

MATHEMATICS 3 PERIODS

PART A

DATE: 2nd June 2025, afternoon

DURATION OF THE EXAMINATION:

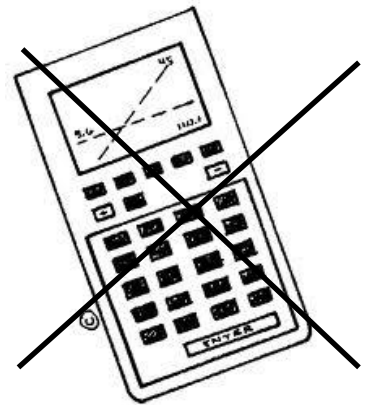
2 hours (120 minutes)

AUTHORISED MATERIAL:

Examination without technological tool

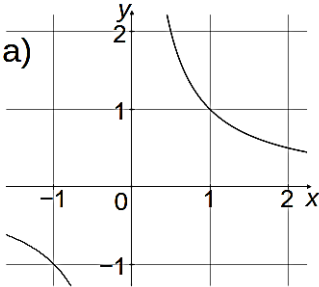
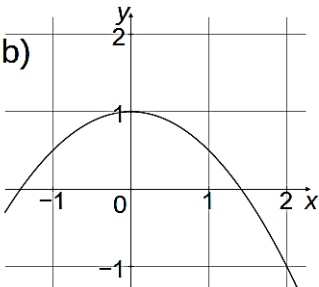
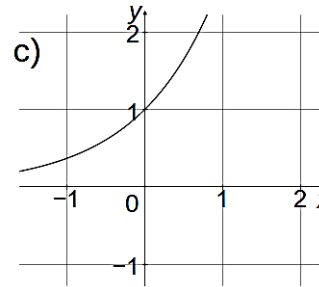
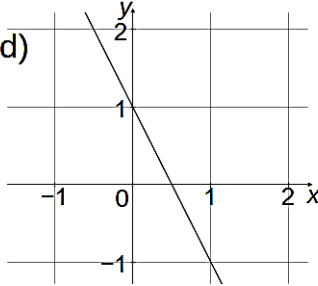
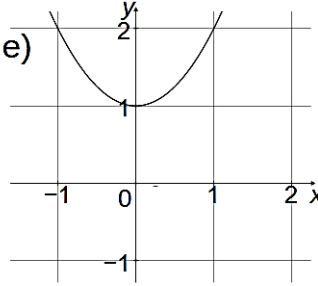
Pencil for the graphs

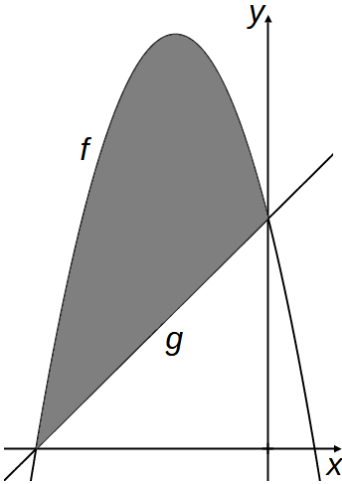
Formelsammlung / Formula booklet / Recueil de formules

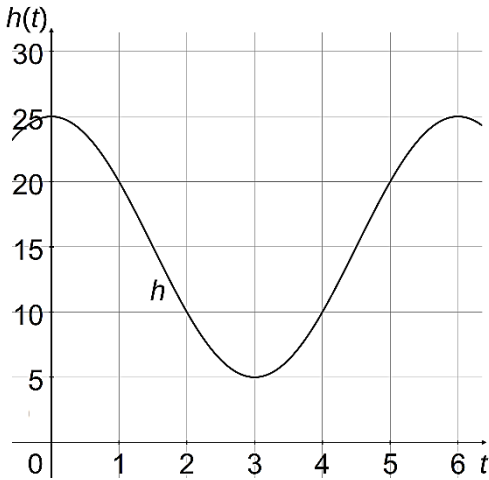


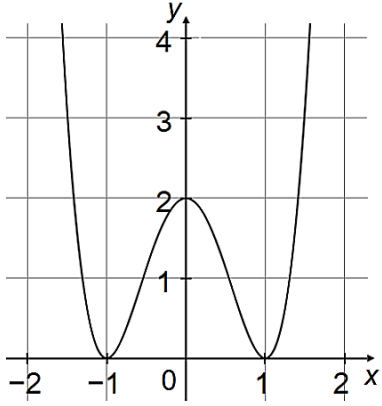
SPECIFIC INSTRUCTIONS:

- Answers must be supported by explanations.
- They must show the reasoning behind the results or solutions provided.
- If graphs are used to find a solution, they must be sketched as part of the answer.
- Unless indicated otherwise, full marks will not be awarded if a correct answer is not accompanied by supporting evidence or explanations of how the results or the solutions have been achieved.
- When the answer provided is not the correct one, some marks can be awarded if it is evident that an appropriate method and/or a correct approach has been used.

PART A	Page 1/5	Marks
<p>1) Given the functions f, g, h, j and k defined by:</p> $f(x) = e^x, \quad g(x) = -2x + 1, \quad h(x) = x^2 + 1, \quad j(x) = \frac{1}{x}, \quad k(x) = -\frac{1}{2}x^2 + 1$ <p>and their graphs shown in a different order below:</p> <div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="text-align: center;">  <p>a)</p> </div> <div style="text-align: center;">  <p>b)</p> </div> <div style="text-align: center;">  <p>c)</p> </div> <div style="text-align: center;">  <p>d)</p> </div> <div style="text-align: center;">  <p>e)</p> </div> </div> <p>Match each function to its graph. No justification is required.</p> <p>2) A teacher wants to select a group of 4 students from a class of 10 to help with an event.</p> <p>a) Calculate the number of different groups the teacher can select.</p> <p>b) The class consists of 4 girls and 6 boys. Calculate how many different groups of 4 the teacher can select, if the group should have 2 girls and 2 boys.</p>		<p>5 marks</p> <p>2 marks</p> <p>3 marks</p>

PART A	Page 2/5	Marks
<p>3) A company produces a new device. The monthly profit from selling these devices is modelled by the function P, defined by:</p> $P(x) = -0.5x^2 + 60x - 500,$ <p>where x is the number of devices sold and $P(x)$ is the monthly profit in euros.</p> <p>a) Calculate the company's monthly profit when they have sold 10 devices in a particular month.</p> <p>b) Determine the number of devices to be sold monthly to maximise the monthly profit.</p> <p>4) Consider the functions f and g defined by:</p> $f(x) = -x^2 - 4x + 5$ $g(x) = x + 5.$ <p>The diagram shows the graphs of f and g.</p>  <p>a) Verify that the graphs of f and g intersect on the coordinate axes.</p> <p>b) Write an integral that gives the area of the shaded region.</p> <p>You do not need to evaluate the integral, only to give an appropriate expression.</p>		<p>2 marks</p> <p>3 marks</p> <p>2 marks</p> <p>3 marks</p>

PART A		Page 3/5	Marks
5)	<p>A company conducts a survey on the mode of transport used and time taken by employees to get to work.</p> <p>The results of the survey are:</p> <ul style="list-style-type: none"> $\frac{2}{3}$ of the employees use a bicycle. The remaining employees use a car. 10% of employees who use a bicycle take longer than 30 minutes. 50% of employees who use a car take longer than 30 minutes. <p>A company employee is selected at random.</p> <p>Determine the probability that the employee takes longer than 30 minutes to get to work.</p>		5 marks
6)	<p>The height of the tip of a windmill sail is modelled by a periodic function h defined by:</p> $h(t) = a \cdot \sin(b \cdot (t - 4.5)) + d,$ <p>where t is the time in seconds and $h(t)$ is the height of the tip above the ground in metres.</p> <p>The graph of h is shown on the right.</p>  <p>a) Determine the height of the tip of the windmill sail at $t = 9$ seconds.</p> <p>b) Determine the values of a, b and d.</p>		<p>2 marks</p> <p>3 marks</p>

PART A	Page 4/5	Marks
<p>7) In a city it is estimated that 1 in 10 people are allergic to gluten.</p> <p>From the city, 6 people are chosen at random. Let X be the number of them who are allergic to gluten.</p> <p>a) Explain why it is appropriate to assume that X follows a binomial distribution.</p> <p>b) Calculate the probability that exactly 5 of the 6 people are allergic to gluten.</p> <p>c) Determine, from the group of 6, the expected value of the number of people who are allergic to gluten.</p> <p>8) The graph of a function f is shown on the right.</p> <p>For each of the following statements, state whether it is true or false.</p> <p>Justify each response.</p>  <p>a) $f'(0) = 0$</p> <p>b) $f'(x)$ changes sign in the interval $(0.5, 1.5)$, i.e. $0.5 < x < 1.5$.</p> <p>c) The equation $f'(x) = 1$ has only two solutions.</p>		<p>1 mark</p> <p>2 marks</p> <p>2 marks</p> <p>1 mark</p> <p>2 marks</p> <p>2 marks</p>

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PART A	Page 5/5	Marks
<p>9) A machine fills bottles with a contact lens cleaning product. From a day's production, a bottle is taken at random.</p> <p>Let V be the random variable which, for each bottle, represents the volume of the product in ml.</p> <p>We assume that V follows the normal distribution with mean $\mu = 250$ ml and standard deviation $\sigma = 16$ ml.</p> <p>Determine the probability that the selected bottle contains between 218 ml and 266 ml of the cleaning product. Illustrate your answer with a sketch of the normal distribution curve.</p> <p>10) A factory produces computer chips. A sample is taken to check the quality. The proportion of faulty chips in the sample is called p.</p> <p>The sample is used to test the hypothesis $H_0 : p = 0.08$.</p> <p>The alternative hypothesis is given by $H_1 : p > 0.08$</p> <p>If the null hypothesis is rejected, the chips will be sent back to the factory.</p> <p>If the null hypothesis is not rejected, the chips will be used.</p> <p>a) Describe the type 1 and type 2 errors in this situation.</p> <p>b) The significance level for this test is set at 2.5%. The p-value of the test is 0.034.</p> <p>Explain what will happen to the computer chips.</p>		<p>5 marks</p> <p>2 marks</p> <p>3 marks</p>