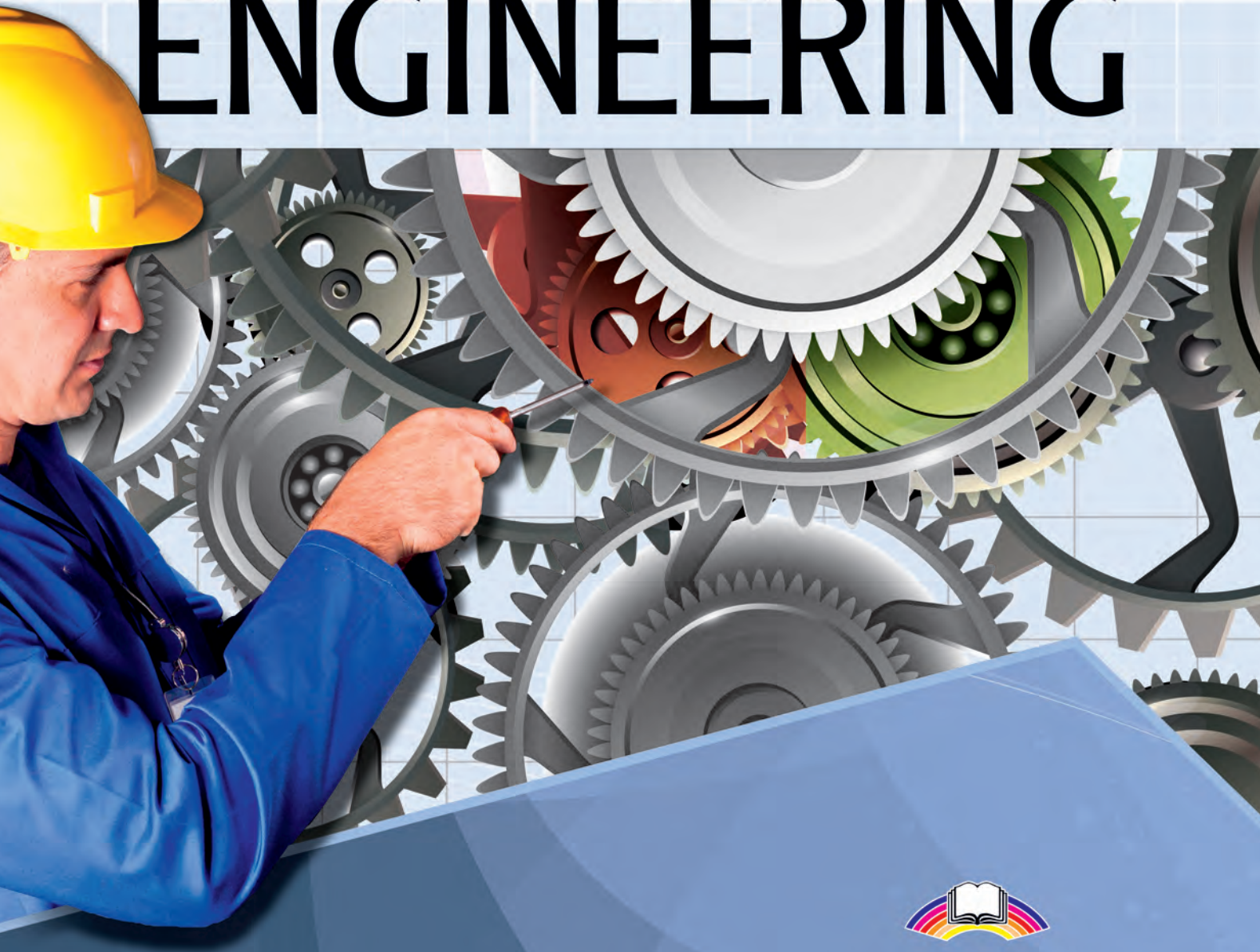
CAREER PATHS

Virginia Evans
Jenny Dooley
Joshua Kern

# MECHANICAL ENGINEERING



Express Publishing

CAREER PATHS

# MECHANICAL ENGINEERING

Book 1

Virginia Evans
Jenny Dooley
Joshua Kern

Express Publishing

## Scope and Sequence

| Unit | Topic | Reading context | Vocabulary | Function |
|---|---|---|---|---|
| 1 | The Mechanical Engineer | Article | assess, broad, design, hardware, improve, manufacture, mechanical engineer, power transmission, specialize in, test | Describing experience |
| 2 | Bearings | Poster | axial, ball bearing, bearing, inner race, journal bearing, outer race, radial, rolling contact bearing, sleeve, straight roller bearing, tapered roller bearing, thrust roller bearing | Making a polite request |
| 3 | Couplings | Textbook Excerpt | align, beam coupling, coupling, flexible, input shaft, offset, output shaft, rigid, sleeve-style coupling, transmit | Making a suggestion |
| 4 | Gears | Encyclopedia Entry | bevel gear, gear, helical gear, mesh, pinion, rack, spur gear, tooth, worm, worm gear | Stating a preference |
| 5 | Drives | Advice Column | belt drive, chain drive, groove, link, sheave, slippage, synchronous rotation, timing belt, v-belt, wedge angle | Making an estimate |
| 6 | Hand Tools | Email | ball peen hammer, box wrench, calipers, hacksaw, Phillips screwdriver, pliers, sledge hammer, slotted screwdriver, socket wrench, vice | Reacting to good news |
| 7 | Machine Tools | Webpage | band saw, broach, CNC mill, drill press, gear shaper, honing machine, lathe, lead screw, machine tool, mill | Talking about necessity |
| 8 | Numbers and Basic Math | Poster | add, divide by, equal, hundred, minus, multiply by, over, plus, subtract, times | Making an apology |
| 9 | Measurements 1 | Conversion Chart | foot, gram, imperial, kilogram, length, meter, metric, ounce, pound, weight | Asking for clarification |
| 10 | Measurements 2 | Email | Celsius, convert, cubic centimeter, Fahrenheit, fluid ounce, gallon, liter, milliliter, temperature, volume | Checking for certainty |
| 11 | SI Units | Poster | base unit, cubic meter, derived unit, force, joule, kelvin, mass, newton, pascal, SI | Expressing confusion |
| 12 | Large Numbers | Email | cubed, exponent, hundredth, rounding error, scientific notation, significant figure, squared, tenth, thousandth, to the nth power, trailing zero | Giving a warning |
| 13 | Analyzing Quantities | Textbook Excerpt | decimal number, fraction, improper fraction, mixed number, out of, percent, point, quantity, reduce, whole number | Making a prediction |
| 14 | Tables and Graphs | Note | bar graph, column, legend, line graph, pie chart, row, scatter plot, table, x-axis, y-axis | Discussing progress |
| 15 | Simple Machines | Textbook Excerpt | axle, fulcrum, inclined plane, lever, leverage, load, pulley, simple machine, wedge, wheel | Providing an example |

# Table of Contents

CAREER PATHS

# MECHANICAL ENGINEERING

Book 2

Virginia Evans
Jenny Dooley
Joshua Kern

Express Publishing

## Scope and Sequence

| Unit | Topic | Reading context | Vocabulary | Function |
|---|---|---|---|---|
| 1 | Electricity | Course Description | AC, ampere, charge, circuit, current, DC, electron, ohm, Ohm's Law, resistance, volt, voltage, watt | Correcting yourself |
| 2 | Basic Physics | Textbook Excerpt | classical mechanics, energy, gravity, matter, motion, Newton's Laws, physics, quantum field theory, quantum mechanics, relativistic mechanics, speed of light | Correcting an error |
| 3 | Accounting | Email | closed system, consumption, extensive quantity, final, generation, initial, input, intensive quantity, open system, output, system, universal accounting equation | Confirming information |
| 4 | Rate Processes | Textbook Excerpt | diameter, driving force, flow rate, flux, inlet, outlet, pressure, rate, rate process, viscosity | Describing degree |
| 5 | Statistics | Memo | event, independent, intersection, median, mutually exclusive, outcome, population, probability, range, sample, sample space, statistics, union | Describing a lack of experience |
| 6 | Problem Solving | Employee Manual | analysis, approach, attack, brainstorm, iteration, iterative, problem identification, problem solving, procedure, redefine, solution, synthesis | Asking for help |
| 7 | Design Method | Email | assemble, constraint, construct, criteria, detailed design, feasibility study, identify, narrow down, preliminary design, revise, sketch, verify | Asking about progress |
| 8 | Patents | Webpage | claims, design patent, drawing, improvement, intellectual property, milestone, monopoly, ornamental, patent, patent duration, specification, technology, utility patent, witnessed | Making a recommendation |
| 9 | The Scientific Method | Abstract | conclusion, control group, evaluate, experiment, experimental group, hypothesis, independent variable, observation, problem, result, scientific method, testable | Talking about expectations |
| 10 | Materials | Webpage | alloy, ceramics, concrete, glass, lumber, materials science, metal, plastic, polymer, rebar, steel | Listing needs |
| 11 | Properties of Materials | Email | brittle, conductor, ductile, elastic limit, hardness, insulator, luster, malleable, natural, proportional limit, synthetic, tensile, yield strength | Asking for explanation |
| 12 | Force | Textbook Excerpt | coordinate system, cumulative, equilibrium, free-body diagram, magnitude, moment, particle, resultant, rigid body, vector | Expressing confusion |
| 13 | Fluid Motion | Course Description | aerodynamics, buoyancy, drag, fluid, gas, laminar flow, lift, liquid, thrust, turbulent flow, wind tunnel | Explaining differences |
| 14 | Tension and Compression | Report | compression, elastic behavior, elongation, fail, internal force, plastic behavior, shear, strain, stress, stretch, tension | Asking for other options |
| 15 | Career Options | Webpage | consultant, design engineer, engine, generator, inspect, management, manufacturing, professor, public safety, R&D, researcher, technical, tool | Stating a goal |

# Table of Contents

CAREER PATHS

# MECHANICAL ENGINEERING

Book 3

Virginia Evans
Jenny Dooley
Joshua Kern

Express Publishing

## Scope and Sequence

| Unit | Topic | Reading context | Vocabulary | Function |
|---|---|---|---|---|
| 1 | Energy | Textbook Excerpt | chemical energy, conserve, convert, elastic potential energy, energy efficiency, energy quality, gravitational potential energy, kinetic energy, mechanical energy, power, thermal energy, work | Making comparisons |
| 2 | Heat and Thermodynamics | Webpage | BTU, burn, combustion, conduction, convection, heat, laws of thermodynamics, radiation, specific heat, thermal conductivity, thermodynamics | Correcting an error |
| 3 | The Combustion Engine | Encyclopedia Entry | combustion chamber, connecting rod, crankcase, crankshaft, cylinder, diesel, engine block, fuel injection pump, gasoline, glow plug, head, piston, piston ring, spark plug, sump, valve | Giving bad news |
| 4 | Two-Stroke Engines | Owner's Manual | burn out, compress, cycle, exhaust, fire, fuel, fuel-to-oil ratio, inlet, mix, revolution, two-stroke engine, two-stroke oil | Stressing a point |
| 5 | Four-Stroke Engines | Webpage | compression stroke, cylinder head, exhaust stroke, exhaust valve, four-stroke engine, head gasket, ignite, intake stroke, intake valve, power stroke, pressure | Troubleshooting problems |
| 6 | Rotational Motion | Textbook Excerpt | angle θ, angular velocity, arc length, center of rotation, degree, pivot point, radian, radius, revolution, rotational motion, RPM, RPS | Asking about benefits |
| 7 | Speed and Torque | Textbook Excerpt | frictional loss, gearset, grind, input torque, output torque, pitch, pitch circle, pitch radius, shift fork, slip, speed, torque, torque ratio, velocity ratio | Expressing concern |
| 8 | Geartrains | Webpage | balanced geartrain, carrier, compound geartrain, direction, idler gear, mesh point, planet gear, planetary geartrain, ring gear, serial, simple geartrain, spider, sun gear | Estimating time |
| 9 | CAD | Email | 2-D, 3-D, B-rep, CAD, CSG, drafting, exploded view, IGES, manifold model, model, non-manifold model, PDES, photorealistic rendering, technical drawing | Approving a request |
| 10 | Product Lifecycle Management | Article | bottom-up design, concurrent engineering, design strategy, lifecycle assessment, manufacturing process management, material intensiveness, material life extension, material selection, packaging, planned obsolescence, product data management, product lifecycle extension, product management, systems engineering, top-down design | Stating an opinion |
| 11 | Robotics | Résumé | actuator, automation, dexterity, enabling device, end-effector, flow line, hydraulic, joint, manipulator, payload, pendant, pneumatic, robotics, serial robot, work envelope | Describing an experience |
| 12 | Structural Analysis | Course Syllabus | arch, beam, catenary, column, elasticity theory, element, finite element method, mechanics of materials, nonbuilding structure, plate, shell, structural analysis, structural load, support | Providing examples |
| 13 | Failure Theory 1 | Textbook Excerpt | brittle failure, buckle, corrosion, creep, deform, ductile failure, failure analysis, failure rate, failure theory, fatigue, fracture, macroscopic failure, metallurgical failure analysis, microscopic failure, thermal shock, yield | Describing unexpected results |
| 14 | Failure Theory 2 | Webpage | crash test, DT, extensometer, force deflection, hardness test, materials testing machine, metallographic test, NDT, NFF, stress test, stress-strain curve, weld verification | Scheduling an appointment |
| 15 | Future of Mechanical Engineering | Article | artificial organ, biomechanics, BioMEMS, carbon fiber, composite, FSW, lab-on-a-chip, mechanosynthesis, mechatronics, MEMS, nanotechnology, prosthetic, rivet, rigidity | Asking for more information |

# Table of Contents

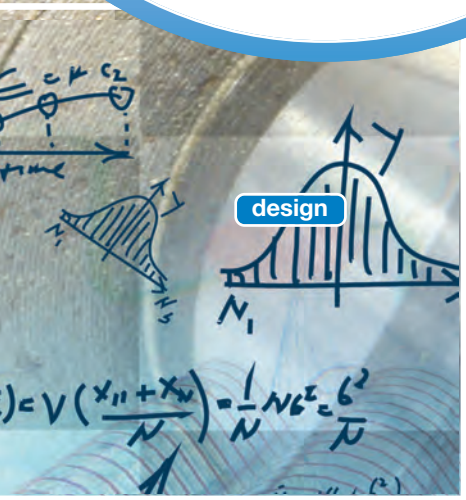
# 1 The Mechanical Engineer

## Get ready!

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

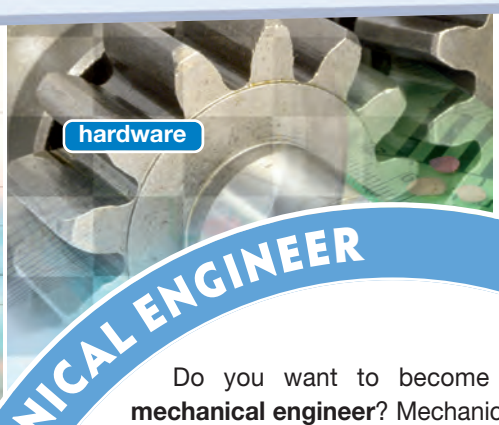
1 What are some responsibilities of a mechanical engineer?

2 What qualifications does a mechanical engineer need?










### THE MECHANICAL ENGINEER

**Sub-fields of Engineering:**

Do you want to become a **mechanical engineer**? Mechanical engineers **design** and build machines. They also **assess** the quality of existing machines. They adjust and **improve** the designs as needed. Sometimes mechanical engineers even invent new types of **hardware**. A qualified mechanical engineer has an engineering degree. Mechanical engineering is a very **broad** discipline. Most mechanical engineers **specialize in** a particular field. Areas of specialization include robotics, thermodynamics, and fluid mechanics.

Students of mechanical engineering study physics and kinematics. Concepts like friction and **power transmission** are essential. Students learn how to **manufacture** machines and components. They also learn how to **test** machines effectively.

## Reading

**2 Read the article. Then, complete the table.**

| Type of Gear | Features |
|---|---|
| Responsibilities | 1 _____ _____ |
| Qualifications | 2 _____ _____ |
| 3 _____ _____ | physics, kinematics, manufacturing, machine testing |

## Vocabulary

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

1 __ test
2 __ broad
3 __ assess
4 __ hardware
5 __ manufacture
6 __ power transmission
7 __ mechanical engineer

**A** the transfer of energy from one place to another to perform work

**B** a person who studies, builds, and works with machines

**C** machinery or mechanical components

**D** to observe a machine's operations in order to determine it's functionality

**E** to build something in a factory

**F** involving a wide variety of topics or disciplines

**G** to study and evaluate something

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

1 Mechanical engineers sometimes **specialize in/assess** a particular sub-field.
2 The design doesn't work, so the engineers need to **improve/manufacture** it.
3 The client asked the engineer to **test/design** a nearly silent engine.

**5** 🎧 **Listen and read the article again. Why do mechanical engineers need college degrees?**

## Listening

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

1 __ The company is looking for someone to design new engines.
2 __ The man's experience includes assessing older engine models.
3 __ The woman offers the man the position.

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

**Engineer:** Hi, I'm Ian Moore. I'm here for an **1** _____.
**Interviewer:** It's nice to meet you, Ian. Tell me about your work experience.
**Engineer:** Well, I **2** _____ _____ Osterbell Incorporated for twelve years.
**Interviewer:** What were your **3** _____ _____?
**Engineer:** I assessed old engine models. Then I made suggestions to **4** _____ them.
**Interviewer:** Did you **5** _____ any engines?
**Engineer:** Not on my own. I designed new parts for older models.
**Interviewer:** If we hire you, you'll design **6** _____ _____ as well.

## Speaking

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

**USE LANGUAGE SUCH AS:**

*Tell me about ...*
*I worked for ...*
*What were your ...?*

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

- a job you are applying for
- your job experience
- your duties at your previous job

**Student B:** You are an interviewer. Talk to Student A about his or her job qualifications.

## Writing

**9** **Use the article and the conversation from Task 8 to fill out the engineer's job application.**

**Vennotec Commercial & Industrial Vehicles**

# Job Application

- What position are you applying for?
  _____
  _____
- What is your educational background?
  _____
  _____
- What were your duties at your previous job?
  _____
  _____

# 1 Energy

## Get ready!

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

1 What are some different types of energy?

2 What is potential energy?

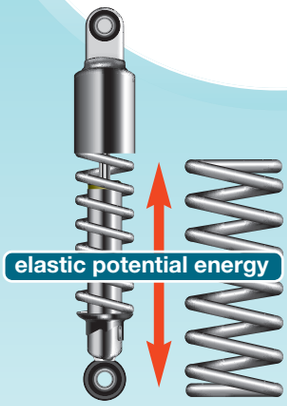

## 9.5 Energy

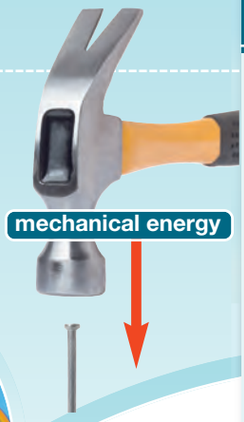
Mechanical engineers deal with many forms of energy. They are primarily concerned with **mechanical energy**. Engineers harness mechanical energy in order to perform useful **work**. Understanding **energy quality** is an essential skill for engineers.

To perform work, mechanical systems must **convert** energy from one form of mechanical energy to another. For instance, kinetic energy may transform into chemical or electrical energy. Additionally, two types of potential energy are especially important. **Gravitational potential energy** is released when gravity acts on an object. **Elastic potential energy** is stored in an object that is stretched or bent. Energy is released as the object springs back into shape. Both of these potential energies are converted into **kinetic energy** during release.

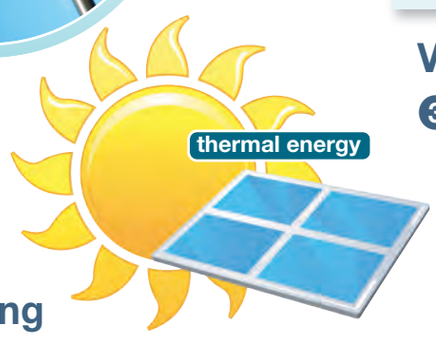
In addition to mechanical energy, mechanical engineers deal with **chemical energy**. Chemical energy is released as chemical bonds form and break. Many machines also release **thermal energy** through the consumption of fossil fuels.

**Energy efficiency** is a growing concern among both engineers and consumers. Whenever energy is converted, a certain amount of **power** is always lost. This is unavoidable. However, engineers are always seeking ways to **conserve** as much energy as possible.








## Reading

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

1 __ Potential energy is a type of mechanical energy.

2 __ Gravitational potential energy is released as thermal energy.

3 __ Engineers must eliminate the loss of power during energy release.

## Vocabulary

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

1 __ work
2 __ power
3 __ kinetic energy
4 __ elastic potential energy
5 __ energy quality
6 __ energy efficiency
7 __ thermal energy
8 __ gravitational potential energy

**A** a type of energy that is active or moving
**B** the transfer of energy, calculated as force times distance
**C** the energy stored in an object that is stretched or bent
**D** the rate at which energy is used or transferred
**E** the energy stored in an object relative to its elevation
**F** the ratio between the energy used and its useful output
**G** a type of energy released by the movement of subatomic particles
**H** the relative ability of a unit of energy to perform work

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

**1** **mechanical energy / chemical energy**

**A** Batteries use stored _____ to power devices.

**B** _____ is a combination of kinetic and potential energy.

**2** **conserve / convert**

**A** There isn't much fuel left, so we need to _____ it.

**B** A dam is used to _____ kinetic energy to electrical energy.

**5** **Listen and read the textbook excerpt again. How is elastic potential energy released?**

## Listening

**6** **Listen to a conversation between a student and an instructor. Choose the correct answers.**

**1** What is the conversation about?

**A** the woman's performance on an assignment about energy

**B** an oral quiz about different types of potential energy

**C** clarification of a lecture on mechanical energy

**D** an upcoming exam about energy conversion

**2** What is true about thermal energy?

**A** It is the result of actively moving particles.

**B** It can be converted into other types of energy.

**C** It is included when calculating chemical energy.

**D** It can be stored and released later.

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

**Student:** Instructor Matthews? I don't think I quite understand what **1** _____ _____ is.

**Instructor:** Okay. Well, mechanical energy is the combined kinetic and potential energy in a mechanical system.

**Student:** Hmm. I think I'm confused about the difference between **2** _____ _____ and potential energy.

**Instructor:** Think of it like this: Potential energy is energy that could be released in the future. But kinetic energy is **3** _____ _____ right now.

**Student:** That's what you said in class. But I don't get how that works.

**Instructor:** Well, picture a rubber band. When you stretch it, it has **4** _____ _____ _____. When you let go of it, that potential energy becomes kinetic energy.

**Student:** Okay, I get it now. But what about thermal energy? Does that **5** _____ _____ mechanical energy?

**Instructor:** **6** _____ _____ is a kind of kinetic energy. So yes, it does.

## Speaking

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

**USE LANGUAGE SUCH AS:**

*I don't think I understand ... / Think of it like this ...*

*Does that count ...?*

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

- an energy concept you do not understand
- an example of that type of energy
- the characteristics of that type of energy

**Student B:** You are an instructor. Talk to Student A about an energy concept that he or she doesn't understand.

## Writing

**9** **Use the textbook excerpt and the conversation from Task 8 to write a report on energy. Include: two types of energy, the differences between them, and why they are important in engineering.**

# Glossary

**ring gear** [N-COUNT-U8] A **ring gear** is a fixed internal gear that encircles a planetary geartrain.

**rivet** [N-COUNT-U15] A **rivet** is a permanent metal fastening device that works by deforming and expanding during installation, preventing removal.

**robotics** [N-UNCOUNT-U11] **Robotics** is the science of designing and manufacturing robots.

**rotational motion** [N-UNCOUNT-U6] **Rotational motion** is the movement of an object in a circle around its center.

**RPM** [N-COUNT-U6] **RPM** (revolutions per minute) are the number of complete rotations around an axis that something can complete in one minute.

**RPS** [N-COUNT-U6] **RPS** (revolutions per second) are the number of complete rotations around an axis that something can complete in one second.

**serial** [ADJ-U8] If something is **serial**, it is part of a series or collection.

**serial robot** [N-COUNT-U11] A **serial robot** is a robot that consists of a linear series of parts connected by joints.

**shell** [N-COUNT-U12] A **shell** is a strong, curved element that is used in construction.

**shift fork** [N-COUNT-U7] A **shift fork** is a mechanism that slides a gear along a splined shaft.

**simple geartrain** [N-COUNT-U8] A **simple geartrain** is a chain of three or more gears in which each shaft bears only one gear.

**slip** [V-I-U7] To **slip** is to move accidentally from a location.

**spark plug** [N-COUNT-U3] A **spark plug** is a device that creates an electrical spark to ignite fuel.

**specific heat** [N-UNCOUNT-U2] **Specific heat** is the amount of heat required to raise the temperature of a particular material.

**speed** [N-UNCOUNT-U7] **Speed** is the rate at which something moves.

**spider** [N-COUNT-U8] A **spider** is a carrier that is specially designed to accommodate multiple planet gears.

**stress test** [N-COUNT-U14] A **stress test** is a destructive test that determines a material's strength under different types of stress.

**stress-strain curve** [N-COUNT-U14] A **stress-strain curve** is the relationship between the amount of force applied to a material and its corresponding deformation.

**structural analysis** [N-UNCOUNT-U12] **Structural analysis** is the study and assessment of structures and their ability to bear loads.

**structural load** [N-COUNT-U12] A **structural load** is the amount of weight or pressure that a structure supports.

**sump** [N-COUNT-U3] A **sump** is a reservoir that collects oil at the bottom of an engine.

**sun gear** [N-COUNT-U8] A **sun gear** is a stationary central gear in a planetary geartrain that transfers rotation to the rest of the machine.

**support** [V-T-U12] To **support** something is to bear its weight or prevent it from collapsing.

**systems engineering** [N-UNCOUNT-U10] **Systems engineering** is an area of product lifecycle management that focuses on meeting consumer needs and requirements and coordinating relevant disciplines in a project.

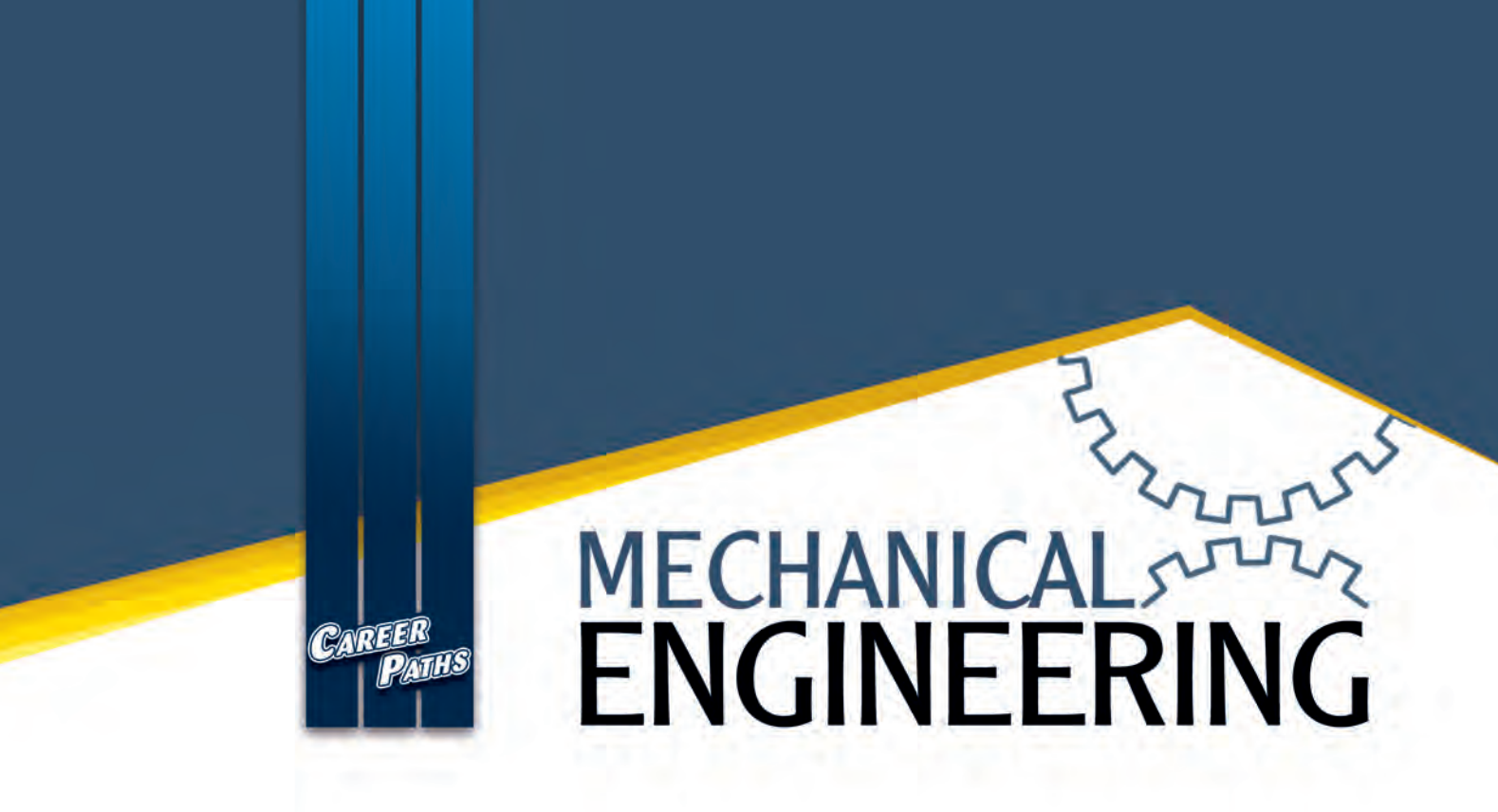
**technical drawing** [N-COUNT-U9] A **technical drawing** is a precise, realistic drawing of something.

**thermal conductivity** [N-UNCOUNT-U2] **Thermal conductivity** is the relative ability of a material to transfer heat.

**thermal energy** [N-UNCOUNT-U1] **Thermal energy** is energy that is released by the movement or vibration of a material's atoms or molecules.

**thermal shock** [N-UNCOUNT-U13] **Thermal shock** is a common cause of material failure that occurs when an object is subjected to sudden changes in temperature.

**thermodynamics** [N-UNCOUNT-U2] **Thermodynamics** is the science of heat energy and its application for performing work.




***Career Paths: Mechanical Engineering*** is a new educational resource for mechanical engineering professionals who want to improve their English communication in a work environment. Incorporating career-specific vocabulary and contexts, each unit offers step-by-step instruction that immerses students in the four key language components: reading, listening, speaking, and writing. ***Career Paths: Mechanical Engineering*** addresses topics including materials, simple machines, measurements, basic physics, and career options.

The series is organized into three levels of difficulty and offers a minimum of 400 vocabulary terms and phrases. Every unit includes a test of reading comprehension, vocabulary, and listening skills, and leads students through written and oral production.

**Included Features:**

- A variety of realistic reading passages
- Career-specific dialogues
- 45 reading and listening comprehension checks
- Over 400 vocabulary terms and phrases
- Guided speaking and writing exercises
- Complete glossary of terms and phrases

The **Teacher's Guide** contains detailed lesson plans, a full answer key and audio scripts.

The **audio CDs** contain all recorded material.

Express Publishing

ISBN 978-1-4715-2895-8