Question 2

(i)

A student conducts a number of experiments to measure the fracture strength of material. After the first set of tests, she realises that she should have polished the samples in order to conform with the standard test method so she discards this set of data and repeats the tests. In the second set of test, a number of samples fail as she sets up the apparatus. She ignores these tests and only presents the data from the tests that she was able to conduct.

It is going to be discussed here the implication of her actions. (Chronologically)

First of all it is said that after the first experiment, she realised that she did not conform exactly with the standard test method and as a consequence of that she immediately discarded the results.

- She did the right thing here, especially if she is not very familiar with this kind of test (from what that can be read further in the extract, apparently she is not...). The accuracy of the results she got is probably altered by what she did wrong during the experiment. However if this can be the safest way to proceed, this is not necessary true every time. Indeed here for instance, saying that the value of the facture strength is altered by the lack of polishing is really questionable... Maybe running a second test was not totally relevant. But as it has been said, the one doing the experiment must absolutely be aware of the consequence of its mistake and be extra careful interpreting the results. (quantifying the loss of accuracy)

She chose the safest way: repeating the experiment; but a number of samples failed.

- She apparently decided to run the tests with the same samples already used in the first experiment. If her first decision was the good one, or at least the safest one, she is here absolutely wrong. Indeed, samples have already been under a large amount of stress during the previous test and have been altered. This is true for every kind of destructive experiment. Once samples are used once, they cannot be used again otherwise the results are absolutely irrelevant. This is confirmed here by the failures.

She ignores these tests and only presents the data from the test she was able to conduct.

- This is her worst decision. Instead of trying to understand what went wrong in the second experiment, she just decided to hide her mistakes... What she presents is absolutely irrelevant. Her results are meaningless and cannot be taken into account in a serious discussion. In fact, the results of the first experiment are certainly far better that the one she presents considering that the lack of polishing had a very small influence on the results.
  As a consequence we could say that the first set of data is probably not as accurate has it should have been but gives a reasonable idea of the real behaviour of the samples. On the contrary the second set of data is largely irrelevant.

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As a conclusion here it is important to keep in mind that before taking any other action after her first mistake she should have analyse it. Indeed, sometimes, it is simply impossible to get new samples if something went wrong in a first experiment (time, cost etc...). As a consequence the question when it is not possible to get new ones is: how far are my first results from reality and are they going to be better if I run the test again with the same samples. The decision is usually very difficult to take.

But after all, for a student not very familiar with its subject, when the experiment is destructive, the safest way is without a doubt to repeat it with new samples.

(iv)

Table 1 below gives the value for the mass and radius of ten spheres. What is the density of the material from which the spheres are made?

Table 1: Mass and radius data for the spheres

Mass (g)	Radius (mm)
47.600	13.21
48.993	13.26
49.117	13.31
47.434	13.27
48.781	13.18
49.781	13.20
47.249	13.37
48.576	13.22
49.384	13.38
49.465	13.36

The density of a material is defined as its mass per unit volume:

$$\rho = \frac{m}{V} \qquad \text{(equation 1)}$$

The following table gives the detailed calculation with all the necessary steps to calculate the standard error.

Table 2: Excel calculation of the density

Mass (g)	Radius (mm)	Volume (cm^3)	Density ($g\ cm^{-3}$)	$(m-x_i)^2$
47.600	13.21	9.656	4.930	1.13E-03
48.993	13.26	9.766	5.017	2.86E-03
49.117	13.31	9.877	4.973	9.45E-05
47.434	13.27	9.788	4.846	1.37E-02
48.781	13.18	9.590	5.086	1.52E-02
49.781	13.20	9.634	5.167	4.16E-02
47.249	13.37	10.011	4.720	5.93E-02
48.576	13.22	9.678	5.019	3.14E-03
49.384	13.38	10.034	4.922	1.71E-03
49.465	13.36	9.989	4.952	1.22E-04
		Volume = $4/3\pi r^3$	Mean m = 4.9632	Variance = $\sum (m-x_i)^2/4$ = 3.472E-02 $(g\ cm^{-3})^2$

As a consequence,

Best estimate of the variance is: V = 3.472E-02 $(g\ cm^{-3})^2$

Standard deviation: s = $(3.472E-02)^{1/2}$ = 0.1863 $g\ cm^{-3}$

Standard error: s(m) = $s/\sqrt{n}$ = $0.1863/\sqrt{10}$ = 0,0589 $g\ cm^{-3}$

Hence, the final result for density is: 4.96 ± 0.06 $g\ cm^{-3}$

(v)

Write an abstract of between 150 and 250 words for the study that you undertook for the group task.

Staplers are mechanical devices widely used in everyday life. They can appear very basic at first, but in fact the final product is the result of important studies .This group work investigated the impact of mechanical and design requirements on the choice of materials used in a stapler and on the manufacturing processes. To do so, four different parts of the stapler have been extracted and analysed: the housing, a pin, a spring, and the anvil. Each sample went through light microscopy observation, hardness tests and SEM experiments in order to underline the main characteristics of the specimens at different scales. Despite the fact that the main material remains steel, it has been found that these stapler parts are totally different. Indeed, results obtained show that heat treatments, carburization, or nickel coating have been done during the manufacturing processes to improve the characteristic of the basic steel and the efficiency of the stapler. As a conclusion, this study sets up a discussion about potential alternatives and further development considering cost improvements or the use of recyclable materials.

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(vii)

An institution is considering changing its regulation so that students have to submit an electronic copy of their thesis rather than a paper copy. Summarise the advantages and disadvantages of such a change for the student, the institution and readers of the thesis (e.g. examiners, other students).

To answer this question the best way possible, this small essay is going to be divided in 3 parts. The first one is going to focus on the student's point of view. Then, the changes for the institution are going to be analysed and finally, other readers are going to be considered.

First of all, for the student it is probably a lot more convenient to submit and electronic copy. Indeed, sending an e-mail to the supervisor or to the institution is usually quick and easy, compare to the time needed to find a printer and print the whole thesis. It is even truer because nowadays students write their entire thesis on a computer and are more and more familiar with them. However, some problems can occur. Indeed, if the electronic copy is the only submission possible, the student would be dependent on the technology. For instance, if the thesis contains a lot of images its size can be important, and as a consequence over the limitation set by the mail box. Moreover if the student if very unlucky, it happens sometimes that for a mysterious reason the file is just impossible to read and the data is lost. On the contrary, paper copies are usually safer. Finally, it is also true that for the student printing a big amount of pages can be expensive. Also because sometimes the student needs several tries before being fully satisfied with the layout and because he has to hand a copy to several people, the number of pages to print could be up to 500 which is, again, long and expensive.

About the institution, things are a little bit similar. Indeed, it is also true that receiving an e-mail is very easy and more convenient than a lot of paper copies. Furthermore, plagiarism checks are now made electronically and again here paper copies cannot fit. In addition, if the thesis is good, the institution may want to send it to a journal for publication. If only a paper copy is available this may takes ages and as a consequence the diffusion on the thesis is a lot slower than for an electronic copy. Finally, it is a known fact that storing thesis only electronically has to be avoided. Indeed, it is not really safe to rely on hard drives or CDs because after 10years they usually fail. Versions of software also change very often (sometimes every year) and as a consequence the thesis ends up being impossible to be opened with the new format. All of it never happens with paper copies.

From the readers' point of view, there are not many advantages in changing the regulation to electronic copies. Indeed, reading a thesis of 100 pages or more on a computer screen is truly painful. In addition, a paper copy is always easier to correct for examiners as they can write down annotations or remarks on it.

As a conclusion, it is important to keep in mind that there are several advantages for both electronic and paper copies. However, neither one nor the other can fully satisfy everyone (students, institution, readers...) and the best solution is probably to submit both of them.