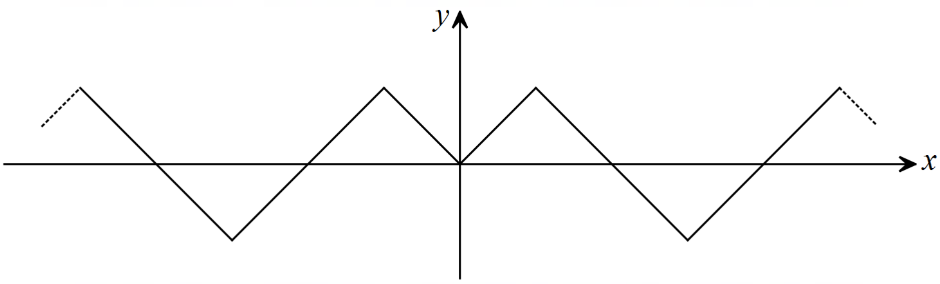
D. $2\times4!\times5!$

6 A portion of the graph of a function $f(x)$ is given below.

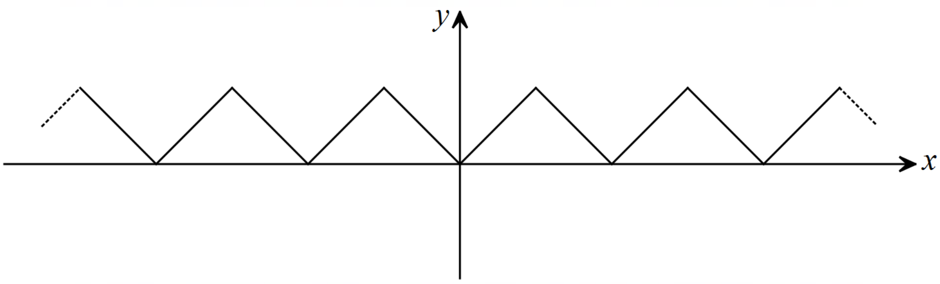


Which of the following best represents the graph of $|y| = f(|x|)$?

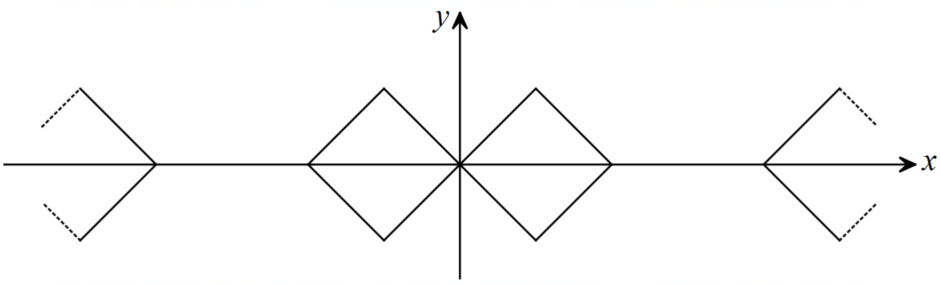
A.



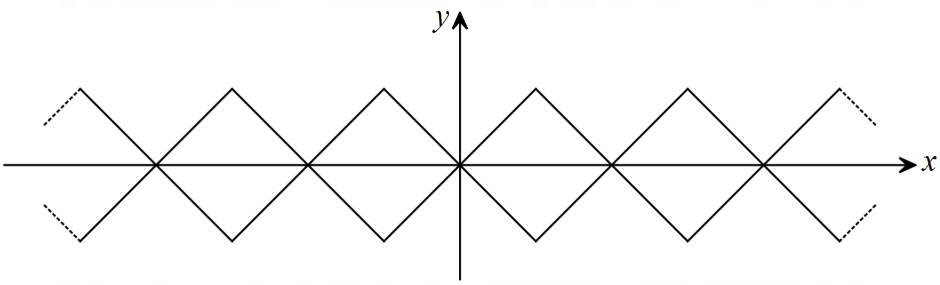
B.



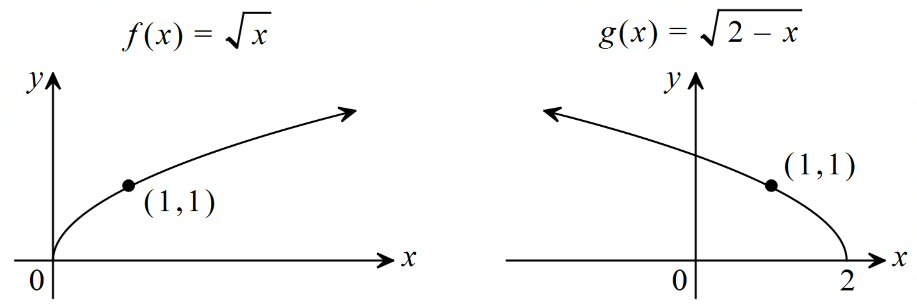
C.



D.



7 The graphs of $f(x)=\sqrt{x}$ and $g(x)=\sqrt{2-x}$ are given below.



What is the domain and range of the graph $y=f(x)+g(x)$?

A. Domain: All real x, range: $0\le y\le 2$.

B. Domain: All real x, range: $\sqrt{2}\le y\le 2$.

C. Domain: $0\le x\le 2$, range: $0\le y\le 2$.

D. Domain: $0\le x\le 2$, range: $\sqrt{2}\le y\le 2$.

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8 Given that $f(x)$ is an odd function with domain $x\in(-\infty,\infty)$ and $f(x)$ is not the zero function, which of the following **does not** represent an even function?

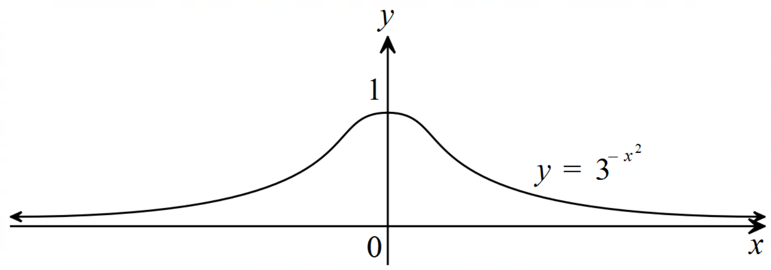
A. $|f(x)|$

B. $f(|x|)$

C. $\sqrt{f(x)}$

D. $[f(x)]^2$

9 The graph of $y = 3^{-x^2}$ is given below:



Which of the following statements is **incorrect**?

A. $3^{x^2} > 3^{-x^2}$ for all values of x except for $x = 0$.

B. $3^{-\frac{x^2}{2}} > 3^{-x^2}$ for all values of x except for $x = 0$.

C. $2 - 3^{-x^2} > 3^{-x^2}$ for all values of x except for $x = 0$.

D. $3^{-2x^2} > 3^{-x^2}$ for all values of x except for $x = 0$.

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10 A function f inputs integers x where $x = 1, 2, 3, \ldots, n-1, n$ and outputs integers y where $y = 1, 2, 3, \ldots, n-1, n$. If f is known to be a one-to-one function, how many such functions are possible?

A. n

B. n^2

C. n^n

D. $n!$

End of Section I

Section II

46 marks
Attempt Questions 11 – 14
Allow about 1 hour and 15 minutes for this section

Answer each question in the appropriate section of the writing booklet. Extra writing paper is available.

In Questions 11 – 14, your responses should include relevant mathematical reasoning and/or calculations.

Question 11 (12 marks) Use the Question 11 section of the writing booklet.

(a) Solve $\dfrac{3x-15}{x} \le 5-x$. **3**

(b) A parabola is defined parametrically by the following pair of equations with t as the parameter.

$$x = -4 - t$$
$$y = t^2 + 4t - 5$$

(i) Find the Cartesian equation of this parabola, expressing your answer in the form $y = (x-h)^2 + k$, where h and k are constants. **2**

(ii) Sketch the section of this parabola where $t \le 0$, showing the coordinates of vertex and any intercepts with the coordinate axes. **3**

(iii) For the parabolic section drawn in part (ii), state the largest possible domain to restrict it to such that its inverse is a function. **1**

(c) In how many ways can Jack, Jill and 4 other friends stand in a line if:

(i) there are no restrictions? **1**

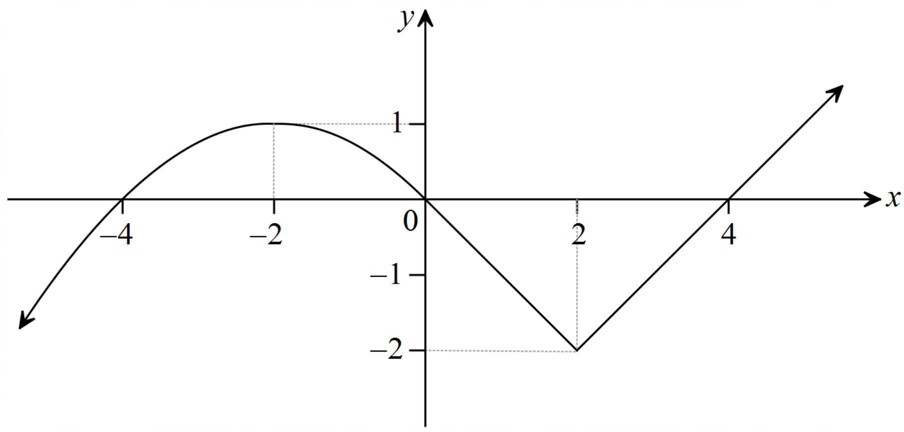
(ii) Jack and Jill want to stand together? **1**

(iii) Jack and Jill are at the ends of the line? **1**

End of Question 11

Question 12 (12 marks) Use the Question 12 section of the writing booklet.

(a) Consider the graph of $y = f(x)$ below.



On separate number planes, graph each of the following:

(i) $y = \dfrac{1}{f(x)}$ **2**

(ii) $y^2 = f(x)$ **2**

(iii) $y = f(-|x|)$ **2**

(iv) $y = x + f(x)$ **2**

(b) The letters A, E, I, O and U are vowels.

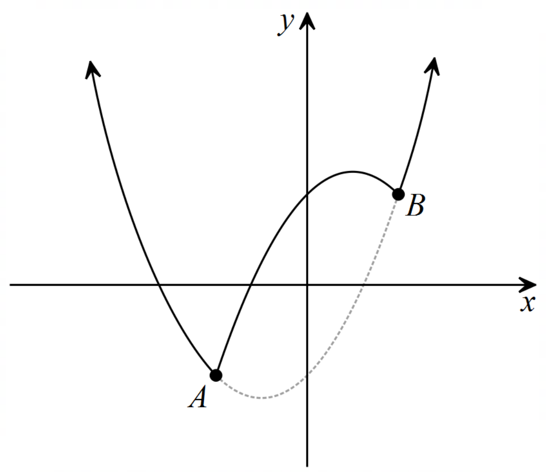
(i) How many arrangements of the letters in the word ISOMORPHISM are possible if it must start and end with the same vowel? **2**

(ii) How many arrangements of the letters in the word ISOMORPHISM are possible if the word PRISM appears as a string of consecutive letters within the arrangement? **2**

End of Question 12

Question 13 (11 marks) Use the Question 13 section of the writing booklet.

(a) The graph of $f(x) = 2x + |x^2 - 4|$ is shown below.



NOT DRAWN TO SCALE

(i) State the coordinates of A and B. **2**

(ii) Find the y-intercept of this graph. **1**

(iii) With the aid of the graph of $y = |f(x)|$, or otherwise, determine all solutions to the equation $\left| 2x + |x^2 - 4| \right| = 4$. **2**

(iv) For what value(s) of k would the equation $\left| 2x + |x^2 - 4| \right| = k$ have 4 distinct solutions? **2**

(b) A palindrome is a word that reads the same forwards as backwards. For example, the words MADAM and ABDDDBA are palindromic.

(i) Of all the possible 7-letter words formed using the standard 26 letters of the English alphabet, what is the probability that the 7-letter word formed is palindromic? **2**

(ii) Using the same construction, are there more 8-letter palindromic words compared to 7-letter palindromic words? Justify your answer with appropriate calculations and reasoning. **2**

End of Question 13

Question 14 (10 marks) Use the Question 14 section of the writing booklet.

(a) A positive number is to be formed using the digits 0, 2, 4, 6, 8. How many numbers are divisible by 3 and less than 1000 if:

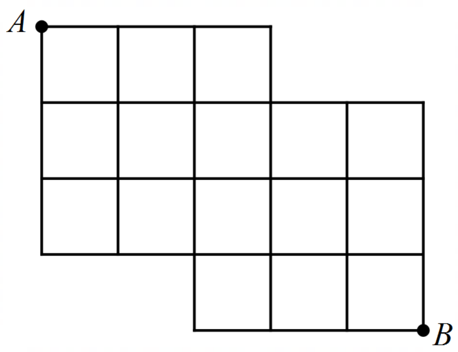
(i) each digit can only be used once? **2**

(ii) the digits can repeat? **2**

(b) Solve the following inequation involving combinations: **3**

$$^{n}C_2 + {}^{n+3}C_2 + {}^{n+6}C_2 < 72$$

(c) The diagram below shows an overlapping 3×3 grid network connecting point A to point B. One step on this grid is defined as walking along one side of a single small square. If you are only allowed to walk one step at a time to the right and downwards, how many different paths are possible to get from A to B? **3**



End of Paper

YEAR 11 ASSESSMENT TASK 1 2025
MATHEMATICS EXTENSION 1
MARKING GUIDELINES

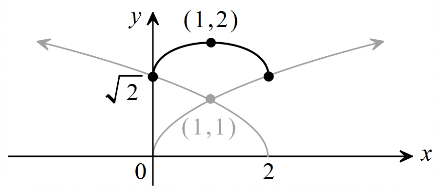
Section I

Multiple-choice Answer Key

Question	Answer
1	C
2	A
3	D
4	B
5	C

Question	Answer
6	C
7	D
8	C
9	D
10	D

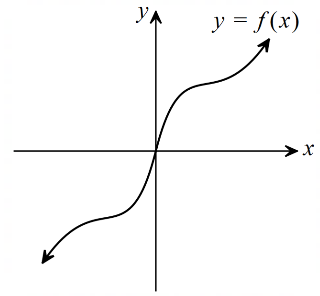
Questions 1 – 10

Answer and explanation		
1.	C. ${}^{15}C_6 \times {}^{8}C_3$	By the basic counting principle, there are ${}^{15}C_6$ ways of choosing the giraffes and ${}^{8}C_3$ ways of choosing the elephants.
2.	A. $x \le -1$, $x \ge 2$	The domain in question: $x^2 - x - 2 \ge 0$ $(x-2)(x+1) \ge 0$ $\therefore x \le -1$, $x \ge 2$
3.	D. 10	This is an unordered selection, substitute each given option and check for a result between 100 and 150: ${}^{5}C_3 = 10$, ${}^{6}C_3 = 20$, ${}^{9}C_3 = 85$, ${}^{10}C_3 = 120$
4.	B. $4^5 + 1$	In total, there are $4\times4\times4\times4\times4 = 4^5$ ways this test could be answered. Pigeonhole principle requires $4^5 + 1$ different responses to guarantee that two students have given the same response.
5.	C. $4!\times5!$	The students must sit around the table such that the school from which they come alternate. This can be achieved in $1\times4!\times5!$ ways. 1 way to seat any one of the students, the remaining 4 students from that same school in every other seat, then $5!$ ways of slotting the five students from the other school into the remaining seats.
6.	C.	Option A is the graph of $y = f(\lvert x\rvert)$, option B is the graph of $y = \lvert f(x)\rvert$, option C is the graph of $\lvert y\rvert = f(\lvert x\rvert)$, option D is the graph of $\lvert y\rvert = \lvert f(x)\rvert$.
7.	D. Domain $0 \le x \le 2$ Range $\sqrt{2} \le y \le 2$	The graph of $y = f(x)+g(x)$ would have a combined domain of $0 \le x \le 2$ as the domain of $f(x)$ is $x \ge 0$ and the domain of $g(x)$ is $x \le 2$. The range of $f(x)+g(x)$ is $\sqrt{2} \le y \le 2$ by addition of graphs and recognising the maximum occurs in the line $x = 1$ by symmetry. $y = f(x) + g(x) = \sqrt{x} + \sqrt{2-x}$ 

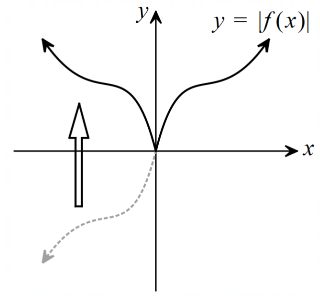
Questions 1 – 10 (continued)

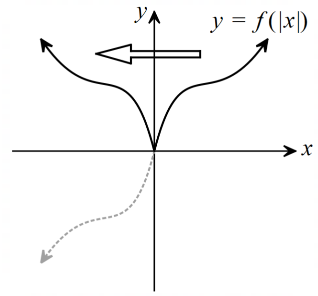
<table>
<tr><th colspan="3">Answer and explanation</th></tr>
<tr><td>8.</td><td>C.</td><td>

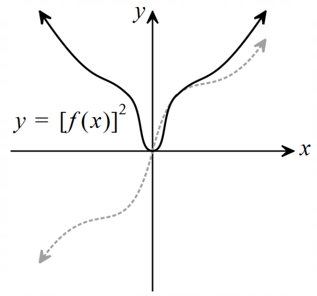
Suppose a random odd function such as:



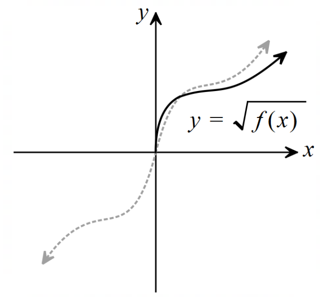
Because of symmetry, options A, B and D will generate a graph with line symmetry in the y-axis, thus creating even functions:







Option C will not:



Algebraically, we can let $g(x)=|f(x)|$, $h(x)=f(|x|)$, $p(x)=\sqrt{f(x)}$ and $q(x)=\left[f(x)\right]^2$, then:

$$\begin{aligned} g(-x) &= |f(-x)| \\ &= |-f(x)| \\ &= |f(x)| \\ &= g(x) \end{aligned} \qquad \begin{aligned} h(-x) &= f(|-x|) \\ &= f(|x|) \\ &= h(x) \end{aligned} \qquad \begin{aligned} p(-x) &= \sqrt{f(-x)} \\ &= \sqrt{-f(x)} \\ &\neq p(x) \end{aligned} \qquad \begin{aligned} q(-x) &= \left[f(-x)\right]^2 \\ &= \left[-f(x)\right]^2 \\ &= \left[f(x)\right]^2 \\ &= q(x) \end{aligned}$$

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Questions 1 – 10 (continued)

<table>
<tr><th colspan="3">Answer and explanation</th></tr>
<tr>
<td>9.</td>
<td>D. $3^{-2x^2} < 3^{-x^2}$</td>
<td>
Let $f(x) = 3^{-x^2}$. For all real x, except $x = 0$, we note from the given graph that $0 < f(x) < 1$.
For this range of values of $f(x)$, from our work on further graphs, we observe that:
$$\frac{1}{f(x)} > f(x)$$
$$\frac{1}{\left(3^{-x^2}\right)} > 3^{-x^2}$$
$$3^{x^2} > 3^{-x^2}$$
$\therefore$ Option A is correct
$$\sqrt{f(x)} > f(x)$$
$$\sqrt{3^{-x^2}} > 3^{-x^2}$$
$$\left(3^{-x^2}\right)^{\frac{1}{2}} > 3^{-x^2}$$
$$3^{-\frac{x^2}{2}} > 3^{-x^2}$$
$\therefore$ Option B is correct

$$0 < f(x) < 1$$
$$-1 < -f(x) < 0$$
$$1 < 2 - f(x) < 2$$
$$\therefore 2 - f(x) > f(x) \quad \left(\text{since } 1 < 2 - f(x) < 2 \text{ and } 0 < f(x) < 1\right)$$
$$2 - 3^{-x^2} > 3^{-x^2}$$
$\therefore$ Option C is correct.

When $0 < f(x) < 1$, $\left[f(x)\right]^2 < f(x)$, therefore:
$$\left(3^{-x^2}\right)^2 < 3^{-x^2}$$
$$3^{-2x^2} < 3^{-x^2}$$
$\therefore$ Option D is incorrect.
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<tr>
<td>10.</td>
<td>D. $n!$</td>
<td>
One-to-one functions map each input (x-value) to a unique output (y-value). By the basic counting principle, there are n output options for the first input, $(n-1)$ output options for the second input, $(n-2)$ output options for the third input and so on until the n^{th} input, with only 1 option for its output.

Another way to think about this problem is to consider filling in a table of values, assigning one of the n unique outputs for each of its n inputs:
<table>
<tr><td>x</td><td>1</td><td>2</td><td>3</td><td>$\cdots$</td><td>$n-1$</td><td>n</td></tr>
<tr><td>y</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
n possible outputs to be filled in where order matters
number of permutations of outputs $= n!$
</td>
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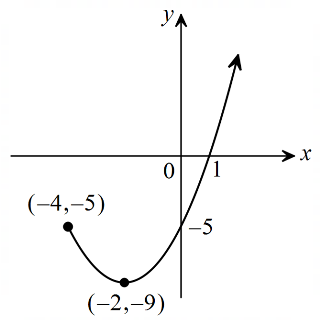
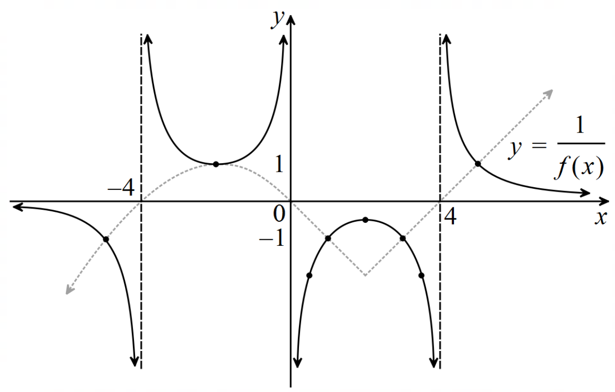
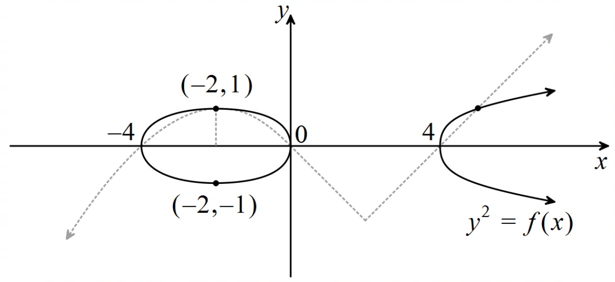
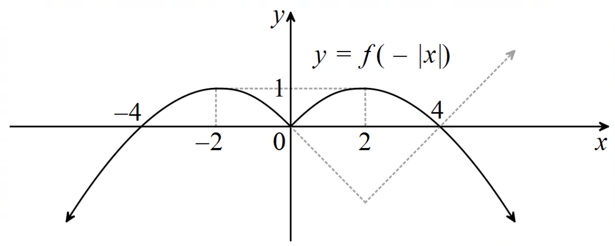
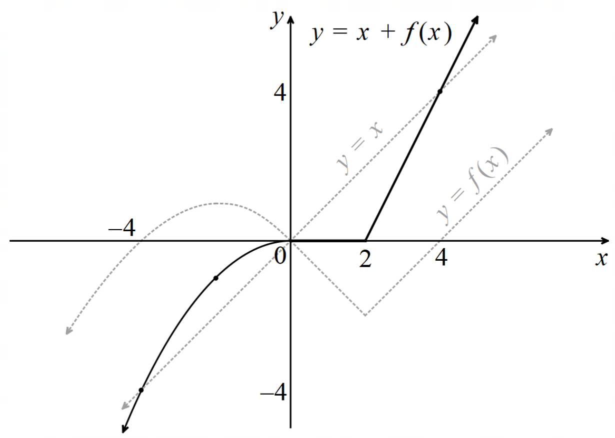
Section II

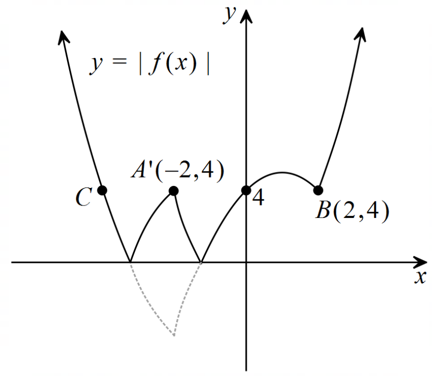
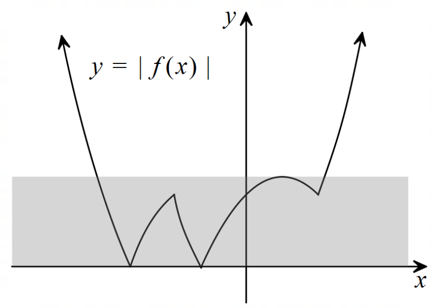
Question 11

Sample solution		Suggested marking criteria
(a)	$\frac{3x-15}{x} \le 5-x$ $3x(x-5) \le -x^2(x-5)$ $(3x+x^2)(x-5) \le 0$ $x(3+x)(x-5) \le 0$ $\therefore x \le -3, 0 < x \le 5$	• 3 – correct solution • 2 – solves the inequation but does not omit $x=0$ • 1 – recognises all 3 critical values – multiplies by the square of the denominator
(b)	(i) $y = t^2 + 4t - 5$ $= (t+2)^2 - 9$ $= (-4-x+2)^2 - 9$ $= (-x-2)^2 - 9$ $= (x-2)^2 - 9$	• 2 – correct solution • 1 – attempts to eliminate the parameter
	(ii) $t \le 0$ $-4-x \le 0$ $x \ge -4$ 	• 3 – correct graph including a correct scale • 2 – sketches a parabola with any **two** of the following correct: i) one correct translation ii) correct domain iii) one endpoint and intercept – sketches a parabola with correct vertex, intercepts and end point • 1 – sketches a parabola with any **one** of the following correct: i) one correct translation ii) correct domain iii) one endpoint and intercept
	(iii) Largest portion of the graph that passes the horizontal line test is $x \ge -2$.	• 1 – correct answer
(c)	(i) Without restrictions, there are $6! = 720$ ways of arranging Jack, Jill and their 4 friends.	• 1 – correct solution
	(ii) There are $2! \times 5! = 240$ ways in total. 2! ways of arranging Jack and Jill, then treating them as one entity, there are then 5! ways of arranging the pair and their four friends.	• 1 – correct solution
	(iii) There are $2! \times 4! = 48$ ways in total. 2! ways of having Jack and Jill at the ends of the line, once they are in position, there are then 4! ways of shuffling their 4 friends in between them.	• 1 – correct solution

Question 12

Sample solution			**Suggested marking criteria**
(a)	(i)		• 2 – correct graph • 1 – correctly identifies the vertical asymptotes and $(x,\pm1)$ on the reciprocal graph
	(ii)		• 2 – correct graph • 1 – correctly sketches $y=\sqrt{f(x)}$ or $-\sqrt{f(x)}$ – attempts to sketch $y=\sqrt{f(x)}$ or $-\sqrt{f(x)}$ and demonstrates a reflection in the x-axis
	(iii)		• 2 – correct graph • 1 – recognises a reflection in the y-axis in an attempt to sketch $y = f\left(-\|x\|\right)$ 1 – sketches $y = f\left(\|x\|\right)$ *N.B. Be careful with the order in which the reflections are applied.*
	(iv)		• 2 – correct graph • 1 – correctly sketches the portion of the graph for $x \ge 0$ or for $x \le 0$
(b)	(i)	There are $45360 \times 2 = 90720$ possible arrangements. The possible arrangements are I……I or O……O. In either case, there are $\frac{9!}{2!\times 2!\times 2!} = 45360$ ways of ordering the remaining letters.	• 2 – correct solution • 1 – performs a suitable calculation involving permutation with repeated elements
	(ii)	There are $\frac{7!}{2!} = 2520$ ways of arranging I, S, O, M, O, H, (PRISM).	• 2 – correct solution • 1 – recognises that problem as being equivalent to an arrangement of 7 entities

Question 13

Sample solution		Suggested marking criteria
(a)	(i) The graph has critical points at the critical values of $\left\|x^2-4\right\|$, i.e. $x=\pm 2$. $f(-2)=2\times(-2)+\left\|(-2)^2-4\right\| = -4$ $f(2)=2\times 2+\left\|2^2-4\right\| = 4$ $\therefore A=(-2,-4), B=(2,4)$	• 2 – correct coordinates for both A and B • 1 – correct coordinates for one of A or B
	(ii) $f(0)=2\times 0+\left\|0^2-4\right\|$ $=0+\left\|-4\right\|$ $=4$	• 1 – correct answer
	(iii)  From the graph, there are four solutions, three of which occur at $x=-2$, $x=0$ and $x=2$. The only solution left to be determined is the x-value of point C (as labelled): $y=2x+x^2-4$ $4=x^2+2x-4$ $0=x^2+2x-8$ $(x+4)(x-2)=0$ $x=-4, x=2$ Therefore, the solutions to $\left\|2x+\left\|x^2-4\right\|\right\|=4$ are $x=-4$, $x=0$, $x=\pm 2$.	• 2 – correction solution • 1 – recognises that the x-value of the points in (i) and (ii) contribute to the solution set – uses the definition of an absolute value to simplify the equation
	(iv)  Any horizontal line drawn within the shaded region (excluding the top and bottom edge) will cut the graph of $y=\left\|f(x)\right\|$ in 4 places. The highest point is the vertex of parabolic section between A and B on the original graph, which by symmetry of the parabola, occurs at $x=1$ (halfway between two points with the same y-value, namely the y-intercept and point B). $f(1)=2\times 1+\left\|1^2-4\right\|$ $=5$ Therefore, $\left\|2x+\left\|x^2-4\right\|\right\|=k$ has four distinct solutions when $0<k<5$.	• 2 – correct solution • 1 – find the point $(1,5)$ – correct upper bound or lower bound for the value of k

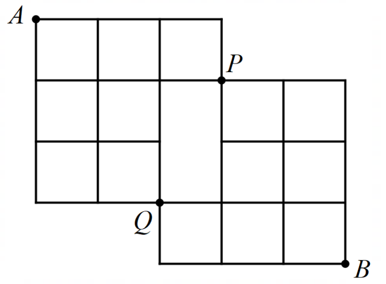
Question 13 (continued)

Sample solution			Suggested marking criteria
(b)	(i)	There are 26^7 possible 7-letter words, 26^4 of which are palindromic. For a 7-letter word to be palindromic, the first four letters fully determine the word (the last three letters will be a reversal of the first three letters), therefore: $P(\text{7-letter palidromic word}) = \frac{26^4}{26^7} = \frac{1}{26^3} = \frac{1}{17576}$	• 2 – correct solution • 1 – correctly evaluates the total number of 7-letter words or 7-letter palindromes
	(ii)	There are 26^4 8-letter palindromic words as an 8-letter palindromic word is also fully determined by the first 4 letters, the final 4 letters would be the reversal of the first 4 letters. Therefore, there are not more 8-letter palindromes, but an equal number of 8-letter palindromes compared to 7-letter palindromes.	• 2 – correct solution • 1 – a suitable conclusion with an attempt to justify

Question 14

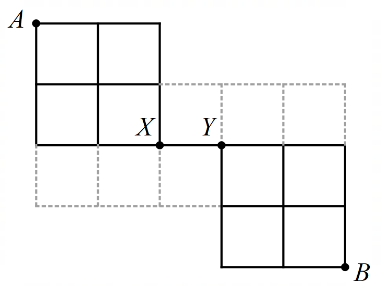
Sample solution			Suggested marking criteria
(a)	(i)	There are 26 numbers that would be less that 1000 and divisible by 3 if digits are not allow to repeat. <u>One-digit number</u> 6 is the only 1-digit number divisible by 3. <u>Two-digit numbers</u> The possible combinations of digits are: (0,6), (2,4) and (4,8), giving 5 2-digits numbers: 60, 24, 42, 48 and 84. <u>Three-digit numbers</u> The possible combinations of digits are: (0,2,4), (0,4,8), (2,4,6) and (4,6,8). If 0 is one of the digits, there are $2\times 2\times 1=4$ different ways of forming the number. If 0 is not one of the digits, there are $3!=6$ different ways of forming the number. In total, there are $2\times 4+2\times 6=20$ different 3-digits numbers. They are 204, 240, 402, 420, 408, 480, 804, 840, 246, 264, 426, 462, 624, 642, 468, 486, 648, 684, 846 and 846. *(Note: Listing not required.)*	• 2 – correct solution • 1 – considers valid cases and uses an appropriate technique to evaluate a sub-total for these cases *(Note: cases must be clearly explained / justified)*
	(ii)	There are 40 numbers that would be less than 1000 and divisible by 3 if digits are allowed to repeat, 14 more than the answer in part (i). <u>Additional two-digit numbers</u> 66 would be added the count. <u>Additional three-digits numbers</u> Any 3-digit number were all the digits are the same would be divisible by 3, as the digit sum is equal to 3 times the repeating digit, so we add to the count the numbers 222, 444, 666 and 888. Other possible combinations of digits include (0,0,6), (0,6,6), (2,2,8) and (2,8,8). This adds 9 more 3-digit numbers to the count, namely 600, 606, 660, 228, 282, 822, 288, 828 and 882.	• 2 – correct solution • 1 – considers extra cases to (i) that are also valid and uses an appropriate technique to evaluate a sub-total for these cases
(b)		${}^{n}C_2+{}^{n+3}C_2+{}^{n+6}C_2<72$ $\frac{n!}{(n-2)!\times 2!}+\frac{(n+3)!}{(n+3-2)!\times 2!}+\frac{(n+6)!}{(n+6-2)!\times 2!}<72$ $\frac{n(n-1)\cancel{(n-2)}!}{\cancel{(n-2)}!\times 2!}+\frac{(n+3)(n+2)\cancel{(n+1)}!}{\cancel{(n+1)}!\times 2!}+\frac{(n+6)(n+5)\cancel{(n+4)}!}{\cancel{(n+4)}!\times 2!}<72$ $\frac{n(n-1)}{2}+\frac{(n+3)(n+2)}{2}+\frac{(n+6)(n+5)}{2}<72$ $(n^2-n)+(n^2+5n+6)+(n^2+11n+30)<144$ $3n^2+15n+36<144$ $3n^2+15n-108<0$ $n^2+5n-36<0$ $(n+9)(n-4)<0$ $-9<n<4$ But from the original question, n is an integer with $n\geq 2$ by definition, therefore $n=2$, $n=3$.	• 3 – correct solution (including the justification of why no other solutions exists for students who test values) • 2 – correctly solves an appropriate quadratic inequation – tests $n=2$ and $n=3$ recognises them as valid solutions • 1 – rewrites the inequation using factorial notation and simplifies the algebraic fractions – tests $n=2$ and recognises it as a valid solution

Question 14 (continued)

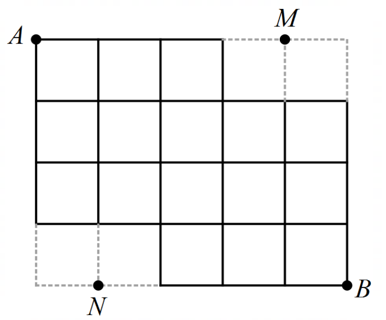
<table>
<tr><th colspan="2">Sample solution</th><th>Suggested marking criteria</th></tr>
<tr><td>(c)</td><td>
There are 9116 possible paths from A to B.
Consider the case where the road in the middle of the network is missing:


The number of paths from A to B through P: ${}^4C_3 \times {}^5C_2 = 40$ (4 steps from A to P, choose 3 “right” steps, then 5 steps from P to B, choose 2 “right” steps)

Similarly, the number of paths from A to B through Q: ${}^5C_2 \times {}^4C_3 = 40$.

Then consider the paths that uses the middle road:


The number of paths from A to B through XY: ${}^4C_2 \times 1 \times {}^4C_2 = 36$.
Note: Be sure the paths are distinct when enumerating paths through different points on the grid.

<u>Alternate solution</u>
Consider the possible paths from A to B on the following 5×3 grid, but without passing through points M and N.


Total number of paths is ${}^9C_5 = 126$ (9 steps, choose 5 “right” steps)
The number of paths from A to B through M: ${}^5C_1 = 5$ (1 way from A to M, then 5 steps from M to B, choose 1 “right” step). Similarly, there are 5 paths from A to B through N.
Removing these 10 paths leaves 116 paths from A to B.
</td><td>
• 3 – correct solution
• 2 – partially evaluates the total number of paths from A to B with cases clearly identified
• 1 – uses a combinatorics calculation to find the number of paths from A to some other point on the network, with clear explanation
– states there are ${}^9C_5$ paths
</td></tr>
</table>