

# **English for the Students of Engineering**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

In the Name of Allah  
the Compassionate, the Merciful

پیش‌تر احتیاج به زبان - زبانهای خارجی - نبود امروز احتیاج است به این، یعنی جزو برنامه تبلیغات مدارس باید زبان باشد و زبانهای زنده دنیا، آنهایی که در همه دنیا شایع‌تر است.

صحیفه امام؛ ج ۱۸، ص ۱۰۴

## «سخن سمت»

یکی از اهداف مهم انقلاب فرهنگی، ایجاد دگرگونی اساسی در محتوا و شیوه تدوین کتب درسی دانشگاهها، بخصوص در زمینه علوم انسانی بوده است.

به همین جهت شورای عالی انقلاب فرهنگی در تاریخ ۶۳/۱۲/۷ تأسیس «سازمان مطالعه و تدوین کتب علوم انسانی دانشگاهها» را که به اختصار «سمت» نامیده می‌شود، تصویب کرد تا اختصاصاً به این مهم بپردازد.

این سازمان با توجه به نیاز دانشجویان، در فرصتی خاص، علاوه بر تدوین متون آموزش زبان خارجی در مرحله عمومی، نیمه تخصصی و تخصصی برای علوم انسانی، در محدوده خاصی به تدوین کتب آموزش زبان تخصصی سایر رشته‌ها پرداخت که کتاب حاضر یکی از آنهاست.

کتاب حاضر برای دانشجویان مهندسی در مقطع کارشناسی به عنوان منبع اصلی درس «زبان تخصصی (ESP)» به ارزش ۲ واحد تدوین شده است. امید می‌رود علاوه بر جامعه دانشگاهی، سایر علاقه‌مندان نیز از آن بهره‌مند شوند.

دشواری چنین کاری بر دانشمندان و صاحب‌نظران پوشیده نیست و به همین جهت مرحله کمال مطلوب آن، باید به تدریج و پس از پیشنهادهای اصلاحی ارباب‌نظر به دست آید و انتظار دارد که این بزرگواران از این همکاری دریغ نورزند.

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## Blueprint of the Book

Units	Theme	Reading Strategy	Vocabulary Fuel	Grammar Engine
<b>1</b>	<b>Electricity</b> Reading 1: Electric Current Reading 2: Electric Shock: What to Do against It?	Previewing	Naming Phenomena	‘On the Other Hand’ & ‘However’
<b>2</b>	<b>Robots</b> Reading 1: Robots Reading 2: Robots and Artificial Intelligence	Scanning	Prefixes 1	Relative Clauses
<b>3</b>	<b>Nanotechnology</b> Reading 1: Nanotechnology Reading 2: Nanotechnology and Its Dangers	Skimming	Compound Words Word Families	Correlative Conjunctions
<b>4</b>	<b>Magnetism</b> Reading 1: Magnetism Reading 2: What Is Induction?	Speed Reading	Parts of Speech	Conditionals
<b>5</b>	<b>Information Technology</b> Reading 1: An Introduction to Wireless Technology Reading 2: The Internet and Fiber Optics	Understanding Purpose & Text Organization	Collocations	Subject-verb Agreement
<b>6</b>	<b>Electric Vehicles</b> Reading 1: Electric Vehicles Reading 2: Advantages and Disadvantages of EVs	Reading without Knowing Every Word	Using Translation	To + Infinitive Structures
<b>7</b>	<b>Radars</b> Reading 1: Radars Reading 2: Radar and Weather Forecasting	Outlining as You Read	Abbreviations	Passive Voice 1
<b>8</b>	<b>Industrial and Systems Engineering</b> Reading 1: Industrial and Systems Engineers Reading 2: The Interdisciplinary Industrial and Systems Engineering	Marginal Notes	Prefixes 2	Comparative & Superlative Adjectives
<b>9</b>	<b>Concrete</b> Reading 1: Concrete Reading 2: Significance of Various Concrete Strengths	Summarizing	Synonyms & Antonyms	Transitional Expressions
<b>10</b>	<b>Nuclear Power Plants</b> Reading 1: Nuclear Power Plants Reading 2: ?	Inferencing	Suffixes	‘(Al)though’ & ‘But’
<b>11</b>	<b>Bridging</b> Reading 1: Bridge Types and Economic Spans Reading 2: Location of Bridges	Highlighting, Underlining, Numbering, & Circling	Geometric Shapes & Angles	Passive Voice 2 So that
<b>12</b>	<b>Gear Drives</b> Reading 1: Gear Drives Reading 2: Gear Drive Troubleshooting	SQ3R System	Filling in the Blanks	Reduced Relative Clauses

## Introduction

*English for the Students of Engineering* is designed as an English for Academic Purposes (EAP) textbook for undergraduate university students of engineering ranging from pre-intermediate to upper-intermediate level of English proficiency. The book aims to help students consolidate general reading skills and strategies they have already acquired through general English courses and transfer these skills and strategies to their target academic tasks. Hence, a wide range of engineering text types/genres have been included in the book to provide students with ample opportunities to learn and practice discipline-based reading skills. With the main focus on reading, the other language skills and components (i.e., vocabulary, grammar, discourse, and genre) are used as a springboard for fostering the reading skills and strategies.

The book consists of 12 units based on engineering themes and topics of maximum authenticity and relevance to the students of engineering. The centerpiece of each unit is two reading passages developing the same theme and all activities of each unit are geared to that theme. To that end, there is an efficient integration of relevant content and language with a good distribution of common genres in the field of engineering.

The units are divided into various sections as introduced below:

**Title Page:** It is designed to give readers a general overview of the theme and content of the unit.

**Start-up:** They aim to engage students mentally to think about the topic of reading and relate it to their lives. A preliminary focus on important vocabulary items is also intended.

**Reading Passages:** Texts from a variety of authentic and credible sources are accompanied by glosses and technical notes.

**Gauge Your Grasp:** These parts assess the readers' comprehension of the texts through a broad range of comprehension questions and tasks.

**Reading Strategy:** A reading strategy that is helpful in academic contexts is introduced in each unit. It matches with the nature of the relevant reading passage.

**Vocabulary Fuel:** Different aspects of word knowledge are taken into account through both explicit instruction and task-based activities.

**Grammar Engine:** Grammar is mostly treated through a discovery approach. The grammar point in each unit is taken from the related reading passage.

**Translation:** This section is designed as a reading practice as well as a translation activity. It also offers focused activity on vocabulary, grammar, and some features of genres presented in the unit.

**Tune-up Time:** To give the learners a sense of achievement, each unit ends up with a self-assessment part in which the main objectives of the unit are worded explicitly using performative verbs.





# Unit 1



# Electricity



## Unit Focus

**Reading 1:** Electric Current

**Reading Strategy:** Previewing

**Vocabulary Fuel:** Naming Phenomena

**Grammar Engine:** ‘On the Other Hand’ & ‘However’

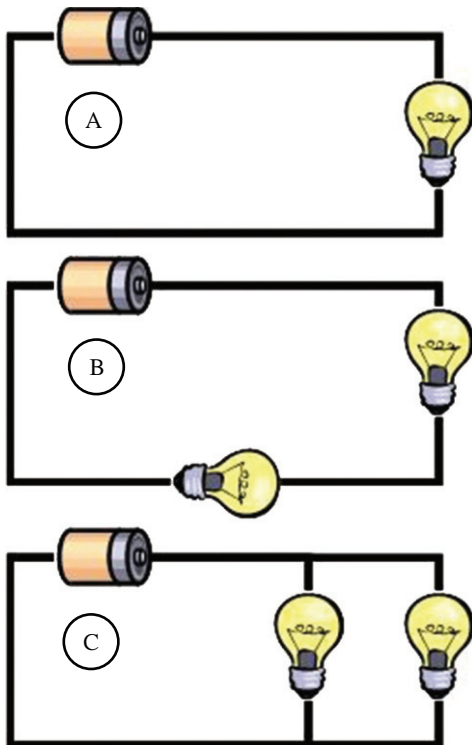
**Reading 2:** Electric Shock: What to Do against It?

## Reading 1



### Start-up

A. What type of circuits do the following photos show? Match them with their descriptions.



..... In a **series circuit**, devices are connected so there is only one closed path for the current to follow. However, if any part of this path is broken, the current will no longer flow in the circuit.

..... In a **parallel circuit**, devices are connected so there is more than one closed path for the current to flow. If the current flow is broken in one path, the current will continue to flow in the other path.

..... In a **simple circuit**, you can find the minimum things needed to have a functioning electric circuit.

B. **PAIR WORK** Answer the following questions.

1. What are the functions of the above-mentioned electric currents?
2. What type of energy is associated with electric currents?

## Read

# Electric Current

When a lamp is switched on, there *occurs*<sup>1</sup> a movement of electricity through the lamp and its connective wires. This is called the electric current although strictly it is only one form of the current, namely the **conduction current**, as distinct from **convection** and **displacement currents**.

5           The electric current may be either direct, flowing in one direction only, or alternating, *reversing*<sup>2</sup> its direction many times per second. Alternating current is now in general use for industrial and *domestic*<sup>3</sup> supply mainly because it is easier to *generate*<sup>4</sup> and *transmit*<sup>5</sup>. Direct current, on the other hand, is used for local systems, such as those on motor vehicles, for supplying  
10 electric trains, where it has certain advantages, and for **electro-plating** and battery charging, where it is essential. For such purposes, however, direct current is not always generated as it is a simple matter to *obtain*<sup>6</sup> it from alternating current.

## Effects of Current

15           The current, although it cannot be observed, can be made to manifest itself by its effects. The most important of these are (i) a heating effect (*utilized*<sup>7</sup> in the electric fire), (ii) the magnetic effect (which is used in the electric bell), and (iii) the chemical effect, which occurs when a current is passed through certain liquids in electro-plating and battery charging. Instruments  
20 for measuring the current depend upon these effects – usually the magnetic one.

## Production of Current

A simple way of *establishing*<sup>8</sup> a current is by means of a cell in which chemical change occurs to *maintain*<sup>9</sup> the **flow**. The cell may be of the *primary*<sup>10</sup> type, such  
25 as a dry cell, or it may be a secondary cell, or accumulator, which is *capable*<sup>11</sup> of

## Glossary

1. happens

2. changing

3. household

4. produce

5. send

6. get

**Can you name some electric devices?**

7. used

8. developing

9. keep

10. main

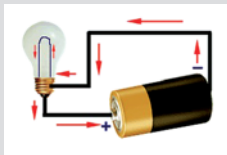
11. able to do something

Do you know any devices that work with cells?

12. part

13. made

14. while; but



15. showing



16. signs

being recharged. Where two or more cells are used, the arrangement is called a battery – a term that is sometimes incorrectly applied to a single cell.

Electricity is not actually used by the cell; it is a constituent part of the matter, and the cell merely acts as a pump to keep it flowing through the wire and also through the cell itself. The complete pass is known as the **circuit** although 30 this term is often applied to a *portion*<sup>12</sup> of the path, e.g., that outside the cell.

A generator, or dynamo, performs the same function as the cell, but it makes use of mechanical energy and must be driven by mechanical means. It can be *constructed*<sup>13</sup> to provide either direct or alternating current *whereas*<sup>14</sup> the current produced by a cell must necessarily be direct. 35

### Direction of Current

A cell, or a DC generator, has two terminals, namely the positive and the negative. These were originally referred to as ‘poles’, and the term ‘polarity’ is still used for the distinction between them. This distinction is necessary because the conventional distinction of the current is from the positive terminal to the 40 negative outside the cell or generator, and from the negative to the positive inside it.

There are various ways of *indicating*<sup>15</sup> the polarity of the terminals. They may be marked + and – ; or they may be colored red and black, respectively, as is often done with accumulators; or they may be of different sizes, as in some 45 motor-car batteries where the positive is made larger to avoid wrong connection of the **cable lugs**. The polarity of dry cells, on the other hand, is not always indicated, but it may be easily determined by remembering that the center terminal is always positive.

### Unit of Current

The unit in which the electric current is measured is called the ampere. The ampere is a measure of the rate of flow of electricity and not the amount of electricity itself.

The capital roman letter A is the standard abbreviation for the ampere. The system for current is, however, the capital italic letter *I*, which has been 55 chosen by international agreement, as have other electrical *symbols*<sup>16</sup>. Thus, the

expression  $I = 2A$  means the current is equal to 2 amperes.

Adapted from: Agger (1971)

**What other electrical symbols are you familiar with?**

## Engineering Terms

**conduction current:** electrical current resulting from the movement of free gas

**convection current:** the transfer of current through a fluid by the physical movement of the fluid itself

**displacement current:** a quantity defined in terms of the rate of change of electric displacement field

**electro-plating:** coating a metal object by electrolytic deposition with chromium, silver, or another metal

**flow:** a smooth steady movement of electricity

**circuit:** the complete circle that an electric current travels

**cable lug:** a device used for connecting cables to electrical appliances, other cables, surfaces, or mechanisms



### Gauge Your Grasp

**A. Based on Reading 1, complete the following table.**

<b>3 types of current</b>	<i>conduction current,</i>
<b>3 effects of current</b>	
<b>2 flowing directions of current</b>	
<b>2 main uses of alternating current</b>	
<b>2 terminals of cell</b>	
<b>2 types of cell</b>	
<b>1 main use of direct current</b>	
<b>the unit of current</b>	

**B. Do the following statements agree with the information given in the text? Write**

- TRUE**                      **if the statement agrees with the information**  
**FALSE**                     **if the statement does not agree with the information**  
**NOT GIVEN**             **if there is no information about this**

**Then correct the false statements.**

- ..... 1. Direct current reverses its direction many times.  
..... 2. A battery is the same as a single cell.

- ..... 3. It is possible to observe the effects of an electric current.
- ..... 4. The effects of an electric current are heating, magnetic, and chemical effects.
- ..... 5. A primary cell is the same as an accumulator.
- ..... 6. Batteries use electricity.

**C. For each item below, circle the best answer.**

1. Direct current is used in all of the following EXCEPT ..... .
  - a. battery charging
  - b. electric trains
  - c. domestic supply
  - d. motor vehicles
2. In line 29, what does the underlined word refer to?
  - a. electricity
  - b. matter
  - c. cell
  - d. pump
3. Which of the following statements is NOT among the characteristics of a generator?
  - a. It makes use of mechanical energy.
  - b. It necessarily provides direct current.
  - c. It must be driven by mechanical means.
  - d. It can provide either direct or alternating current.
4. According to the text, which sentence is true?
  - a. In dry cells, the central terminal can be positive.
  - b. Ampere is used to show the current.
  - c. Direct current is easier to generate than alternating current.
  - d. The positive pole can also be marked as red.

**D. Answer the following questions.**

1. Can you explain the most important electrical effects referred to in the text?
2. How does a generator function?

**Reading Strategy** **Previewing**

Before reading a text, it is a good idea to **preview** it and think about the topic since thinking about the topic can activate your background information about it so that you can understand the text more easily. Often the heading, subheadings, and pictures of the text present key points that can help your comprehension.

While previewing, you should also pay attention to the first paragraph of the text. The first paragraph is the most important paragraph as it usually contains the thesis statement. A thesis statement introduces the main topic of the text. It is often located at the beginning of the first paragraph.



**A. Before you read, have a look at the heading and subheading of the following passage and try to predict its general idea. Why do you think electricity is not a form of energy?**

**B. Now read the passage and see if your prediction and answer are right or not.**

### **ELECTRICITY IS NOT A FORM OF ENERGY**

**Many encyclopedias, dictionaries, and textbooks contain very clear statements about the nature of electricity. They say this:**

**Electricity is a type of energy.**

**Electric current is a flow of energy.**

---

The above statements are wrong. Yes, electrical energy does exist. However, this energy cannot be called electricity. Energy and charge are two different things, so they cannot both be the electricity. It's not too difficult to demonstrate the mistake. Below is a simple fact which shows that electricity, the stuff that flows within copper wires, is not a form of energy.

In a simple electric circuit, the electricity flows slowly in a complete circle, while the energy moves differently. The electrical energy flows rapidly across the circuit, going from the source to the load but not returning. The energy does not follow the circular flow of electricity; electricity and electrical energy are two different things. No charges of electricity are gained or lost as the charges circulate within the wires, yet batteries create electrical energy from chemical energy, and light bulbs destroy the electrical energy as they convert it into light. Electrical energy takes a rapid one-way path from battery to bulb and then leaves the circuit as light, while electricity flows slowly around (and around and around) a closed-loop path and none is lost.

Adapted from: [amasci.com](http://amasci.com).

Pay attention to the following extracts:

When a lamp is switched on, there occurs a movement of electricity through the lamp and its connective wires. This **we call** the electric current although strictly it is only one form of the current, **namely** the conduction current.

The cell may be of the primary type, such as a dry cell, or it may be a secondary cell, or accumulator, which is capable of being recharged. Where two or more cells are used, the arrangement **is called** a battery.

The complete pass **is known as** the circuit although this term is often applied to a portion of the path, e.g., that outside the cell.

A cell, or a DC generator, has two terminals, namely the positive and the negative. These **were** originally **referred to as** 'poles'.

➤ **The above words in bold type are used to name objects, activities, processes, etc.**

A. Look at Reading 1 again. Can you find some more examples of the words used to name different phenomena?

B. **VOCABULARY PRACTICE** Complete each sentence with a word from the box. (Two words are extra.)

indicated	primary	occurs	transmit	reversed
capable	constructed	obtained	portion	establish

1. Direct current is usually ..... from alternating current.
2. A dry cell is of the ..... type.
3. The polarity of the terminals can be ..... by different ways.
4. When you switch on the TV, a movement of electricity .....
5. Since it is easier to ....., alternating current is more common.
6. An accumulator is ..... of being recharged.
7. In an alternating electric current, the direction is ..... many times.
8. A generator can be ..... to produce electricity.

**Read the paragraph:**

The electric current may be either direct, flowing in one direction only, or alternating, reversing its direction many times per second. Alternating current is now in general use for industrial and domestic supply mainly because it is easier to generate and transmit. Direct current, **on the other hand**, is used for local systems, such as those on motor vehicles, for supplying electric trains, where it has certain advantages, and for electro-plating and battery charging, where it is essential. For such purposes, **however**, direct current is not always generated as it is a simple matter to obtain it from alternating current.

**Now answer the following questions.**

1. What is the function of the words in bold type?
2. How will you translate them into Persian?
3. Can you find one more example of each in Reading 1?

**A. Rewrite the following sentences using *however* or *on the other hand*.**

1. A generator performs the same function as the cell, but it makes use of mechanical energy and must be driven by mechanical means.

.....

2. The polarity of dry cells is not always indicated, but it may be easily determined by remembering that the center terminal is always positive.

.....

3. The skin resistance is affected by the area of contact and the pressure but it depends particularly on the amount of moisture present and may be quite low if the skin is wet.

.....

**B. Fill in the blanks using *on the other hand*/*however* and *but*.**

Rheostats of high resistance are required for the control of light-current appliances. They are usually of circular construction, ..... the wire is replaced by a certain ring. ...., low-resistance rheostats required to carry heavy currents often consist of a number of thick carbon plates between two end ones of metal with terminals attached.

## Reading 2



### Start-up

**PAIR WORK** Answer the following questions.

1. Have you ever seen a person shocked by electricity?
2. Do you think electrical shock is always deadly?
3. Preview the first paragraph and answer:
  - a. What do you think the passage is about?
  - b. Can you find the thesis statement?



### Glossary

1. needed
2. area
3. come with



### Read

## Electric Shock: What to Do against It?

The current *required*<sup>1</sup> to produce the sensation of shock in the human body is quite small, perhaps as low as 2 **milliamperes**. The effect becomes painful in the *region*<sup>2</sup> of 10 milliamperes, and loss of muscular control begins at about 15. Currents of 20 milliamperes upwards are dangerous and may cause interruption of breathing due to the paralysis of the muscles controlling the lungs, often *accompanied by*<sup>3</sup> loss of consciousness. Moreover, these effects may continue after the current has been stopped, hence the necessity for immediate and prolonged artificial respiration. Still higher currents may damage the heart by fibrillation or produce severe burns.

Fortunately, the resistance of the human body is normally high, perhaps between 10000 and 50000 ohms. The skin resistance is affected by the area of

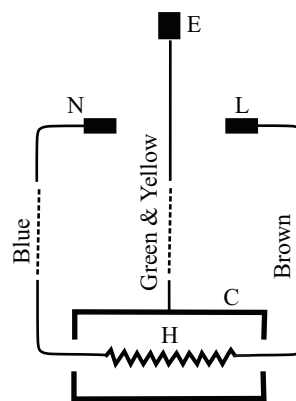
contact and the pressure but it depends particularly on the amount of moisture present and may be quite low if the skin is wet.

### Precautions against Shock

15 Most electric shocks are accidentally caused by touching the **line conductor** or something in contact with it; the current then passes through the body between the hand and ground. Here the resistance between the body and earth is important, and shocks should be particularly avoided when standing on tiles, concrete, or soil particularly if wet. When immersed in water, as in a bath, the  
20 risk of a shock proving fatal is very great indeed.

An important method of protection consists in **earthing** the frames of electrical machines and the metallic cases of electrical appliances. In the domestic AC supply there is, in addition to the 'line' and 'neutral', a third wire which is permanently connected to earth. The **pins** on the power **plug** make  
25 contact with these and the appliance is joined to the plug by a three-core flexible cable in which the individual wires are colored for ease of identification.

The arrangement is shown diagrammatically in the figure where H is the heating element of, say, an electric iron, and C is the metallic **casing** which  
30 is earthed through the third pin of the plug. Although the casing is **insulated** from the heating element, there is always a risk of accidental contact, which, if it were not for the earth wire, would cause the casing to become **alive** and a source of danger. The  
35 earth wire prevents this, and, if contact did *occur*<sup>A</sup>, the extra current flowing to earth would probably melt the fuse in the line and put the appliance out of action.



Adapted from: Agger (1971)

### Engineering Terms

**milliampere:** a measure for small electric currents that is one thousandth of an ampere

Have you ever experienced electric shock?



Can you think of any other means of protection against electric shock?

4. happen

**line conductor:** a metal used as a conductor in a power line

**earthing:** making electrical equipment safe by connecting it to the ground with a wire

**pin:** one of the pieces of metal that sticks out of an electric plug

**plug:** a small object at the end of a wire that is used for connecting a piece of electrical equipment to the main supply of electricity

**casing:** an outer layer of metal, rubber, etc. that covers and protects something such as a wire

**insulate:** to cover or protect something with a material that stops electricity, sound, heat, etc. from getting in or out

**alive:** (also 'live') connected to a source of electric power



## Gauge Your Grasp

### A. Answer the following questions.

1. What are the dangers of currents of 20 milliamperes upwards for the human body?
2. What happens when someone touches a line conductor?
3. How can you protect yourself against electric shock?
4. In the domestic AC supply, which wire is always connected to earth?

### B. Complete the following paragraph with the words from the box.

however      accompanied      required      dangerous      region

A small current is 1..... to bring about a feeling of shock in the human body and if it is too small, it will not be painful. 2..... when it reaches the 3..... of 10 milliamperes, it becomes painful. Currents of 20 milliamperes upwards are 4..... and might be 5..... by loss of consciousness.

## Translation

A. Take 20 seconds to preview the following symbols and decide which ones refer to electricity.



### DANGER

Electrocution risk!  
In case of fire, use CO2  
extinguisher only. Do not  
use water.

A

### IMPORTANT

No user-serviceable  
parts inside. Opening  
panel invalidates  
guarantee.

B

### BEWARE

Moisture-sensitive  
device. Store in a dry  
place.

C



D

B. Now that you have found the electricity symbols, translate them into Persian.

.....

.....

.....

.....

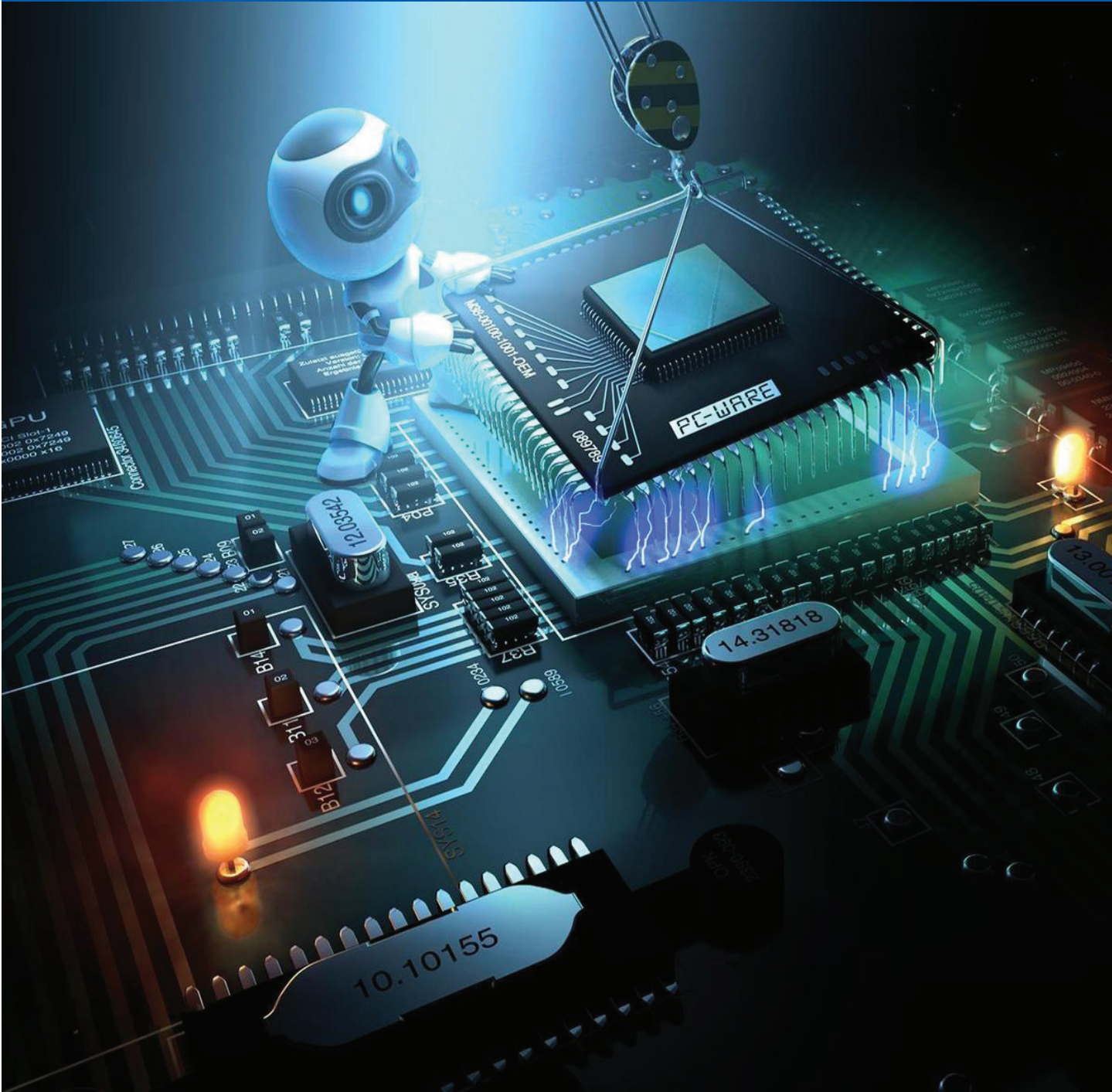


### Tune-up Time!

Assess your progress in this unit. Tick  the statements which are true about you.

- I can understand general information about electricity.
- I can understand technical terms about electricity.
- I can preview a passage before reading it carefully.
- I can recognize specific ways of naming phenomena.
- I can recognize the uses of 'on the other hand' and 'however' correctly.

# Unit 2





# Robots

## Unit Focus

**Reading 1:** Robots

**Reading Strategy:** Scanning

**Vocabulary Fuel:** Prefixes 1

**Grammar Engine:** Relative Clauses

**Reading 2:** Robots and Artificial  
Intelligence

# Reading 1



## Start-up

A. Look at the photos and guess if what you see is a robot or not.



Now read the following paragraphs to check your answers.

1. Satellites are programmed to stay around the Earth, always at the same altitude and with the same orientations. They feel their position and acceleration, and use their thrusters to maintain them. **Satellites are robots.**
2. The Segway is a self-balancing robot that can be used as a vehicle. It can feel its position and move accordingly to keep the user with a comfortable feeling of being always vertical. **This is a rather simple robot**, but converted into a very useful vehicle.
3. The Da Vinci Surgical System is a machine that follows the movements of the surgeon and repeats them on a smaller scale. It uses complex control techniques to improve the movement of the surgeon into an even more stable movement. **This is also a robot.**

B. **PAIR WORK** Can you list some other functions of robots? Which of these functions do Iranian robots currently perform?

## Read

# Robots

A robot is a computer-programmed machine that performs actions, *manipulates*<sup>1</sup> objects, etc. in a *precise*<sup>2</sup> and, in many cases, repetitive way. Robots may be **automata**, or man-like machines, whose basic *components*<sup>3</sup> are similar to a human body. They have mechanical links, joints, which connect their movable parts. Their heart and muscles are the electric or **pneumatic** motors or systems, the **actuators**, which *create*<sup>4</sup> the movement. Robots also have hands, usually tools or grippers, called **end effectors**. They may be *equipped*<sup>5</sup> with cameras or infrared controls, sensors, which *transmit*<sup>6</sup> information to the central system in order to *locate*<sup>7</sup> objects or *adjust*<sup>8</sup> movements. Finally, robots depend on a computer system, the brain that directs the actions.

## Uses for Robots

The word robot comes from robota, meaning compulsory *labor*<sup>9</sup> in Czech; similarly, robots are helpful in activities which are too dangerous, too boring or too precise for human beings.

Robotic arms, telescopic or bending arms, are widely used in the automobile industry to paint, weld and *assemble*<sup>10</sup> car parts. Robots are also used in electronic assembly of **microchips** where precision of movements is essential. Planetary rovers, remotely-operated vehicles, and space probes, unpiloted spaceships, are used to explore space. Surgical robots, which help human surgeons, are programmed to *assist*<sup>11</sup> in very delicate microsurgery operations or mimic the surgeons' movements in telesurgery operations. Mobile robots, vehicles controlled by human operators, are used for defusing bombs and handling hazardous materials.

The possibilities of using robots are indeed unlimited. Robots can play football, the violin and serve the gas stations, they even work as waiters. The latest breakthrough has come with using them as bodyguards. According to the

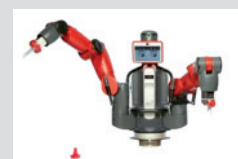
## Glossary

1. controls
2. exact
3. parts
4. make
5. provided
6. send
7. find; place
8. change; adapt
9. work
10. put together

**Are robotic arms used in car factories in Iran?**

11. help

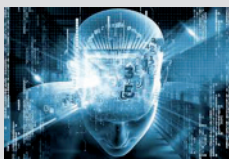
**What other hazardous situations are robots used in?**



**Do you think robots will have emotions in the future?**

12. noticing; understanding

**Can robots be smarter than human beings?**



13. change

14. examine

research organization Machine Industry Memorial Foundation, robots will have replaced 3.5 million of workers in Japan by 2025.

### **Characteristics of Robots**

A robot has these essential characteristics:

- Sensing: First of all your robot would have to be able to sense its surroundings.

It would do this in ways that are not unsimilar to the way that you sense your surroundings. Giving your robot sensors: light sensors (eyes), touch and pressure sensors (hands), chemical sensors (nose), hearing and sonar sensors (ears), and taste sensors (tongue) will give your robot *awareness*<sup>12</sup> of its environment.

- Movement: A robot needs to be able to move around its environment.

Whether rolling on wheels, walking on legs or propelling by thrusters a robot needs to be able to move. To count as a robot either the whole robot moves, like the **Sojourner** or just parts of the robot moves, like the **Canada Arm**.

- Energy: A robot needs to be able to power itself. A robot might be solar

powered, electrically powered, battery powered. The way your robot gets its energy will depend on what your robot needs to do.

- Intelligence: A robot needs some kind of ‘smarts’. This is where programming enters the picture. A programmer is the person who gives the robot its smarts.

The robot will have to have some way to receive the program so that it knows what it is to do.

### **Artificial Intelligence (AI)**

AI is the science that tries to recreate the human thought process and build machines that perform tasks that normally require human intelligence. It has several applications. **Androids** are anthropomorphic robots designed to look and behave like a human being. Most androids can walk, talk and understand human speech. Some react to gestures and voice inflection. Some learn from the environment: they store information and *adapt*<sup>13</sup> their behavior according to a previous experience. Expert system is the term given to computer software that mimics human reasoning, by using a set of rules to *analyze*<sup>14</sup> data and reach conclusions. Some expert systems help doctors diagnose illnesses based

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on symptoms. Neural networks are a new *concept*<sup>15</sup> in computer programming, designed to replicate the human ability to handle *ambiguity*<sup>16</sup> by learning from trial and error. They use silicon neurons to imitate the *functions*<sup>17</sup> of brain cells and usually *involve*<sup>18</sup> a great number of processors working at the same time.

- 15. idea
- 16. uncertainty
- 17. roles; responsibilities
- 18. include

Adapted from: [student.agh.edu.pl](http://student.agh.edu.pl).

## Engineering Terms

**automata:** (the plural of ‘automaton’) a machine which operates on its own without the need for human control

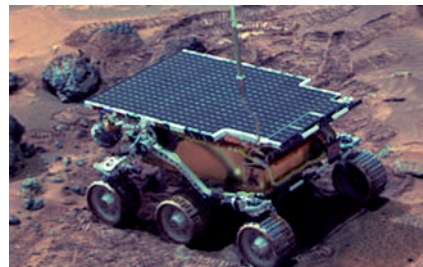
**pneumatic:** operated by air pressure

**actuator:** a mechanism that puts something into automatic action

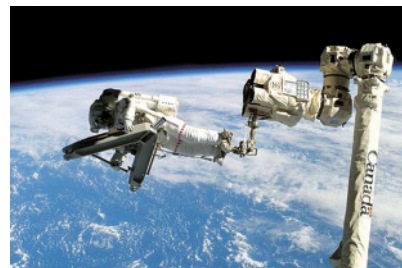
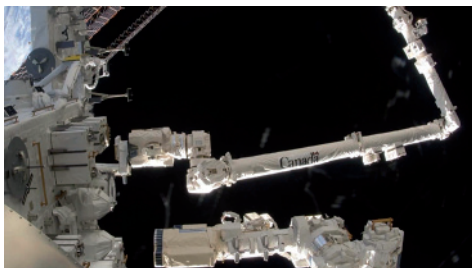
**end effector:** the device at the end of a robotic arm, designed to interact with the environment

**microchip:** (also called ‘chip’) a group of tiny electronic circuits that work together on a very small piece of hard material (such as silicon)

**Sojourner:** a small rover that was sent to Mars in 1997 as part of NASA’s Mars Pathfinder mission. (The verb ‘sojourn’ means: ‘to stay temporarily’.)



**Canada Arm:** Canada’s most famous robotic and technological achievement sent to space on the Space Shuttle Columbia (STS-2) on November 13, 1981



**android:** (also called ‘humanoid’) a robot with a human appearance



## Gauge Your Grasp

### A. Match the items in column A with their functions in column B.

A	B
.....1. actuator	a. replicates the human ability to handle ambiguity
.....2. neural network	b. computer software that mimics human reasoning
.....3. sensor	c. the brain that directs the actions
.....4. expert system	d. transmits information to the central system
.....5. computer system	e. creates movement in robots

### B. Do the following statements agree with the information given in the text? Write

<b>TRUE</b>	<b>if the statement agrees with the information</b>
<b>FALSE</b>	<b>if the statement does not agree with the information</b>
<b>NOT GIVEN</b>	<b>if there is no information about this</b>

### Then correct the false statements.

- ..... 1. Robots have been used for defusing bombs.
- ..... 2. Robots are mostly used in Japan.
- ..... 3. A robot senses its surroundings similar to human beings.
- ..... 4. Robots are mostly powered by batteries.
- ..... 5. Some robots are not able to move.
- ..... 6. Robots can only talk; they cannot understand human speech.

### C. For each item below, choose the best answer.

1. According to the text, .....
  - a. robots can be equipped with cameras to locate objects
  - b. robotic bending arms are used in remotely-operated vehicles
  - c. robots can perform microsurgery operations
  - d. three and a half million robots are used in Japan today
2. 'Energy' is an essential characteristic of robots, because by using it they can .....
  - a. walk on legs

- b. sense in ways not dissimilar to human beings
  - c. power themselves
  - d. have many different sensors
3. Which of the following is related to ‘programming’?
- a. sensing
  - b. movement
  - c. energy
  - d. intelligence
4. The computer software that uses rules to analyze in order to reach conclusions is called .....
- a. expert system
  - b. anthropomorphic robot
  - c. neural network
  - d. artificial intelligence

**D. Answer the following questions.**

1. How can robots locate objects?
2. What are mobile robots, and what are their uses?
3. What is artificial intelligence?
4. Compare and contrast robots with human beings.

## Reading Strategy Scanning

**Scanning** involves looking quickly through a text to find specific words or pieces of information. When scanning, you need to predict how the information you are looking for will appear in the text. Also, you need to pay attention to important clues that will help you in your search. For example, looking for capital letters when scanning for proper nouns or using headings to locate the sections that may contain a specific piece of information.

Some of the functions of scanning are as follows:

- a. looking through a text for key words or phrases
- b. searching for a definition in a dictionary
- c. searching for names, dates, and numbers
- d. answering reading comprehension questions

**A. Scan Reading 1 and answer the following questions.**

1. All of the following countries are mentioned EXCEPT .....

  - a. Canada
  - b. Japan
  - c. Poland
  - d. Czech

2. All of the following jobs are mentioned EXCEPT .....

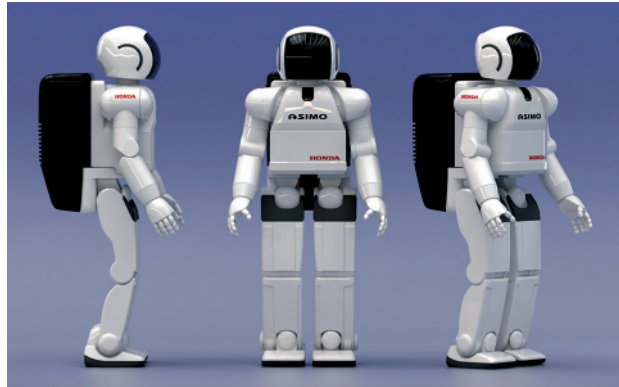
  - a. pilot
  - b. doctor
  - c. waiter
  - d. surgeon

3. Which of the following body components are mentioned? (Choose three options.)

- |        |          |          |
|--------|----------|----------|
| a. ear | b. brain | c. hand  |
| d. eye | e. foot  | f. joint |

**B. To answer the questions, scan the following passage.**

1. How is a robot guided?
2. In what areas have robots replaced humans?
3. What are robots blamed for?
4. Which science strengthened the field of robotics?



A robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry. Robots can be autonomous or semi-autonomous and range from humanoids such as Honda's Advanced Step in Innovative Mobility (ASIMO) to industrial robots. By mimicking a lifelike appearance or automating movements, a robot may convey a sense of intelligence or thought of its own.

The branch of technology that deals with the design, construction, operation, and application of robots is robotics. Robots can take the place of humans in dangerous environments or manufacturing processes. They can also resemble humans in appearance, behavior, and/or cognition.

From the time of ancient civilization, there have been many accounts of user-configurable automated devices and even automata resembling animals and humans, designed primarily as entertainment. As mechanical techniques developed through the Industrial Age, there appeared more practical applications such as automated machines, remote-control and wireless remote-control. Electronics evolved into the driving force of development with the advent of the first electronic autonomous robots. Robots have replaced humans in the assistance of performing those repetitive and dangerous tasks which humans prefer not to do, or are unable to



do due to size limitations, or even those such as in outer space or at the bottom of the sea where humans could not survive the extreme environments.

There are concerns about the increasing use of robots and their role in society. Robots are blamed for rising unemployment as they replace workers in increasing numbers of functions. The use of robots in military combat raises ethical concerns.

Adapted from: [wikipedia.org](http://wikipedia.org).

## Vocabulary Fuel Prefixes 1

A **prefix** is a letter or group of letters at the beginning of a word that changes its meaning. Learning the meaning of some of the common prefixes can expand your vocabulary and improve your reading comprehension. In addition, the meaning of prefixes can help you guess the meaning of unknown words.

**Study the meanings of the following prefixes:**

1. **un-:** The prefix un- means *not, opposite of, contrary to*. It attaches mainly to adjectives (unable, unclean) and participles used as adjectives (unfinished, unsaid).
2. **in-:** The prefix in- means *not*. Before l, in- is usually turned into il- (illegal); before r to ir- (irregular, irrelevant); and before b, m, and p to im- (imbalanced, immature, impossible).
3. **re-:** The prefix re- means *again* (redo, rebuild), *back, backward* (react).
4. **tele-:** The prefix tele- means *at or over a long distance* (telescope, telecommunication).
5. **micro-:** The prefix micro- means *extremely small* (microelectronics, micro-organism).
6. **pro-:** The prefix pro- means *forward* (proceed).

**A. Scan Reading 1 and find the words starting with the following prefixes. Then using the context and the information in the vocabulary fuel, guess their meanings.**

Prefixes	Words	Meanings
tele-		
un-		
re-		
micro-		
pro-		

**B. VOCABULARY PRACTICE** Complete each sentence with a word from the academic vocabulary of Reading 1. (The first letter of each answer is given.)

1. Silicon neurons are used to copy the f..... of brain.
2. A robot can m..... objects carefully.
3. Using cameras, some robots can a..... their movements.
4. Automata's basic c..... are like human body.
5. The actuators c..... the movement.
6. Sensors give robots a..... of environment.

## Grammar Engine **Relative Clauses**

**Pay attention to the following sentences:**

1. A programmer is a person who gives the robot its smarts.
2. The Segway is a self-balancing robot that can be used as a vehicle.

**Relative clauses** (the underlined clauses in sentences 1 and 2) give more information about someone or something referred to in main clauses.

**The relative clauses in sentences 1 and 2 give more information about ..... and ..... respectively.**

Along with 'who' and 'that', there are some other words (**relative pronouns**), such as 'where', 'which', that can introduce relative clauses.

3. There are already some robots which help people to walk.
4. It is the field of robotics where Artificial Intelligence is especially important.

**A. Complete the following sentences with the appropriate relative pronouns (sometimes more than one answer is possible).**

1. Researchers are investigating the possibility of creating robots ..... can shift their physical form to suit a particular task.
2. People are being replaced by robots ..... don't take coffee breaks.
3. Scientists are experimenting with soft-bodied robots ..... can move quickly across mud.
4. Currently, researchers are working on robots ..... will see and feel.

**B. Using relative pronouns, combine the following sentences into one sentence.**

1. Robots are used in electronic assembly of microchips.

In assembly of microchips precision of movements is essential.

.....  
.....

2. Robotics is the branch of technology.

Robotics deals with the design, construction, operation and application of robots and computer systems for their control.

.....  
.....

3. Androids are robots.

Androids can be mistaken for humans.

.....  
.....

## Reading 2



### Start-up

A. Do you know what kind of robots the following photos show?



They are Web Robots. Web Robots (also known as Web Wanderers, Crawlers, or Spiders), are programs that move through the Web automatically. Search engines such as Google use them to index the web content, spammers use them to scan for email addresses, and they have many other uses.

B. **PAIR WORK** Can you think of some other uses of Web Robots? Is there any relationship between Web Robots and Artificial Intelligence?

### Read

#### Glossary

1. causing a lot of disagreement

## Robots and Artificial Intelligence

Artificial intelligence (AI) is arguably the most exciting field in robotics. It is certainly the most *controversial*<sup>1</sup>: everybody agrees that a robot can work in an **assembly line**, but there is no consensus on whether a robot can ever be intelligent.

Like the term ‘robot’ itself, artificial intelligence is hard to *define*<sup>2</sup>.  
5 Ultimate AI would be a recreation of the human thought process – a man-made machine with our intellectual abilities. This would include the ability to learn just about anything, the ability to reason, the ability to use language and the ability to formulate original ideas. Roboticists are nowhere near achieving this level of artificial intelligence, but they have made a lot of progress with more limited AI.

10 Today’s AI machines can replicate some specific elements of intellectual ability.

Some modern robots have the ability to learn in a limited capacity. Learning robots recognize if a certain action (moving its legs in a certain way, for instance) achieved a desired result (navigating an obstacle). The robot stores this information and attempts the successful action the next time it *encounters*<sup>3</sup> the same situation.

15 The real challenge of AI is to understand how natural intelligence works. Developing AI is not like building an artificial heart – scientists do not have a simple, concrete model to work from. We do know that the brain contains billions and billions of neurons, and that we think and learn by establishing electrical connections between different neurons. But we do not know exactly  
20 how all of these connections add up to higher reasoning, or even low-level operations. The complex **circuitry** seems incomprehensible.

Just as physical robotic design is a handy tool for understanding animal and human anatomy, AI research is useful for understanding how natural intelligence works. For some roboticists, this insight is the *ultimate*<sup>4</sup> goal of  
25 designing robots. Others envision a world where we live side by side with intelligent machines and use a variety of lesser robots for *manual*<sup>5</sup> labor, health care and communication. A number of robotics experts *predict*<sup>6</sup> that robotic evolution will ultimately turn us into **cyborgs** – humans *integrated*<sup>7</sup> with machines. *Conceivably*<sup>8</sup>, people in the future could load their minds into a  
30 sturdy robot and live for thousands of years!

In any case, robots will certainly play a larger role in our daily lives in the future. In the coming *decades*<sup>9</sup>, robots will gradually move out of the industrial and scientific worlds and into daily life, in the same way that computers spread to the home in the 1980s.

Adapted from: [howstuffworks.com](http://howstuffworks.com).

2. describe; explain

**Can a robot ever be intelligent?**

3. experiences

**Do you have any information about natural intelligence?**

4. final

5. by hand

6. to say what will happen in the future

7. combined

8. imaginably

9. a period of ten years

## Engineering Terms

**assembly line:** a system for making things in a factory in which the products move past a line of workers who make or check their different parts

**circuitry:** a system of electric circuits

**cyborg:** a creature that is partly human and partly machine



### Gauge Your Grasp

#### A. Match (a-e) with (1-5) to make complete sentences.

- |  |   |
|--|---|
| a. Learning robots recognize if a certain action | 1. live side by side with intelligent machines.   |
| b. We do not know how all of these connections   | 2. contains billions and billions of neurons.     |
| c. Roboticists have a long way to                | 3. achieved a desired result.                     |
| d. Others imagine a world where we               | 4. achieve this level of artificial intelligence. |
| e. We know that the brain                        | 5. add up to higher reasoning.                    |

#### B. Answer the following questions.

1. Which field is the most controversial in robotics?
2. Why is understanding natural intelligence so challenging?
3. What is the final purpose of designing robots?

#### C. Scan Reading 2 to find:

a. all the words including the prefixes pro-, re-, and in-.

b. the words that express the following meanings.

1. made by humans rather than occurring in nature .....
2. distinguish; know .....
3. difficult or impossible to understand .....
4. finally .....
5. a period of 10 years .....

D. **VOCABULARY PRACTICE** Use the most appropriate word from the box to fill in the blanks below in the extract based on Reading 2. DO NOT look at the reading immediately; instead, first see if you can remember the words.

manual	ultimate	predict	controversial
decades	conceivably	integrated	define

AI is the most 1..... field and also very difficult to 2..... . AI research is useful for understanding how natural intelligence works. For some roboticists, this insight is the 3..... goal of designing robots. Others envision a world where we live side by side with intelligent machines and use a variety of lesser robots for 4..... labor, health care and communication. A number of robotics experts 5..... that robotic evolution will finally turn us into cyborgs – humans 6..... with machines. 7....., people in the future could load their minds into a sturdy robot and live for thousands of years! In the coming 8....., robots will gradually move out of the industrial and scientific worlds and into daily life.

**Now check your answers in Reading 2.**

*Translation*

**A. Scan the passage below in 10 seconds and answer the following questions.**

1. What are robots directed by?
2. What is one example of function of robots?

The computer age is producing an army of robots – machines that are directed by electronic brains and which replace human labor in industrial operations. Many are artificial arms which reach into areas man enters only at his peril, such as the inside of a nuclear reactor. Already in 1980 there were over 8000 such robots working in industrial plants throughout the world, the big changeover to the robot, *however*, is likely to come only when their costs go down while workers’ wages continue to rise.

**B. Now translate it into Persian and pay attention to the meaning of *however*.**

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### **Tune-up Time!**

Assess your progress in this unit. Tick  the statements which are true about you.

- I can understand how robots work.
- I can understand technical terms about robots.
- I can guess the meanings of different prefixes.
- I can scan a text for specific information.
- I can recognize relative clauses correctly.