STUDENT NAME		EDUCATION	
STUDENT NUMBER			

Test name	Object-Oriented Programming 2
Subject code	OOP2
Test date	
Test time	
Examiners	Martijn Pomp, Jan Doornbos
Test duration	180 minutes
Number of exercies/questions	5 (+1 challenge exercise)
☐ Answer form ☐ Answer sheet ☐ Writing paper ☐ On the test itself ☒ Git repository	You can get your repository here:

Maximum attainable points	100
Number of points with which the test was passed	55

Permitted aids

☐ none	☐ textbook	☐ calculator	☒ printed coding conventions
☒ draft paper	☐ law book	☐ graphics calculator	☐
☐ graph paper	☐ dictionary	☒ IntelliJ (without plugins)	☐

General test instructions:

- Write your details clearly and correctly in your repository (README.md).
- Warn the invigilator if something is unclear about the test.
- Hand in all the material when leaving the test room.

If, during the test, you have a complaint about the contents of the test or about how the test is held, you must submit your complaint in writing within 2 working days to the relevant Examination Committee.

My school can trust the fact that I took this test independently without the help of others and that I have only used the tools and aids that the examiner has allowed me to do.

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CASE NUCLEAR POWER PLANT

The municipality of Emmen, because of the good reputation of Information Technology students, has asked you to write the software for a new nuclear power plant being built on the site of the Rensenpark/the old zoo. Because of hard deadlines, this software must be ready within three hours.

The nuclear power plant consists of a reactor. In the reactor there are one or more splitting rods. A splitting rod has a residual percentage that indicates how much the rod can still be split. This is initially 100%. The rods are split using the so-called `split` method. This `split` method returns a residual heat (rw) (in Kelvin) and an amount of steam in m^3. The parameters of the `split` method are a temperature in Kelvin (T) and time in seconds (t). There are now two types of splitting rods. Table 1 gives the properties about the splitting rods. $\sqrt{x}$ in Java is `Math.sqrt(x)`.

Table 1 Properties of splitting rod types

SPLITTING ROD	PROPERTIES
NHLIUM	The residual percentage decreases by 0.06% per second time. At a temperature less than 90 Kelvin the amount of m^3 steam is: $\frac{T}{70} \cdot t \cdot 0{,}9$. The residual heat is then $t \cdot 3$. Under other conditions, the amount of steam is $0{,}9 \cdot \frac{T*0{,}9}{t} \cdot \sqrt{3} \cdot t$. The residual heat is $\frac{T}{10}$.
STENDAANIUM	The residual percentage decreases by $0.00007 \cdot T \cdot t + 0.0004$ percent. If the temperature is below 50 Kelvin, the residual percentage does not decrease. The amount of $m3$ steam generated is $50 \cdot T$. The residual heat is $\frac{t}{0{,}5} \cdot 20$.

The nuclear power plant also contains a generator. This generator converts the steam that comes out of the reactor into energy (kWh). This is done in a `generateEnergy` method. This method returns the number of kWh. The number of kWh is $m^3 \cdot 8.0$. In addition, the generator keeps track of the **total** number of kWh produced.

In addition to the generator, there is also a cooling system. This cools the residual heat. This is done in the `abductResidualHeat` method. The cooling system keeps track of the water temperature. This is initially 0. The water temperature is the $rw \cdot 0.40$.

Eventually everything comes together in the power plant. So, the power plant consists of three buildings: a reactor, a generator and a cooling system. In this power plant, create a method `run` that has a temperature and time as parameters. This makes the power plant work (run): the reactor generates steam and residual heat from the splitting rods. These are then dissipated in the generator and cooling system. This `run` method ultimately returns only the number of kWh generated.

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Your colleague has already created a foundation with the class diagram. This can be found in Appendix 1. Unfortunately, he spilled his coffee.

ASSIGNMENT 1

Build the software based on the class diagram and the text above.

ASSIGNMENT 2

Unfortunately, a nuclear power plant is not without danger! For example, a meltdown can occur.

a) Create a `MeltdownException`.
b) Throw the `MeltdownException` in the following cases during splitting:
   - *NHLium*: The time is more than 60 seconds and the temperature above 100 Kelvin. Also, if the percentage left of the fission rod is less than 0.1 percent.
   - *Stendaanium*: If the temperature exceeds 150 degrees.

ASSIGNMENT 3

It seems to be useful to have a so-called control room that monitors the status of all buildings of the nuclear power plant. This is done with the `getStatus()` method. It must be implemented *mandatorily* in all buildings except the control room itself. The `getStatus()` method can only return one of the following three values: `Stable`, `Needs Attention` and `Unstable`.

a) Add this method to the buildings. Keep in mind the following:

BUILDING	`Attention`	`Unstable`
REACTOR	If 0.2 percent or less of one of the splitting rods remains.	-
COOLING SYSTEM	If the temperature is between 80 and 90 degrees.	If the temperature is 90 degrees or higher.
GENERATOR	-	If more than 560 kWh were produced.

b) Create the control room. This eventually contains all the buildings to be controlled.
c) Create a method in the control room (`isNuclearReactorStable`). This returns `false` if one of the buildings is not `Stable`. Otherwise, it returns `true`.
d) Add the control room to the nuclear power plant.

ASSIGNMENT 4

Make a Unit test for the material Stendaanium.

APPENDIX 1: CLASS DIAGRAM