Entrance Examination 1 D
for Engineering Education
Universities of Applied Sciences
April 2015

INSTRUCTIONS

The examination consists of two parts:
Part 1: Mathematics, Logical reasoning, Physics and Chemistry.
Part 2: English language.

The total duration of the exam is 4 hours. There is no break between the two parts. You may leave the examination room at 11.00.

You may only bring your writing material (pencil, sharpener, rubber and ruler) and your calculator to the examination. The memory of the calculator must be empty, and the calculator must not be able to send or receive information wirelessly. Formula books and dictionaries are not allowed. Answer sheets and extra paper are distributed with the exam papers. **All papers must be returned.**

Part 1 (Mathematics, Logical reasoning, Physics and Chemistry)

There are 10 problems to be solved. Each is worth 4 points and the maximum score is 40 points. Solve only three of the problems 8, 9, 10, 11 and 12 (Physics and Chemistry). If you solve more, the three with the lowest scores will be counted.

Write your solutions in the provided space on the answer sheet and write the final answer in the specified place. **Only solutions written on your answer sheets will be checked!** Please use a pencil.

Include details of calculation whenever the solution requires calculations.

Part 2 (English)

The English test is compulsory to all applicants and must be passed for admission.

Use of communication devices is forbidden. Mobile phones must be switched OFF.

Problems 1 – 7: Answer to all questions.

1. Solve x from the following equations.

a) $\frac{2x+1}{2-2x} = 0$ b) $\frac{2x+1}{2-2x} = 1$ c) $\frac{x-1}{1-2x} = x$

2. Simplify the following expressions.

a) $\frac{2}{3} - \frac{1}{2} \cdot \frac{5}{3}$ b) $a + \frac{6a}{5} - 2a$ c) $\frac{\sqrt{\pi r^2}}{\sqrt{\frac{1}{\pi}}}$

3. An operation $\boxplus$ is defined as follows: $a \boxplus b = \frac{a^2}{2-b}$. Calculate and simplify

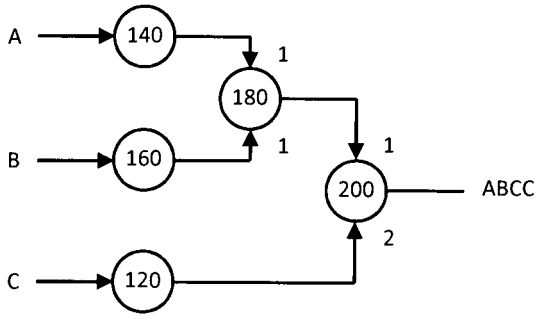
a) $\frac{3}{2} \boxplus \frac{1}{2}$

b) $3x \boxplus (2 - x)$

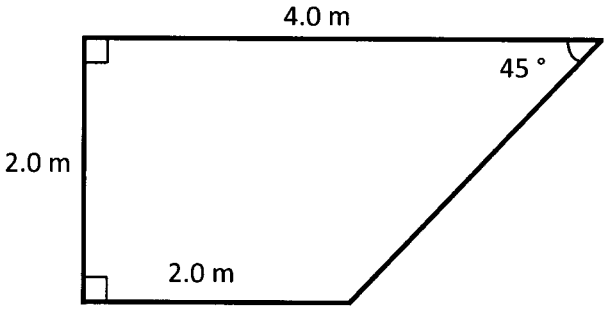
4. Fill in the empty cells of the matrix using the letters A, B, C and D so that each row and each column contains each letter exactly once. If you can do it in many ways, show them all.

		D	
C			A
			D

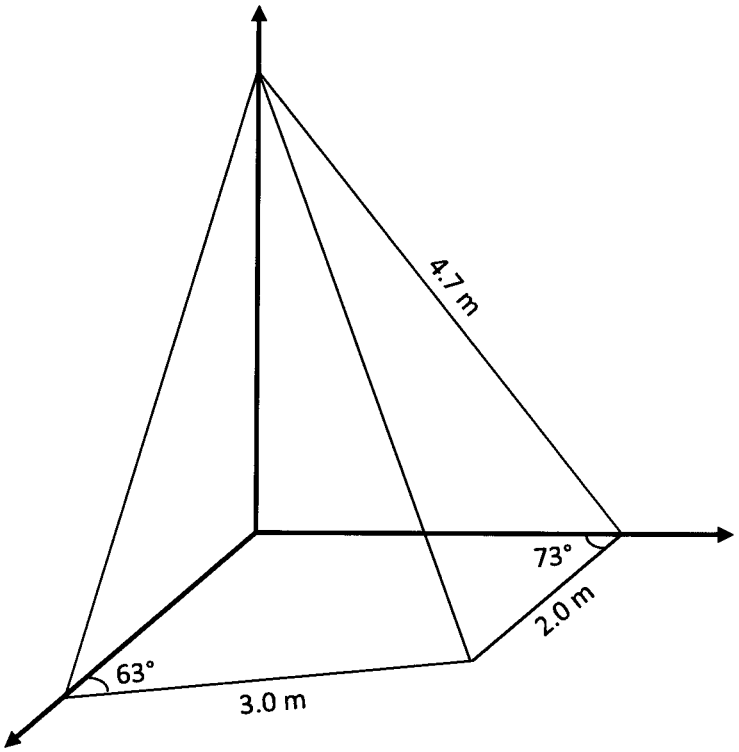
5. The diagram below shows a manufacturing line where parts are machined before they are assembled together. First, parts A, B, C are processed in machines whose maximum capacity is 140 parts, 160 parts, and 120 parts per hour, respectively. Then parts A and B, one of each, are assembled in a machine whose maximum speed is 180 assemblies per hour. The final product consists of one subassembly AB and two parts C which are combined at a maximum rate of 200 assemblies per hour. How many products ABCC can be made in one hour? The flow of material is continuous and the supply of new parts is unlimited.



6. Copy the trapezoid on the answer sheet and draw a line around it so that each point on the line has a distance of 0.5 m to the boundary line of the trapezoid. Calculate the length of this line. (Hint: Think carefully what happens at the corners.)



7. Calculate the volume of the cone in the picture. The bottom of the cone is on the xy-plane and the top of the cone is on the z-axis.



Problems 8 – 12: Solve three of the following five questions.

If you solve more, the three with the lowest scores will be counted.

8. A truck travels at a constant speed 75 km/h and passes a car standing at rest on the side of the road. After 5.0 seconds the car starts to chase the truck. The car accelerates to 120 km/h at a rate of 3.4 m/s^2 and keeps this speed until it meets the truck. How far are they from the passing point? How much time has elapsed?

9. A body of some unknown material has weight 7.4 N when measured in air and 3.9 N when submerged in water. Calculate the volume and the density of the body.

10. A container with volume 33 L is filled with helium gas at pressure 15 MPa. Calculate the pressure in the container after consuming 200 g of gas. Assume that the temperature remains all times at 19 °C. The gas constant is 8.314 J K^{-1} mol^{-1}. The Avogadro constant is $6.022 \cdot 10^{23}$ mol^{-1}. The molar mass of helium is 4.0 g mol^{-1}.

11. Write the chemical reaction equation of the combustion of butane and calculate the mass and volume of carbon dioxide produced when 420 kg of butane is combusted. When necessary, assume standard temperature and pressure. $M_H = 1.0$, $M_C = 12.0$, $M_O = 16.0$.

12. Calculate the mass and molarity of sulfuric acid, H_2SO_4, in 800 ml of water solution of which 65% is acid. The density of the solution 1500 kg/m^3. $M_H = 1.0$, $M_O = 16.0$, $M_S = 32.1$.

Read the following text and answer the TRUE and FALSE statements on the answer sheet.

(Adapted from Science Daily Feb. 19, 2015, www.sciencedaily.com)

Vara Prasad, a professor of crop ecophysiology at Kansas State University, states that wheat yields are projected to decrease by 6 percent for each degree Celsius that the temperature rises if no measures to adapt to extreme weather fluctuations are taken. Based on the 2012-2013 wheat harvest of 701 million tons worldwide, the resulting temperature increase would result in 42 million tons less produced wheat per degree of temperature increase. To put this in perspective, the amount is equal to a quarter of the global wheat trade, which reached 147 million tons in 2013. Changes in genetics and crop management can minimize some of these losses.

"It's pretty severe," Prasad said. "The projected effect of climate change on wheat is more than what has been forecast. That's challenging because the world will have to at least double our food supply in the next 30 years if we're going to feed 9.6 billion people."

Prasad is a co-author of a study called "Rising temperatures reduce global wheat production," published in a recent issue of the scientific journal *Nature Climate Change*. For the study, the researchers systematically tested 30 wheat crop models against field experiments from around the world that were conducted in areas where the average temperature of the growing season ranged from 15 to 32 degrees Celsius. The models accounted for planting dates, planting rates, temperatures and other crop management factors. With the models, researchers were able to look at the effects of temperature stresses on wheat and predict future changes based on temperature changes.

The researchers found that the effects from climate change and its increasing temperatures on wheat will be more severe than once projected and are happening sooner than expected. While, according to Prasad, increases in the average temperature are problematic, a bigger challenge is the extreme temperatures that are resulting from climate change.

"Extreme temperature does not only mean heat; it also means cold," Prasad said. "Simply looking at the average temperature does not really show us anything because it is the extremities that are more detrimental to crops. Plants can handle gradual changes because they have time to adapt, but an extreme heat wave or cold snap can kill a plant because that adjustment period is often nonexistent."

Researchers also found that increasing temperatures are shortening the time frame that wheat plants have to mature and produce full heads for harvest, resulting in less grain produced from each plant. "It's like having one minute to fill a tall glass with water. Under optimal conditions, we can fill that glass pretty well," Prasad said. "But now we are factoring in extreme temperatures that are affecting the growing window and the grain size. So, it becomes like trying to fill that same glass, but now we only have 40 seconds to do it and the faucet is running slower."

Currently, Prasad and colleagues at Kansas State University, in collaboration with the university's Wheat Genetics Resource Center, are using growth chambers and heat tents to quantify the effects of temperature and to identify heat tolerant sources of wheat. The data will help in refining the crop models so that they can be more accurate in predicting wheat responses.

Their work will help scientists develop more robust models that can help farmers globally select more weather-tolerant and resilient wheat varieties based on their location. Additionally, farmers can determine the optimal planting date to avoid stress and minimize possible exposure to extreme weather events, such as heat and cold snaps, during the growing season.

VOCABULARY AND GRAMMAR

Read the sentences on the answer sheet and choose the right alternatives.

WRITING PART

Write a short essay of about 200-250 words on the answer sheet on the topic given below.

Global warming is said to be one of the main problems of today. In what ways has it already affected your country? What do you think will happen in your country if nothing is done about it? What can done globally, by national governments, communities and by individuals in order to slow down or stop the process of global warming? Discuss these issues in your essay and give it a suitable title.