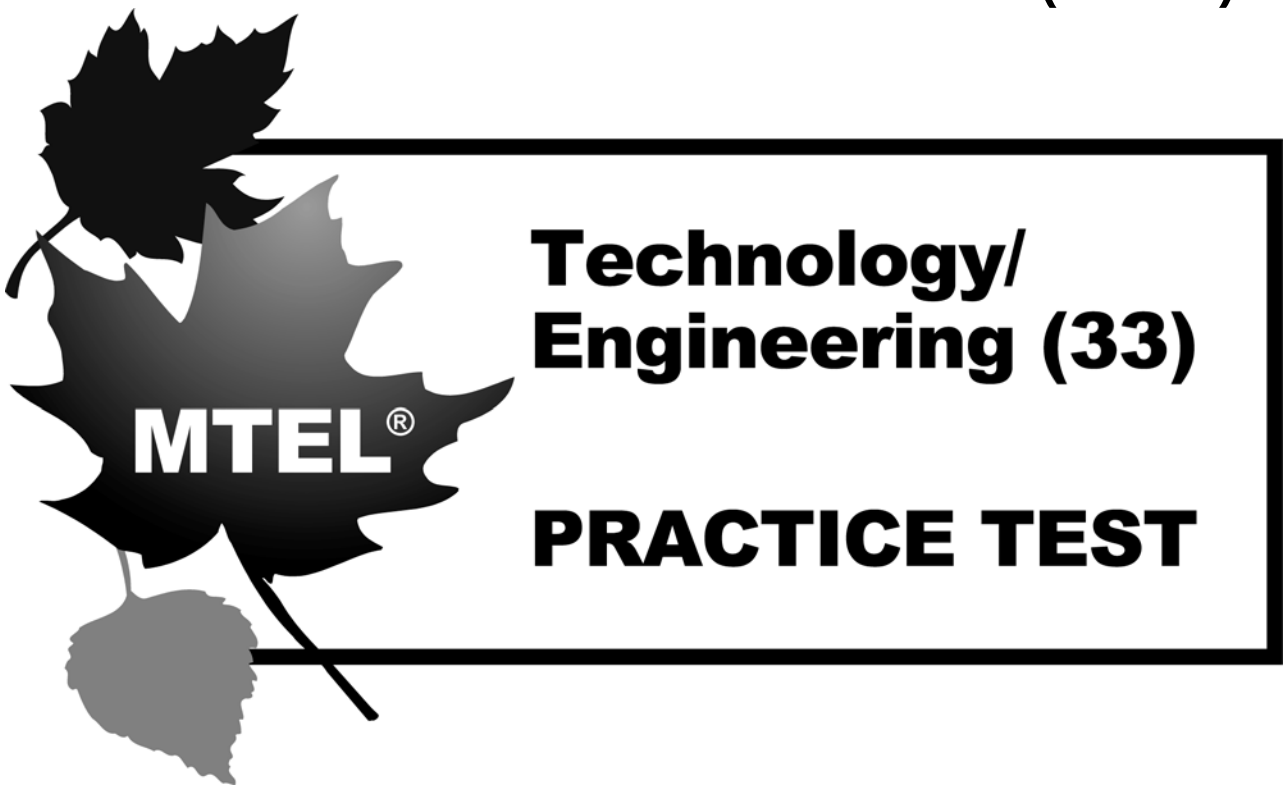
Massachusetts
Tests for Educator Licensure® (MTEL®)



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INTRODUCTION

This document is a printable version of the Massachusetts Tests for Educator Licensure® (MTEL®) Technology/Engineering (33) Online Practice Test. This practice test is a sample test consisting of 100 multiple-choice questions and 2 open-response item assignments.

To assist you in recording and evaluating your responses on the practice test, a Multiple-Choice Answer Sheet, an Answer Key Worksheet, and an Evaluation Chart by test objective are included for the multiple-choice questions. A blank Response Sheet, Evaluation Information, and Sample Responses and Analyses, as well as a Scoring Rubric, are included for the open-response items. Lastly, there is a Practice Test Score Calculation worksheet.

PURPOSE OF THE PRACTICE TEST

The practice test is designed to provide an additional resource to help you effectively prepare for the MTEL Technology/Engineering (33) test. The primary purpose of the practice test is to help you become familiar with the structure and content of the test. It is also intended to help you identify areas in which to focus your studies. Education faculty and administrators of teacher preparation programs may also find this practice test useful as they help students prepare for the official test.

TAKING THE PRACTICE TEST

In order to maximize the benefits of the practice test, it is recommended that you take this test under conditions similar to the conditions under which the official MTEL tests are administered. Try to take the practice test in a quiet atmosphere with few interruptions and limit yourself to the four-hour time period allotted for the official test administration. You will find your results to be more useful if you refer to the answer key only after you have completed the practice test.

INCORPORATING THE PRACTICE TEST IN YOUR STUDY PLAN

Although the primary means of preparing for the MTEL is your college education, adequate preparation prior to taking or retaking the MTEL test is strongly recommended. How much preparation and study you need depends on how comfortable and knowledgeable you are with the content of the test.

The first step in preparing to take the MTEL is to identify what information the test will address by reviewing the objectives for your field. A complete, up-to-date list of the Test Objectives is included in the Test Information Booklet for each test field. The test objectives are the core of the testing program and a helpful study tool. Before taking or retaking the official test, focus your study time on those objectives for which you wish to strengthen your knowledge.

This practice test may be used as one indicator of potential strengths and weaknesses in your knowledge of the content on the official test. However, because of potential differences in format and difficulty between the practice test and an official MTEL Technology/Engineering (33) test, it is not possible to predict precisely how you might score on an official MTEL Technology/Engineering (33) test. Keep in mind that the subareas for which the test weighting is greatest will receive emphasis on this test. Refer to the Test Information Booklet for additional information about how to prepare for the test.

TECHNOLOGY/ENGINEERING
PRACTICE TEST

CONSTANTS AND FORMULAS

Description	Value/Formula
Force and motion:	$g = 9.8$ m/s^2
	$PE = mgh$
	$KE = \frac{1}{2}mv^2$
	$W = fd$
Electric circuits:	$V = IR$
	$P = IV$
	$R_{series} = R_1 + R_2 + R_3 + \ldots$
	$R_{parallel} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots}$
Gas law:	$PV = nRT$
	$R = 8.31$ J/mol•K
Pressure:	$P = \frac{\text{force}}{\text{area}}$
Waves:	$f = 1/\text{T}$
	$v = f\lambda$
Geometry:	$\pi = 3.1416$
Area:	circle: $A = \pi r^2$
	triangle: $A = \frac{1}{2}ab$
	rectangle: $A = ab$
Volume:	cube: $V = a^3$
	cylinder: $V = \pi r^2 h$
	sphere: $V = \frac{4}{3}\pi r^3$
Circumference:	circle: $C = 2\pi r$

GENERAL TEST DIRECTIONS

This practice test consists of two sections: (1) a multiple-choice question section and (2) an open-response item assignment section. Each multiple-choice question on the practice test has four answer choices. Read each question carefully and choose the ONE best answer. Record each answer on the answer sheet provided.

Sample Question: 1. What is the capital of Massachusetts?

A. Worcester
B. New Bedford
C. Boston
D. Springfield

The correct answer to this question is C. You would indicate that on the answer sheet.

The open-response section of this practice test requires written responses. Directions for the open-response item assignments appear immediately before those assignments.

You may work on the multiple-choice questions and open-response item assignments in any order that you choose. You may wish to monitor how long it takes you to complete the practice test. When taking the actual MTEL Technology/Engineering (33) test, you will have one four-hour test session in which to complete the test.

MULTIPLE-CHOICE ANSWER SHEET

Question Number	Your Response
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MULTIPLE-CHOICE QUESTIONS

1. Which of the following is a technology used primarily to reduce CO emissions?

   A. catalytic converter

   B. smokestack scrubbers

   C. carbon offsets

   D. coal gasification

2. Which of the following media sources is most likely to be a valid source of information?

   A. popular magazine

   B. infomercial

   C. Web page

   D. professional journal

3. Approximately 3,000 years ago, smelting furnaces that could achieve high temperatures were developed. This new technology was responsible for iron replacing which of the following metals in the industry of the time?

   A. tin

   B. brass

   C. pewter

   D. bronze

4. In the mid-twentieth century, televisions and radios became smaller and more portable as vacuum tubes were replaced by:

   A. microprocessors.

   B. transistors.

   C. electron guns.

   D. capacitors.

5. The Manhattan Project was a government-sponsored research project that would eventually provide the foundation for which of the following technologies?

   A. supercomputers

   B. space flight

   C. the Internet

   D. nuclear power

6. Which of the following is an example of reverse engineering?

   A. disassembling a device to determine its internal mechanisms

   B. redesigning a product to reduce the number of parts or assemblies

   C. finding a new use for an existing tool or machine

   D. replacing energy-intensive processes with more fuel-efficient processes

7. A rheostat has a maximum resistance of 3.5×10^3 Ω. A second rheostat also has a maximum resistance of 3.5×10^3 Ω. What is the sum of the two maximum resistances?

   A. 3,500 Ω

   B. 7,000 Ω

   C. 3,500,000 Ω

   D. 7,000,000 Ω

8. What is the product of 2.1×10^3 and 5.2×10^3 correctly reported using significant figures?

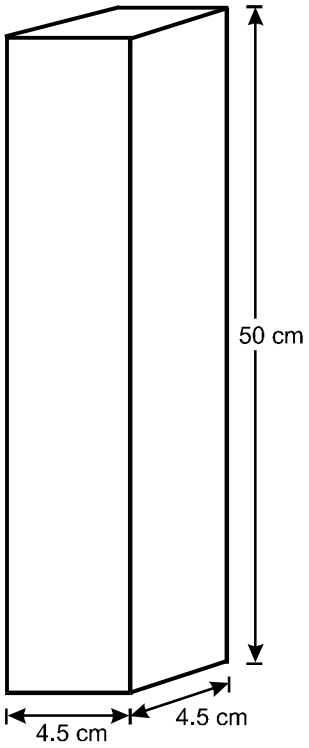
   A. 1.096×10^6

   B. 1.096×10^7

   C. 1.1×10^6

   D. 1.1×10^7

9. **Use the diagram below to answer the question that follows.**



Copper has a density of 8.96 g/cm^3. What is the approximate mass in kilograms of the solid bar of copper in the diagram?

A. 1.12 kg

B. 9.1 kg

C. 91 kg

D. 112 kg

10. In manufacturing and engineering, *tolerance* refers to:

    A. the average error in a series of measurements.

    B. the clearance between two workpieces.

    C. the actual measured dimension of a workpiece.

    D. a permissible deviation from a specification.

11. A circular garden has a radius of 12 feet. If the garden is enlarged so that its new radius is 24 feet, by what factor will the garden's area increase?

    A. 2

    B. 4

    C. 8

    D. 12

12. A manufacturing company is producing dowels that have a diameter of 8.5 mm ± 0.1 mm. The hole the diameter must fit into has a diameter of 9.0 mm ± 0.1 mm. According to these specifications, what is the greatest clearance that can occur between the two parts?

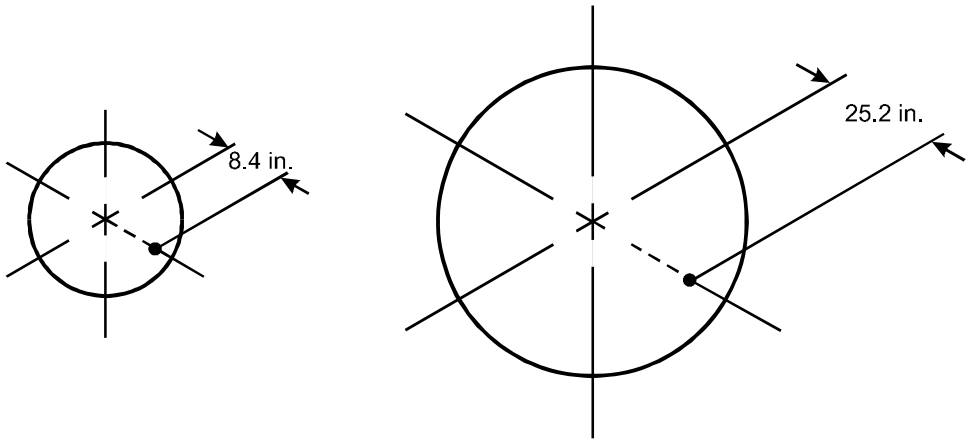
    A. 0.1 mm

    B. 0.2 mm

    C. 0.5 mm

    D. 0.7 mm

13. **Use the diagram below to answer the question that follows.**



A spherical workpiece has a radius of 8.4 inches and a volume of V cubic inches. A larger spherical version of the sphere has a diameter of 25.2 inches. What is the volume of this larger sphere?

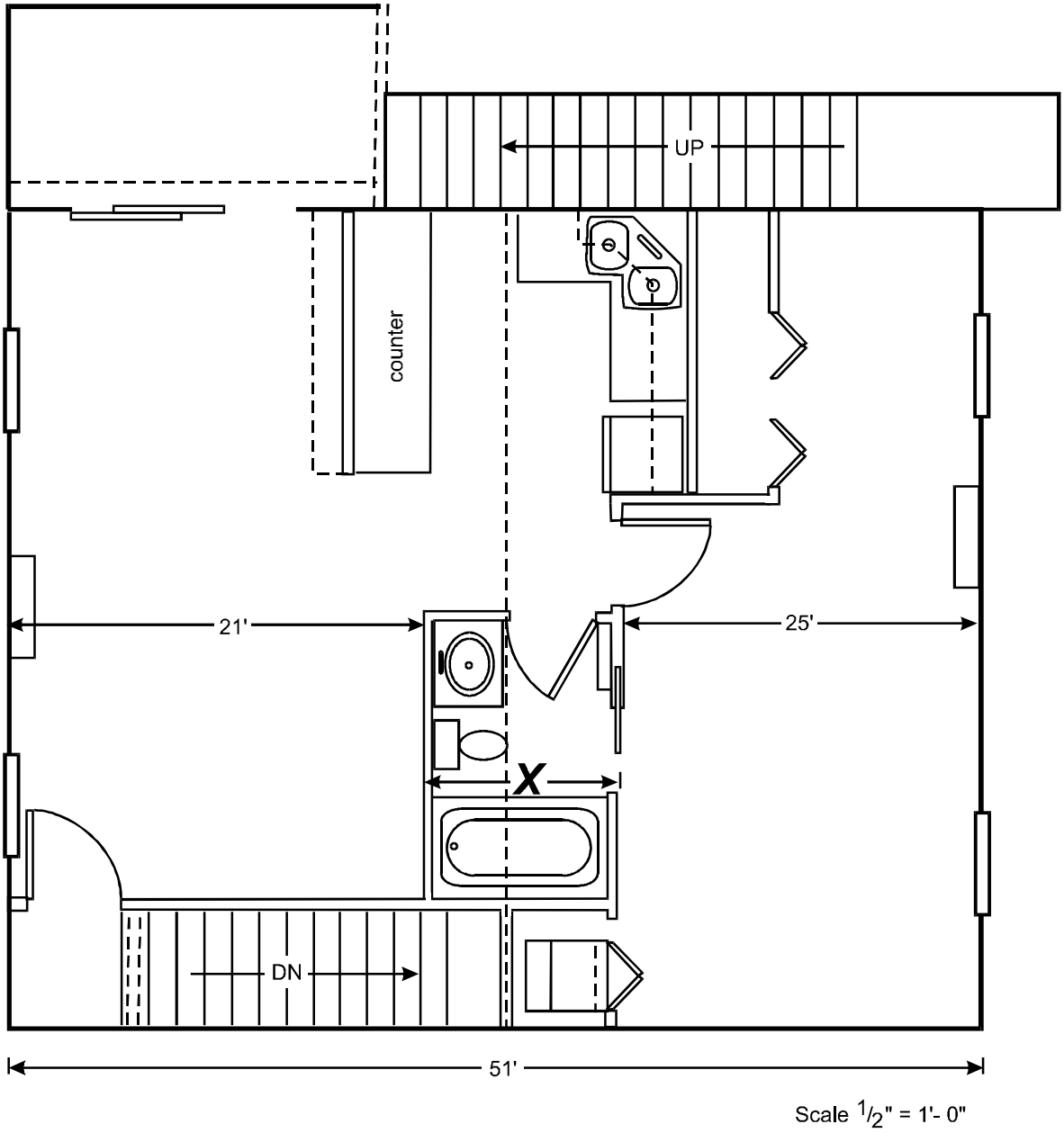
A. $8.0V$

B. $13.5V$

C. $27.0V$

D. $54.0V$

Use the floor plan below to answer the two questions that follow.



14. If the scale used to draw the floor plan is 1/2 inch to 1 foot, what should be the length of the dimension labeled *X* in the floor plan?

    A. 2.0 inches

    B. 2.5 inches

    C. 3.5 inches

    D. 5.0 inches

15. Which of the following is not shown in the plan?

    A. kitchen sink

    B. bathroom sink

    C. kitchen range

    D. water closet

16. Which of the following steps should be taken first in administering first aid to a person who has received a puncture wound while using a drill press?

    A. Call 9-1-1.

    B. Apply a bandage.

    C. Apply direct pressure to the wound.

    D. Rinse the wound with running water.

17. Which of the following is an important component of a solution used to clean up a blood spill on a workplace floor?

    A. baking soda

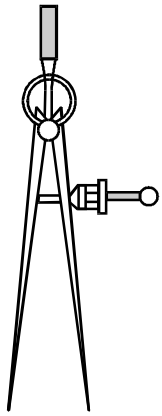
    B. acetic acid

    C. chlorine bleach

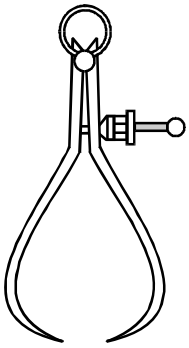
    D. hydrogen peroxide

18. Which of the following tools would be the most appropriate choice for determining the distance between two points on a flat surface of a workpiece?

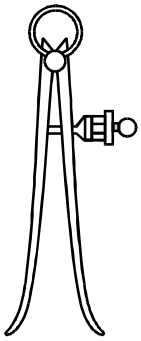
A.



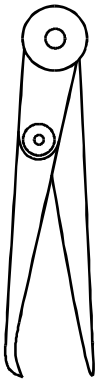
B.



C.



D.



19. A design engineer would like to determine the diameter of a circle. He begins by using a straightedge to draw a line tangent to the circle. Which of the following steps would be most appropriate next?

    A. Use a compass to construct the perpendicular bisector of the tangent and extend it until it intersects the circle at two points.

    B. Draw a second tangent parallel to the first tangent using a T-square, and then connect the two points of tangency.

    C. Beginning at one end of the tangent, use a straightedge to construct a second tangent, then connect the two free ends of the tangents.

    D. Use a compass to draw an arc centered on one end of the tangent. Draw an equal arc centered on the other end of the tangent.

20. A jointer would most likely be used to create:

    A. flat edges so that two boards may be edge joined.

    B. precisely shaped cuts to produce a dovetail joint.

    C. matching pins and holes for a mortise and tenon joint.

    D. accurately mitered cuts to produce a miter joint.

21. Which of the following is an example of an open geothermal heat pump system?

    A. Water from naturally hot springs is circulated through finned-tube radiators before being released into a nearby body of water.

    B. Water heated in a boiler is piped to buildings through underground conduits to minimize heat loss and then released into a river.

    C. Thermocouples in the ground take advantage of natural temperature differences in the soil to generate energy.

    D. Subsurface steam from a volcanically active region is circulated throughout a city to heat buildings and melt ice.

22. Which of the following is commonly used to reduce line pressure in an industrial gas delivery system?

A. expander

B. reducer

C. regulator

D. decompression valve

23. Which of the following types of pumps uses an impeller to push fluid entering at the center of the pump housing into a peripheral canal and exit?

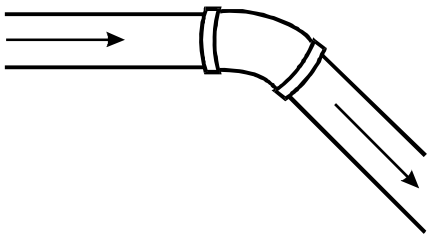
A. turbine pump

B. centrifugal pump

C. rotating vane pump

D. external gear pump

24. **Use the diagram below to answer the question that follows.**



A section of a fluid system carrying water is changed to include a 45° bend and a downward slope as indicated in the diagram. This change is most likely to have which of the following effects on the fluid in the system?

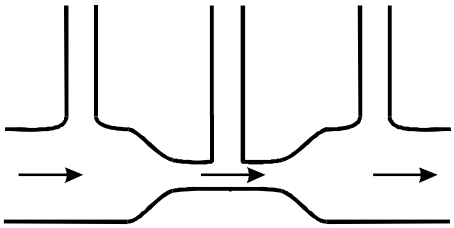
A. Resistance to flow will decrease.

B. Flow will change from laminar to turbulent.

C. Resistance to flow will increase.

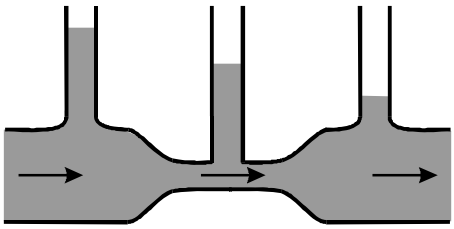
D. Flow will change from turbulent to laminar.

25. **Use the diagram below to answer the question that follows.**



A fluid flows from left to right through a tube in a cooling unit that has a constriction as shown in the diagram. Which of the following diagrams correctly represents the relative pressures within the tube?

A.



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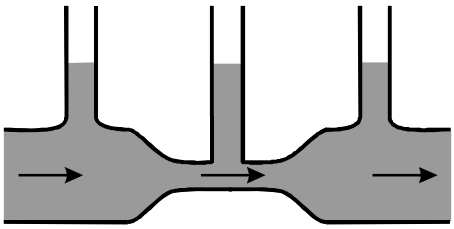
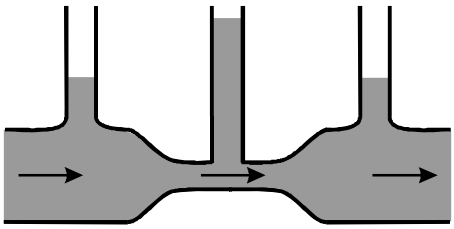
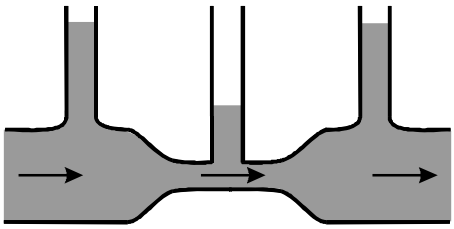


C.



D.



26. The operation of a typical bimetallic-strip thermostat is based on the difference in two metals':

    A. specific heat.

    B. coefficient of friction.

    C. specific gravity.

    D. coefficient of expansion.

27. A rock that has a mass of 64 kg is at the edge of a cliff that has a height of 20 m. If the rock falls from the cliff, what will be its kinetic energy when it strikes the ground below?

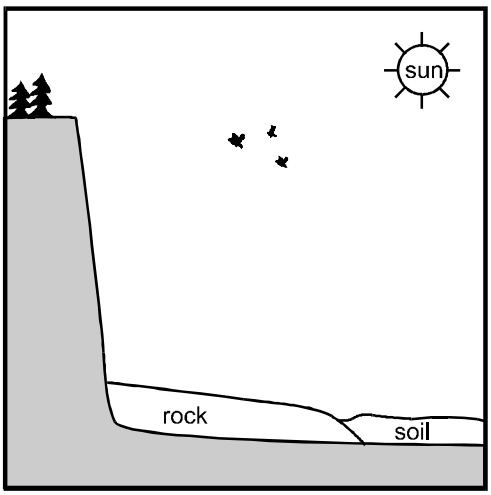
    A. 1,568 J

    B. 12,544 J

    C. 15,366 J

    D. 122,931 J

28. **Use the diagram below to answer the question that follows.**



On a warm day, the sun warms the surface of a rock face. Birds soar on the warm air rising from the heated rock. Some of the rock's heat is transferred to the soil that is in contact with the rock. As the birds fly over the rockface, they generate metabolic heat. Which of the following provides the best example of energy transfer by radiation?

    A. The sun warms the surface of the rockface.

    B. Birds soar on the warm air rising from the heated rock.

    C. Some heat is transferred from the rock to the adjoining soil.

    D. The birds generate metabolic heat as they fly.

29. A heat pump is most likely to become inefficient in which of the following environmental situations?

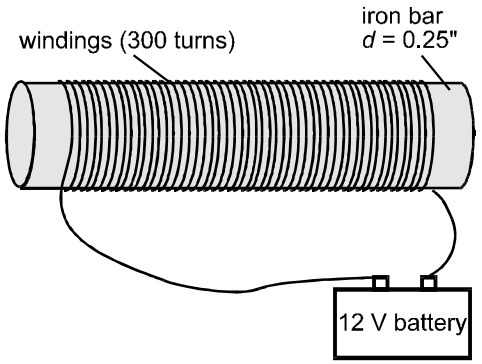
    A. The outdoor temperature falls below freezing.

    B. The outdoor temperature rises above 90°.

    C. The indoor temperature is about 10° higher than the outdoor temperature.

    D. The outdoor temperature is about 10° higher than the indoor temperature.

30. **Use the diagram below to answer the question that follows.**



Which of the following changes in the design of the electromagnet would be most effective in increasing the mass that the electromagnet can lift?

A. replacing the 12-volt DC source with a 12-volt AC source

B. replacing the iron bar with one having a greater diameter

C. replacing the iron bar with a copper bar

D. increasing the number of windings on the bar

31. A transformer has 1.5×10^2 input windings and 4.5×10^2 output windings. What is the transformer's output voltage when 220 V is applied to the input windings?

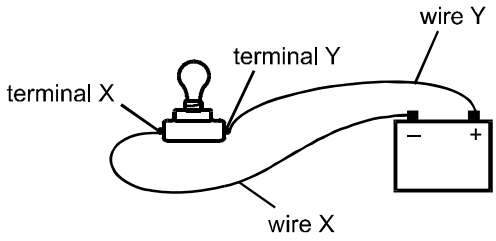
    A. 73.3 V

    B. 110 V

    C. 440 V

    D. 660 V

32. **Use the diagram below to answer the question that follows.**



    A simple circuit consists of a lamp, a battery, and two wires as shown in the diagram. A person who wants to use a multimeter to measure the current through the lamp should connect the meter:

    A. between wire X and the negative terminal.

    B. between terminal X and terminal Y.

    C. between the positive and negative terminals of the battery.

    D. from terminal X to terminal Y with the bulb removed.

33. The resistance of a wire is inversely proportional to the square of its diameter. A copper wire of diameter *Y* has a resistance of 8 Ω. What would be the resistance of a copper wire of diameter 2*Y*?

    A. 2 Ω

    B. 8 Ω

    C. 16 Ω

    D. 64 Ω

34. Which of the following is the end product of the chemical process commonly used in fuel cells?

    A. hydrogen

    B. water

    C. carbon dioxide

    D. methane

35. Which of the following best describes the characteristic of power in mechanical systems?

    A. the rate at which work is done

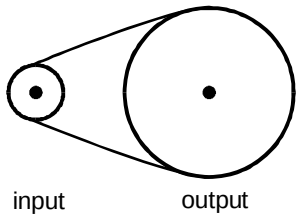
    B. the total force applied

    C. the ability to perform work

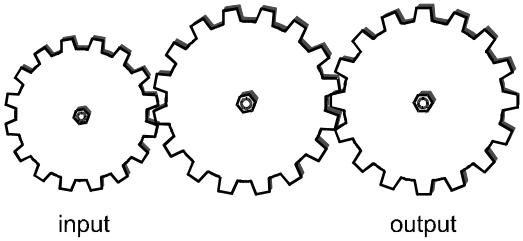
    D. the efficiency of energy conversion

36. Which of the following systems allows for the output shaft to rotate faster than the input shaft while rotating in the same direction as the input shaft?

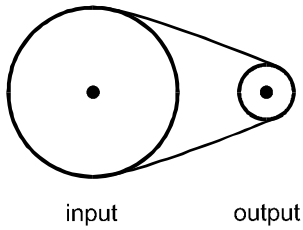
A.



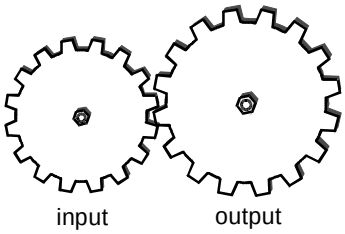
B.



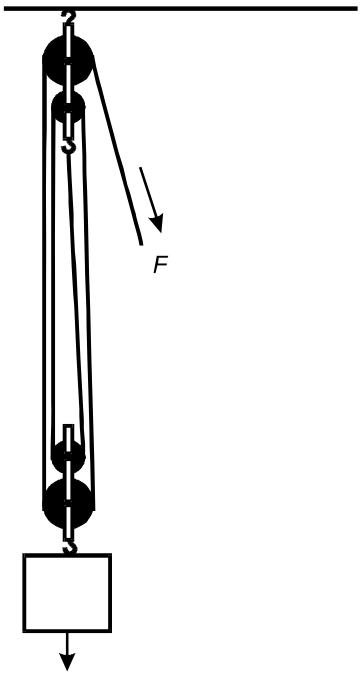
C.



D.



37. **Use the diagram below to answer the question that follows.**



In this system, the lifting force is increased at the expense of:

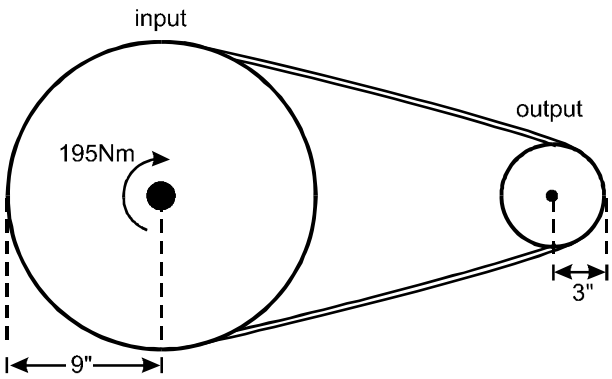
A. work.

B. distance.

C. power.

D. weight.

38. **Use the diagram below to answer the question that follows.**



What is the torque, τ, produced by the output pulley when a torque of 195 Nm is applied to the input pulley?

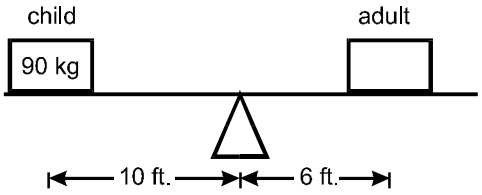
A. 65.0 Nm

B. 97.5 Nm

C. 390 Nm

D. 585 Nm

39. **Use the diagram below to answer the question that follows.**



An adult and a child are balanced on a seesaw as shown in the diagram. What is the weight of the adult?

A. 135 kg

B. 150 kg

C. 175 kg

D. 240 kg

40. State and local building codes are primarily intended to perform which of the following functions?

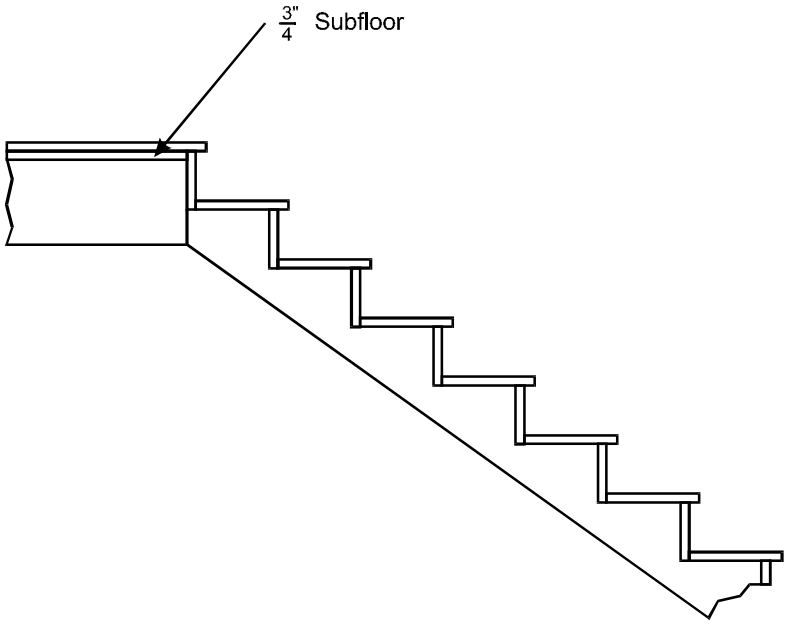
A. protecting environmentally sensitive areas from development that could degrade natural habitats

B. guiding the growth and development of towns and cities by designating areas for various uses

C. specifying materials and procedures that should be followed in building projects in order to ensure safety and sound construction

D. ensuring that the most recent innovations in the construction industry are incorporated into building projects

41. **Use the diagram below to answer the question that follows.**



In the stairs in the diagram, the subfloor transfers loads directly to:

A. risers.

B. stringers.

C. studs.

D. joists.

42. A furniture manufacturing company is designing a new wooden dresser. Use of which of the following types of wood would result in the highest shipping costs of finished products?

    A. maple

    B. cedar

    C. balsa

    D. ebony

43. Which of the following metals has a high compressive strength but very low tensile strength?

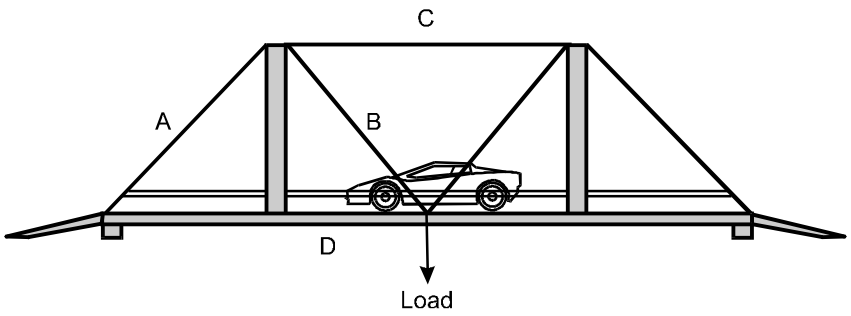
    A. cast iron

    B. copper

    C. structural steel

    D. zinc

44. **Use the diagram below to answer the question that follows.**



In the bridge design above, which member is in compression?

A. A

B. B

C. C

D. D

45. Which of the following types of bridges is most appropriate for short spans?

A. suspension

B. beam

C. cantilever

D. truss

46. Which of the following features is an important advantage of slab-on-grade foundations over slab-and-crawl-space foundations?

    A. Construction is less costly and takes less time.

    B. Plumbing and wiring are easily accessible.

    C. Heat is easily conducted out of the house.

    D. Footings are protected from weather and humidity.

47. In choosing materials for structural members of an aircraft, there is most often a trade-off between which of the following characteristics?

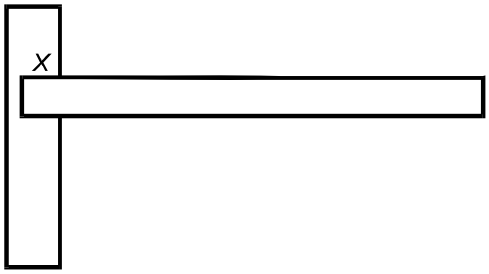
    A. strength and weight

    B. plasticity and weight

    C. strength and elasticity

    D. plasticity and elasticity

48. **Use the diagram below to answer the question that follows.**



In the cantilever above, what type of force is being applied to the wall at point *X*?

    A. compression

    B. tension

    C. shear

    D. torsion

49. The weight of which of the following is part of the live load on a building?

    A. air conditioning unit

    B. accumulated snow

    C. roof trusses

    D. structural members

50. The stability of a truss bridge is based primarily on the integrity of:

    A. circles.

    B. triangles.

    C. squares.

    D. cylinders.

51. A person using a wrench to tighten a bolt applies excessive pressure and snaps the bolt. Which of the following types of forces is the primary cause of the failure of the part?

    A. torsion

    B. shear

    C. compression

    D. tension

52. A winch is being used to raise a beam to an upper floor of a building under construction. The primary force on the winch's cable is:

    A. shear.

    B. compression.

    C. tension.

    D. torsion.

53. Rebar in concrete is primarily intended to increase the material's strength in:

    A. compression.

    B. curing.

    C. torsion.

    D. tension.

54. A 600 N piece of metal rests on a concrete column. The line from a winch is pulling upward on the column with a force of 25 N. What is the resultant force on the column?

    A. 575 N compression

    B. 575 N tension

    C. 625 N compression

    D. 625 N tension

55. Metal fatigue is most likely to result from which of the following types of forces?

    A. tension

    B. compression

    C. shear

    D. bending

56. Placer mining and panning separate ore from surrounding sediments by taking advantage of the ore's:

    A. buoyancy.

    B. particle size.

    C. density.

    D. melting point.

57. Polymerization is a process used to produce which of the following materials?

    A. ball bearings

    B. textiles

    C. metallic wire

    D. plastics

58. The increased efficiency that results from assembly-line manufacturing processes is primarily a result of:

    A. a reduction in energy use.

    B. a reduction in nonproductive efforts.

    C. a decreased need for raw materials.

    D. a greater reliance on human inputs.

59. Which of the following welding processes is used primarily to weld metals such as aluminum and magnesium?

    A. shielded metal arc welding

    B. oxyacetylene welding

    C. gas tungsten arc welding

    D. carbon arc welding

60. In preparing petroleum products, cracking is a process used to:

    A. break complex molecules into simpler molecules.

    B. remove impurities from crude oil.

    C. convert liquid petroleum products into tars and plastics.

    D. assay the quality of petroleum.

61. Which of the following manufacturing processes is most commonly used to create detailed metal parts that require minimal finishing?

    A. sand casting

    B. mold casting

    C. centrifugal casting

    D. die casting

62. Which of the following manufacturing processes is most appropriate for producing steel I-beams?

    A. forging

    B. casting

    C. extrusion

    D. injection

63. The steel connecting rods for an engine need to be strong and lightweight and have a consistent grain. Which initial manufacturing process would be most appropriate for creating these rods?

    A. machining

    B. investment casting

    C. molding

    D. hot forging

64. A company that decides to adopt lean manufacturing techniques will most likely focus primarily on the company's:

    A. quality control.

    B. resource expenditures.

    C. accounts receivable.

    D. management structure.

65. The quality control team for a company that produces camshafts for gasoline engines currently takes one camshaft in every 100 off the production line and subjects it to rigorous testing. The company is considering changing the production process to include sampling one camshaft out of every 75 camshafts. Arguments against this change will most likely focus on which of the following factors?

    A. long-term profits

    B. production costs

    C. sales volume

    D. marketing needs

66. A production line produces electric golf carts and ride-on mowers. For which of the following steps in the company's production lines is robotics most likely to be appropriate?

    A. troubleshooting part failures

    B. adding custom details

    C. spot-welding metal body parts

    D. arc-welding frame members

67. Which of the following correctly defines the relationship between the fields of biomechanics and bioengineering?

    A. Bioengineering is a field within the larger field of biomechanics.

    B. Biomechanics is a field within the larger field of bioengineering.

    C. Bioengineering is related to large-scale structures such as limbs and organs while biomechanics is related to individual cells.

    D. Biomechanics is related to large-scale structures such as limbs and organs while bioengineering is related to individual cells.

68. Which of the following is an example of cloning?

    A. artificially cross-pollinating corn plants

    B. selectively breeding cattle

    C. fertilizing a mammalian egg in vitro

    D. propagating a plant using cuttings

69. The Human Genome Project is expected to benefit primarily which of the following areas?

    A. biomechanics and bionics

    B. trauma response and remediation

    C. medical diagnosis and treatment

    D. prosthetic manufacturing

70. Which of the following is most commonly used as a vector for gene transfer in genetic engineering?

    A. insect

    B. fungus

    C. bacterium

    D. virus

71. In which of the following situations is a living organism used in food production?

    A. emulsification

    B. homogenization

    C. pasteurization

    D. fermentation

72. A small business has several computers and printers that are not networked throughout its office. The business owner is considering installing a local area network (LAN). Which of the following is the most significant benefit of installing a local area network?

    A. Software applications with a single-use license can legally be installed on multiple networked computers.

    B. Printers on the network can be accessed from any of the networked computers.

    C. The performance of the computers and peripherals on the network will improve.

    D. Peripheral devices installed on the network are less likely to experience technical difficulties.

73. Which of the following is typically a digital signal?

    A. the output from a microphone

    B. the input to a sound amplifier

    C. the output from a computer's speaker

    D. communication between computers

74. Which of the following statements regarding digital and analog sound files is accurate?

    A. Digital signals more closely represent natural sound than do analog signals.

    B. Digital files can be copied more times without loss of quality than can analog files.

    C. Analog files can be transferred electronically whereas digital files cannot.

    D. Analog files can be directly stored on a CD.

75. Which of the following best explains why electromagnetic waves, but not sound waves, can travel through interstellar space?

    A. Sound waves attenuate over distance more easily than electromagnetic waves.

    B. Sound waves require a gravitational force in order to propagate.

    C. Sound waves have a greater amplitude than electromagnetic waves.

    D. Sound waves are dependent on a carrying medium.

76. An optical cable has a critical angle of 40°. Which of the following best describes rays of light that strike the internal wall of the cable at angles closer than this to perpendicular?

A. They are scattered.

B. They are partially reflected.

C. They are dispersed.

D. They are totally reflected.

77. Which of the following is the best example of the Doppler effect?

A. An ambulance's siren changes from high pitch to low pitch after passing an observer.

B. An ambulance's siren changes from low pitch to high pitch after passing an observer.

C. An ambulance's siren changes from high amplitude to low amplitude after passing an observer.

D. An ambulance's siren changes from low amplitude to high amplitude after passing an observer.

78. The period of a wave is 30 seconds. What is its approximate frequency?

A. 0.033 Hz

B. 0.50 Hz

C. 33 Hz

D. 50 Hz

79. A sound wave having a frequency of 80 Hz interacts with a sound wave having a frequency of 90 Hz. The interaction will produce a beat frequency of:

A. 0.9 Hz.

B. 10 Hz.

C. 85 Hz.

D. 170 Hz.

80. A sound is traveling through a gas. Which of the following changes would most likely cause an increase in the speed of the sound?

A. reducing the frequency of the sound

B. replacing the gas with a more dense gas

C. raising the temperature of the gas

D. increasing the amplitude of the sound

81. Which of the following is most likely to cause a refraction of sound waves as they travel across an open outdoor area?

    A. rainfall

    B. moving air

    C. regions of sun and shade

    D. temperature differences

82. Which of the following best describes the function of a laser in a laser printer?

    A. fusing carbon particles to each other

    B. detecting the ink on the original document

    C. changing an electrostatic charge

    D. heating the paper to a specified temperature

83. Which of the following is a primary color for pigment?

    A. orange

    B. yellow

    C. green

    D. black

84. A person places a pencil in a glass of water and notices that the pencil appears to bend at the point of entry into the water. This illusion occurs primarily because:

    A. light behaves as either a wave or a particle depending on the medium.

    B. some media absorb more light than others.

    C. eyes process light differently depending on the medium observed.

    D. light travels at different speeds in different media.

85. The lenses of a pair of binoculars perform their basic function primarily as a result of:

    A. dispersion.

    B. refraction.

    C. reflection.

    D. diffraction.

86. Typically, lasers in DVD players operate at a wavelength of about 640 nm. Lasers in CD players typically operate at a wavelength of 780 nm. The reason for the smaller wavelength in DVDs is that the smaller wavelength:

    A. results in higher resolution.

    B. allows for compact equipment.

    C. saves on energy usage.

    D. has greater burning power.

87. In fiber-optic telephone systems, messages are transmitted along optical cables as:

    A. light pulses.

    B. electrical current.

    C. changes in wavelength.

    D. changes in color.

88. A compression gauge is most likely to be used to diagnose a problem in the:

    A. ignition coil.

    B. crankcase.

    C. engine cylinders.

    D. fuel system.

89. Which of the following best describes the primary reason for using multistaging in launching rockets?

    A. Lower stages that have become depleted of fuel provide an increase in the efficiency of upper stages.

    B. Stages can be recovered and reused after they are jettisoned and fall back to Earth.

    C. Total weight is reduced by jettisoning unnecessary empty stages.

    D. Stages provide additional thrust as they fall away from the rest of the rocket.

90. For which of the following types of marine vehicles is lift an important force?

    A. barge

    B. hydrofoil

    C. tanker

    D. tug

91. Which of the following types of motors is most commonly used in automotive starters?

    A. AC induction motor

    B. AC synchronous motor

    C. DC brushed motor

    D. DC stepper motor

92. The primary motivation for companies using containers in intermodal freight transport is that this system:

    A. reduces delivery time.

    B. minimizes weight.

    C. reduces fuel consumption.

    D. minimizes freight handling.

93. A test vehicle uses a parachute to decrease speed at the end of a trial run. This parachute functions by increasing which of the following forces?

    A. lift

    B. thrust

    C. drag

    D. gravity

94. Compared to non-stretching seatbelts, stretching seatbelts more effectively contribute to automobile passenger safety by:

    A. reducing the average impact force on the passenger during a collision.

    B. better protecting passengers with a wider variety of body types.

    C. providing greater comfort and increasing the likelihood that a seatbelt will be worn.

    D. keeping the passenger's hips positioned more securely in the seat.

95. Safety guidelines recommend that infants be placed in rear-facing car seats rather than front-facing car seats because:

    A. the seat of the car provides a soft point of impact during a collision.

    B. rear-facing car seats better protect the infant's head, neck, and shoulders.

    C. the car's seatbelt holds rear-facing car seats in place more securely.

    D. infants in rear-facing car seats are less likely to be thrown from a moving car.

96. Which of the following is a safety guideline that should be followed regarding the replacement of a motorcycle helmet?

    A. The helmet should be replaced after it has sustained an impact during an accident.

    B. The helmet does not need to be replaced unless visible damage is apparent.

    C. The helmet should be replaced every ten years even if it has not been dropped or sustained an impact.

    D. The helmet should be replaced whenever the visor is scratched.

97. Which of the following statements about air bags is correct?

    A. Infants should only ride in a front seat with a passenger-side air bag if the infant is in a rear-facing car seat.

    B. An adjustable steering wheel should be tilted up to ensure that the airbag points toward the head and neck.

    C. An air bag is only effective when a vehicle's occupant is no more than ten inches from the air bag.

    D. Air bags are only effective when they are used with a lap/shoulder belt.

98. In turning a ship, the main advantage of using a bow thruster rather than a rudder is that a bow thruster:

    A. does not require forward motion.

    B. can make small directional adjustments.

    C. does not increase fuel consumption.

    D. allows for computerized course adjustments.

99. A torsion bar is part of what system in a car?

    A. propulsion

    B. suspension

    C. guidance

    D. control

100. In automobiles, rack-and-pinion gears are commonly used in which of the following systems?

    A. support

    B. suspension

    C. steering

    D. braking

DIRECTIONS FOR THE OPEN-RESPONSE ITEM ASSIGNMENTS

This section of the test consists of two open-response item assignments that appear on the following pages. You will be asked to prepare a written response of approximately 1–2 pages for each assignment. You should use your time to plan, write, review, and edit your response for each assignment.

For each assignment, read the topic and directions carefully before you begin to work. Think about how you will organize your response. You may use any blank space in this test booklet to make notes, write an outline, or otherwise prepare your response.

As a whole, your response to each assignment must demonstrate an understanding of the knowledge of the field. In your response to each assignment, you are expected to demonstrate the depth of your understanding of the subject area by applying your knowledge rather than by merely reciting factual information.

Your response to each assignment will be evaluated based on the following criteria.

- **PURPOSE:** the extent to which the response achieves the purpose of the assignment
- **SUBJECT KNOWLEDGE:** appropriateness and accuracy in the application of subject knowledge
- **SUPPORT:** quality and relevance of supporting evidence
- **RATIONALE:** soundness of argument and degree of understanding of the subject area

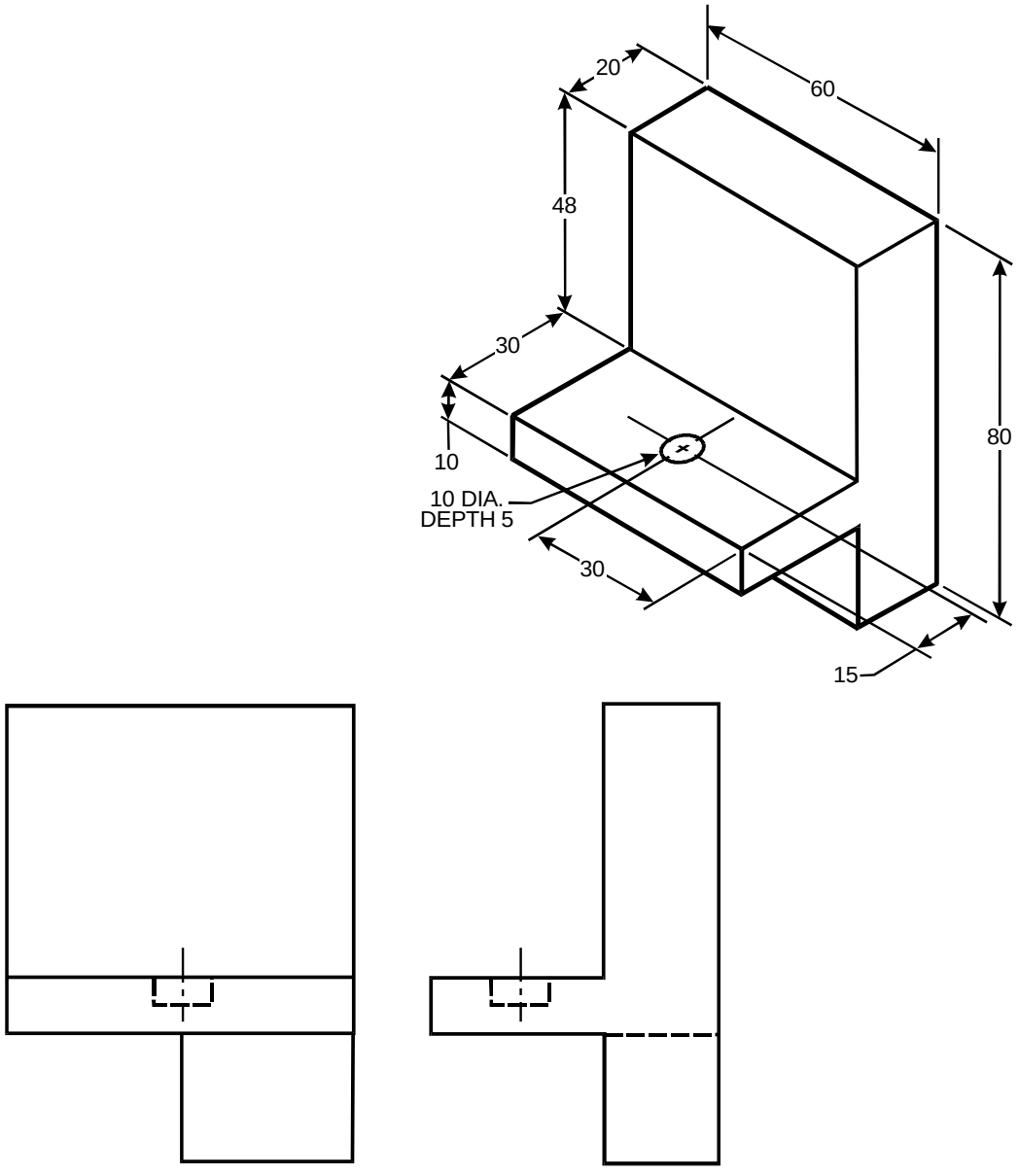
The open-response item assignments are intended to assess subject knowledge. Your responses must be communicated clearly enough to permit valid judgment of the evaluation criteria by scorers. Your responses should be written for an audience of educators in this field. The final version of each response should conform to the conventions of edited American English. Your responses should be your original work, written in your own words, and not copied or paraphrased from some other work.

Be sure to write about the assigned topics. Please write legibly. You may not use any reference materials during the test. Remember to review your work and make any changes you think will improve your responses.

Write or print your response in the space provided following the assignment.

OPEN-RESPONSE ITEM ASSIGNMENT #1

Use the information below to complete the assignment that follows.



The diagram above represents an isometric view of a workpiece, and front and right side views of the same workpiece. All dimensions are in inches. The top view of the orthographic projection is missing from the diagram. In your response:

- sketch the two given views and the missing top view of the object in the diagram; and
- add labels and dimensions to your drawings according to ANSI standards.

OPEN-RESPONSE SHEET—ASSIGNMENT #1

OPEN-RESPONSE SHEET—ASSIGNMENT #1

OPEN-RESPONSE ITEM ASSIGNMENT #2

Use the information below to complete the assignment that follows.

The size of student backpacks has been increasing, and school lockers can no longer accommodate them. You have been asked to help solve this problem. In your response:

- identify the steps of the engineering design process; and
- describe and provide examples of how you would use each of the steps to address this problem.

OPEN-RESPONSE SHEET—ASSIGNMENT #2

OPEN-RESPONSE SHEET—ASSIGNMENT #2

PRACTICE TEST RESULTS

PRACTICE TEST RESULTS OVERVIEW

The practice test provides valuable information regarding your preparedness for the MTEL Technology/ Engineering (33) test. In this section, you will find information and tools to help you determine your preparedness on the various sections of the test.

Multiple-Choice Questions

A Multiple-Choice Question Answer Key Worksheet is provided to assist you in evaluating your multiple-choice responses. The worksheet contains five columns. The first column indicates the multiple-choice question number, the second column indicates the objective to which the test question was written, and the third column indicates the correct response. The remaining columns are for your use in calculating the number of multiple-choice questions you answered correctly or incorrectly.

An Evaluation Chart for the multiple-choice questions is also provided to help you assess which content covered by the test objectives may require additional study.

Open-Response Items

Evaluation Information, Sample Responses and Analyses, as well as a Scoring Rubric are provided for these items. You may wish to refer to this information when evaluating your practice test responses.

Total Test

Practice Test Score Calculation information is provided to help you estimate your score on the practice test. Although you cannot use this practice test to precisely predict how you might score on an official MTEL Technology/Engineering (33) test, you may be able to determine your degree of readiness to take an MTEL test at an operational administration. No passing score has been determined for the practice test.

MULTIPLE-CHOICE QUESTION ANSWER KEY WORKSHEET

Question Number	Objective Number	Correct Response	Your Response	
			Correct?	Incorrect?
1	0001	A		
2	0001	C		
3	0001	D		
4	0001	B		
5	0001	D		
6	0002	A		
7	0002	B		
8	0002	D		
9	0002	B		
10	0002	D		
11	0003	B		
12	0003	D		
13	0003	C		
14	0003	B		
15	0003	C		
16	0004	C		
17	0004	C		
18	0004	A		
19	0004	B		
20	0004	A		
21	0005	A		
22	0005	C		
23	0005	B		
24	0005	C		
25	0005	D		
26	0006	D		
27	0006	B		
28	0006	A		
29	0006	A		
30	0007	D		
31	0007	D		
32	0007	A		
33	0007	A		
34	0007	B		

MULTIPLE-CHOICE QUESTION ANSWER KEY WORKSHEET (continued)

Question Number	Objective Number	Correct Response	Your Response	
			Correct?	Incorrect?
35	0008	A		
36	0008	C		
37	0008	B		
38	0008	A		
39	0008	B		
40	0009	C		
41	0009	D		
42	0009	D		
43	0009	A		
44	0009	C		
45	0009	B		
46	0009	A		
47	0009	A		
48	0010	A		
49	0010	B		
50	0010	B		
51	0010	A		
52	0010	C		
53	0010	D		
54	0010	A		
55	0010	D		
56	0011	C		
57	0011	D		
58	0011	B		
59	0011	C		
60	0011	A		
61	0011	D		
62	0012	C		
63	0012	D		
64	0012	B		
65	0012	B		
66	0012	C		
67	0013	B		
68	0013	D		

MULTIPLE-CHOICE QUESTION ANSWER KEY WORKSHEET (continued)

Question Number	Objective Number	Correct Response	Your Response	
			Correct?	Incorrect?
69	0013	C		
70	0013	D		
71	0013	D		
72	0014	B		
73	0014	D		
74	0014	B		
75	0014	D		
76	0014	B		
77	0015	A		
78	0015	A		
79	0015	B		
80	0015	C		
81	0015	D		
82	0016	C		
83	0016	B		
84	0016	D		
85	0016	B		
86	0016	A		
87	0016	A		
88	0017	C		
89	0017	C		
90	0017	B		
91	0017	C		
92	0017	D		
93	0017	C		
94	0018	A		
95	0018	B		
96	0018	A		
97	0018	D		
98	0018	A		
99	0018	B		
100	0018	C		

Count the number of multiple-choice questions you answered correctly:

_____ of 100 multiple-choice questions

MULTIPLE-CHOICE QUESTION PRACTICE TEST EVALUATION CHART

In the evaluation chart that follows, the multiple-choice questions are arranged in numerical order and by test objective. Check your responses against the correct responses provided to determine how many questions within each objective you answered correctly.

Subarea I: Foundations and Engineering Design

Objective 0001: Understand the historical and social contexts of technology/engineering.
1A____ 2D_____ 3D_____ 4B_____ 5D_____ _____/5

Objective 0002: Understand the connections among engineering, technology, mathematics, and natural science.
6A____ 7B_____ 8D_____ 9B_____ 10D_____ _____/5

Objective 0003: Understand engineering design and the role of modeling and optimizing in developing technological solutions to problems within given constraints.
11B____ 12D____ 13C_____ 14B_____ 15C_____ _____/5

Objective 0004: Understand the selection and safe use of appropriate materials, tools, equipment, and machines in technology/engineering.
16C____ 17C_____ 18A_____ 19B_____ 20A_____ _____/5

Subarea I (Objectives 0001–0004) Total _____/20

MULTIPLE-CHOICE QUESTION
PRACTICE TEST EVALUATION CHART (continued)

Subarea II: Energy and Power Systems

Objective 0005: Understand fluid systems and their role in technology systems.	
21A____ 22C_____ 23B_____ 24C_____ 25D_____	**_____/5**

Objective 0006: Understand thermal systems and their role in technology systems.	
26D____ 27B_____ 28A_____ 29A_____	**_____/4**

Objective 0007: Understand electrical principles and components and their roles in technology systems.	
30D____ 31D_____ 32A_____ 33A_____ 34B_____	**_____/5**

Objective 0008: Understand basic principles of energy, work, and power and their relationship to mechanical systems.	
35A____ 36C_____ 37B_____ 38A_____ 39B_____	**_____/5**

Subarea II (Objectives 0005–0008) Total _____/19

MULTIPLE-CHOICE QUESTION
PRACTICE TEST EVALUATION CHART (continued)

Subarea III: Construction Technologies

Objective 0009: Understand design factors, material selection, and constraints in building structures.								
40C____	41D_____	42D_____	43A_____	44C_____	45B_____	46A_____	47A_____	_____/8

Objective 0010: Understand the effects of forces in construction technology.								
48A____	49B_____	50B_____	51A_____	52C_____	53D_____	54A_____	55D_____	_____/8

Subarea III (Objectives 0009–0010) Total _____/16

Subarea IV: Manufacturing Technologies

Objective 0011: Understand primary and secondary manufacturing processes used to create manufactured products.						
56C____	57D_____	58B_____	59C_____	60A_____	61D_____	_____/6

Objective 0012: Understand how manufacturing enterprises and facilities are structured and managed.					
62C____	63D_____	64B_____	65B_____	66C_____	_____/5

Objective 0013: Understand bioengineering technologies.					
67B____	68D____	69C_____	70D_____	71D_____	_____/5

Subarea IV (Objectives 0011–0013) Total _____/16

MULTIPLE-CHOICE QUESTION
PRACTICE TEST EVALUATION CHART (continued)

Subarea V: Communication Technologies

Objective 0014: Understand processes used to communicate messages and ideas.	
72B____ 73D_____ 74B_____ 75D_____ 76B_____	_____/5

Objective 0015: Understand waves, wave motion, and the basic principles of acoustics.	
77A____ 78A_____ 79B_____ 80C_____ 81D_____	_____/5

Objective 0016: Understand the nature of light and its application to communication technology.	
82C____ 83B_____ 84D_____ 85B_____ 86A_____ 87A_____	_____/6

Subarea V (Objectives 0014–0016) Total _____/16

Subarea VI: Transportation Technologies

Objective 0017: Understand the principles and characteristics of transportation technology.	
88C____ 89C____ 90B_____ 91C_____ 92D_____ 93C_____	_____/6

Objective 0018: Understand processes and devices used in transportation technologies.	
94A____ 95B____ 96A_____ 97D_____ 98A_____ 99B_____ 100C_____	_____/7

Subarea VI (Objectives 0017–0018) Total _____/13

OPEN-RESPONSE ITEM EVALUATION INFORMATION

How Open-Response Items Are Scored

Open-response items are scored through a process called focused holistic scoring. Scorers judge the overall effectiveness of the response rather than individual aspects considered in isolation. Scorer judgments are based on the quality of the response, not on length or neatness. Responses must be long enough to cover the topic adequately and scorers must be able to read what is written.

How to Evaluate Your Practice Responses

On the following pages, you will find two "strong" and two "weak" sample responses. PLEASE DO NOT REVIEW THE SAMPLE RESPONSES UNTIL AFTER YOU HAVE WRITTEN YOUR OWN RESPONSE. When you do review the two "strong" and "weak" sample responses and analyses included here, please note the following points:

- ✓ For the purposes of the practice test, responses are identified as "strong" or "weak" rather than given a score point of 1–4.
- ✓ The responses identified as "strong" may contain flaws; however, these responses do demonstrate the performance characteristics of a "strong response."
- ✓ The two "strong" responses demonstrate the examinees' appropriate understanding and application of the subject matter knowledge. However, these responses do not necessarily reflect the full range of "correct answers" that would demonstrate an understanding of the subject matter.
- ✓ The "Analysis" accompanying each "strong" and "weak" response discusses the main attributes of the responses, but does not identify all flaws or strengths that may be present.

Compare your practice responses to the Sample Responses to determine whether your responses are more similar to the strong or weak responses. Also review the Analyses on those pages and the Scoring Rubric to help you better understand the characteristics of strong and weak responses. This evaluation will help you identify specific problems or weaknesses in your practice responses. Further information on scoring can be found in the Test Information Booklet and Faculty Guide at www.mtel.nesinc.com and at www.doe.mass.edu/mtel; select "FAQ," then "After the Test."

OPEN-RESPONSE ITEM
SCORING RUBRIC, SAMPLE RESPONSES, AND ANALYSES

Massachusetts Tests for Educator Licensure®
SCORING RUBRIC FOR SUBJECT TESTS

Performance Characteristics:

Purpose	The extent to which the response achieves the purpose of the assignment.
Subject Matter Knowledge	Accuracy and appropriateness in the application of subject matter knowledge.
Support	Quality and relevance of supporting details.
Rationale	Soundness of argument and degree of understanding of the subject matter.

Scoring Scale:

Score Point	Score Point Description
4	**The "4" response reflects a thorough knowledge and understanding of the subject matter.** • The purpose of the assignment is fully achieved. • There is a substantial, accurate, and appropriate application of subject matter knowledge. • The supporting evidence is sound; there are high-quality, relevant examples. • The response reflects an ably reasoned, comprehensive understanding of the topic.
3	**The "3" response reflects an adequate knowledge and understanding of the subject matter.** • The purpose of the assignment is largely achieved. • There is a generally accurate and appropriate application of subject matter knowledge. • The supporting evidence is adequate; there are some acceptable, relevant examples. • The response reflects an adequately reasoned understanding of the topic.
2	**The "2" response reflects a limited knowledge and understanding of the subject matter.** • The purpose of the assignment is partially achieved. • There is a limited, possibly inaccurate or inappropriate, application of subject matter knowledge. • The supporting evidence is limited; there are few relevant examples. • The response reflects a limited, poorly reasoned understanding of the topic.
1	**The "1" response reflects a weak knowledge and understanding of the subject matter.** • The purpose of the assignment is not achieved. • There is little or no appropriate or accurate application of subject matter knowledge. • The supporting evidence, if present, is weak; there are few or no relevant examples. • The response reflects little or no reasoning about or understanding of the topic.

U	**The response is unrelated to the assigned topic, illegible, primarily in a language other than English, not of sufficient length to score, or merely a repetition of the assignment.**
B	**There is no response to the assignment.**

FIRST SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

Sample weak responses to the open-response item assignments will be available in late fall 2009.

ANALYSIS FOR FIRST WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

Analyses for weak responses to the open-response item assignments will be available in late fall 2009.

SECOND SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

Sample weak responses to the open-response item assignments will be available in late fall 2009.

ANALYSIS FOR SECOND WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

Analyses for weak responses to the open-response item assignments will be available in late fall 2009.

FIRST SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

Sample strong responses to the open-response item assignments will be available in late fall 2009.

ANALYSIS FOR FIRST STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

Analyses for strong responses to the open-response item assignments will be available in late fall 2009.

SECOND SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

Sample strong responses to the open-response item assignments will be available in late fall 2009.

ANALYSIS FOR SECOND STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

Analyses for strong responses to the open-response item assignments will be available in late fall 2009.

FIRST SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

Sample weak responses to the open-response item assignments will be available in late fall 2009.

ANALYSIS FOR FIRST WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

Analyses for weak responses to the open-response item assignments will be available in late fall 2009.

SECOND SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

Sample weak responses to the open-response item assignments will be available in late fall 2009.

ANALYSIS FOR SECOND WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

Analyses for weak responses to the open-response item assignments will be available in late fall 2009.

FIRST SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

Sample strong responses to the open-response item assignments will be available in late fall 2009.

ANALYSIS FOR FIRST STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

Analyses for strong responses to the open-response item assignments will be available in late fall 2009.

SECOND SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

Sample strong responses to the open-response item assignments will be available in late fall 2009.

ANALYSIS FOR SECOND STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

Analyses for strong responses to the open-response item assignments will be available in late fall 2009.

PRACTICE TEST SCORE CALCULATION

The practice test score calculation information will be available in winter 2010, following setting of qualifying scores.