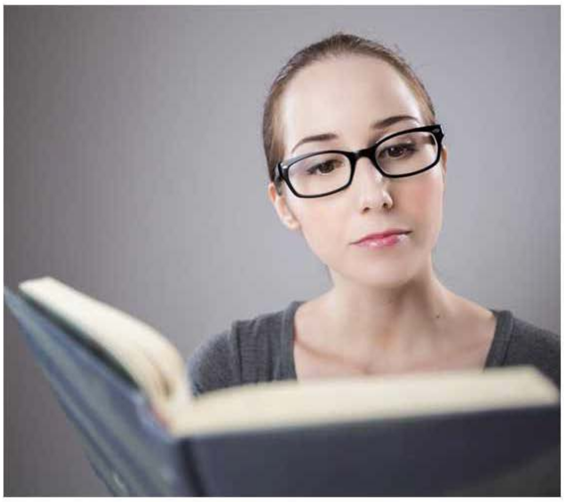

information on additional exams/university entrance qualifications.

INFORMATION & SAMPLE QUESTIONS

AUGUST 2018

MCI MANAGEMENT CENTER INNSBRUCK

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1 university entrance requirements/bachelor studies.

Applicants with a university entrance qualification from abroad might fall under the regulations for additional examinations. Your program representatives will have more information.

2 additional examinations.

The persons mentioned under Point 1 have to take additional examinations, which are based on the contents and level of the examination subjects of the Austrian university entrance examination. Additional examinations include the following subjects:

- English Level I (B1) (for technical courses of study) or English Level II (B2) (for economics courses of study)
- Mathematics Level I (for business courses of study) or Mathematics Level II (for technical courses of study)
- Chemistry Level II (for technical courses of study)
- Physics Level I (for technical courses of study)

2.1 OVERVIEW

Below you will find an overview table of the additional examinations to be taken in the individual degree programs:

Course of studies	German	English Level I	English Level II	Mathematics Level I	Mathematics Level II	Chemistry Level II	Physics Level I
Business Administration Online	x		x	x			
Business Administration Online (English)			x	x			
Biotechnology & Food Engineering	x	x			x	x	x
Business & Management (German)	x		x	x			
Business & Management (English)			x	x			
Digital Business & Software Engineering	x	x			x		
Environmental, Process & Energy Engineering	x	x			x	x	x
Industrial Engineering & Management	x	x			x		x
Management, Communication & IT	x		x	x			
Management & Law	x		x	x			
Mechatronics	x	x			x		x
Nonprofit, Social & Health Care Management	x		x	x			
Social Work	x		x	x			
Tourism Business Studies	x		x	x			

- The German examination must be taken for applications for German-language courses of study
- The German examination is not required for English-language courses of study
- In case of multiple applications, the German examination must always be taken.

2.2 EXAMINATION CONTENTS

2.2.1 English Level I (B1)

The English Level I additional examination corresponds to Level B1 according to the European Framework of Reference for Languages. Qualifications are described as follows:

Ability to make everyday conversation about leisure, school, education or work, small talk doesn't pose a problem. Ability to narrate in coherent sentences, especially about one's own areas of interest. Ability to report on experiences from the past as well as future ones, and to discuss topics in writing.

2.2.2 English Level II (B2)

The English level II additional examination corresponds to level B2 according to the European Framework of Reference for Languages. Qualifications are described as follows:

Ability to understand the main content of complex texts on concrete and abstract topics; ability to understand technical discussions in one's own special field. Ability to communicate spontaneously and fluently so that a normal conversation with native speakers is possible without much effort on both sides.

2.2.3 Mathematics Level I

The additional examination in mathematics covers the following topics from Mathematics Level I:

Number sets; equations and inequations; linear systems of equations; vectors; matrices; determinants; elementary functions; finite sequences and series; basic concepts of differential calculus and integral calculus; introduction to probability and statistics.

2.2.4 Mathematics Level II

The additional examination in mathematics covers the following topics from Mathematics Level II:

Number sets; equations and inequations; elementary functions; vectors; matrices; determinants; finite sequences and series; basic concepts of differential calculus and integral calculus; trigonometry and angular functions; vector analytical geometry (straight lines, planes, circles, spheres); introduction to probability and statistics.

2.2.5 Chemistry Level II

The additional examination in chemistry covers the following topics from Chemistry Level II:

Substances, states and reactions: the properties of matter, measurements and units of measurement; substances and their properties; physical and chemical properties; substances and mixtures; measurements and units of measurement; the international system of units; accuracy and precision in measurements and calculations; calculations taking into account significant places; percentage by mass

The structure of matter: the periodic table; atoms; ion bond; covalent bond

Properties of gases: the gas laws; pressure; the ideal gas

2.2.6 Physics Level I

The additional examination in physics is intended to test scientific thinking and methodologies and covers the following topics from core areas of physics: atomic physics (atomic structure), electricity (basic electrical quantities, electrical work and power, simple circuits), mechanics (kinematics and dynamics of translation as well as rotation, forces, work, energy, power, conservation laws), optics (propagation of light, refraction, electromagnetic waves, reflection), basic physical quantities (SI unit system, conversion of units) and thermodynamics (general gas law, thermal expansion, heat transfer).

3 exam mode of written examination.

Place of examination:	Only on site at one of the MCI locations. The exact location of the examination will be announced in due time.
Date:	The date will be announced in due time.
Duration:	60 minutes per subject with a 30 minutes break in between the subjects. On examination dates with a high number of applications the examinations will be held in the morning and afternoon. For study programs with more than three examination subjects, the examinations extend into the afternoon. The exact starting time will be announced in due time.
Permitted aids:	All necessary tools are provided by the MCI. For mathematics, the Texas Instruments TI-30Xa calculator will be used. Using your own tools is treated as cheating.
Important notes on the examination:	• You must bring a valid photo ID. • The use of the Internet or a mobile phone or other technical devices (smartwatches etc.) during the test is prohibited. • Any paper used (also sheets from notepads) must be handed in. Everything that is not to be assessed (concept etc.) must be clearly crossed out.
Assessment:	• For the written part of the additional examination, there is a maximum of 100 achievable points. A minimum of 50 points is required for the written part in the respective subject to be considered "passed". • If you fail an examination, that examination may be repeated up to **two times**. • If the examination is aborted prematurely without good cause by the candidate, it is considered not passed. Admissible grounds of excuse are sickness and unforeseen or unavoidable events for which the candidate is not responsible. • If the candidate fails to cancel his or her registration for the additional examination in time without sufficient justification, the examination attempt will be lost.

4 sample questions with notes.

4.1 ADDITIONAL EXAMINATION: ENGLISH

4.1.1 General Information

The English Exam is an electronic test and comprises a writing exercise plus up to 6 different parts dealing with all or some of the following topics:

PART	MAIN SKILL FOCUS	RESPONSE	HOW CAN YOU PREPARE?
1	Grammatical Accuracy ***...tests your ability to express yourself accurately***	Multiple Choice Test Matching	Any practice in the grammatical and structural aspects of the language
2	Vocabulary Section ***...tests your ability to recognize clear and concise expression.***	Multiple Choice Test	Expose yourself to a wide range of texts taken from all kinds of settings
3	Reading for gist and specific information ***...tests your ability to understand the substance and logical structure of a selection of texts.***	Multiple Choice True/False Statements	Expose yourself to a wide range of texts taken from all kinds of settings You are not expected to understand every word in the text, but you should be able to pick out salient points.
4	Writing ***...tests your ability to present an argument, to explain, describe and draw conclusions in writing***	e.g. stating opinion, agreeing/disagreeing, explaining... (medium may be letter, e-mail, memo, summary, short report..)	Familiarize yourself with a variety of text types. Learn how to structure texts

4.1.2 Example Part 1

1.	Heathrow, London, ...more international traffic than any other airport.			
	A handles	B is handling	C handle	D handling
2.	If you reduce the price, we........... your offer.			
	A accept	B would accept	C will accept	D would have accepted
3.	It is ....hot today.			
	A terrible	B terribly	C too terrible	D most terrible

4.1.3 Example Part 2a

Bill Bullen had always dreamed of going 1_______Europe on a bus. As a child, he had seen Cliff Richard's film *Summer Holiday*, in which Cliff and his friends travel through southern Europe on a red double-decker bus, and he 2___________ always wanted to do the same thing. In 1998 he decided to make his dream come true, and he bought a twenty-year old bus 3__________ had been fitted with a kitchen, toilet, and a CD player.

1	A up	B over	C round
2	A has	B had	C is
3	A whose	B who	C which

4.1.4 Example Part 2b

Match the following words and descriptions:

1 **innovative**

A	modern	B new	C state-of-the-art

2 **consider**

A	to think about	B to wonder	C to know

3 **qualification**

A	ability	B requirement	C standard

4.1.5 Example Part 3

One aspect of business life which managers are unhappy with is the need to attend meetings. Research indicates that managers will spend between a third and half of their working lives in meetings. Although most managers would agree that it is hard to think of an alternative to meetings, as a means of considering information and making collective decisions, their length and frequency can cause problems with the workload of even the best-organised executives.

What do most managers think about meetings?

A. Meetings take up most of their working life.
B. Meetings allow them to monitor decision-making.
C. Meetings prevent them from establishing a routine.
D. Meetings are the only way they know of achieving certain objectives.

4.2 ADDITIONAL EXAMINATION: MATHEMATICS

4.2.1 Mathematics problems

Problem 1:
Sound intensity decreases exponentially with increasing wall thickness. At 5 *cm* brick wall thickness the intensity decreases by half.

Draw the curve $I(x) = I_0 \cdot 2^{-\frac{x}{5cm}}$ with $I_0 = 100\%$. How thick must the wall be so that $I(x) = 1\%$?

Problem 2: Extreme value problem:
A conical coffee filter (radius *r*, height *h*, length of side edge *s*) is to be dimensioned in such a way that for a given volume V the lateral surface area M becomes minimal (to minimize costs).

Note: $M = \pi \cdot r \cdot s$, $V = \frac{1}{3} G \cdot h = \frac{1}{3} \pi \cdot r^2 \cdot h$

Problem 3: Probability calculus:
You roll three dice. If the number of eyes is greater than 15, you win 20 €, otherwise you have to pay 1 €.

What is the probability of winning? How much money do you have on average after 100 games?

Problem 4: Curve sketching:

Calculate the zeros, extremes and inflection points of the function $f(x) = \frac{x^2}{1+x^2}$.

Problem 5:
Verify whether the following cost functions satisfy the law of diminishing returns (that is, the marginal cost function $K'(x)$ is always positive) and draw the function graphs:

a) $K(x) = 0.1 \cdot x^3 - 5 \cdot x^2 + 90 \cdot x + 100$

b) $K(x) = 0.1 \cdot x^3 - 5 \cdot x^2 + 80 \cdot x + 100$

Determine the minimum marginal costs.
Note: the inflection point of the cost function is called point of diminishing returns.

Problem 6: Equation systems:
The same 2 products P_1, P_2 can be produced in 2 factories F_1, F_2. The weekly quantities can be taken from the table. How many hours t_1 are required to manufacture one piece of product P_1 $(t_2 \rightarrow P_2)$ if the total times per week are $400\ h$ in factory F_1 and $500\ h$ in F_2.

	P_1	P_2
F_1	100	25
F_2	60	80

Problem 7:
At the beginning of a board game you can roll a six-face fair die three times. What is the probability of rolling a 6 for the first time on the third roll? What is the probability to have rolled a 6 at the latest after the 3rd roll?

Problem 8:

A student estimates the odds of passing the math exam at 60:40. What is the probability that he will have passed at the latest after his third attempt?

Problem 9:

The production of carbon film resistors is almost normally distributed with expected value μ=2200 Ω and standard deviation σ=50 Ω.

How many resistors are within the tolerance range [2100 Ω, 2300 Ω]?

Problem 10:

An anonymous survey of 90 graduates of a certain university of applied sciences who completed their Master's degree 5 years ago was conducted regarding their gross earnings in euros:

Class midpoint	Class	Tally	n_j	h_j	H_j
2000	$1875 < x \le 2125$	I	1		
2250	$2125 < x \le 2375$	IIII	4		
2500	$2375 < x \le 2625$	~~IIII~~ I	6		
2750	$2625 < x \le 2875$	~~IIII~~ IIII	9		
3000	$2875 < x \le 3125$	~~IIII~~ ~~IIII~~	10		
3250	$3125 < x \le 3375$	~~IIII~~ ~~IIII~~ ~~IIII~~ IIII	19		
3500	$3375 < x \le 3625$	~~IIII~~ ~~IIII~~ ~~IIII~~ II	17		
3750	$3625 < x \le 3875$	~~IIII~~ ~~IIII~~ I	11		
4000	$3875 < x \le 4125$	~~IIII~~ II	7		
4250	$4125 < x \le 4375$	II	2		
4500	$4375 < x \le 4625$	III	3		
4750	$4625 < x \le 4875$		0		
5000	$4875 < x \le 5125$	I	1		
			90		

Calculate the mean value $\bar{x}$, dispersion s_{n-1}, coefficient of variation v. Draw a frequency histogram of the relative frequency h_j and calculate the cumulative frequency H_j.

Problem 11:

Calculate the following indefinite integrals:

a) $\int dx$ b) $\int x^3 dx$ c) $\int \sqrt{x}\, dx$ d) $\int (x+1)\left(x^3 - x\right) dx$

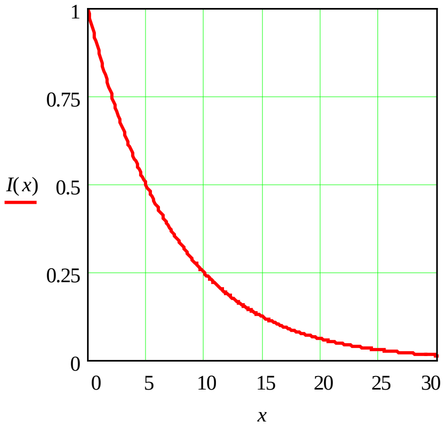
e) $\int \left(x - \sqrt{x}\right)\left(\frac{1}{x} + \sqrt{x}\right) dx$ f) $\int \left(2\sin t - 3\cos t\right) dt$

Problem 12:

Calculate the following definite integrals (area under the curve $f(x)$):

a) $\int_0^{\pi} \sin(x) dx$ b) $\int_0^1 \pi \cdot (1 - x^2) dx$ c) $\int_0^5 e^{-x} dx$ d) $\int_0^1 \sqrt{x}\, dx$

4.2.2 Mathematics solutions



Problem 1: Sound intensity $I(x) = I_0 \cdot 2^{-\frac{x}{5cm}}$, $I_0 = 100\%$.

x	0	5	10	15	20	25	30
$I(x)$	1	0.5	0.25	0.125	0.0625	0.03125	0.0156

Thickness for $I(x) = 1\% = 0{,}01 = I_0 \cdot 2^{-\frac{x}{5cm}} \Rightarrow 0{,}01 = 2^{-\frac{x}{5cm}}$

$$\lg(0{,}01) = \lg\left(2^{-\frac{x}{5cm}}\right) \Rightarrow \frac{\lg(0{,}01)}{\lg(2)} = -\frac{x}{5cm} \Rightarrow x = -5cm \cdot \frac{\lg(0{,}01)}{\lg(2)} = 33{,}22cm$$

Problem 2: Extreme value problem: coffee filter with smallest lateral surface *M* at given volume *V*:

$M = \pi \cdot r \cdot s \ldots \min$ H.B.

N.B. $V = \pi r^2 \cdot \frac{h}{3} \to h = \frac{3V}{\pi r^2}$

$$s = \sqrt{r^2 + h^2} \to s = \sqrt{r^2 + \frac{9V^2}{\pi^2 r^4}}$$

$$M(r) = \pi r s = \pi r \sqrt{r^2 + \frac{9V^2}{\pi^2 r^4}} = \sqrt{\pi^2 r^4 + \frac{9V^2}{r^2}}$$

$$\frac{dM^2(r)}{dr} = \pi^2 4r^3 - \frac{18V^2}{r^3} \overset{!}{=} 0 \Rightarrow \qquad r^6 = \frac{9}{2}\frac{V^2}{\pi^2} \text{ or } r = \sqrt[6]{\frac{9}{2}\frac{V^2}{\pi^2}}$$

$$h = \frac{3V}{\pi r^2} = \frac{3V}{\pi \sqrt[3]{\frac{9}{2}\frac{V^2}{\pi^2}}} = \frac{1}{\pi}\sqrt[3]{\frac{27V^3 \cdot 2\pi^2}{9V^2}} = \sqrt[3]{\frac{6V}{\pi}}$$

$$\tan\alpha = \frac{r}{h} = \frac{\sqrt[6]{\frac{9}{2}\frac{V^2}{\pi^2}}}{\sqrt[6]{\frac{36V^2}{\pi^2}}} = \sqrt[6]{\frac{1}{8}} = \frac{1}{\sqrt{2}} \to \qquad \alpha = \arctan\frac{1}{\sqrt{2}} = 35{,}26°$$

$2\alpha = 70{,}53°$ Aperture angle

Problem 3: Probability calculus:

You roll three dice. If the number of eyes is greater than 15, you win 20 €, otherwise you have to pay 1 €.

What is the probability of winning?

The winning combinations are as follows: (6,6,6), (5,6,6),(6,5,6), (6,6,5), (4,6,6),(6,4,6), (6,6,4), (5,5,6),(5,6,5), (6,5,5,5), 10 favorable cases in total. There are $6 \cdot 6 \cdot 6 = 6^3$ possible cases. This gives us the winning probability:

$$P = \frac{10}{6^3} = 4{,}63\%$$

How much money do you have on average after 100 games?

$$G = (P \cdot 20 - (1-P) \cdot 1) \cdot 100 = -2{,}77$$

Problem 4: Curve sketching:

Calculate the zeros, extremes and inflection points of the function $f(x) = \frac{x^2}{1+x^2}$.

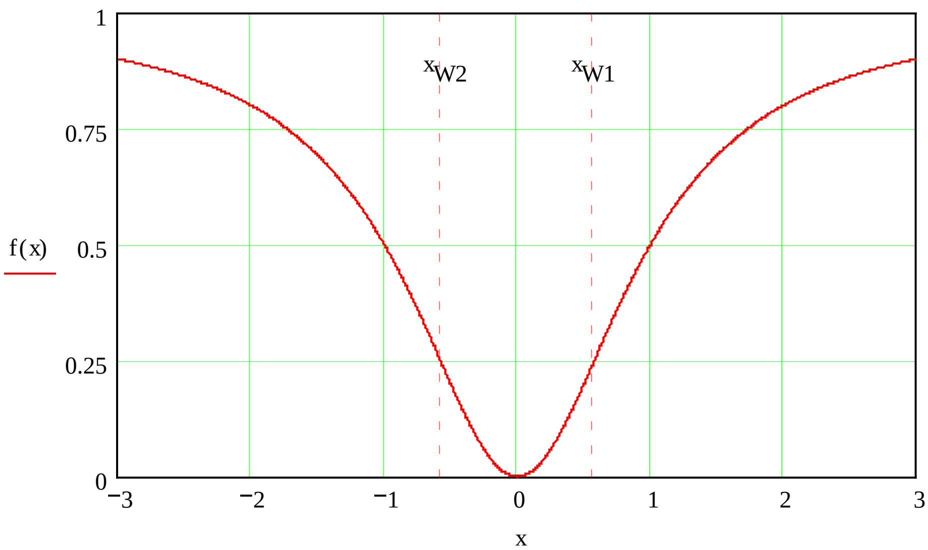
Zeros: $f(x) = \frac{x^2}{1+x^2} = 0 \Rightarrow x_n = 0$

Extremes: $f'(x) = \frac{(1+x^2)\cdot 2\cdot x - x^2 \cdot 2 \cdot x}{(1+x^2)^2} = \frac{2\cdot x}{(1+x^2)^2} = 0 \Rightarrow x_E = 0, y_E = 0$ possible extreme

2nd derivative: $f''(x) = \frac{(1+x^2)^2 \cdot 2 - 2\cdot x \cdot 2 \cdot (1+x^2)\cdot 2 \cdot x}{(1+x^2)^4} = \frac{(1+x^2)\cdot 2 - 8 \cdot x^2}{(1+x^2)^3} = \frac{2-6\cdot x^2}{(1+x^2)^3}$

so that $f''(x_E = 0) = \frac{2 - 6 \cdot 0^2}{(1+0^2)^3} = 2 > 0 \Rightarrow x_E = 0, y_E = 0$ minimum

Inflection points (“W”): $f''(x) = \frac{2-6\cdot x^2}{(1+x^2)^3} = 0 \Rightarrow x_{W1} = \frac{1}{\sqrt{3}}, y_{W1} = \frac{1}{4}, x_{W2} = -\frac{1}{\sqrt{3}}, y_{W2} = \frac{1}{4}$



Problem 5: Check whether the following cost functions satisfy the law of diminishing returns:

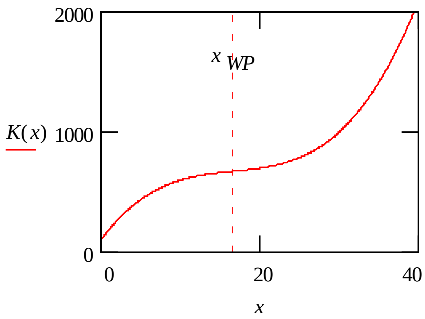
$K(x) = a + b \cdot x + c \cdot x^2 + d \cdot x^3$ cost function satisfying the law of diminishing returns $\Leftrightarrow K'(x) > 0$ for all x

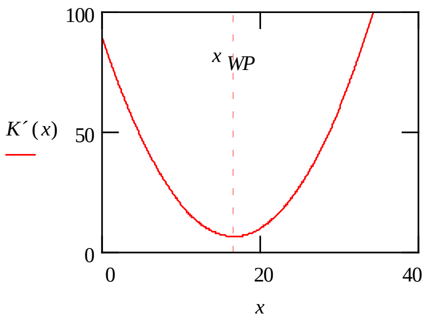
a) $K(x) = 0.1 \cdot x^3 - 5 \cdot x^2 + 90 \cdot x + 100$

Determination of minimum marginal costs:

$$K'(x) = 0.3 \cdot x^2 - 10 \cdot x + 90$$

$K''(x) = 0.6 \cdot x - 10 = 0 \Rightarrow x_{WP} = \frac{10}{0.6} = 16.66 \Rightarrow K'(x_{WP}) = 6.667 > 0$ i.e. satisfying the law of diminishing returns; "WP" stands for inflection point (German "Wendepunkt").



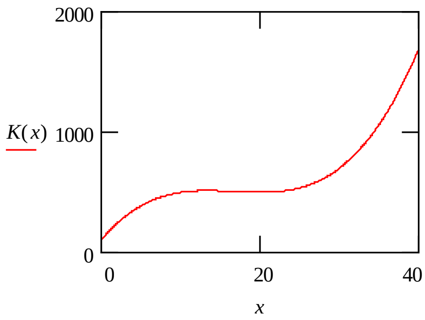


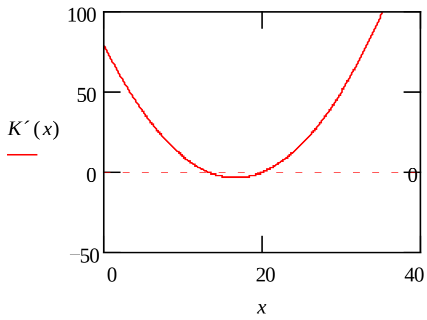
b) $K(x) = 0.1 \cdot x^3 - 5 \cdot x^2 + 80 \cdot x + 100$

Determination of minimum marginal costs:

$$K'(x) = 0.3 \cdot x^2 - 10 \cdot x + 80$$

$K''(x) = 0.6 \cdot x - 10 = 0 \Rightarrow x_{WP} = \frac{10}{0.6} = 16.66 \Rightarrow K'(x_{WP}) = -3.333 < 0$, i.e. not satisfying the law of diminishing returns





Problem 6: Systems of equations:

$$100 \cdot t_1 + 25 \cdot t_2 = 400 \qquad \rightarrow \qquad t_2 = 16 - 4t_1$$
$$60t_1 + 80 \cdot t_2 = 500$$
$$60 \cdot t_1 + 80 \cdot (16 - 4t_1) = 500$$
$$60t_1 - 320t_1 = 500 - 1280$$
$$-260t_1 = -780$$

$t_1 = \frac{78}{26} = 3$ hours for one piece of product P_1

$t_2 = 16 - 4t_1 = 4$ hours for one piece of product P_2

Problem 7: Dice:

The probability of rolling a 6 for the first time on the third roll:

$$P = P_{no6} \cdot P_{no6} \cdot P_6 = \frac{5}{6} \cdot \frac{5}{6} \cdot \frac{1}{6} = 11{,}6\%$$

What is the probability to have rolled a 6 at the latest after the 3rd roll?

$$P = P_6 + P_{no6} \cdot P_6 + P_{no6} \cdot P_{no6} \cdot P_6 = \frac{1}{6} + \frac{5}{6} \cdot \frac{1}{6} + \frac{5}{6} \cdot \frac{5}{6} \cdot \frac{1}{6} = 42{,}1\%$$

Problem 8: Math exam:

The probability of passing is $P_j = 0{,}6$, the one of failing is $P_n = 0{,}4$. What is the probability of having passed at the latest after the third attempt:

$$P = P_j + P_n \cdot P_j + P_n \cdot P_n \cdot P_j = 0{,}6 + 0{,}4 \cdot 0{,}6 + 0{,}4 \cdot 0{,}4 \cdot 0{,}6 = 93{,}6\%$$

Problem 9: The production of carbon film resistors is almost normally distributed with expected value μ=2200 Ω and standard deviation σ=50 Ω.

How many resistors are within the tolerance range [$x_{lower} = 2100$ Ω, $x_{upper} = 2300$ Ω]?

$$P(x_{un} \le X \le x_{ob}) = G_{nv}(x_{ob}, \mu, \sigma) - G_{nv}(x_{un}, \mu, \sigma) = \Phi(u = \frac{x_{ob} - \mu}{\sigma} = 2) - \Phi(u = \frac{x_{un} - \mu}{\sigma} = -2) = 95{,}45\%$$

Note: the value $\Phi(u = 2) = 0{,}97725$ can be read from the normal distribution table and the relationship $\Phi(-u) = 1 - \Phi(u)$ yields $\Phi(u = -2) = 1 - \Phi(2) = 1 - 0{,}97725 = 0{,}02275$

Problem 10: An anonymous survey of 90 graduates of a certain university of applied sciences who completed their Master's degree 5 years ago was conducted regarding their gross earnings in euros:

Class midpoint	Class	Tally	n_j	h_j	H_j
2000	$1875 < x \leq 2125$	I	1	0.011	0.011
2250	$2125 < x \leq 2375$	IIII	4	0.044	0.055
2500	$2375 < x \leq 2625$	~~IIII~~ I	6	0.067	0.122
2750	$2625 < x \leq 2875$	~~IIII~~ IIII	9	0.100	0.222
3000	$2875 < x \leq 3125$	~~IIII~~ ~~IIII~~	10	0.111	0.333
3250	$3125 < x \leq 3375$	~~IIII~~ ~~IIII~~ ~~IIII~~ IIII	19	0.211	0.544
3500	$3375 < x \leq 3625$	~~IIII~~ ~~IIII~~ ~~IIII~~ II	17	0.189	0.733
3750	$3625 < x \leq 3875$	~~IIII~~ ~~IIII~~ I	11	0.122	0.855
4000	$3875 < x \leq 4125$	~~IIII~~ II	7	0.078	0.933
4250	$4125 < x \leq 4375$	II	2	0.022	0.955
4500	$4375 < x \leq 4625$	III	3	0.033	0.989
4750	$4625 < x \leq 4875$		0	0	
5000	$4875 < x \leq 5125$	I	1	0.011	1
		$\sum$	90	1	

First, the relative and absolute frequencies are calculated and entered in the table.

For the calculation of the position and dispersion measures we use the interval centers. Thus we get for the mean value

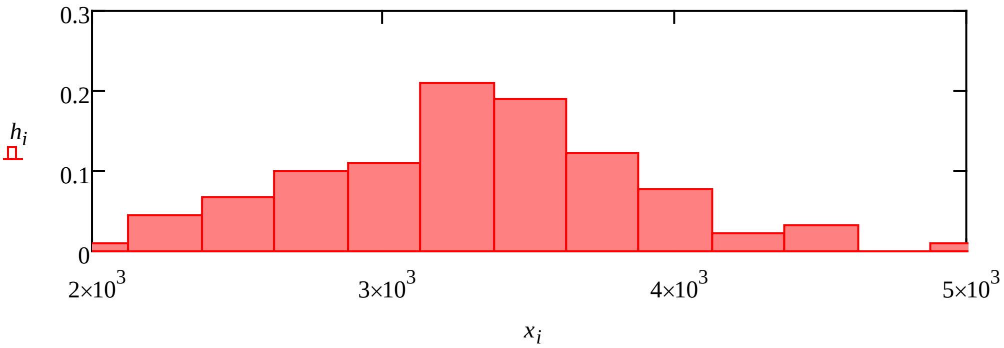
$$\bar{x} = \frac{n_1 \cdot x_1 + n_2 x_2 + \ldots n_m x_m}{n} = \frac{\sum n_j x_j}{n} = 3314$$

for the dispersion s_{n-1}

$$s = \sqrt{\frac{1}{n-1} \sum_{j=1}^{m} n_j \left(x_j - \bar{x}\right)^2} = 570{,}29$$

and, using the last two results, the coefficient of variation v

$$v = \frac{s}{\bar{x}} = 17{,}21\%$$



Problem 11: Calculate the following indefinite integrals:

a) $\int dx = x + C$

b) $\int x^3 dx = \frac{x^4}{4} + C$

c) $\int \sqrt{x} dx = \frac{x^{\frac{3}{2}}}{\frac{3}{2}} + C$

d) $\int (x+1)(x^3 - x)dx = \int (x^4 + x^3 - x^2 - x)dx = \frac{x^5}{5} + \frac{x^4}{4} - \frac{x^3}{3} - \frac{x^2}{2} + C$

e) $\int (x - \sqrt{x})\left(\frac{1}{x} + \sqrt{x}\right)dx = \int \left(1 - \frac{1}{\sqrt{x}} + x^{\frac{3}{2}} - x\right)dx = x - \frac{x^{\frac{1}{2}}}{\frac{1}{2}} + \frac{x^{\frac{5}{2}}}{\frac{5}{2}} - \frac{x^2}{2} + C$

f) $\int (2 \sin t - 3 \cos t)dt = 2 \cos t + 3 \sin t + C$

Problem 12: Calculate the following definite integrals (area under the curve $f(x)$):

a) $\int_0^\pi \sin(x)dx = -\cos(x)\Big|_0^\pi = -\cos(\pi) + \cos(0) = 2$

b) $\int_0^1 \pi \cdot (1 - x^2)dx = \pi \cdot (x - \frac{x^3}{3})\Big|_0^1 = \pi \cdot \frac{2}{3}$

c) $\int_0^5 e^{-x} dx = -e^{-x}\Big|_0^5 = -e^{-5} + e^0 = 0{,}993$

d) $\int_0^1 \sqrt{x} dx = \frac{x^{\frac{3}{2}}}{\frac{3}{2}}\Bigg|_0^1 = \frac{2}{3}$

4.3 ADDITIONAL EXAMINATION: CHEMISTRY

4.3.1 Chemistry sample problems

Problem 1:
What is the following salt called? $Ca(NO_2)_2$

1. potassium nitrate
2. potassium nitrite
3. calcium nitrite
4. potassium nitrate

Problem 2:
What are the stoichiometric coefficients for the following reaction: a Fe^{2+} + b H^+ + c NO_3^- → d Fe^{3+} + e NO + f H_2O

1. a=2 b; b=1 ; c=-1 ; d=3 ; e=0 ; f=0
2. a=1 b; b=1 ; c=3 ; d=1 ; e=1 ; f=2
3. a=0 b; b=0 ; c=3 ; d=0 ; e=1 ; f=2
4. a=3 b=4 ; c=1 ; d=3 ; e=1 ; f=2

Problem 3:
The occupation of electrons in orbitals is described by what, among other things?

1. Hund's rule
2. Schrödinger's cat
3. Fischer projection
4. Snake formula

Problem 4:
Calculate the mass of potassium permanganate necessary to prepare 250 ml of a 0.0380 M $KMnO_4$ solution.

1. 1.20 g
2. 1.30 g
3. 1.40 g
4. 1.50 g

Problem 5:
What mass of aluminium must be used for a reaction so that the reaction with 10.0 kg of chromium(III) oxide results in a complete conversion of the oxide to elemental chromium?

- 3.55 kg
- 5.55 kg
- 7.55 kg
- 9.55 kg

4.3.2 Chemistry solutions

Chemistry Problem 1:	3. calcium nitrite
Chemistry Problem 2:	4. a=3 ; b=4 ; c=1 ; d=3 ; e=1 ; f=2
Chemistry Problem 3:	1. Hund's rule
Chemistry Problem 4:	4. 1.50 g
Chemistry Problem 5:	1. 3.55 kg

4.4 ADDITIONAL EXAMINATION: PHYSICS

4.4.1 Physics sample problems

Problem 1:
An ideal gas flows from the high pressure side to the low pressure side through a porous medium. How does the temperature change?

1. The temperature rises
2. The temperature drops
3. The temperature remains constant
4. It is not possible to make a general statement about the temperature change

Problem 2:
Martin carries one liter of water 1km through the city and then to the 3rd floor, 10m up. How much work did he expend?

1. Between 0 and 5 J
2. Between 5 and 50 J
3. Between 50 and 500 J
4. Between 500 and 5000 J
5. More than 5 kJ

Problem 3:
How far does a steel ball fly when fired horizontally from a height of 5m above a plane? The muzzle velocity is 10m/s and air friction can be neglected.

1. Approx. 1m
2. Approx. 10m
3. Approx. 100m
4. More than 100m

Problem 4:
Lightning strikes, you hear the thunder 5s after you have seen the lightning. How far away did lightning strike?

1. Less than 100m
2. Between 100m and 1km
3. Between 1 and 3km
4. Between 3 and 5km
5. Between 5 and 10km
6. Further than 10 km

Problem 5:

The power or active factor P/S in AC technology is related to the phase difference phi of voltage and current. This is describes by which law?

1. P/S=cos(phi)
2. P/S=sin(phi)
3. P/S=tan(phi)
4. P/S=phi^2
5. P/S=log(phi)

Problem 6:

The SI unit system is based on 7 basic units. Which of the following units belong to these base units?

1. ampere (A)
2. newton (N)
3. mole (mol)
4. kilogram (kg)
5. Volt (V)

Problem 7:

Which of the following density conversions is correct?

1. $5\ \frac{g}{cm^3} = 0{,}005\frac{kg}{m^3}$
2. $5\ \frac{g}{cm^3} = 500\frac{kg}{m^3}$
3. $5\ \frac{g}{cm^3} = 5000\frac{kg}{m^3}$
4. $5\ \frac{g}{cm^3} = 0{,}000005\frac{kg}{m^3}$

Problem 8:

Which of these physical quantities are vector quantities?

1. Energy
2. Velocity
3. Power
4. Force

Problem 9:

Which statement on the centrifugal force is correct?

1. The centrifugal force points in the direction of the centripetal force.
2. The centrifugal force occurs in inertial frames of reference.
3. The centrifugal force occurs in rotating frames of reference.
4. The centrifugal force is independent of radius.

Problem 10:

Which statement about isotopes of a chemical element is correct?

1. Isotopes have the same mass number A, but different atomic number Z and neutron number N.
2. Isotopes have the same number of neutrons N, but different atomic number Z and thus different mass number A.
3. Isotopes have the same atomic number Z and neutron number N, but different mass number A.
4. Isotopes have the same atomic number Z, but different neutron number N and thus different mass number A.

4.4.2 Physics solutions

Physics Problem 1:	3. The temperature remains constant.
Physics Problem 2:	3. between 50 and 500 J
Physics Problem 3:	2. approx. 10m
Physics Problem 4:	3. between 1 and 3km
Physics Problem 5:	1. P/S=cos(phi)
Physics Problem 6:	1. ampere (A), 3. mol (mol) and 4. kilogram (kg)
Physics Problem 7:	3. $5\ \frac{g}{cm^3} = 5000 \frac{kg}{m^3}$
Physics Problem 8:	2. velocity, 4. force
Physics Problem 9:	3. The centrifugal force occurs in rotating reference systems.
Physics Problem 10:	4. Isotopes have the same atomic number Z, but different neutron number N and thus different mass number A.