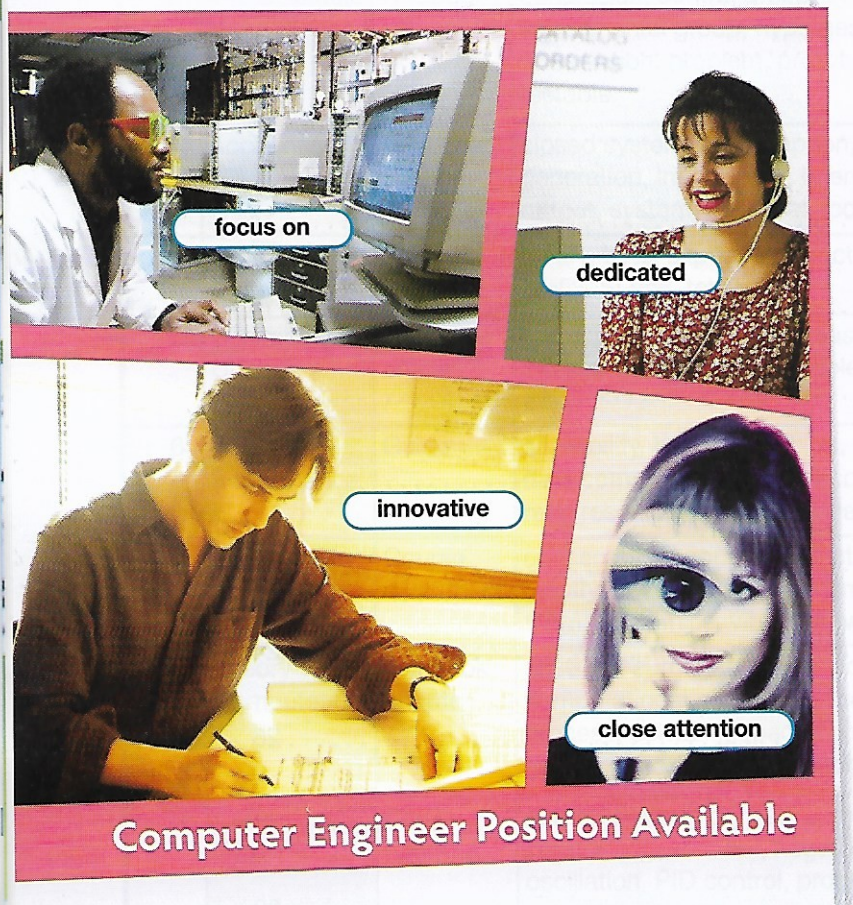
1 Traits of a Computer Engineer

Get ready!

1 Before you read the passage, talk about these questions.

1 What traits are valuable in an engineer?

2 Why is critical thinking an important skill in an engineer?



Computer Engineer Position Available

Dynxis Corp. is seeking **talented** computer engineers. Candidates must have at least five years of experience. They should have **mastery** of both hardware design and programming. We will only consider an applicant with a bachelor's degree in a relevant field. Additionally, he or she must **pay close attention** to current technology and trends.

We want someone who is **thorough** and **detail-oriented**. Candidates should be able to **focus on** multiple tasks simultaneously. Our systems are extremely complex. This means that even minor errors can be critical.

At Dynxis Corp., we value **critical thinking**. We appreciate employees who can find **logical** solutions. However, we also seek **curious** individuals with **innovative** ideas. We encourage employees to think creatively. We want people with a balance of both practical and creative skills.

We have high standards at Dynxis Corp. If you are **dedicated** and **efficient**, we encourage you to apply.

Email your résumé to hr@dynxis.com.

Reading

2 Read the job listing. Then, mark the following statements as true (T) or false (F).

1 __ The company will train inexperienced candidates.

2 __ The company is hiring someone to resolve previous critical errors.

3 __ The candidate should be equally practical and creative.

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __	focus on	4 __	dedicated
2 __	mastery	5 __	innovative
3 __	efficient	6 __	detail-oriented

A able to pay attention to small, specific parts of something

B new, creative, and advanced

C able to do something competently and quickly

D advanced knowledge or skills in a particular area

E to be devoted to a task or cause

F to give full attention to something

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 critical thinking / close attention

A The supervisor pays _____ to his team's work.

B The junior engineer program promotes problem-solving and _____.

2 thorough / logical

A The technician found a _____ solution to the problem.

B The employee was _____ and checked each compartment.

3 talented / curious

A A display of the engineer's advanced skills proved how _____ she was.

B The employee was _____ about the new software, so he researched it further.

5 🎧 **Listen and read the job listing again. Why does the company want thorough and detail-oriented candidates?**

Listening

6 🎧 **Listen to a conversation between an interviewer and an applicant. Choose the correct answers.**

1 What is the conversation mostly about?

A traits that are most important to the woman
B the man's work experience
C educational requirements for a position
D responsibilities at a new job

2 Why does the man mention that he monitored multiple projects?

A to demonstrate his programming mastery
B to indicate that he is efficient
C to prove that he is detail-oriented
D to suggest that he is curious

7 🎧 **Listen again and complete the conversation.**

Interviewer: Yes, it's very impressive. Can you **1** _____ _____ your skills?
Applicant: Well, I try to find **2** _____ _____ to problems whenever possible.
Interviewer: I like to hear that. Could you provide **3** _____ _____ ?
Applicant: Um, actually, I once had to troubleshoot a problem in my company's mainframe.
Interviewer: Wow. I'm sure that required **4** _____ _____ to detail.
Applicant: Oh, yes. **5** _____ _____ _____ I'm very detail-oriented.
Interviewer: How else do you use this trait?
Applicant: At my previous job, I had **6** _____ _____ _____ multiple projects at once.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Can you elaborate on ...?
I'd say that I'm ...
How else have you used this trait?

Student A: You are an interviewer. Talk to Student B about:

- his or her traits as an employee
- his or her responsibilities at a previous job
- traits needed for particular tasks

Student B: You are an applicant for a job. Talk to Student A about your traits as an employee.

Writing

9 **Use the conversation from Task 8 to fill out the interviewer's notes.**

Applicant: _____

Applicant's previous job responsibilities:

_____

_____

Applicant's traits:

_____

_____

Do you plan to hire the applicant? Why or why not?

_____

_____

2 The Scientific Method

Get ready!

1 Before you read the passage, talk about these questions.

1 Why is the scientific method an effective way to solve problems?

2 How does the scientific method apply to engineering?

About our engineering process:

NetSharp is dedicated to solving **problems**. That's why we structure our engineering process around the **scientific method**.

First, we make an **observation** about a problem. For computer engineers, problems are usually defined by hardware or software requirements.

Next, we research the problem and form a **hypothesis**. To test it, we need a **testable prototype**. We expect a prototype to function, but we aren't certain until we perform **experiments**.

During the test, we note if a component does not work as expected. We adjust this **independent variable** and test again. The new prototype becomes the **experimental group**, while the **control group** remains unchanged. That lets us monitor whether our adjustments improved functionality.

Finally, we draw **conclusions** based on the **results**. If the new prototype functions better, we test the next independent variable. Our **evaluation** is not complete until we have a fully functional product.

Reading

2 Read the webpage. Then, choose the correct answers.

1 What is the purpose of the webpage?
- **A** to illustrate how product users can apply the scientific method
- **B** to describe a company's problem-solving process
- **C** to explain the challenges of experimenting on computer products
- **D** to show how testing prototypes slows production

2 What part of an experiment does a prototype test?
- **A** an observation
- **B** an evaluation
- **C** a conclusion
- **D** a hypothesis

3 Which of the following is NOT part of the company's engineering process?
- **A** altering a control group
- **B** making an observation
- **C** studying a problem
- **D** testing a variable

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ control group
2 __ testable
3 __ conclusion
4 __ hypothesis
5 __ independent variable
6 __ scientific method
7 __ experimental group

- **A** a system that tests ideas through experimentation
- **B** part of an experiment that tests the effect of an altered variable
- **C** a determination or decision made after an experiment
- **D** an idea that explains something that has not been tested
- **E** able to be proven or disproven through an experiment
- **F** the factor that changes between groups in an experiment
- **G** part of an experiment that does not have an altered variable

4 Read the sentence pairs. Choose which word best fits each blank.

1 **observation / evaluation**

A After the procedure, the professor made an _____.

B After careful study, the engineer formed his _____ of the chip's performance.

2 **problem / experiment**

A The team developed a(n) _____ to test the hypothesis.

B The hypothesis seeks to explain a(n) _____.

3 **prototype / result**

A At the end of the experiment, the engineer reported a surprising _____.

B The engineer was disappointed when the _____ failed to function.

5 Listen and read the webpage again. What do you need in order to test a hypothesis?

Listening

6 Listen to a conversation between two engineers. Mark the following statements as true (T) or false (F).

1 __ The processor stopped functioning.

2 __ The experiment was conducted correctly.

3 __ The man plans to conduct the experiment again.

7 Listen again and complete the conversation.

Engineer 1: The processor speed wasn't **1** _____ _____ _____. But it's much faster in the experimental group.

Engineer 2: Hmm. Do you think something interfered **2** _____ _____ _____?

Engineer 1: I don't know. We definitely altered just one **3** _____ _____, right?

Engineer 2: That's what the test log says. Maybe we should just record it **4** _____ _____ _____.

Engineer 1: What do you mean?

Engineer 2: Well, maybe it's faster **5** _____ _____ _____ the independent variable. That could mean that the new prototype performs better.

Engineer 1: That's possible. But we'll have to **6** _____ _____ _____ to be sure.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

Do you think ...?

Maybe, it's ...

That's possible.

Student A: You are an engineer. Talk to Student B about:

- the unexpected results of an experiment
- possible causes of the results
- what to do next

Student B: You are an engineer. Talk to Student A about the results of an experiment.

Writing

9 Use the conversation from Task 8 to fill out the engineer's log entry.

TEST LOG:

Experiment # 45009

How did the experimental group perform?

_____

Why did this happen?

_____

What are your suggestions?

_____

3 Accounting

Accounting

Engineering projects require engineers to monitor various quantities. The process they use to monitor quantities is known as accounting.

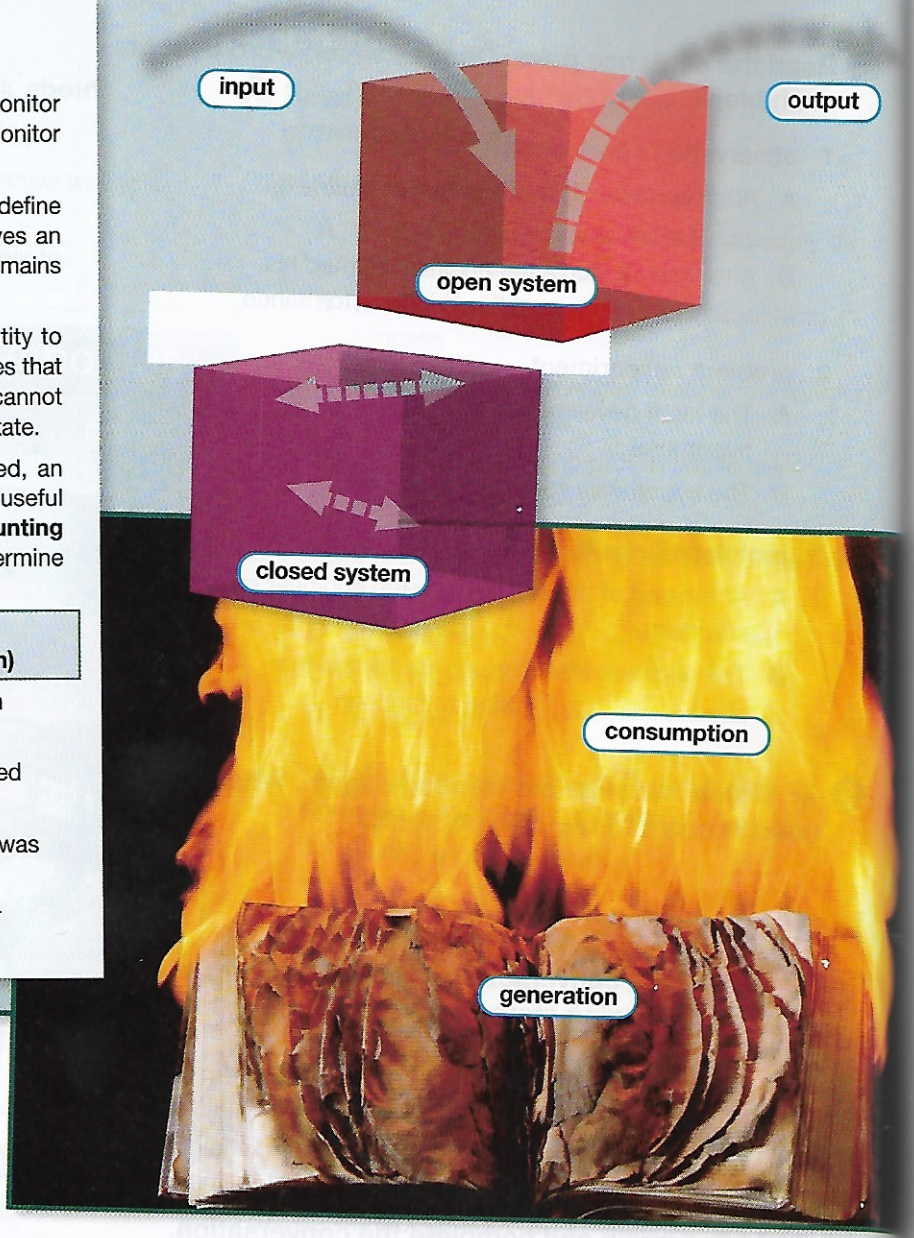
Before accounting can begin, engineers must define the monitored **system**. Mass enters and leaves an **open system**. In a **closed system**, the mass remains constant.

Engineers must also know what kind of quantity to account for. **Extensive quantities** are quantities that an engineer can count. **Intensive quantities** cannot be counted, but they still affect the system's state.

Once the system and quantity are determined, an engineer can begin accounting. The most useful accounting measure is the **universal accounting equation** (UAE). This is a simple way to determine changes in amounts:

Final amount – **initial** amount =
(**input** – **output**) + (**generation** – **consumption**)

- **Step 1:** Take the amount that you started with (input).
- **Step 2:** Subtract any amount that was removed (output).
- **Step 3:** Add the amount of new material that was created (generation).
- **Step 4:** Subtract any material that was lost or destroyed (consumption).



Get ready!

1 Before you read the passage, talk about these questions.

1 What is the purpose of accounting in the field of engineering?
2 What are some examples of open and closed systems?

Reading

2 Read the textbook chapter. Then, mark the following statements as true (T) or false (F).

1 __ In a closed system, mass changes constantly.
2 __ The UAE determines whether a quantity is extensive or intensive.
3 __ According to the UAE, the output should be subtracted from the input.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ final
2 __ initial
3 __ open system
4 D consumption
5 __ closed system
6 H intensive quantity
7 B extensive quantity
8 __ universal accounting equation

A relating to something's status at the end of a period of time
B a type of measurable quantity that can be counted
C a system that allows mass to enter or leave it
D an amount of a quantity that is destroyed in a system
E a system that does not allow mass to enter or leave it
F a way to measure changes in countable quantities
G relating to something's status at the beginning of a period of time
H a type of measureable quantity that cannot be counted

output

4 **Read the sentence pairs. Choose which word best fits each blank.**

1 **system / output**

A The engineer defined the colling fan as the monitored _____.

B The engineer measured the engine's _____ of exhaust.

2 **generation / input**

A The engineer measured the _____ that the system created.

B The engineer did not account for the _____ of mass from other sources.

5 **Listen and read the textbook chapter again. What is the difference between an extensive quantity and an intensive quantity?**

Listening

6 **Listen to a conversation between two students. Choose the correct answers.**

1 What is the conversation mostly about?

A the differences between accounting concepts

B how to calculate changes in quantities

C terms on an upcoming accounting test

D the importance of measuring accurate quantities

2 What term does the man use incorrectly?

A extensive quantity **C** generation

B intensive quantity **D** input

7 **Listen again and complete the conversation.**

Student 1: I'm having trouble understanding these **1** _____ _____.

Student 2: Perhaps I can help. Which ones don't you understand?

Student 1: Extensive quantities and **2** _____ _____, for one. How are they different?

Student 2: Well, extensive quantities change based on the **3** _____ _____ _____ _____. Volume measurements are one example.

Student 1: I still don't really get it. Can you explain that further?

Student 2: Let's say a system has one liter of water. Then you add mass, and **4** _____ _____ _____ two liters of water.

Student 1: Okay, so the **5** _____ _____. So what's an intensive quantity?

Student 2: Color, **6** _____ _____. One liter of water is clear. If you add a second liter, the water is still clear.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

I really don't understand ...

What's the problem?

I still don't get it.

Student A: You are a student. Talk to Student B about:

- differences between accounting concepts
- examples of different concepts
- a term that he or she uses incorrectly

Student B: You are a student. Talk to Student A about the differences between accounting terms.

Writing

9 **Use the conversation from Task 8 to fill out the student's notes.**

Accounting Notes

Concept: _____

An example of this concept is _____ _____

because _____.

Concept: _____

An example of this concept is _____ _____

because _____.

4 SI and IEC Units

Get ready!

1 Before you read the passage, talk about these questions.

1 What is the difference between an SI unit and a binary unit?

2 Between SI units and binary units, which do you think is more useful?

Dear Mr. Dvorak,

I am worried about the company's inconsistent use of units. Some of our products have **SI units** like **mega**bytes. Meanwhile, others use the **IEC's binary** units, such as **mebi**bytes.

Some **prefixes** sound similar, but the units are quite different. SI units increase by **factors** of ten. For instance, something with the prefix **kilo-** has 1,000 units. So a kilobyte equals 1,000 **bytes**. Binary units, on the other hand, increase by factors of two. A **kibi**byte actually contains 1,024 bytes. This may seem like a small difference. However, it increases at an **exponential** rate. The difference between a megabyte and mebibyte is 48,576 units. And a **tera**byte and **tebi**byte are separated by nearly 100 billion units!

That's why our labeling needs to be clear and consistent. I recommend listing SI units. The factors of ten are easier for customers to understand and remember.

Regards,
Rebecca Moore
Computer Engineer
Hype Drive Systems

Reading

2 Read the email. Then, mark the following statements as true (T) or false (F).

1 __ The company labels its products with both SI and binary units.

2 __ The difference between SI and binary units increases exponentially.

3 __ The email recommends switching to binary units only.

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1 __ kilo-
2 __ tebi-
3 __ kibi-
4 __ mebi-
5 __ mega-
6 __ tera-

A a prefix equal to 1,000,000 units
B a prefix equal to 1,048,576 units
C a prefix equal to 1,024 units
D a prefix equal to 1,000 units
E a prefix equal to 1,000,000,000 units
F a prefix equal to 1,099,511,627,776 units

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 binary / exponential

A The amount increased at a(n) _____ rate.

B The _____ system measures amounts in factors of two.

2 prefix / factor

A To scale the image, increase its dimensions by a _____ of two.

B The _____ of a unit indicates how large it is.

3 IEC / SI units

A The device memory is listed in both binary and _____.

B The company follows guidelines that are established by the _____.

exponential

5 🎧 **Listen and read the email again. What recommendation is made in the email?**

Listening

6 🎧 **Listen to a conversation between an engineer and a manager. Choose the correct answers.**

1 What is the main idea of the conversation?

- **A** which system of units the company should use
- **B** why the company should use one set of units
- **C** how to tell the difference between types of units
- **D** why the company recently had to correct units on its labels

2 Why does the man prefer the current system?

- **A** The units are easier to remember.
- **B** The customers are more comfortable with it.
- **C** The company requires a particular system.
- **D** The product labels are already designed.

7 🎧 **Listen again and complete the conversation.**

Engineer: Why not? Customers are getting confused. They're buying products with **1** _____ _____ _____ _____ than they need.

Manager: Perhaps. But we'd have to **2** _____ _____ _____. Besides, aren't the differences small?

Engineer: Not at all. The two sets of units convey very different numbers.

Manager: The difference between **3** _____ _____ and a kibibyte is twenty-four bytes, right?

Engineer: Indeed it is. But the differences grow exponentially as **4** _____ _____ _____.

Manager: **5** _____ _____ _____. What do you mean?

Engineer: Well, the difference between a terabyte **6** _____ _____ _____ is over ninety-nine billion bytes.

Manager: Wow. That actually seems like a lot.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Have you ...?
As I mentioned ...
I don't follow ...

Student A: You are an engineer. Talk to Student B about:

- the company's data measurement system
- why you think the company should change the system
- the consequences of keeping the current system

Student B: You are a manager. Talk to Student A about the company's data measurement system.

Writing

9 **Use the conversation from Task 8 to fill out the email about changing the company's unit labeling practices.**

Hi Janice,

I've been thinking about your suggestion. I'm not sure whether we should change the units on product labels. The idea has both pros and cons.

Pros:

- _____
- _____

Cons:

- _____
- _____

Let's schedule a meeting to talk about this further.

-Lou

5 Describing Change

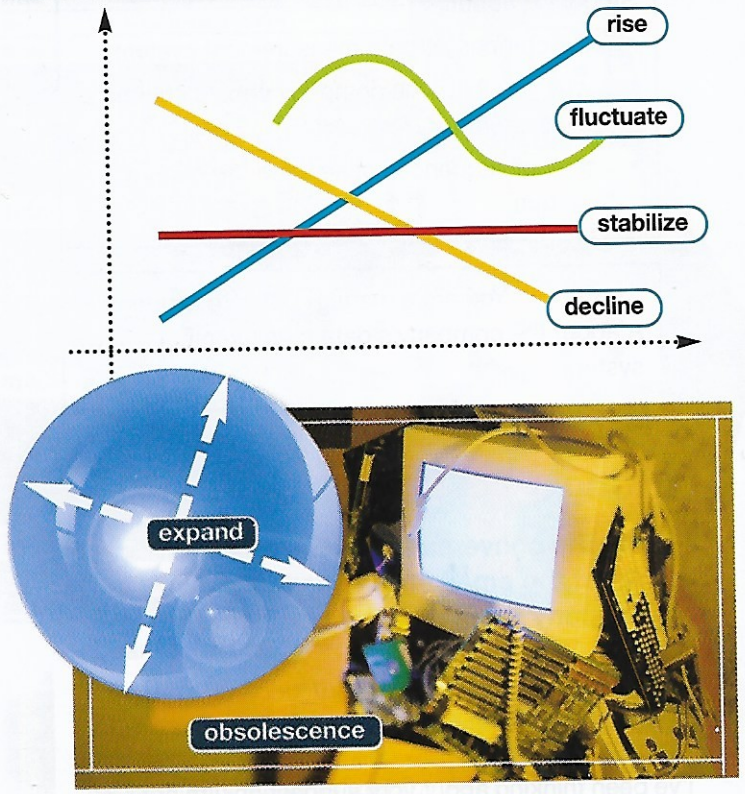
Get ready!

1 Before you read the passage, talk about these questions.

1 What is Moore's law?

2 How does Moore's law affect consumers who buy computers?

Moore's Law



In 1965, engineer Gordon Moore made a remarkable prediction. He said that computer processing power should **double** every two years. While the rate **fluctuates**, the overall **trend** actually follows it quite closely. This theory is known as **Moore's law**.

Moore's law is based on various factors. As manufacturing improves, the cost of transistors **decreases**. The **decline** in costs **corresponds** to a **rise** in production. Engineers can afford to place more transistors on each circuit. As a result, computing power **increases** at a **steady** rate.

However, not everyone benefits from such rapid improvements. As computing power **expands**, older models fade quickly into **obsolescence**. Even though costs have decreased, computers are still expensive for some. Many average consumers cannot afford a new computer every two years.

Some analysts predict that the trend will not last. They suggest that growth will begin to **stabilize** in a few years. If predictions are correct, growth may double in three years instead of two.

Reading

2 Read the magazine article. Then, choose the correct answers.

1 What is the purpose of the article?

A to discuss the rate at which computers improve over time

B to explain how consumers influence computer technology trends

C to persuade people to buy more efficient computers

D to describe the need for new processing systems

2 Which of the following is NOT a component of Moore's law?

A a decline in technology costs

B doubled computing power

C a rise in transistors per circuit

D decreased obsolescence

3 What do analysts predict about the growth of processing power?

A It will lead to higher costs.

B It will slow down.

C It will stop within a few years.

D It will become more rapid.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 __ trend
2 __ steady
3 __ double
4 __ stabilize
5 __ correspond
6 __ Moore's law
7 __ obsolescence

A a consistent change over time

B the state of not being useful anymore

C a rule that says computer power doubles every two years

D to reach a state with infrequent change

E to become twice as much

F not changing or changing slowly

G to have a direct relationship with something

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **rise / decline**

A The need for new computers caused a _____ in sales.

B The price of computers is in _____ as parts become cheaper.

2 **decrease / expand**

A The abilities of computers _____ as they grow more powerful.

B The rate of progress will _____ without better technology.

3 **fluctuate / increase**

A Some trends are hard to predict because they _____ wildly.

B In general, the abilities of computers _____ over time.

5 **Listen and read the magazine article again. What happens to older computer models as a result of Moore's law?**

Listening

6 **Listen to a conversation between two engineers. Mark the following statements as true (T) or false (F).**

1 __ The article predicts that the growth of computing power will increase at a faster rate.

2 __ The man is concerned that the changes will hurt the computer industry.

3 __ The woman believes that the change will lead to added waste.

7 **Listen again and complete the conversation.**

Engineer 1: Did you read the article about **1** _____ _____? It looks like growth may begin to stabilize.

Engineer 2: So computer power will double **2** _____ _____?

Engineer 1: Yes. Basically, within a few years, computing power **3** _____ _____ _____ every three years.

Engineer 2: That's unfortunate. The steady increase in power **4** _____ _____ _____ the entire industry. This could really damage software companies.

Engineer 1: I'm **5** _____ _____ _____ about that. I think such a trend may have positive effects.

Engineer 2: Really? How could it be beneficial?

Engineer 1: Well, for one thing, it may mean that the rate of **6** _____ _____ will decrease.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

According to ...

That's interesting ...

Really? How so?

Student A: You are an engineer. Talk to Student B about:

- an article about Moore's law
- how predicted changes could have negative effects
- how predicted changes could have positive effects

Student B: You are an engineer. Talk to Student A about Moore's law.

Writing

9 **Use the conversation from Task 8 to fill out the engineer's blog.**

Computalking
with Ryan Henderson

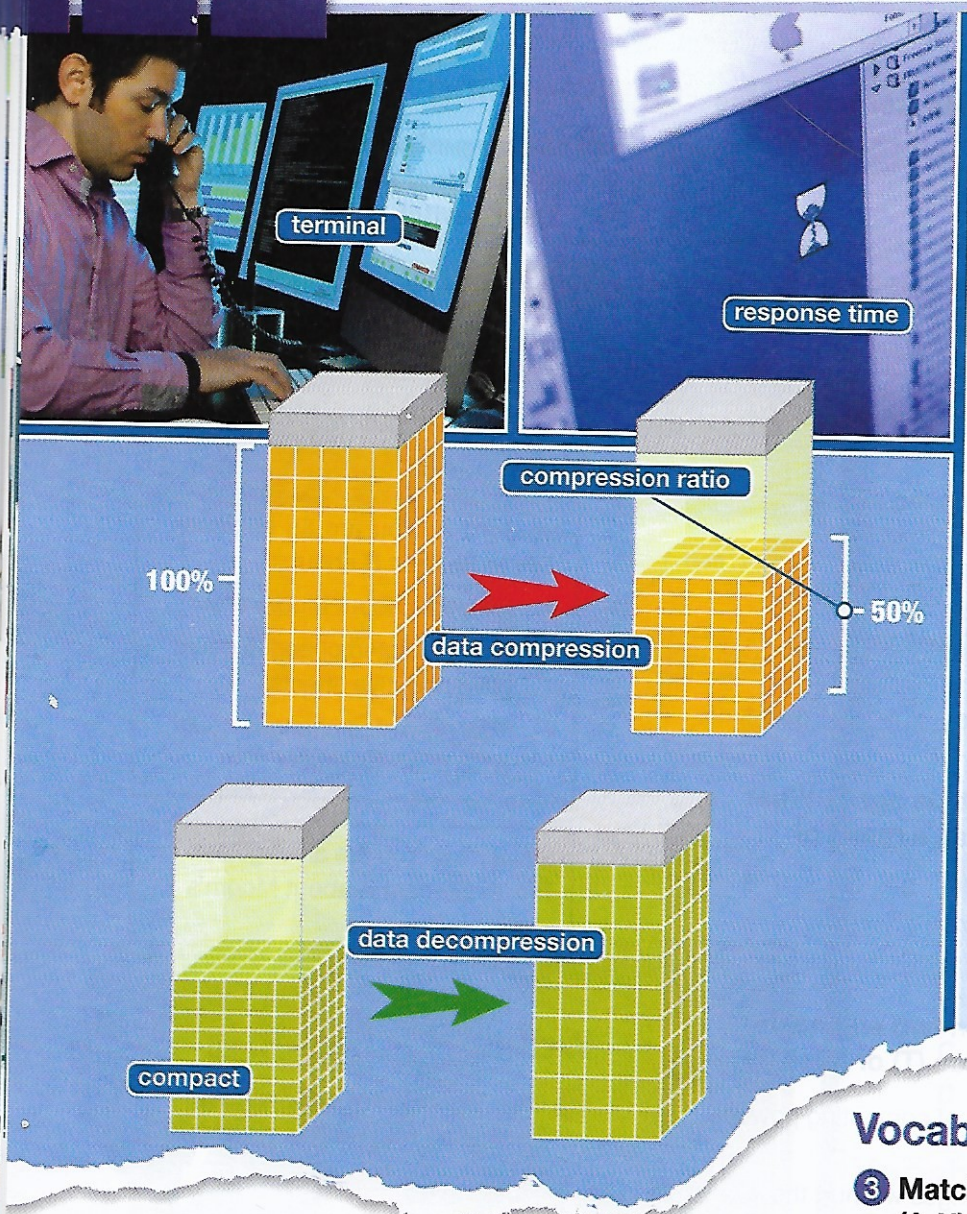
I recently read an article about Moore's law. It predicted that computer processing growth will _____ _____. This could be positive because _____.

On the other hand, it could also be negative because _____.

What do you think?

-Ryan

6 Describing Performance



Computer Performance

A computer's performance is measured by how well it performs tasks. Good computers can perform work quickly with few **resources**. Users can use various criteria to evaluate computer performance.

Response time – When a user enters data at a **terminal**, the computer responds. The amount of time the process takes is the response time. Computers with slow response times are inefficient and frustrating.

Availability – A computer's availability is simply its ability to work at any given time. Most users need a computer that is available immediately, and at any time.

Data transmission – A computer's ability to send and receive data quickly is important. The transmission **rate** is measured in **bit/s**, and is called **bandwidth**. Slow bandwidth leads to delays receiving information.

Software implementation – A computer's **compression ratio** is how **compact** it can make information. Its rates of **data compression** and **decompression** also affect its performance.

Get ready!

1 Before you read the passage, talk about these questions.

1 How does data compression affect computer performance?

2 How does bandwidth affect computer performance?

Reading

2 Read the guide. Then, mark the following statements as true (T) or false (F).

1 __ According to the guide, computers with additional terminals are less efficient.

2 __ According to the guide, most people need the same type of availability.

3 __ Data compression ratios are measured in bit/s.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ bit/s
2 __ terminal
3 __ compact
4 __ bandwidth
5 __ data compression
6 __ data transmission
7 __ compression ratio
8 __ data decompression

A a measure of how quickly a computer transmits information

B the exchange of information between computers

C occupying a small amount of space

D a process that restores compressed information to its original size

E a unit that measures the rate of information transmission

F a compressed size compared to an uncompressed size

G a process that reduces the size of information

H a location where a user can access a computer system

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **resource / rate**

A The software ensures systems can access each _____ quickly.

B The new cables should improve the _____ of data transmission.

2 **availability / response time**

A Installing faster processors will improve the computer's _____.

B The frequent power outages decrease the system's _____.

5 🎧 **Listen and read the guide again. What are the consequences of poor computer response times?**

Listening

6 🎧 **Listen to a conversation between an IT manager and a salesperson. Choose the correct answers.**

1 What is the conversation mostly about?

A choosing a system which can transmit information quickly

B how to improve response times

C pricing options

D how to calculate data compression ratios

2 What performance aspect is the man most concerned about?

A the data compression speeds

B the system's availability

C the data transmission rate

D the system's response time

7 🎧 **Listen again and complete the conversation.**

Salesperson: We offer a range of high quality computer systems. What **1** _____ _____ do you require?

IT Manager: Well, I'd like a quick **2** _____ _____. But of course, bandwidth is really important as well.

Salesperson: Okay. We have two systems that excel in both those areas, the 2260 model and the 2950 model.

IT Manager: Which of the systems **3** _____ _____ _____?

Salesperson: That depends on whether you're more concerned about response time or transmission.

IT Manager: I'm definitely more concerned with the system's **4** _____ _____ capabilities.

Salesperson: In that case, I recommend the 2950 model. It runs at more **5** _____ _____ _____.

IT Manager: That **6** _____ _____.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

We offer a ...

Which ... would you recommend?

That depends on ...

Student A: You are an IT manager. Talk to Student B about:

- *purchasing a new system for* your company
- a system that he or she recommends
- what aspects contribute to the system's performance

Student B: You are a salesperson. Talk to Student A about his or her computer performance needs.

Writing

9 **Use the conversation from Task 8 to fill out the salesperson's email.**

Hi Mr. Gregson,

Thank you for your interest in our computer systems. I'm confident that we have something to meet your needs. Since you need something that _____, I recommend _____. It has _____ _____.

If you would prefer something with _____, then I might recommend _____ instead.

Let me know if you have further questions.

Sincerely,

Gina Bolino

CMM Computer Supply and Consulting

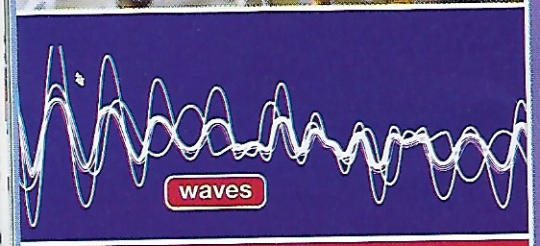
7 Concepts in Physics

Get ready!

1 Before you read the passage, talk about these questions.

1 What is a scientific law?

2 What is a constant?



Intro to Physics 101

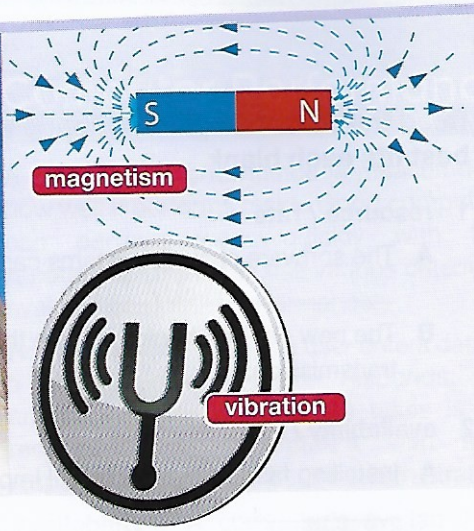
This course provides students with a basic understanding of physics. It consists of three sections: mechanics, **electromagnetism**, and **thermodynamics**.

In the mechanics section, students will learn about **motion**. This section will primarily focus on Newton's **laws** of motion. Students will use Newton's laws to calculate quantities like **momentum**. Students will also use the gravitational **constant** to calculate **gravity** between objects.

In thermodynamics, the course will address the **conservation** of energy. Students will discuss energy's relationship with heat. They will also explore how mechanical **waves** and **vibrations** transfer energy. Thermodynamic **equilibriums** in systems will also be covered.

Finally, the electromagnetism portion of the course will discuss electricity and **magnetism**. Students will learn how these properties interact with each other. The class will conclude by exploring how each section's concepts act together.

Prerequisites include Calculus and Intro to Physical Science.



Reading

2 Read the course description. Then, mark the following statements as true (T) or false (F).

1 __ The conservation of energy and thermodynamic equilibriums are covered in the same section.

2 __ In the last section, students will study Calculus.

3 __ Students must study electromagnetism before enrolling in the course.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __	law	4 __	constant	7 __	thermodynamics
2 __	wave	5 __	vibration	8 __	electromagnetism
3 __	motion	6 __	equilibrium		

A a disturbance that moves through a substance

B a repeated movement in a substance or field of energy

C the action or process of moving

D an explanation for a natural process that is always true

E a number that does not change

F the interactions that occur between electricity and magnetism

G a stable condition in which forces cancel one another

H a branch of physics that deals with the relations between heat and other forms of energy

4 Read the sentence pairs. Choose which word best fits each blank.

1 **magnetism / gravity**

A _____ causes objects to fall to the ground.

B Many people use _____ to hold metal objects together.

2 **conservation / momentum**

A The swinging pendulum shows the principal of _____ of energy in action.

B The tire generated _____ as it rolled down the hill.

5 🎧 **Listen and read the course description again. What is covered in the thermodynamics section of the course?**

Listening

6 🎧 **Listen to a conversation between two students. Choose the correct answers.**

1 What's the conversation mostly about?

A why a range of ideas is important
B the meanings of different terms
C practical applications of physics concepts
D which topics appeared on a recent test

2 What does the man confuse with equilibrium?

A conservation
B constants
C magnetism
D gravity

7 🎧 **Listen again and complete the conversation.**

Student 2: Okay. What is a constant?
Student 1: Oh, that's easy. **1** _____ _____ _____ a number that doesn't change, like the gravitational constant.
Student 2: You are correct. Now give me a term.
Student 1: All right. **2** _____ _____.
Student 2: Magnetism is the interaction between magnetic and electrical fields. **3** _____ _____, that's electromagnetism.
Student 1: Right. Magnetism is the force between two objects caused by a magnetic field. How about **4** _____?
Student 2: Let's see. Is that **5** _____ _____ _____ two opposing forces?
Student 1: No. **6** _____ _____. Conservation is a principle that prevents a total quantity from changing.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Would you like me to ...?
Now give me a ...
No, wait ...

Student A: You are a student. Talk to Student B about:

- studying for an exam
- what terms will be in the exam
- the definitions of different terms

Student B: You are a student. Talk to Student A about what terms will be in an exam

Writing

9 **Use the conversation from Task 8 to fill out the student's exam correction sheet.**

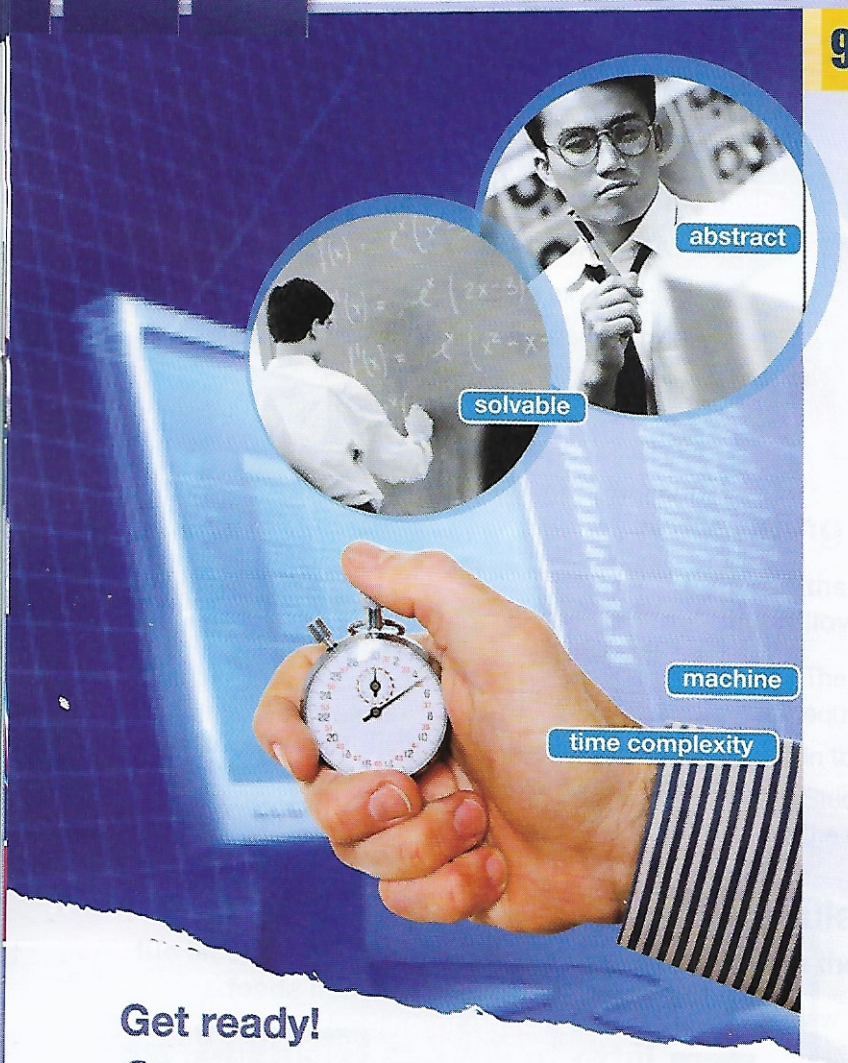
Intro to Physics Exam #3

Exam Corrections

Name: _____

Concept	What was your error?	Correction
1 Magnetism	Identified as the interaction between magnetic and electrical fields.	This is actually the definition for electromagnetism
2 _____	_____ _____	_____ _____
3 _____	_____ _____	_____ _____

8 Theory of Computation



9.2 Theory of Computation

The **theory of computation** is mainly concerned with efficient computation and computer modeling. This branch of computer science is further divided into smaller fields. **Automata theory**, **computability theory**, and **computational complexity theory** are all aspects of general computing theory.

Automata theory deals primarily with **abstract machines**, or imaginary computers. Unlike real computers, abstract machines are mathematical models. Automata theory seeks to discover what problems they could potentially solve.

Computability theory studies to what extent problems are **solvable**. It does this with current computer models. The **Turing machine** is one of computability theory's main tools. Turing machines are abstract machines that have unlimited memory. If a Turing machine can **process** a problem, it is considered solvable.

Finally, computational complexity theory is based on computer resources. It attempts to organize problems in order of difficulty. A problem's difficulty reflects how **efficiently** a computer can solve it. This efficiency is measured in terms of **time complexity** and **space complexity**.

Get ready!

1 Before you read the passage, talk about these questions.

1 What is the purpose of abstract machines?

2 What is the difference between computability theory and computational complexity theory?

Reading

2 Read the textbook chapter. Then, mark the following statements as true (T) or false (F).

1 __ Real computers are not typically used in Automata theory.

2 __ Computability theory studies ways to improve Turing machine memory.

3 __ Efficiency is a major subject of computational complexity theory.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ process
2 __ efficiently
3 __ time complexity
4 __ Turing machine
5 __ automata theory
6 __ theory of computation
7 __ computability theory
8 __ computational complexity theory

A the study of abstract machines and the computational problems they can solve

B to organize data or change it from one form to another

C the amount of time a computer needs to process a problem

D a field that studies the resources computers need to solve problems

E operating while using minimal resources

F an abstract computer with infinite storage capacity

G a general branch of computer science that deals with modeling and efficiency

H a field that examines whether certain problems are solvable

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **solvable / abstract**

A _____ computers test hypothetical problems.

B If a Turing machine can't process it, it is not _____.

2 **machine / space complexity**

A The _____ of a problem contributes to its overall difficulty.

B A computer is a _____ that most people use.

5 **Listen and read the textbook chapter again. What does a Turing machine do?**

Listening

6 **Listen to a conversation between a teaching assistant and a student. Choose the correct answers.**

1 What is the conversation mostly about?

A a comparison of computing theories

B practical applications for different computing theories

C why studying computing theories is important

2 What error does the man make?

A He mixes up automata theory and computability theory.

B He incorrectly defines computational complexity theory.

C He thinks an unsolvable problem is solvable.

7 **Listen again and complete the conversation.**

Student: I'm having trouble understanding some of the concepts from class. **1** _____ _____ _____ clarifying a few things?

Teaching Assistant: Sure, no problem. What are you having trouble with?

Student: The three theories that make up the **2** _____ _____ _____. They all seem to study whether an abstract computer can solve a problem.

Teaching Assistant: Well, they do sound pretty similar at first. However, they concentrate on different aspects.

Student: So what's the focus of **3** _____ _____?

Teaching Assistant: Automata theory checks if abstract machines can **4** _____ _____.

Student: So it's about **5** _____ _____ _____, then.

Teaching Assistant: That's right. And **6** _____ _____ _____ studies resources.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Would you mind ...?

Isn't that the same ...?

So it's primarily ...

Student A: You are a student. Talk to Student B about:

- the theory of computation
- how to distinguish between different theories
- the focus of each theory

Student B: You are a teaching assistant. Talk to Student A about the theory of computation.

Writing

9 **Use the conversation from Task 8 to fill out the student's notes.**

Theory of Computation

Automata Theory focuses on _____ _____.

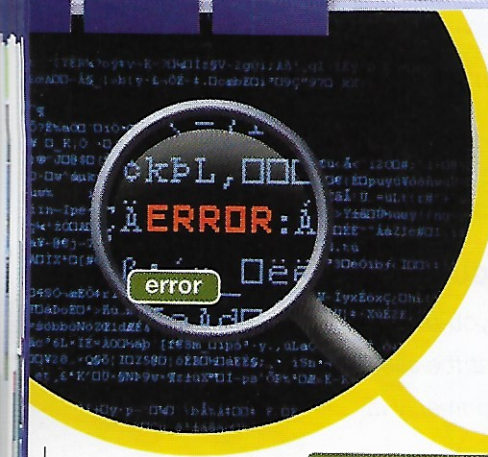
It deals with machines that are _____ _____.

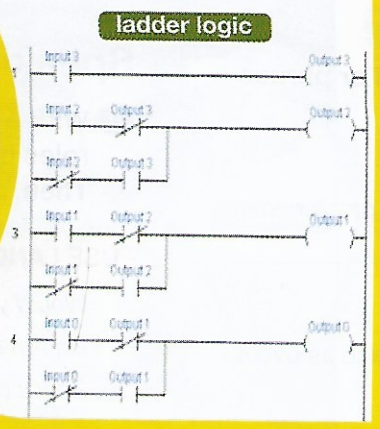
_____

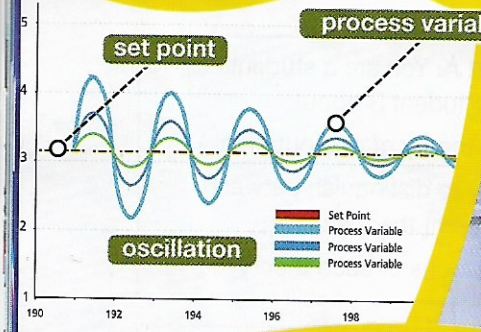
focuses on _____ _____.

It deals with machines that are _____ _____.

9 Control systems







Unit 12.4 Nov. 17 & 19

Review of Control Systems

There are a number of different **control systems**. Some are very simple, while others are much more elaborate.

Logic control:

In Unit 12.3, we designed control systems using **ladder logic**. These were simple **logic control** systems. Historically, logic control systems consisted of multiple small mechanical relays. Today, most logic control systems use microcontrollers instead.

Feedback control:

Simple **on/off controls** are a type of feedback control. A standard electric oven is a good example. The oven thermostat uses **negative feedback** to control the heating elements. The thermostat monitors the temperature, or **process variable** (PV). The elements turn off when the PV passes the **set point** (SP). The difference between the PV and SP is the **error**.

Linear control:

Linear control produces a constant control signal. Simple **proportional control** changes the control signal relative to the error. However, these may produce undesirable **oscillations** in PV. More advanced **PID control** uses **derivative** and **integral** functions to increase efficiency.

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some different types of control systems?

2 What are the characteristics of PID control?

Reading

2 Read the class handout. Then, choose the correct answers.

1 What is the handout mostly about?

- **A** benefits of combining control systems
- **B** troubleshooting steps for control systems
- **C** characteristics of different control systems
- **D** historical uses of control systems

2 Which control system can create oscillations in the value of PV?

- **A** proportional control
- **B** logic control
- **C** PID control
- **D** on/off control

3 What is NOT true about the set point of an oven?

- **A** It is needed to calculate the error.
- **B** It is used to determine the PV.
- **C** It is connected to the thermostat.
- **D** It can prompt a component to turn off.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ error
2 __ ladder logic
3 __ set point
4 __ linear control
5 __ process variable
6 __ on/off control
7 __ control system
8 __ proportional control

- **A** a system that responds to input with equivalent reverse action
- **B** a system that activates and deactivates a device
- **C** a device or set of devices that regulate the actions of other devices
- **D** the desired value of the PV
- **E** a system that produces a constant output signal
- **F** a condition that is being monitored by the control system
- **G** the difference between the PV and SP
- **H** a way to express relay logic in a diagram

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **integral / derivative**

A A(n) _____ action keeps increasing its effort until the error is zero.

B A(n) _____ action measures the change in error over time.

2 **oscillation / PID control**

A _____ uses mathematical functions to increase efficiency.

B A(n) _____ is a repeated variation in signal.

3 **logic control / negative feedback**

A _____ uses binary inputs and outputs.

B Common thermostats operate on the principle of _____.

5 Listen and read the class handout again. When does the oven thermostat turn the heating elements off?

Listening

6 Listen to a conversation between two students. Mark the following statements as true (T) or false (F).

1 __ The man is confused about integral functions in PID control.

2 __ The woman explains the difference between logic and linear control.

3 __ According to the woman, logic control parts are sometimes used in linear control systems.

7 Listen again and complete the conversation.

Student 1: Well, I'm going over my notes. And I don't quite understand the difference between **1** _____ _____ _____ and PID control.

Student 2: Okay. Well, they both respond in proportion to the **2** _____.

Student 1: Right, I knew that. But what do the derivative and integral functions do in **3** _____ _____?

Student 2: Straight proportional control creates **4** _____ in PV. Derivative and integral functions reduce the oscillations.

Student 1: I see. So they make the control signal more precise?

Student 2: Yeah, exactly.

Student 1: And they're both **5** _____ _____, right?

Student 2: Yes. But **6** _____ _____ _____, in the real world there's some overlap. Linear control systems might have some logic control parts.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

Can you help me?

What do you need ...?

I'm confused about ...

Student A: You are a student. Talk to Student B about:

- an upcoming exam on control systems
- differences between control systems
- what you are confused about

Student B: You are a student. Talk to Student A about different types of control systems.

Writing

9 Use the conversation from Task 8 to fill out the test on control systems.

Unit 12.4 **Control Systems**

Name: _____

Date: _____

1 a. **Name two types of control systems.**

_____

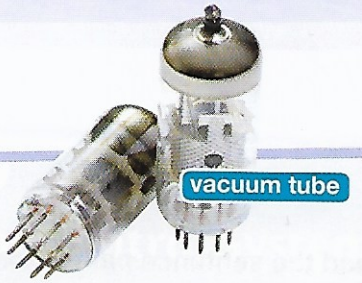
_____

b. **What is the difference between them?**

_____

_____

10 Solid-state Electronics

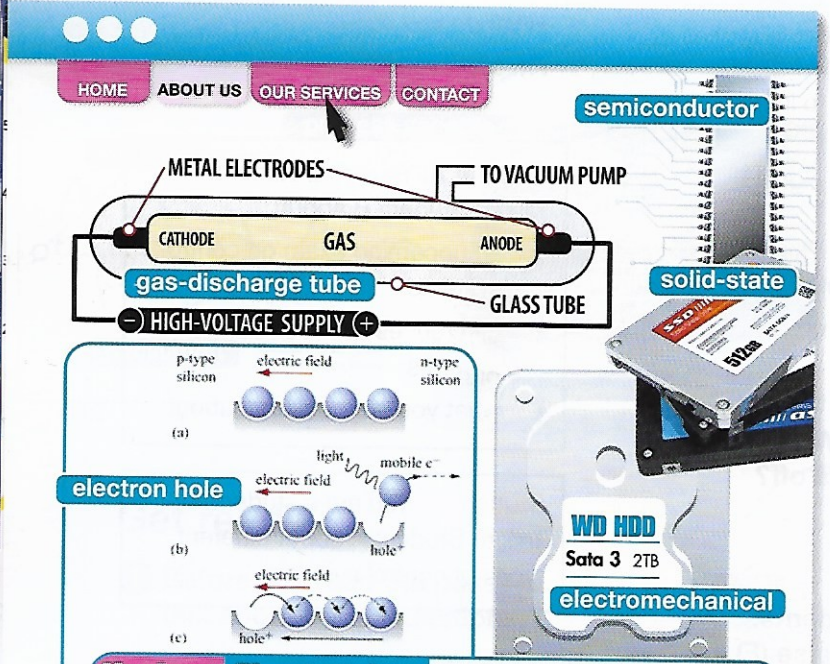


Get ready!

1 Before you read the passage, talk about these questions.

1 What are some examples of solid-state devices?

2 What types of devices existed before solid-state technology?



Krakov Electronics
A leader in solid-state technology

Krakov began as a manufacturer of **gas-discharge tubes** in 1902. In the 1930s, many early computers used Krakov **vacuum** tubes. Today, Krakov specializes in manufacturing **solid-state** drives and storage devices.

What are solid-state electronics?

Solid-state electronics consist entirely of **solid** components. Krakov Electronics builds solid-state devices out of **crystalline semiconductors**. Semiconductors are unique because they contain both electrons and **electron holes**. In solid-state devices, electrical current only flows within solid parts. Electrons and other **charge carriers** move within the **confined** space. This makes solid-state devices exceptionally fast and efficient.

What is the difference between solid-state drives and hard disk drives?

A hard disk drive (HDD) is an **electromechanical** device. An HDD stores information on a rigid, magnetic spinning disk. A solid-state drive (SSD) stores data in integrated circuits. The SSD has many advantages over devices with vulnerable **moving parts**. They are quieter, more durable, and more power-efficient. Make your next storage device a Krakov solid-state drive!

Reading

2 Read the webpage. Then, choose the correct answers.

1 What is the webpage mostly about?

A the historical applications of solid-state technology

B a catalog of solid-state devices available for purchase

C a comparison of solid-state and older technologies

D instructions for installing solid-state drives

2 According to the webpage, what is NOT an advantage of solid-state devices?

A They are quieter than electromechanical devices.

B They do not have vulnerable moving parts.

C They require low levels of power to operate.

D They store information on a magnetic disk.

3 What is true of semiconductors?

A They have both electrons and electron holes.

B They are usually made up of multiple pieces.

C They allow charge carriers to move freely in and out.

D They contain rigid, spinning disks.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1	__ solid	5	__ crystalline
2	__ vacuum	6	__ charge carrier
3	__ confined	7	__ electromechanical
4	__ electron hole	8	__ gas-discharge tube

A a space devoid of air or other matter

B a device that runs on electricity and also has moving parts

C restricted to a certain area

D a positively charged space where a negatively charged particle could be

E a subatomic particle that is electrically charged

F devoid of cavities or breaks

G having the structural qualities of a solid with a regular molecular pattern

H a glass cylinder filled with ionized gas

4 Read the sentences and choose the correct words or phrases.

1 A **crystalline / solid-state** device has no mechanical parts.
2 A material with moderate conductivity is a **semiconductor / gas-discharge** tube.
3 In portable devices, the **electron holes / moving parts** are most likely to break.

5 Listen and read the webpage again. Where does electrical current flow in solid-state devices?

Listening

6 Listen to a conversation between an intern and a computer engineer. Mark the following statements as true (T) or false (F).

1 __ The woman recently learned about gas-discharge tubes on TV.
2 __ The woman mistakes a hard drive for a solid-state device.
3 __ The man explains the difference between electrons and electron holes.

7 Listen again and complete the conversation.

Intern: Definitely. We watched a TV program about those. It said that **1** _____ _____ practically every day. Can you imagine that?
Engineer: I'm sure it was really frustrating.
Intern: **2** _____ - _____ technology is so much better. Hard drives hold so much more information. And they're way more reliable.
Engineer: Well actually, a hard drive isn't solid-state. It's **3** _____.
Intern: Really? I thought they were made from **4** _____ parts.
Engineer: Technically, that's true. But devices with **5** _____ _____ aren't really solid-state.
Intern: Oh, okay. I thought solid-state just meant it didn't have vacuum tubes.
Engineer: No, solid-state electronics are made out of **6** _____.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

It's amazing ...
Actually ...
I thought ...

Student A: You are an intern. Talk to Student B about:

- recent advancements in solid-state technology
- a TV program you saw about older technology
- the distinction between different technologies

Student B: You are an engineer. Talk to Student A about solid-state technology.

Writing

9 Use the conversation from Task 8 to fill out the intern evaluation form.

Monthly Intern Evaluation

Intern: _____
Mentor: _____

Overall Performance:
Excellent ❑ Good ❑ Fair ❑ Poor ❑

What additional training do you recommend?

_____
_____

Why do you recommend this training?

_____
_____

11 Design Processes

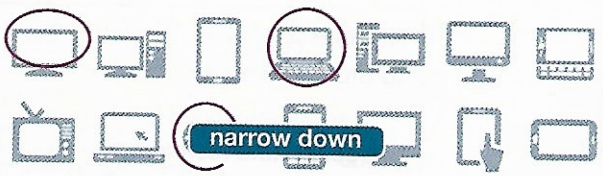
Get ready!

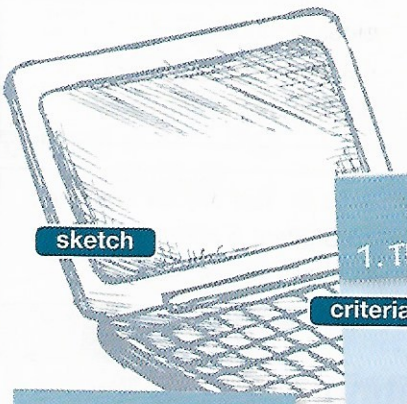
1 Before you read the passage, talk about these questions.

1 What are the major stages of the computer design process?

2 Why do engineers conduct feasibility studies?

Tekknic Systems: Policies & Procedures





CHECK LIST
1. The new model must be
criteria
Quiet ☐
Cost- effective ☐
Energy efficient ☐

Design Methods

All new products and devices go through a standard design process:

1. **Identify** a need in the market. Research any similar products from competitors. Identify flaws in the existing products.
2. Present **preliminary designs** and **sketches** to your creative team. Explain how the product will meet market demands.
3. Conduct an in-depth **feasibility study** to determine the project's likelihood for success. **Estimate** the cost and time required to **construct** prototype models. (This applies to hardware devices only.) Identify the practical **constraints** of the project.
4. **Narrow down** designs to the most feasible options. Eliminate any designs that are obviously not cost-effective.
5. With the results of the feasibility study, produce some **detailed designs**. Identify potential problems in the designs and make changes as necessary.
6. **Assemble** and test prototypes or produce initial version of software. Adjust the design to ensure the product meets company **criteria**.
7. Decide on the final design version. **Verify** the final designs with the creative team and superiors.

Reading

2 Read the employee manual. Then, choose the correct answers.

1 According to the manual, what is the purpose of researching products from other companies?

A to identify problems with existing designs
B to estimate the possible costs of prototypes
C to eliminate designs that are not cost-effective
D to determine a project's likelihood for success

2 Which of the following is NOT part of the feasibility study?

A estimating costs of prototypes
B producing detailed designs
C identifying practical limitations
D narrowing down design options

3 According to the manual, which designs should engineers eliminate?

A designs with potential problems
B designs with many practical constraints
C designs that are too expensive
D designs that are available from competitors

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ sketch
2 __ identify
3 __ verify
4 __ construct
5 __ constraint
6 __ narrow down
7 __ detailed design
8 __ preliminary design

A to eliminate less desirable options
B to recognize or establish something
C a rough drawing that is not meant to be a finished product
D to build something
E a restricting condition
F an in-depth version of project plans
G an initial, conceptual version of project plans
H to make sure something is correct or valid

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **assemble / estimate**

A It took two hours to _____ the parts.

B We need to _____ the total cost of the project.

2 **criteria / feasibility study**

A The engineer is waiting for the results of the _____.

B The prototype did not meet the company's _____.

5 🎧 **Listen and read the employee manual again. When do engineers estimate the cost of building a prototype?**

Listening

6 🎧 **Listen to a conversation between two computer engineers. Mark the following statements as true (T) or false (F).**

1 __ The woman will bring detailed designs to the meeting.

2 __ The man plans to work with other engineers on a preliminary design.

3 __ The woman is used to a different type of design process.

7 🎧 **Listen again and complete the conversation.**

Engineer 1: Well, you'll start by bringing your **1** _____ to the meeting tomorrow.

Engineer 2: Okay. Is that when we'll discuss the **2** _____ _____ _____?

Engineer 1: Yes. The engineering team will **3** _____ the strengths and weaknesses of the design. Then we'll make some initial adjustments.

Engineer 2: Right. I realize that the design process is **4** _____ _____ _____.

Engineer 1: Yes, very much so. After tomorrow's meeting, we'll do a **5** _____ _____.

Engineer 2: And that's when we'll decide whether to proceed, right?

Engineer 1: Exactly. If it looks like the project is viable, we'll move on to the **6** _____ _____.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

You'll start by ...

Is that when we'll ...?

Exactly.

Student A: You are an engineer. Talk to Student B about:

- his or her designs for a new project
- the steps he or she will take in the design process
- the benefits of the design procedures

Student B: You are an engineer. Talk to Student A about the design process.

Writing

9 **Use the conversation from Task 8 to fill out the manual.**

Tekknic Systems:

Guidelines for new employees – Stages of the design process

Firstly, _____ _____ to the board.

A team of engineers will help you to narrow down the designs.

If your design is approved _____ _____.

12 Algorithms

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some uses of algorithms?

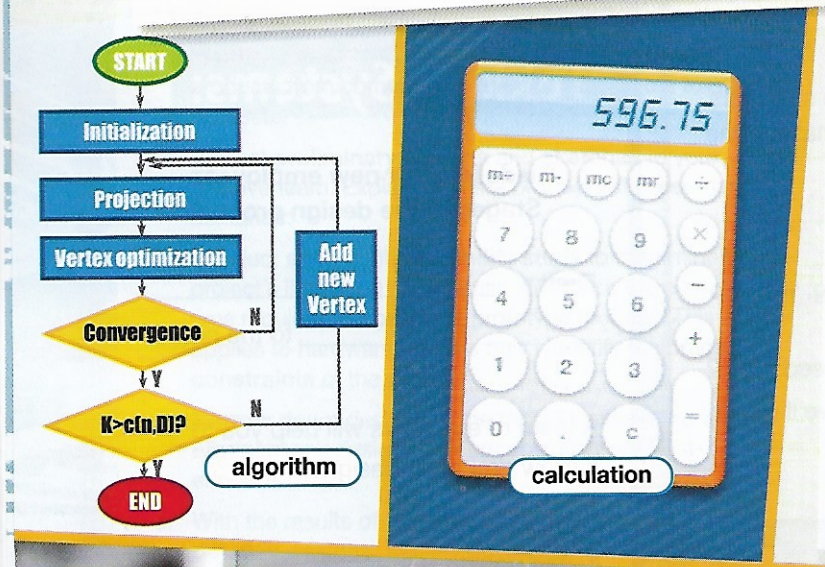
2 What are the two desirable traits of a computer algorithm?

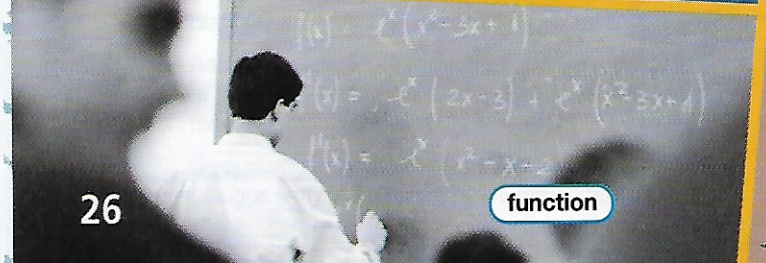
Algorithms

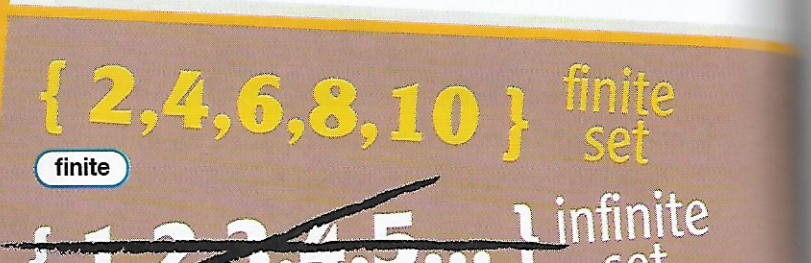
An **algorithm** is a **step-by-step** process for performing **calculations**. In computer engineering, algorithms have many uses. They are an **effective method** for **automated** reasoning and data processing. People first began to use algorithms to solve the famous **decision problem**.

In essence, an algorithm **determines** the procedure to calculate a **function**. In computing, algorithms take input values through a prescribed **sequence**. The output of the algorithm is the solution to the problem. By definition, an algorithm is a **finite** list of steps. Algorithms can only solve problems that are inherently **decidable**.

Computer algorithms come with a unique set of problems. The main problem is striking a balance between **goodness** and **elegance**. A computer can solve a 'good' algorithm very quickly and efficiently. By contrast, an 'elegant' algorithm has a minimal number of steps. Skilled engineers can create algorithms that are both good and elegant.







Reading

2 Read the textbook chapter. Then, choose the correct answers.

1 What is the passage mostly about?

A a comparison of different types of algorithms
B an overview of the properties of algorithms
C instructions for programming algorithms
D a history of the use of algorithms

2 Which idea is NOT in the passage?

A An algorithm is a finite sequence of steps.
B Algorithms should be both good and elegant.
C Algorithms are used for automated reasoning.
D Algorithms are used to create new functions.

3 Why were algorithms first used?

A to perform data processing tasks
B to solve the decision problem
C to aid in computer engineering
D to ensure that problems are decidable

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ finite
2 __ sequence
3 __ elegance
4 __ algorithm
5 __ determine
6 __ step-by-step
7 __ calculation
8 __ effective method

A a problem-solving process that always produces the correct answer
B following a specific sequence of actions
C the process of analyzing and solving a mathematical problem
D a set of actions or numbers arranged in order
E having definite limits on its value
F a set of precise rules for solving mathematical functions
G the compactness of a computer program
H to decide conclusively based on the available evidence

4 Read the sentences and choose the correct words or phrases.

1 In a(n) **finite / automated** system, machines are programmed to do the work.
2 The **goodness / sequence** of an algorithm is its speed and efficiency.
3 Algorithms calculate the value of a(n) **function / elegance**.
4 A **calculation / decision problem** is a formal question with a yes or no answer.
5 An algorithm can only solve a problem that is **step-by-step / decidable**.

5 Listen and read the textbook chapter again. What kind of problems can algorithms solve?

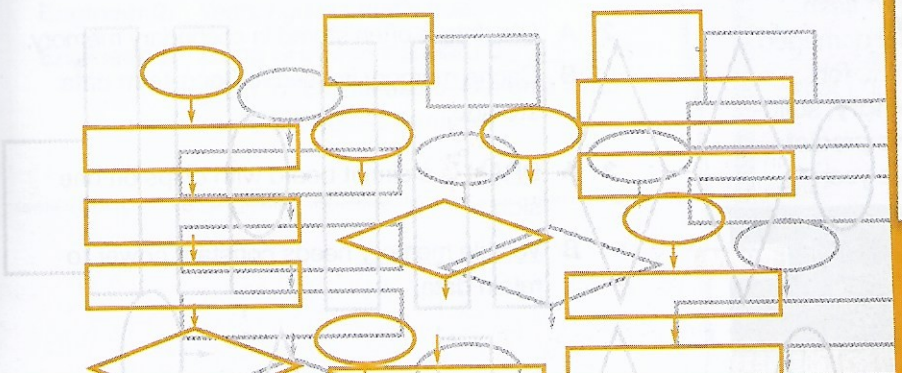
Listening

6 Listen to a conversation between two engineers. Mark the following statements as true (T) or false (F).

1 __ The woman wants the man to create a new algorithm.
2 __ The man suggests removing a calculation.
3 __ The algorithm needs improved goodness.

7 Listen again and complete the conversation.

Engineer 1: Hey Matt, I'm having a hard time with this algorithm. **1** _____ your opinion on it?
Engineer 2: Sure, Maggie. Let me **2** _____ at it.
Engineer 1: It's just a simple **3** _____ for a spam filter.
Engineer 2: Yes, I'm familiar with those. So it's **4** _____ based on keywords, right?
Engineer 1: That's right. It looks for common words in spam messages. But I'm worried that it's too big.
Engineer 2: Let me see. I think you can remove one of the **5** _____. It's kind of redundant.
Engineer 1: In what way?
Engineer 2: Go through it **6** _____-_____-_____. You'll see that you're doing the same calculation twice.



Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

Could I get your opinion on ...?
I think you ...
In what way?

Student A: You are an engineer. Talk to Student B about:

- an algorithm you are working on
- what you should add or remove
- how the changes will improve the algorithm

Student B: You are an engineer. Talk to Student A about an algorithm.

Writing

9 Use the conversation from Task 8 to fill out the note from a computer engineer to a coworker.

Hi Matt,

I made some changes to that algorithm.

Changes I made:

_____

_____

Why I made these changes:

_____

_____

Let me know what you think now.

-Maggie

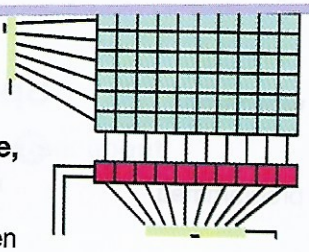
13 Memory

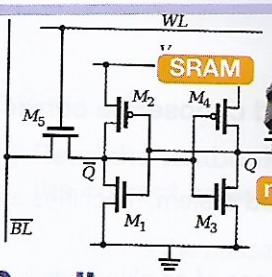
Get ready!

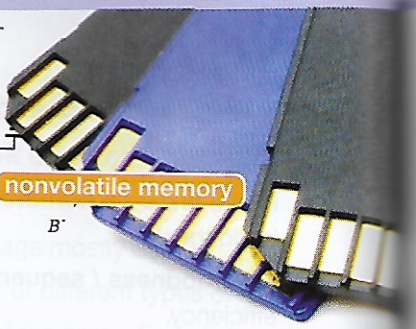
1 Before you read the passage, talk about these questions.

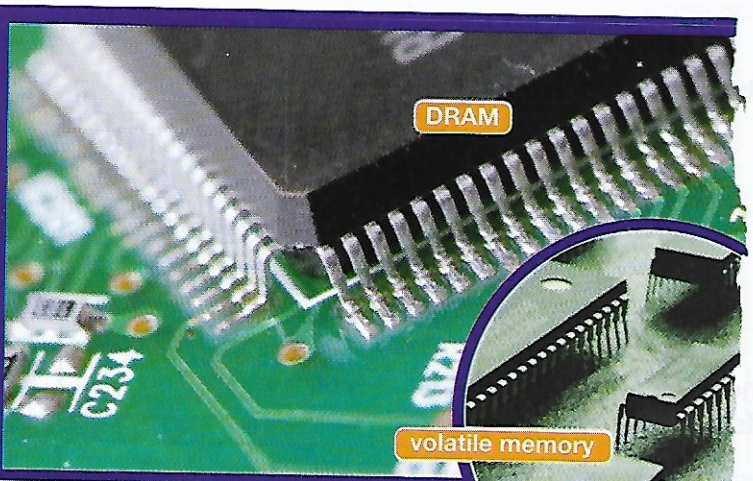
1 What is the difference between volatile and nonvolatile memory?

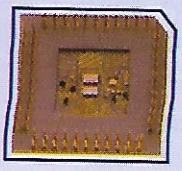
2 What are some different kinds of volatile memory?











Trends in Computer Memory Usage

Article from the Journal of Computer Science and Microelectronics

An examination of recent computer **memory** trends produced interesting results. Last year, experts predicted that the cost of **SRAM** would drop. In this prediction, they were correct. However, they also predicted that SRAM would begin to replace **DRAM**. To date, SRAM is still used primarily in **cache memory**. Most memory used in **DIMMs** and **SIMMs** today is still DRAM. Why isn't the industry switching to faster **volatile memory**? The production cost of DRAM is still significantly lower. But some analysts still see SRAM as the **primary memory** of the future.

This year's trends in **nonvolatile memory** followed industry predictions. Flash memory is overtaking optical discs at a steady rate. Compared to flash memory, discs are inconvenient and easily damaged. Most consumers are abandoning CD-ROMs for portable flash drives. For **secondary memory**, solid-state drives are gaining popularity. Experts predict they will replace magnetic discs within five years.

Reading

2 Read the journal article. Then, mark the following statements as true (T) or false (F).

1 ___ SRAM has replaced DRAM as the standard primary memory unit.

2 ___ According to the article, experts' predictions about nonvolatile memory were inaccurate.

3 ___ Solid-state devices are gaining popularity over magnetic discs for secondary memory.

Vocabulary

3 Match the words (1-7) with the definitions (A-G).

1 ___ DIMM
2 ___ SIMM
3 ___ DRAM
4 ___ *memory*
5 ___ cache memory
6 ___ primary memory
7 ___ nonvolatile memory

A a circuit board that has chips on only one side
B memory in the form of a chip that needs to be refreshed periodically
C a circuit board that has chips on both sides
D fast memory that stores recent or frequently requested data
E memory that retains data with or without constant power
F data storage for computers
G volatile memory used to store active programs

4 Read the sentence pairs. Choose the sentence that uses the underlined part correctly.

1 **A** SRAM does not need to be refreshed.
B A SIMM has DRAM chips on both sides.

2 **A** Old data is often stored in secondary memory.
B Cache memory is used for long-term data storage.

3 **A** DRAM is a circuit board with chips on one side.
B Volatile memory needs constant power to retain data.

5 🎧 **Listen and read the journal article again. Why doesn't SRAM replace DRAM as the standard primary memory?**

Listening

6 🎧 **Listen to a conversation between two engineers. Choose the correct answers.**

1 What is the conversation mostly about?

A a broken SIMM unit
B problems with cache memory
C the advantages of DIMMs
D a new type of memory module

2 What will the woman likely do next?

A write a report about nonvolatile memory trends
B install more memory in her office computer
C look up information about the new type of DRAM
D replace a defective cache memory unit

7 🎧 **Listen again and complete the conversation.**

Engineer 1: Have you heard about the new **1** _____ modules? They're using them in the X39 units.

Engineer 2: I've heard a bit. It's just a new type of **2** _____, isn't it?

Engineer 1: That's right. It seems to be a lot more efficient.

Engineer 2: I don't know. **3** _____ _____ _____ to be worth the cost to me.

Engineer 1: Well, it doesn't have to be refreshed as often. That's a major advantage.

Engineer 2: I know that. But at that price, I think it **4** _____ _____ _____ to switch to SRAM.

Engineer 1: Well, the problem with **5** _____ is that it has more transistors per bit.

Engineer 2: Yeah, I guess that's true.

Engineer 1: Using SRAM in standard **6** _____ is great for casual users. But on a large scale, it's not sustainable.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Have you heard ...?
It seems to be ...
You're right ...

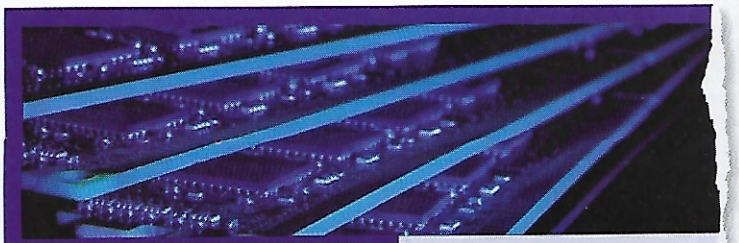
Student A: You are an engineer. Talk to Student B about:

- a new type of memory module
- the advantages of the new memory module
- your opinion about the new memory module

Student B: You are an engineer. Talk to Student A about a new memory module.

Writing

9 **Use the conversation from Task 8 to fill out the tech blog post.**



Thursday, March 1, 8:34 PM

New DRAM memory modules

A conversation with my coworker prompted me to learn more about the new DRAM units.

What I thought at first: _____

_____

_____

_____

What I discovered: _____

_____

_____

_____

14 Chips

Get ready!

1 Before you read the passage, talk about these questions.

1 What is the difference between VLSI and ULSI?
2 How are integrated circuits made?

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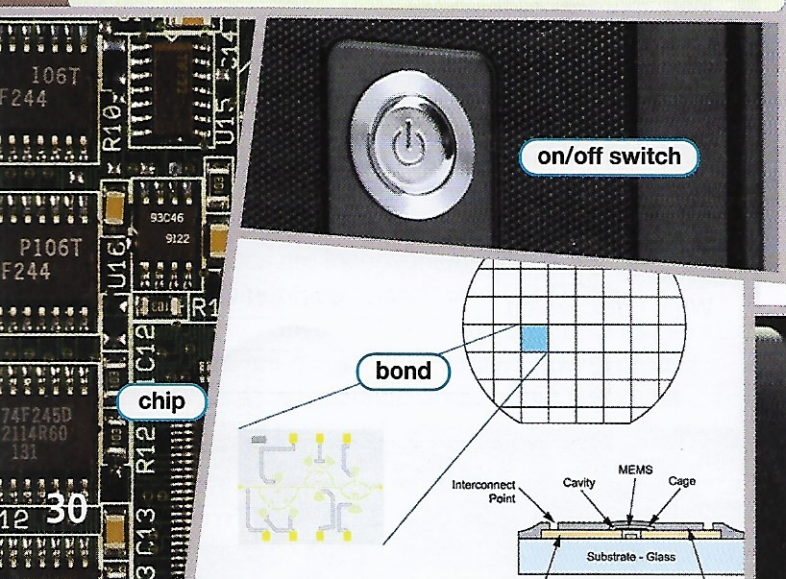
Seed Microelectronics

How does Seed build superior integrated circuits?

Integrated circuits, also called **chips**, begin with **silicon** crystal. The manufacturing process is the same for both **VLSI** and **ULSI** chips. The difference between VLSI and ULSI is the number of **transistors**. Transistors are like tiny **on/off switches** powered by electricity.

A machine slices the silicon crystal into thin, round **wafers**. Then, we apply a **pattern** of chemicals to the wafer. This process forms the basis of conductors, **insulators**, and transistors. A dicing machine cuts the wafer into multiple small **dies**. Inconsistencies in the silicon material make some dies unusable. We inspect the dies for **defects** and **discard** dies with major imperfections.

The dies that pass inspection move on to the bonding process. We **bond** the die to the I/O connectors of the packaging. Then, we test the chips to make sure they function properly. The finished integrated circuits are now ready for consumer use.



Reading

2 Read the webpage. Then, choose the correct answers.

1 What is the webpage mostly about?
- **A** a comparison of different types of integrated circuits
- **B** why integrated circuits are made of particular materials
- **C** the types of chemicals used to make integrated circuits
- **D** the manufacturing process for integrated circuits

2 Which is NOT a part of a finished chip?
- **A** I/O connectors
- **B** silicon dies
- **C** patterned wafers
- **D** electric transistors

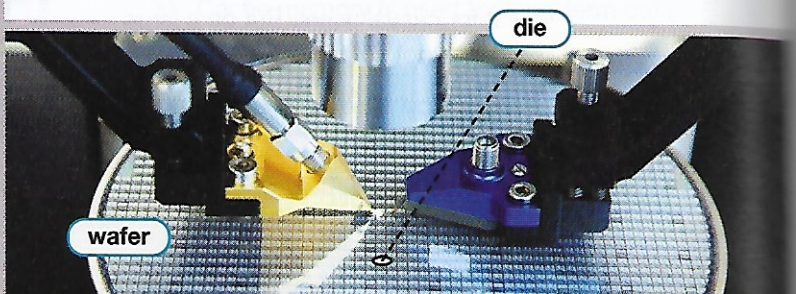
3 What happens during the bonding process?
- **A** the die is attached to the packaging
- **B** the wafer is cut into multiple dies
- **C** the defective dies are discarded
- **D** the integrated circuits are tested

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ chip
2 __ VLSI
3 __ wafer
4 __ discard
5 __ defect
6 __ silicon
7 __ insulator
8 __ on/off switch

- **A** a device that completes or interrupts a circuit
- **B** a thin slice of crystal
- **C** a way of building chips with hundreds of thousands of transistors
- **D** a naturally occurring semiconductor
- **E** a flaw or inconsistency
- **F** an electronic circuit mounted on a piece of semiconductor material
- **G** a material that does not conduct electricity
- **H** to throw something away



4 **Fill in the blanks with the correct words from the word bank.**

WORD BANK

integrated circuit die pattern
bond transistor ULSI

1 _____ technology incorporates millions of on/off switches into one chip.
2 Machines _____ the flawless dies to the packaging.
3 If a(n) _____ contains a defect, it is discarded before it is attached to connectors.
4 Most system memory exists in the form of a(n) _____.
5 Chemicals can transform an area of silicon into a(n) _____.
6 After the wafer is sliced, a _____ of chemicals and metals is applied.

5 **Listen and read the webpage again. Why are some dies discarded?**

Listening

6 **Listen to a conversation between a manager and an employee. Mark the following statements as true (T) or false (F).**

1 __ The company is using ULSI manufacturing technology.
2 __ The man discarded the defective dies.
3 __ The current batch of dies is being bonded.

7 **Listen again and complete the conversation.**

Manager: Manny, what's the status on the new batch of **1** _____ _____?
Employee: Well, Josie, we just finished dicing the **2** _____.
Manager: Great. It sounds like things are moving ahead of schedule. Did you have any problems with the new machinery?
Employee: None at all. It's the best **3** _____ manufacturing technology I've ever used.
Manager: That's good to hear. Are the **4** _____ ready for bonding?
Employee: Well, first we still have to inspect the dies for defects. Then we'll **5** _____ the defective ones.
Manager: Ah, I see. I thought you did that already.
Employee: Not yet. The dies are **6** _____ _____ _____ to inspection right now.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

What's the status ...?
Did you have ...?
First ... then ...

Student A: You are a manager. Talk to Student B about:

- progress on a batch of integrated circuits
- problems he or she encountered
- what steps are left in the process

Student B: You are an employee. Talk to Student A about the current batch of chips.

Writing

9 **Use the conversation from Task 8 to fill out the progress report.**

Seed Microelectronics
Manufacturing Progress Update

Date: _____

Type of chip: _____

Have you encountered any problems? **Y / N**

What is the current status of the chips?

_____

_____

15 Internet Security

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some different Internet security methods?

2 Why is Internet security important?

Reading

2 Read the email. Then, complete the table.

Problem	Solution
1 _____ _____	Change firewall permissions settings
Server has insufficient email encryption.	2 _____ _____
3 _____ _____	Update the anti-virus software.

From: s.medina@fosterwatson.com

To: jeff@greentechwizards.com

Sub: Network Security (Help!)

Jeff,

We have a real problem with network **security** at our office. The main concern is with the **firewall** on the router. Some of our new machines can't access the network. Even with the network **password**, it doesn't seem to work. I think we need to change the permissions settings. We want to **deny** unauthorized users, but **permit** our own machines!

I'm also looking for a new way to **encrypt** our email. We're using an outdated **SSL connection** and we need to upgrade. I'm worried that it can't **authenticate** communications from our mail server. I tried to check the **audit log**, but I couldn't **log in**.

Finally, I want to update our **anti-virus software**. Some of my employees found malware on their machines. We're worried about **viruses** entering our local network. How much damage could a virus cause to our network?

I'd really appreciate if you could come down to the office. Does Friday afternoon work for you?

Thanks,
Sally

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ deny
2 __ virus
3 __ permit
4 __ security
5 __ password
6 __ authenticate
7 __ SSL connection
8 __ anti-virus software

A to prove that something is correct or legitimate

B a program to protect computers from damaging software

C an Internet connection protected by a cryptographic protocol

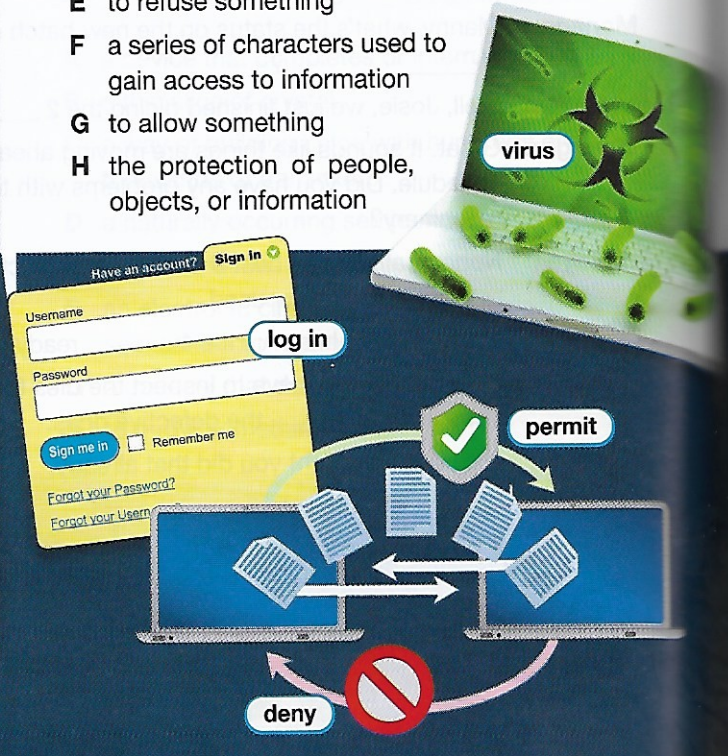
D a program designed to replicate itself and spread to other machines

E to refuse something

F a series of characters used to gain access to information

G to allow something

H the protection of people, objects, or information



4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **firewall / audit log**

A A(n) _____ protects a local network from unauthorized users.

B We checked the _____ for signs of suspicious activity.

2 **log in / encrypt**

A Kathryn had to _____ to use the student forum.

B We _____ our emails so other people can't read them.

5 **Listen and read the email again. Why is the writer concerned about viruses on the local network?**

Listening

6 **Listen to a conversation between a computer engineer and a business owner. Mark the following statements as true (T) or false (F).**

1 __ The woman found an unauthorized user in the audit log.

2 __ The man recommends resetting SSL permissions.

3 __ The woman will pay extra to upgrade the anti-virus software.

7 **Listen again and complete the conversation.**

Engineer: Did you check the **1** _____ _____ like I suggested?

Owner: I tried to **2** _____ _____ with the password you sent me. But it still didn't work.

Engineer: Okay, I'll have to **3** _____ _____ _____ at it myself.

Owner: Based on what you've seen, what changes do you recommend?

Engineer: Well, first of all, **4** _____ _____ _____ upgrading your anti-virus software.

Owner: I had a feeling you would say that. Is it going to be expensive?

Engineer: Don't worry, you can upgrade for free. I'd also like to change your **5** _____ _____.

Owner: Okay. That sounds like a good idea.

Engineer: After that, I can reset the permissions on your **6** _____ Does that sound good to you?

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

I understand ...

I tried to ...

I highly recommend ...

Student A: You are an engineer. Talk to Student B about:

- his or her security concerns
- what steps he or she already took
- what changes you recommend

Student B: You are a business owner. Talk to Student A about your security concerns.

Writing

9 **Use the conversation from Task 8 to fill out the engineer's notes.**

Green Tech Wizards!

Assessment and Estimate Notes

Client Name: _____

What is the main security problem?

_____

_____

_____

Is this an urgent problem? Y / N

How will we solve the problem?

_____

_____

_____

Glossary

abstract [ADJ-U8] If something is **abstract**, it exists in the form of a thought, but not as a real object or event.

algorithm [N-COUNT-U12] An **algorithm** is a set of precise rules describing the process for performing calculations.

anti-virus software [N-UNCOUNT-U15] **Anti-virus software** is a type of security software that removes malware, or prevents its installation.

assemble [V-T-U11] To **assemble** something is to put its parts together.

audit log [N-COUNT-U15] An **audit log** is a record of all user interactions with a protected system.

authenticate [V-T-U15] To **authenticate** something is to prove that it is correct or legitimate.

automata theory [N-UNCOUNT-U8] **Automata theory** is the study of abstract machines and the problems they are theoretically able to solve.

automated [ADJ-U12] If an action is **automated**, it is done by a machine.

availability [N-UNCOUNT-U6] **Availability** is the proportion of time that a computer system is functional and able to complete a task.

bandwidth [N-COUNT-U6] A **bandwidth** is a measurement of a computer network's ability to transmit information.

binary [ADJ-U4] If something is **binary**, it uses a number system based on two.

bit/s [N-COUNT-U6] A **bit/s**, or bit per second, is a unit that measures the rate of data transmission.

bond [V-T-U14] To **bond** two or more objects is to cause them to adhere to each other.

byte [N-COUNT-U4] A **byte** is a very small unit of computer data.

cache memory [N-UNCOUNT-U13] **Cache memory** is small, fast memory that stores recent or frequently-used data for fast access.

calculation [N-COUNT-U12] A **calculation** is the process of analyzing a mathematical problem and determining its solution.

charge carrier [N-COUNT-U10] A **charge carrier** is a free subatomic particle that carries an electrical charge.

chip [N-COUNT-U14] A **chip**, also called an integrated circuit, is an electronic circuit consisting of a large number of small devices mounted on one solid piece of semiconductor material.

closed system [N-COUNT-U3] A **closed system** is a system that does not gain or lose mass.

compact [ADJ-U6] If something is **compact**, it occupies a very small amount of space and its parts are usually closely joined or compressed.

compression ratio [N-COUNT-U6] A **compression ratio** is the difference between a file's actual size and its size while compressed.

computability theory [N-UNCOUNT-U8] **Computability theory** is the study of abstract machines and the computational problems they can solve.

computational complexity theory [N-UNCOUNT-U8] **Computational complexity theory** is the study of the resources computers need to solve problems.

conclusion [N-COUNT-U2] A **conclusion** is a decision or determination that is made after an experiment.

confined [ADJ-U10] If an object is **confined**, its movement is restricted to a certain area.

conservation [N-UNCOUNT-U7] **Conservation** is a principle that prevents the total value of a quantity in a system from changing.

constant [N-COUNT-U7] A **constant** is a number that never changes.

constraint [N-COUNT-U11] A **constraint** is a restricting condition.

construct [V-T-U11] To **construct** something is to build it.

consumption [N-UNCOUNT-U3] **Consumption** is the amount of an extensive quantity that is destroyed during a particular period of time.

control group [N-COUNT-U2] A **control group** is a part of an experiment that does not receive the action or treatment that is being tested.

control system [N-COUNT-U9] A **control system** is a device or set of devices that regulates the actions of other devices.

correspond [V-I-U5] To **correspond** to something is to have a direct relationship or similarity with it.

criteria [N-COUNT-U11] **Criteria** are standards or requirements that must be met.

critical thinking [N-UNCOUNT-U1] **Critical thinking** is the ability to draw logical conclusions based on facts and evidence.

crystalline [ADJ-U10] If a material is **crystalline**, it has the structural characteristics of a crystal.

curious [ADJ-U1] If someone is **curious**, he or she wants to know more about something.

data compression [N-UNCOUNT-U6] **Data compression** is a process of encoding information so that it occupies a smaller space on a computer.

data decompression [N-COUNT-U6] **Data decompression** is a process that returns compressed data to its original size.

data transmission [N-UNCOUNT-U6] **Data transmission** is the exchange of information between computers.

decidable [ADJ-U12] If a problem is **decidable**, its solution can be reached by logical or algorithmic methods.

decision problem [N-COUNT-U12] A **decision problem** is a formal question with a yes or no answer, the most famous of which is a logical challenge to create an algorithm that will determine conclusively whether a statement is inherently true or false.

decline [N-COUNT-U5] A **decline** is the process of becoming worse or smaller in amount.

decrease [V-I-U5] To **decrease** is to become smaller.

dedicated [ADJ-U1] If someone is **dedicated**, he or she is devoted to a task or cause.

defect [N-COUNT-U14] A **defect** is a flaw or inconsistency.

deny [V-T-U15] To **deny** something is to refuse it.

derivative [ADJ-U9] If an action is **derivative**, it is a mathematical function that measures the variation in the value of an error over time.

detailed design [N-COUNT-U11] A **detailed design** is an in-depth version of a design, usually updated from the preliminary design with the results of research and analysis.

detail-oriented [ADJ-U1] If someone is **detail-oriented**, he or she is capable on focusing on small, specific parts of something.

determine [V-T-U12] To **determine** something is to decide conclusively based on the available evidence.

die [N-COUNT-U14] A **die** is a small piece of a wafer.

DIMM [ABBREV-U13] A **DIMM** (dual inline memory module) is a circuit board that has DRAM chips on both sides and plugs into the memory slot of a motherboard.

discard [V-T-U14] To **discard** something is to throw it away.

double [V-I-U5] To **double** is to become twice as large or abundant.

DRAM [ABBREV-U13] **DRAM** (dynamic random access memory) is memory in the form of an integrated circuit that can provide random access to any data, but needs to be refreshed periodically.

effective method [N-COUNT-U12] An **effective method** is a process for solving a problem that always produces the correct answer in a limited number of steps.

efficient [ADJ-U1] If someone is **efficient**, he or she works in a quick and organized way.

Glossary

efficiently [ADV-U8] If something occurs **efficiently**, it operates using a minimum amount of time and resources.

electromagnetism [N-UNCOUNT-U7] **Electromagnetism** is the interaction between electrical currents and magnetic fields.

electromechanical [ADJ-U10] If a device is **electromechanical**, it operates on electrical current and also has moving parts.

electron hole [N-COUNT-U10] An **electron hole** is the concept of a positively charged space that lacks an electron where an electron could conceivably exist.

elegance [N-UNCOUNT-U12] **Elegance** is the compactness of an algorithm within a computer program.

encrypt [V-T-U15] To **encrypt** information is to apply an algorithm to it that makes it unreadable to those without a key.

equilibrium [N-COUNT-U7] An **equilibrium** is a state in which there is a balance between two opposing forces.

error [N-COUNT-U9] An **error** in a control system is the difference in value between the current PV and the required SP.

estimate [V-T-U11] To **estimate** a value is to make an educated guess about it based on the available facts.

evaluation [N-COUNT-U2] An **evaluation** is a conclusion that someone reaches after thinking carefully about something.

expand [V-I-U5] To **expand** is to become larger in size.

experiment [N-COUNT-U2] An **experiment** is a scientific process that is designed to reveal the effect of something.

experimental group [N-COUNT-U2] An **experimental group** is a part of an experiment that receives the action or treatment that is being tested.

exponential [ADJ-U4] If an amount is **exponential**, its rate of growth increases as it becomes larger.

extensive quantity [N-COUNT-U3] An **extensive quantity** is an amount that changes based on the size of a system and has distinct, countable units.

factor [N-COUNT-U4] A **factor** is a number that an amount of something is repeatedly multiplied by.

feasibility study [N-COUNT-U11] A **feasibility study** is a period of research to determine whether a proposition is possible and likely to be successful, based on realistic conditions.

final [ADJ-U3] If something is **final**, it is related to the status of something at the end of a process or period of time.

finite [ADJ-U12] If a number is **finite**, it has definite limits on its value.

firewall [N-COUNT-U15] A **firewall** is a type of security software that screens network transmissions to prevent unauthorized access to a system.

fluctuate [V-I-U5] To **fluctuate** is to change regularly.

focus on [V-T-U1] To **focus on** something is to watch it closely or give full attention to it.

function [N-COUNT-U12] A **function** is a mathematical relationship between two or more sets of values.

gas-discharge tube [N-COUNT-U10] A **gas-discharge tube** is an insulated glass or ceramic tube filled with ionized gas that creates electrical signals.

generation [N-UNCOUNT-U3] **Generation** is the amount of an extensive quantity that is created during a particular period of time.

goodness [N-UNCOUNT-U12] **Goodness** is the speed and efficiency of an algorithm when performed by a computer.

gravity [N-UNCOUNT-U7] **Gravity** is a force that attracts bodies with mass towards each other.

hypothesis [N-COUNT-U2] A **hypothesis** is an idea, statement, or prediction that explains something, but which has not been tested or proven correct.

identify [V-T-U11] To **identify** something is to recognize or establish it.

IEC [ABBREV-U4] The **IEC** (International Electrotechnical Commission) is a global organization that establishes standards for electrical and technological units of measurement.

increase [V-I-U5] To **increase** is to grow larger in amount or numbers.

independent variable [N-COUNT-U2] An **independent variable** is the factor in an experiment that is changed.

initial [ADJ-U3] If something is **initial**, it is related to the status of something at the beginning of a process or period of time.

innovative [ADJ-U1] If something is **innovative**, it is new, creative, and advanced.

input [N-UNCOUNT-U3] **Input** is the amount of an existing extensive quantity that is added to a system during a particular period of time.

insulator [N-COUNT-U14] An **insulator** is a material that does not conduct electricity.

integral [ADJ-U9] If an action is **integral**, it is a mathematical function that makes increasing adjustments to a control signal until the error is reduced to zero.

integrated circuit [N-COUNT-U14] An **integrated circuit**, also called a chip, is an electrical circuit consisting of a large number of small devices mounted on one solid piece of semiconductor material.

intensive quantity [N-COUNT-U3] An **intensive quantity** is an amount that does not change based on the size of a system, which can be measured, but cannot be separated into distinct, countable units.

kibi- [PREFIX-U4] **Kibi-** is a binary prefix equivalent to 1,024 of the units it is attached to.

kilo- [PREFIX-U4] **Kilo-** is an SI prefix equivalent to 1,000 of the units it is attached to.

ladder logic [N-UNCOUNT-U9] **Ladder logic** is a way of expressing relay logic in the form of a diagram.

law [N-COUNT-U7] A **law** is an explanation of a natural process that is always true.

linear control [N-UNCOUNT-U9] **Linear control** is a type of a control system that produces a constant, variable control signal based on one or more inputs.

log in [V PHRASE-U15] To **log in** to a computer system or website is to gain access to it by proving one's identity.

logic control [N-UNCOUNT-U9] **Logic control** is a type of a control system that can be constructed using relays or microcontrollers and is characterized by binary inputs and outputs.

logical [ADJ-U1] If something is **logical**, it is based on evidence and reason.

machine [N-COUNT-U8] A **machine** is a mechanical or electrical device with several parts that performs a certain task.

magnetism [N-UNCOUNT-U7] **Magnetism** is a force of attraction or repulsion and is caused by moving electrically charged particles.

mastery [N-UNCOUNT-U1] **Mastery** is expert knowledge or skills in a particular subject or area.

mebi- [PREFIX-U4] **Mebi-** is a binary prefix equivalent to 1,048,576 of the units it is attached to.

mega- [PREFIX-U4] **Mega-** is an SI prefix equivalent to 1,000,000 of the units it is attached to.

memory [N-UNCOUNT-U13] **Memory** is temporary or long-term data storage.

momentum [N-UNCOUNT-U7] **Momentum** is a measure of the motion of an object equal to the product of its mass and velocity.

Moore's law [PHRASE-U5] **Moore's law** is an indistinct rule that states that computer power doubles about once every two years.

motion [N-UNCOUNT-U7] **Motion** is the act of moving.

moving part [N-COUNT-U10] A **moving part** is a part of a mechanical device that changes its position.

narrow down [V PHRASE-U11] To **narrow** something **down** is to eliminate the less feasible or less desirable options.

negative feedback [N-UNCOUNT-U9] **Negative feedback** is a state in which the control system reacts to an input condition in a way that reverses the condition.

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nonvolatile memory [N-UNCOUNT-U13] **Nonvolatile memory** is long-term data storage that does not require sustained power in order to retain data.

observation [N-COUNT-U2] An **observation** is a fact that is discovered by watching something closely.

obsolescence [N-UNCOUNT-U5] **Obsolescence** is the state of being no longer used because something more effective is available.

on/off control [N-COUNT-U9] An **on/off control** is a type of simple control system that activates or deactivates a device depending on certain criteria.

on/off switch [N-COUNT-U14] An **on/off switch** is a device that either completes or interrupts an electronic circuit.

open system [N-COUNT-U3] An **open system** is a system that allows mass to enter and leave it.

oscillation [N-COUNT-U9] An **oscillation** is a repeated movement or variation in signal.

output [N-UNCOUNT-U3] **Output** is the amount of an extensive quantity that is removed from a system, but not destroyed, during a particular period of time.

password [N-COUNT-U15] A **password** is a unique series of characters used to gain access to protected information.

pattern [N-COUNT-U14] A **pattern** is a repeated design, layout, or sequence of events.

pay close attention [V-PHRASE-U1] **Pay close attention** to something is a heightened level of focus that somebody gives to something.

permit [V-T-U15] To **permit** something is to allow it.

PID control [N-UNCOUNT-U9] **PID** (proportional-integral-derivative) **control** is a type of a control system that uses mathematical functions to make proportional controls more precise and efficient.

prefix [N-COUNT-U4] A **prefix** is a word placed at the beginning of a word or number to alter its meaning.

preliminary design [N-COUNT-U11] A **preliminary design** is an initial, conceptual design meant to explore the general idea of a design.

primary memory [N-UNCOUNT-U13] **Primary memory** is volatile memory that is used to hold active programs.

problem [N-COUNT-U2] A **problem** is a question or situation that needs to be answered or resolved.

process [V-T-U8] To **process** data is to organize it or change it from one form into another during a computer operation.

process variable [N-COUNT-U9] A **process variable** (PV) is the condition that is being monitored by the control system.

proportional control [N-UNCOUNT-U9] **Proportional control** is a type of linear control system that directs devices to act in proportion to a constant input.

prototype [N-COUNT-U2] A **prototype** is an original or early version of something, usually for the purposes of analysis and development.

rate [N-COUNT-U6] A **rate** is a measure of the speed or number of times that something happens during a fixed period of time.

resource [N-COUNT-U6] A **resource** is something with a limited supply or availability.

response time [N-COUNT-U6] A **response time** is the amount of time it takes for a computer to respond to an input signal.

result [N-COUNT-U2] A **result** is something that occurs because of something else.

rise [N-COUNT-U5] A **rise** is the process of increasing in quality or amount.

scientific method [N-UNCOUNT-U2] A **scientific method** is a system of observation, measurement, and experimentation used to form and test hypotheses.

secondary memory [N-UNCOUNT-U13] **Secondary memory** is a nonvolatile memory that is used to store inactive programs and data.

security [N-UNCOUNT-U15] **Security** is the protection of people, objects, or information.

semiconductor [N-COUNT-U10] A **semiconductor** is a material that has less electrical conductivity than a conductor, but more conductivity than an insulator.

sequence [N-COUNT-U12] A **sequence** is a set of actions, objects, or numbers arranged in a specific order.

set point [N-COUNT-U9] A **set point** (SP) is the desired value of a PV.

SI unit [N-COUNT-U4] An **SI unit** is a unit of measurement with a prefix based on factors of ten.

silicon [N-UNCOUNT-U14] **Silicon** is a naturally occurring semiconductor used in microelectronics.

SIMM [ABBREV-U13] A **SIMM** (single inline memory module) is a circuit board that has DRAM chips on only one side and plugs into the memory slot of a motherboard.

sketch [N-COUNT-U11] A **sketch** is a rough drawing that is not usually intended to be a finished product.

solid [ADJ-U10] If an object is **solid**, it has no cavities, breaks, or inconsistencies.

solid-state [ADJ-U10] If an electronic device is **solid-state**, it is constructed entirely from solid parts.

solvable *[ADJ-U8] If a problem is* **solvable**, *finding its solution is possible.*

space complexity [N-UNCOUNT-U8] **Space complexity** is the amount of memory or space a computer requires to solve a given problem.

SRAM [ABBREV-U13] **SRAM** (static random access memory) is memory that can provide random access to any data, and does not need to be refreshed.

SSL connection [N-COUNT-U15] An **SSL** (secure sockets layer) **connection** is an Internet connection protected by a cryptographic protocol.

stabilize [V-I-U5] To **stabilize** is to reach a state in which changes are small and infrequent.

steady [ADJ-U5] If something is **steady**, it doesn't change or changes at a slow and constant rate.

step-by-step [ADJ-U12] If something is **step-by-step**, it follows a specific sequence of actions.

system [N-COUNT-U3] A **system** is a set of connected things that work together to produce a result.

talented [ADJ-U1] If someone is **talented**, he or she does something very well.

tebi- [PREFIX-U4] **Tebi-** is a binary prefix equivalent to 1,099,511,627,776 of the units it is attached to.

tera- [PREFIX-U4] **Tera-** is an SI prefix equivalent to 1,000,000,000,000 of the units it is attached to.

terminal [N-COUNT-U6] A **terminal** is a place where a user enters and receives information from a computer system.

testable [ADJ-U2] If something is **testable**, it can be proven or disproven by performing an experiment.

theory of computation [N-UNCOUNT-U8] The **theory of computation** is a branch of computer science that deals with efficient computation and computer modeling.

thermodynamics [N-UNCOUNT-U7] **Thermodynamics** is a branch of science that deals with the relationships between heat and other forms of energy.

thorough [ADJ-U1] If someone is **thorough**, he or she is careful not to miss any tasks or details.

time complexity [N-UNCOUNT-U8] **Time complexity** is the amount of time a computer requires to solve a given problem.

transistor [N-COUNT-U14] A **transistor** is an electronic semiconductor device used to switch or amplify electrical signals.

trend [N-COUNT-U5] A **trend** is a consistent change or development.

Turing machine [PHRASE-U8] A **Turing machine** is an abstract machine that has an infinite amount of memory and can perform any computation.

ULSI [ABBREV-U14] **ULSI** (ultra large scale integration) is the process of creating integrated circuits with over a million transistors per chip.

Glossary

universal accounting equation [N-UNCOUNT-U3] The **universal accounting equation** (UAE) is an equation that is used to measure changes in extensive quantities over particular periods of time.

vacuum [N-COUNT-U10] A **vacuum** is a space without air or other matter.

verify [V-T-U11] To **verify** information is to make sure it is correct or valid.

vibration [N-COUNT-U7] A **vibration** is a repeated movement in a substance or field of energy.

virus [N-COUNT-U15] A **virus** is a damaging computer program that is designed to replicate itself and spread to other machines.

VLSI [ABBREV-U14] **VLSI** (very large scale integration) is the process of creating integrated circuits with hundreds of thousands of transistors per chip.

volatile memory [N-UNCOUNT-U13] **Volatile memory** is temporary data storage that requires sustained power in order to retain data.

wafer [N-COUNT-U14] A **wafer** is an extremely thin slice of silicon crystal.

wave [N-COUNT-U7] A **wave** is a disturbance that moves through a substance without permanently changing it.