EXTRA PRACTICE

**Section A- 1) Read the text about FRICTION and complete the gaps(1-6) with the missing sentences listed below (A-F).**

**Friction: blessing and curse**

**When two objects are in contact and one object is moved past the other, a force is created which resists the movement of the objects: it is called friction. Friction occurs in all machines and is usually considered detrimental to the machine’s efficiency, but there are times when it is required for the correct functioning of a machine. Although the effect that friction has on an engineering system depends on the nature of the materials that are in contact, certain facts are known to be consistent for all materials.**

In many mechanical design specifications, engineers must bear in mind several principles of friction. These are, specifically:

* Friction is a force that opposes movement between two objects.
* **1**

1

* To initiate movement from a standstill, more force is needed to overcome friction than the force required to maintain a constant speed when the objects are already in motion.
* Generally speaking, the smother the surface, the lower the friction.
* Friction can be reduced by lubrication and by good design.

If friction is not taken into account by engineers beginning work on a design, the results are both costly and damaging. Any machine with bearings loses a certain amount of power in overcoming the friction in the bearings, but the friction also causes wear and heat. As surfaces wear, one of two things can happen. **2 .** When corollary heat is generated, the components can reach very high temperatures and the material properties can change.

1

In order to reduce friction, the surfaces that are in contact need to be made smoother. In addition to machining (or polishing), this can be done in two ways. Firstly, a lubricant can be added to reduce the coefficient of friction and so minimize the wear and heat. **3** . Secondly, the components can be designed so that the friction is minimal. A ball bearing, consisting of many balls rolling freely in a groove, is an example of a part designed to overcome friction: the friction of the rolling balls is lower than the sliding friction between a shaft and its housing.

1

Many examples of components that are affected by friction can be found in an internal combustion engine. **4** . Without lubrication, this sliding will quickly cause overheating and the engine would seize; the pistons might even weld themselves to the inside of the cylinders. Gears and cams too require careful lubrication: components are often subject to pitting as a result of erosive wear, which is a common cause of car engine inefficiency.

1

The lubrication system also provides oil to the moving parts of the engine. **5**  . For the same reason, frequent oil changes with the machines at rest are necessary to prevent dirt causing damage.

1

Not all friction is harmful to the performance of a car, however. **6**  . In fact, most engineering systems usually contain a mixture of parts that require lubrication to reduce friction and parts that deliberately wear out, using friction “usefully”.

1

1. Some parts of cars are deliberately designed to dissipate energy through friction- brake pads and tyres, for example.
2. There is always some friction when two touching objects move relative to one another.
3. There are many types of lubricants: thick or thin oil; powders, like talc; solids, such as graphite, and even acoustic lubrication, i.e., sound.
4. Either greater friction is caused by the worn parts, requiring more power to overcome it, or good contact is lost between the surface, causing machine failure.
5. The pistons require lubrication because they slide up and down the cylinders.
6. Before being pumped to the relevant parts of the engine, however, oil must be passed through a filter in order to remove dirt which otherwise create friction and cause wear to components



**Complete the summary below with words from the box. There are extra words.**

Friction is a force which **7\_\_\_\_\_\_\_\_\_\_\_**when two **8\_\_\_\_\_\_\_\_**which are in contact move relative to each other. In an **9\_\_\_\_\_\_\_\_\_,** friction is generally considered to be **10\_\_\_\_\_\_\_\_\_\_\_**to the system as it

**11\_\_\_\_\_\_\_\_\_\_\_\_\_\_**heat and wear, and extra power is **12\_\_\_\_\_\_\_\_\_\_\_\_** to overcome it. Lubrication and careful polishing are used by designers to help **13\_\_\_\_\_\_\_\_\_** the **14\_\_\_\_\_\_\_\_\_\_\_\_**of friction.

**effects increase minimize components occurs properties engineering system affects needed detrimental unnecessary generates reduces**

**SECTION B- Read the text below about computer integrated manufacturing.**

**Computer integrated manufacturing**

Microprocessors have been part of the manufacturing process since the 1960s. At first, they were only for certain processes in high- profit companies, because computers were very large and expensive. However, with the advent of the personal computer (PC) in the early 1980s, it became viable to computerize even small processes, taking humans out of tedious operations and unfriendly environments. More and more computers entered manufacturing, but only as aids, not as an integral part of the system. This was sometimes called CAM-computer assisted manufacturing. The overall process does not change, but steps are computerized.

By the end of the 20th century, a totally new and more efficient approach had become possible. CIM(computer-integrated manufacturing), as it is called, interlinks technologies to create the best manufacturing environment, from order to delivery. It spans all facets of business, although engineering plays the central role. However, CIM requires all software and hardware to be compatible, i.e., able to communicate with each other. Unfortunately, many companies have islands of computerization with hardware from different suppliers, and programs written in different languages- BASIC, PASCAL, etc. It is often impossible to pass information from one island to another, so a full CIM system cannot be implemented.

Many companies, therefore, are unable to use CIM. With the alternative, CAM, every step may be computerized, but each is a discrete process. Orders are logged into the computer. The designers then produce detailed drawings, probably using computer- aided design (CAD), with data input from the customer’s specifications, as well as current research in product development and manufacturing technologies. The CAD output is then sent to manufacturing engineering, where it is translated into instructions for processes on the shop floor.

CIM is very different from CAM. Let us compare CIM and CAM in just one step- the interface between design and engineering. A customer’s specification may require non-standard components or a process that the company does not have. If the designer applies that specification in a CAM environment, the engineering department must order special components and processes to follow the design. With CIM, such problems are avoided. Instead of a linear manufacturing process, as in figure 1, integrated manufacturing (figure 2) involves all the enabling technologies revolving around the CIM database, with processes interacting all the time. Designers are automatically reminded of previous similar designs and problems. If a designer asks for a non-standard screw, CIM signals a warning and suggests similar standard screws. If engineering asks for components to be CAMmed in a certain order, CIM prompts that the machine is occupied with another job at that time. If computer -aided testing (CAT) finds a problem in the first batch, this data is immediately fed out to all the enabling technologies so that it can be promptly rectified. Even the salesmen can use these technologies when negotiating with customers.

CIM is clearly the future. However, companies can only introduce CIM to new factories and will continue to rely on CAM in existing facilities.



1. What is the structure of this text? A or B?



1. What exactly is CIM?
2. How are CIM and CAM different?
3. Why can’t all manufacturing companies use CIM?

**Section C- Read the text below and do the tasks below.**

Sustainable development is one of the biggest challenges facing engineers in the 21st century. Currently, industrial and economic development rely on the use of resources which will not last forever, and whose consumption may threaten the future of the planet. Sustainable development is about improving the standard of living across the world in a way that can be maintained in the long term. For example, it is pointless to dig a well to provide water for a village if the pump cannot be maintained when it breaks down, or if over-abstraction of the water results in the well drying up, or if the villagers do not have the skills or cannot afford to keep the well going. This example shows that the sustainable development must take into account not only economic issues such as capital and maintenance costs, but also social and environmental factors. The recognition that there is more to a project than exclusively financial sustainability is sometimes called “triple bottom line” (economic, social and environmental).

Usually, engineers are driven by short-term economics at the expense of the other factors. This is short-sighted. The planet’s resources are finite; that is to say we have limited land, energy and water, resource which must be shared amongst the earth’s population. It is estimated that, if everyone on Earth uses the same amount of energy as someone living in the UK, we would need 8.5 planets to live on! Clearly this situation is not sustainable.

Engineering has played a big part in the way that energy has been produced and used. It is now widely recognized that human-induced greenhouse gas emissions, mainly due to the combustion of fossilized hydrocarbons, are changing the composition of the atmosphere in such a way that the earth’s average global temperatures will increase. The consequences of global average temperature rise of even 2°C will be profound and potentially disastrous: mass flooding due to a rise in sea levels, destruction of important ecosystems and food supplies, and the spread of tropical diseases such as malaria. Yet, the physics of planetary temperature balance are nothing new; in fact, they were first understood by the renewed mathematician Fourier, almost two hundred years ago. The primary use of hydrocarbon-molecules containing hydrogen and carbon which can be combusted to release energy- is for energy; the energy that moves our cars and trucks, heats our homes and lights our offices. Oil, coal and natural gas, or methane are the chief suspects, the unsustainable modern-day workhorses which help us do the tasks that would otherwise require manual labor.

The urgent challenges of sustainable energy production and use need to be met by engineers. Firstly, energy demands need to be reduced to an absolute minimum. This will partly be through behavioral changes; for example, using the car as little as possible (or getting rid of it), but demand reduction will primarily be through the implementation of more efficient lightening, heating, cooling and transport technologies. Secondly, energy needs to be generated from sources that do not place further global warming gases in the atmosphere. Renewable energy sources, such as wind, tidal and solar power, have a big part to play with nuclear power as a potentially important interim solution.

Another area where engineers have an important role is in the way that materials are used. Most products are designed with a “cradle to grave” life in mind, that is to say they begin as some raw material (for example, aluminum) and end up as a product such as drinks can, which is then discarded into a landfill site. A tremendous amount of energy and effort has gone into the manufacturing of the product and at the end of its life it is no longer useful. This situation does not exist in the natural world, where decaying plants and animal matter become food for other plants, animals and organisms. Engineers should try to copy this “cradle to cradle” idea, which is an approach where products are still useful at the end of their lives. A radical shift is required in how products are designed by engineers. This process is sometimes called “eco-design” or “green design”. For example, materials should be sourced from other “dead products” rather than fresh sources. The designer should consider how those disposing of the product will be able to sell it on for another use, as a valuable commodity.

A final area where there is a huge scope for engineering creativity is in water and sanitation, which is sometimes abbreviated to “watsan”. It was engineers who, in 19th century Victorian Britain, constructed the water supply and sewerage systems that enabled London to be significantly cleaner and less disease-ridden. The principles of good water supply and sanitation have been known since Roman times. Yet, many in the world still go without clean water, and there are large inequalities between water use from country to country. Innovative, cheap, appropriate solutions to give people access to clean water are in great need.

In summary, the situation on our planet is currently unsustainable. Human beings are “living on the capital rather than the interest”. A range of urgent changes is required if the effects of catastrophic climate change, over-use of resources and widespread pollution are to be avoided. Engineering has a key role to play in many areas, including energy, materials, waste, and water and sanitation.

1. Choose the most appropriate title for this article:
2. Alternative energy sources
3. The future of our planet’s resources
4. A sustainable future-the challenge for engineering
5. What other factors besides the financial ones, affect sustainable development?
6. What are they called?
7. What will happen if the average temperatures rise even 2°C?
8. What is the problem with aluminum drink cans?
9. What is the concept of eco-design or green design?
10. What do you understand the author means with: “Human beings are “living on the capital rather than the interest”?

Match each word **(8-12)** with its meaning **(A-E)**

**A**

**B**

**C**

**D**

**E**

1. triple bottom line
2. Hydrocarbons
3. Renewable energy sources
4. Cradle to grave
5. Cradle to cradle