

PROBLEMS

12.4.2010

**Entrance examination for degree programme in
maritime management**

Instructions

The duration of the examination is 2 h 45 min

Part 1 (Reading comprehension test)

There are 10 statements to be marked false or true. The maximum score is 5 points.

Part 2 (Mathematics + Logical deduction + physics/chemistry)

There are 10 problems to solve, each worth 3 points.

For each problem, write the answer in the space provided on the answer sheet, C, and include calculation details whenever the solution requires calculation.

Whenever solving the problems 8 through 10, you have to choose either the one in physics or the one in chemistry, if you solve both, the one with lower score will count.

All papers must be returned.

Do not turn the page until you are given the permission to do so.

The problems are the following:

1.

a) Simplify the expression $[1 - 3(x + 2)] - 2x$

b) Simplify the expression $\frac{3y-6y^2}{1-2y}$

c) Evaluate the following expression for $m = 3$ and $n = -1$: $3m^2 - \frac{2m-n}{n(m-2)}$

2.

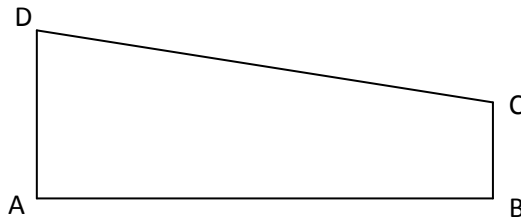
a) Solve the following equation for x : $x - 2(1 - x) = 2(1 + 3x) + 1$

b) Solve the following equation for m : $W = \frac{1}{2} m v^2$

c) Solve the following equation for t : $3t - \frac{3t-2}{2} = 4$

3. A bookstore reduced the price of a book with 25%. After that the sale rose by 10%. With how many per cent rose the number of sold books?

4. In the trapezium below the angle A and B are 90° and the angle C 102° . AB is 9.1 m and BC is 3.2 m. Calculate a) DC and b) the area of the trapezium.



5. A person makes a cubical object of steel. Inside the object is a ball-shaped hollow room which is as big as possible and so that the steel's least thickness is 5.5 mm. The length of the side of the cube is 210.0 mm. Calculate the weight of the object. Steel's density is 7.87 kg/dm^3 . The volume of the ball-room can be calculated by the formula $V = \frac{4}{3} \pi r^3$, r = radius of the ball.

6. Fill in the table with the positive integer numbers a, b, c and d using the tips 1 to 4.

	A	B	C	D
Row 1	10	b	11	12
Row 2	a	15	12	13
Row 3	17	20	13	c
Row 4	23	49	19	d

Tip 1: On row 1 there is only three different numbers.

Tip 2: The sum of the numbers in column A is $\frac{2}{3}$ of the sum of the numbers of column B.

Tip 3: The sum of the numbers in column D is 66.

Tip 4: The sum of the numbers in row 3 is a multiple of 23.

7. A box, whose weight is 182 kg, is drawn with constant speed 21 m along a horizontal concrete floor. The kinetic friction between the box and the floor is 0.58. Calculate the work done when the box is drawn with a horizontal force. (acceleration due to gravity, $g = 9,81 \text{ m/s}^2$).

When solving any of the problems 8 through 10, you have to choose either the one in physics (A) or the one in chemistry (B). If you solve both, the one with lower score will count.

8A. A lamp is marked 12V/10W. The lamp is connected to 24V accumulator. In series with lamp you must then connect a resistor. Calculate the resistance of the resistor.

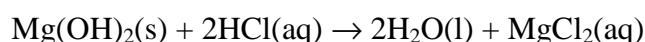
8B. Caffeine, a stimulant found in coffee, tea, chocolate, and some medications, contains 49.48% carbon, 5.15% hydrogen, 28.87% nitrogen, and 16.49% oxygen by mass and has a molar mass of 194.2. Determine the molecular formula of caffeine.

9A. In an electric kettle with good heat insulation 0.85 kg water is warmed by an electrical resistance of 25Ω , which is connected to a voltage of 230 V. In what time will the temperature of the water rise by 20°C ? The specific heat capacity of water is $4190 \text{ J}/(\text{kg}^\circ\text{C})$

9B. Baking soda (NaHCO_3) is often used as an antacid. It neutralizes excess hydrochloric acid secreted by the stomach:



Milk of magnesia, which is an aqueous suspension of magnesium hydroxide, is also used as an antacid:



Which is the more effective antacid per gram, NaHCO_3 or $\text{Mg}(\text{OH})_2$?

10A. A meteorological balloon has volume of 20.0 m^3 and a weight of 10.5 kg (gas included). What amount of cargo in kg can the balloon lift? The density of the air is $1.18 \text{ kg}/\text{m}^3$ and acceleration of gravity $9.81 \text{ m}/\text{s}^2$.

10B. Quicklime (CaO) is produced by the thermal decomposition of calcium carbonate (CaCO_3). Calculate the volume of CO_2 produced at STP from the decomposition of 152 g of CaCO_3 according to the reaction



Chemistry Reference Sheet

																		18
																		1A
1	1		2														2	
	1	H	2														He	
		Hydrogen	Helium														Helium	
		1.01	4.00														4.00	
2	3		4														10	
	3	Li	4														Ne	
		Lithium	Beryllium														Neon	
		6.94	9.01														20.18	
3	11		12														18	
	11	Na	Mg														Ar	
		Sodium	Magnesium														Argon	
		22.99	24.31														39.95	
4	19		20		21		22		23		24		25		26		30	
	19	K	Ca		Sc		Ti		V		Cr		Mn		Fe		Zn	
		Potassium	Calcium		Scandium		Titanium		Vanadium		Chromium		Manganese		Iron		Zinc	
		39.10	40.08		44.96		47.87		50.94		52.00		54.94		55.85		65.39	
5	37		38		39		40		41		42		43		44		48	
	37	Rb	Sr		Y		Zr		Nb		Mo		Tc		Ru		Cd	
		Rubidium	Strontium		Yttrium		Zirconium		Niobium		Molybdenum		Technetium		Ruthenium		Cadmium	
		85.47	87.62		88.91		91.22		92.91		95.94		(98)		101.07		112.41	
6	55		56		57		72		73		74		75		76		80	
	55	Cs	Ba		La		Hf		Ta		W		Re		Os		Hg	
		Cesium	Barium		Lanthanum		Hafnium		Tantalum		Tungsten		Rhenium		Osmium		Mercury	
		132.91	137.33		138.91		178.43		180.06		183.84		186.21		190.23		200.59	
7	87		88		89		104		105		106		107		108		112	
	87	Fr	Ra		Ac		Rf		Db		Sg		Bh		Hs		Lv	
		Francium	Radium		Actinium		Rutherfordium		Dubnium		Seaborgium		Bohrium		Hassium		Livermorium	
		(223)	(226)		(227)		(261)		(262)		(266)		(264)		(269)		(293)	

13	14	15	16	17	18
3A	4A	5A	6A	7A	8A
5	6	7	8	9	10
B	C	N	O	F	Ne
Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon
10.81	12.01	14.01	16.00	19.00	20.18
13	14	15	16	17	18
3A	4A	5A	6A	7A	8A
Al	Si	P	S	Cl	Ar
Aluminum	Silicon	Phosphorus	Sulfur	Chlorine	Argon
26.98	28.09	30.97	32.07	35.45	39.95
31	32	33	34	35	36
Ga	Ge	As	Se	Br	Kr
Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton
69.72	72.61	74.92	78.96	79.90	83.80
49	50	51	52	53	54
In	Sn	Sb	Te	I	Xe
Iridium	Tin	Antimony	Tellurium	Iodine	Xenon
114.82	118.71	121.76	127.60	126.90	131.29
81	82	83	84	85	86
Tl	Pb	Bi	Po	At	Rn
Thallium	Lead	Bismuth	Polonium	Astatine	Radon
204.38	207.2	208.98	(209)	(210)	(222)

65	66	67	68	69	70	71
Tb	Dy	Ho	Er	Tm	Yb	Lu
Terbium	Dysprosium	Holmium	Erbium	Thulium	Ytterbium	Lutetium
158.93	162.50	164.93	167.26	168.93	173.04	174.97
85	86	87	88	89	90	91
Bk	Cf	Es	Fm	Md	No	Lr
Berkelium	Californium	Einsteinium	Fermium	Mendelevium	Nobelium	Lawrencium
(247)	(251)	(252)	(257)	(258)	(259)	(262)

63	64	65	66	67	68	69
Eu	Gd	Tb	Dy	Ho	Er	Tm
Europium	Gadolinium	Terbium	Dysprosium	Holmium	Erbium	Thulium
151.96	157.25	158.93	162.50	164.93	167.26	168.93
95	96	97	98	99	100	101
Am	Cm	Bk	Cf	Es	Fm	Md
Ameicium	Curium	Berkelium	Californium	Einsteinium	Fermium	Mendelevium
(243)	(247)	(247)	(251)	(252)	(257)	(258)

59	60	61	62	63	64	65
Pr	Nd	Pm	Sm	Eu	Gd	Tb
Praseodymium	Neodymium	Promethium	Samarium	Europium	Gadolinium	Terbium
140.91	144.24	(145)	150.36	151.96	157.25	158.93
91	92	93	94	95	96	97
Pa	U	Np	Pu	Am	Cm	Bk
Protactinium	Uranium	Neptunium	Plutonium	Ameicium	Curium	Berkelium
231.04	238.03	(237)	(244)	(243)	(247)	(247)

53	54	55	56	57	58	59
Ce	La	Ce	Pr	Nd	Pm	Sm
Cerium	Lanthanum	Cerium	Praseodymium	Neodymium	Promethium	Samarium
140.12	138.91	140.12	140.91	144.24	(145)	150.36
90	91	92	93	94	95	96
Th	Pa	U	Np	Pu	Am	Cm
Thorium	Protactinium	Uranium	Neptunium	Plutonium	Ameicium	Curium
232.04	231.04	238.03	(237)	(244)	(243)	(247)

* If this number is in parentheses, then it refers to the atomic mass of the most stable isotope.