SPH4C: Physics, Grade 12, College Preparation

Exam Review Package

Unit 1: Motion and Its Applications

Part A: Multiple Choice Questions

1. A vector is different from a scalar because:
   a. a vector has a number and a unit whereas a scalar has a number only.
   b. a vector has direction whereas a scalar does not have direction.
   c. a vector has mass whereas a scalar does not have mass.
   d. a vector measures speed whereas a scalar measures velocity.
   e. a vector does not have a number whereas a scalar does have a number.

2. Chen left home and went for a jog. He jogged 8.0 km [W], then 5.0 km [E] followed by 3.0 km [W]. What is Chen’s final position from home?
   a. 0.0 km
   b. 6.0 km [W]
   c. 6.0 km [E]
   d. 10.0 km [E]
   e. 16 km [W]

3. A runner makes 2 laps around a circular track, ending up at the same point she started from. Which of the following pairs of quantities would both equal zero?
   a. displacement and average velocity
   b. average speed and average acceleration
   c. distance and average speed
   d. average speed and average velocity
   e. displacement and average speed

4. A car is travelling south while slowing down as it approaches a stop sign. The directions associated with the object’s velocity and acceleration, respectively, are
   a. [N], [S]
   b. [N], [N]
   c. [S], [S]
   d. [S], [N]
   e. not enough information to tell

5. Which of the following statements about motion graphs is incorrect?
   a. The slope of a position-time graph gives velocity.
   b. The slope of a velocity-time graph gives acceleration.
   c. The area under a velocity-time graph gives displacement.
   d. The area under a position-time graph gives velocity.
   e. The slope of an acceleration-time graph is zero when there is uniform velocity.

6. A boy pulls on a wagon with a force of 100 N [E]. The wagon pulls on the boy with a force of
   a. zero
   b. less than 100 N [W] if the wagon’s speed is decreasing
   c. 100 N [W] regardless of whether the wagon is accelerating
   d. 100 N [W] only if the wagon is moving at constant velocity
e. greater than 100 N [W] if the wagon is accelerating

7. If a car is travelling north at constant velocity, the net force acting on the car is:
   a. directed north
   b. directed south
   c. zero
   d. upward
   e. downward

8. The acceleration of an object is always in the direction:
   a. of the initial velocity
   b. of the average velocity
   c. of the net force
   d. of the force of friction
   e. of displacement

9. Which of the following statements is always true?
   a. There are no forces acting on an object if it is at rest.
   b. There is an unbalanced force on an object if it is in motion.
   c. An object in motion has a tendency to stay in motion.
   d. An object in motion has a tendency to come to rest.
   e. An object in motion at constant velocity may or may not have an unbalanced force acting on it.

10. If you were to increase the mass of an object in motion, the net force required to keep it moving at the same rate of acceleration would:
    a. increase
    b. decrease
    c. stay the same because the object was already in motion
    d. be zero because the object is already in motion
    e. either increase or decrease (too little information to tell)

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**Part B: Short Answer Questions**

Please submit answers for this section electronically.

1. (A) Describe the motion depicted in the following position-time graph.

   ![Position-Time Graph](image)

   (B) Given that the change in velocity is constant, sketch a velocity-time graph and an acceleration-time graph to match the position-time graph above.

2. A man is suing the bus company for a physical injury he received while riding on the bus. He claims that the bus driver accelerated forward so quickly that a suitcase came flying from the
back of the bus hitting him in the head. Using Newton’s Laws, explain why this man does or does not have a case.

**Part C: Problem Solving**

1. A motorcycle accelerates from rest to a velocity of 32 m/s [forward]. If its rate of acceleration was 7 m/s² [forward], how long did it take him to reach this velocity?

2. In a period of 2.0 h, a sailboat travels 15 km [E] and then 11 km [W].
   (a) What is the boat’s total distance travelled?
   (b) What is the boat’s total displacement?
   (c) What is the boat’s final position?
   (d) What is the boat’s average speed (in km/h)?
   (e) What is the boat’s average velocity (in km/h)?

3. Use the position-time graph below to answer the questions that follow.

![Position-Time Graph](image)

(a) Describe the motion of the object:
   (i) from 0.0 s to 15.0 s
   (ii) from 15.0 s to 30.0 s
   (iii) from 30.0 to 40.0 s

(b) How do the motions of the object from 0.0s to 15.0 s and 30 s to 40 s compare?
4. Use the velocity-time graph below to answer the questions that follow.

(a) Describe the motion of the object:
   (i) from 0.0 s to 20.0 s
   (ii) from 35.0 s to 50.0 s

(b) How do the motions of the object from 20.0 s to 35.0 s and 50.0 s to 60.0 s compare?

(c) What is the velocity of the object at 10.0 s?

(d) What is the acceleration of the object at 30.0 s?

(e) What is the displacement of the object after the first 20.0 s?

5. A block is being pushed forward on a flat surface with a force of magnitude 45 N. The force of friction on the block is 13 N. The mass of the block is 11 kg.

   (a) Draw a free-body diagram of the block.
   (b) What is the net force acting on the block?
   (c) What is the acceleration of the block?

Unit 2: Mechanical Systems

Part A: Multiple Choice Questions

Select the correct response for each question.
1. The term "weight" in physics means the same thing as
   A) mass
B) applied force  
C) force of gravity  
D) tension force

2. A box with a mass of 9.5 kg is sitting on the floor. The magnitude of the normal force acting on the mass:

A) is 9.5 N  
B) is 93 N  
C) cannot be found with the information given  
D) 0.97 N

3. What type of lever is a wheelbarrow?

A) first-class  
B) a wheelbarrow is not a lever  
C) second-class  
D) third-class

4. The turning effect on a rigid bar around a pivot point is referred to as

A) applied force  
B) tension  
C) torque  
D) frictional force

5. A student is moving dirt with a shovel. He must lift 1.0 kg of dirt into a bucket and the load arm is 1.50 m away from the pivot end of the shovel and the effort arm is 0.30 m (this is a third-class lever with $g = 9.8 \, \text{m/s}^2$). The load force is:

A) 9.8 N  
B) 49 N  
C) 1.96 N  
D) 0.2 N

6. A moveable pulley system has four support strings. What is the ideal mechanical advantage of this system?

A) 3  
B) 4  
C) 5  
D) 100%

7. A person lifts a wheelbarrow from the handles located 125 cm from the wheel which acts as the fulcrum. The person lifts with a force of 640 N, and the load is located 50 cm from the wheel. The effort torque is equal to

A) 320 N·m  
B) 32 000 N·m  
C) 1600 N·m  
D) 80 000 N·m

8. The ideal mechanical advantage of a ramp with a height of 2.0 m and length of 5.0 m is:

A) 5
9. In a pair of gears, the gear where the effort is applied has 4 teeth and the gear with the load attached has 12 teeth. The:

A) IMA is 3
B) IMA is 0.3
C) AMA is 3
D) AMA is 0.3

10. If the amount of friction present in a moving machine increases,

A) the AMA decreases and the percent efficiency decreases
B) the AMA increases and the percent efficiency increases
C) the AMA increases and the percent efficiency decreases
D) the AMA decreases and the percent efficiency increases

11. The torque is greatest on an object when

A) the effort force is applied parallel to the object and as close to the fulcrum as possible
B) the effort force is applied perpendicular to the object and as close to the fulcrum as possible
C) the effort force is applied perpendicular to the object and as far from the fulcrum as possible
D) the effort force is applied parallel to the object and as far from the fulcrum as possible

Part B: Short Answer Questions

1. Friction can be your best friend or your worst enemy. Describe a situation where friction is helpful in your daily life and a situation where friction is not helpful.

2. Identify the class of lever of these common household items. Choose from the list on the right.

___ second-class lever  1. nut cracker
___ second-class lever  2. wrench
___ third-class lever  3. scissors
___ first-class lever  4. bicycle crank
___ first class lever  5. barbecue tongs

Part C: Problem Solving

1. A 10 kg cardboard box is pushed across the floor with a horizontal force of 50 N [right]. If $\mu_k = 0.080$, then what is the acceleration of the box? (remember, $g = 9.8 \text{ m/s}^2$).

2. A 2.0 m long bar is being used as a first-class lever. It has a load of 720 N placed on one end (located 1.2 m from the fulcrum) and the effort is being applied at the opposite end.

(a) State the Law of the Lever.

(b) Draw a diagram of the lever, showing the load, effort, fulcrum, effort arm, and load.
(c) Determine the effort force needed to balance the load.

(d) If this lever has an actual mechanical advantage of 1, determine the percent efficiency of the lever.

Unit 3: Energy Transformations

Part A: Multiple Choice Questions (10 marks)

Select the correct response for each question.

1. A ball is thrown up into the air. As it rises:
   (a) its gravitational potential energy increases and its kinetic energy increases
   (b) its gravitational potential energy increases and its kinetic energy decreases
   (c) its gravitational potential energy decreases and its kinetic energy decreases
   (d) its gravitational potential energy decreases and its kinetic energy decreases

2. If a 1000 kg car accelerates from 10 m/s to 20 m/s, the amount of work done is:
   (a) 112 500 J
   (b) 10 000 J
   (c) 150 000 J
   (d) 5000 J

3. If mechanical energy is conserved, then
   (a) the sum of the kinetic energy and gravitational potential energy remains constant
   (b) the amount of kinetic energy is constant
   (c) thermal energy losses due to friction are constant
   (d) the amount of gravitational potential energy is constant

4. The amount of energy required to raise a 20 kg child onto a countertop that is 1.25 m off the ground is (g=9.8 m/s²)
   (a) 30 J
   (b) 0.25 N
   (c) 245 J
   (d) 30 N

5. A cyclist has 4 100 J of energy. The velocity of this 82 kg cyclist (with bike) is
   (a) 100 km/h
   (b) 50 km/h
   (c) 100 m/s
   (d) 10 m/s

6. The amount of energy used by a 60 W light bulb in 1 hour is
   (a) 216 000 J
   (b) 1 J
   (c) 60 J
   (d) 60 W

7. An electrical device outputs 40 J of radiant light energy for every 100 J of electrical energy input. The efficiency of this device is
   (a) 0.4
   (b) 40 %
   (c) 0.6
   (d) 60 %
8. Which of the following energy transformations best describes the operation of a solar powered battery charger?

(a) electrical energy --> thermal energy --> kinetic energy  
(b) nuclear energy --> potential energy --> chemical energy  
(c) thermal energy --> elastic potential energy --> electrical energy  
(d) radiant energy --> electrical energy --> chemical potential energy

9. A cup of water is boiling at 100 °C.
(a) its thermal energy is 100 J  
(b) the average kinetic energy of the particles is greater than in a 90°C cup of water  
(c) the particles of water are not moving  
(d) the particles of water are moving at 100 m/s

10. If a frictional force of 15 N acts on a box as it slides a distance of 5 m, the thermal energy produced would be:
(a) 3 J  
(b) 37.5 J  
(c) 6 J  
(d) 75 J

Part B: Short Answer Questions

1. Match each word with the most appropriate choice by filling in the correct number. (6 marks)

___ power  1. metric unit of power  
___ energy  2. light energy from electromagnetic waves  
___ watt  3. total energy due to movement of particles within a substance  
___ elastic  4. rate at which work is done  
___ thermal  5. the ability to do work  
___ radiant  6. type of energy stored when a spring is stretched

2. Explain the difference between renewable and non-renewable energy resources. Give one example of each. State one advantage and disadvantage of each example you give. (5 marks)

3. Explain how a $10.00 compact fluorescent light bulb (15 W) can cost less than an incandescent light bulb (60 W) that costs $0.50. (2 marks)

4. Explain how you could determine the efficiency with which the mechanical energy of a pendulum is conserved. (4 marks)

Part C: Problem Solving

1. a) An apple (0.100 kg) is thrown vertically upward at a speed of x m/s (from an arm 1.5 m off of the ground). What is the maximum height that the apple reaches? (g=9.8 m/s²)
b) With what speed will the apple return to the thrower if mechanical energy continues to be conserved? Why?

2. A 0.25 kg pendulum swings through its minimum height of 0.50 m from the ground with a maximum speed of 3.1 m/s. How fast is it moving when it is \( x \) m off of the ground? \((g = 9.8 \text{ m/s}^2)\)

3. How much light energy is radiated from a 10% efficient light bulb if electrical energy is supplied at the rate of 60 W for a time period of \( x \). (Remember, there are 3600 s in 1 h)

Unit 4: Electricity and Magnetism

Part A: Multiple Choice Questions (11 marks)

Select the correct response for each question. You may change your answer after making your initial selection, but remember that your first instinct is often your best one!

1. If two 100 \( \Omega \) resistors are placed in series, their total resistance is:
   (a) 100 \( \Omega \)
   (b) 200 \( \Omega \)
   (c) 10 000 \( \Omega \)
   (d) 50 \( \Omega \)

2. The potential difference across a 100 ohm resistor that has 0.01 amperes of current is:
   (a) 0.01 volts
   (b) 100 volts
   (c) 1 volt
   (d) 10 000 volts

3. A load that has 2 A of current passing through it with a potential difference of 6 V has a resistance of:
   (a) 2 \( \Omega \)
   (b) 2/6 \( \Omega \)
   (c) 12 \( \Omega \)
   (d) 3 \( \Omega \)

4. If two 200 \( \Omega \) resistors are connected in parallel, their total resistance is:
   (a) 100 \( \Omega \)
   (b) 200 \( \Omega \)
   (c) 400 \( \Omega \)
   (d) 50 \( \Omega \)

5. If five light bulbs are connected in series to an energy source and one of them burns out, the others:
   (a) go out
   (b) become brighter
   (c) become dimmer
   (d) are not affected

6. How do potential drop and potential rise compare in a completed simple circuit?
   (a) Potential rise does not affect potential drop.
   (b) Potential rise in the source is equal to the potential drop in the load.
   (c) Potential rise in the source is greater than potential drop across the load.
   (d) Potential rise in the source is less than potential drop across the load.

7. How will the current in the first ammeter compare with the reading in the second?
8. Which of the following graphs best represents the relationship between electric potential difference and current for an ohmic resistor?

(a) 

(b) 

(c) 

(d) 

9. The direction of current flow is shown in the conductor below. What would be the direction of the magnetic field lines around the conductor on the side of the conductor closest to you?

(a) upward 
(b) downward 
(c) to the right 
(d) to the left 

10. In the diagram below,
(a) the magnetic field lines between the poles are directed from left to right, the current is flowing away from you into the page, and the wire is forced upward toward the middle of the magnet.

(b) the magnetic field lines between the poles are directed from right to left, the current is flowing away from you into the page, and the wire is forced upward toward the middle of the magnet.

(c) the magnetic field lines between the poles are directed from right to left, the current is flowing toward you, and the wire is forced downward away from the magnet.

(d) the magnetic field lines between the poles are directed from right to left, the current is flowing toward you, and the wire is forced to move downward away from the magnet.

11. In the following electromagnet,

(a) the current in the wires on the side closest to you is directed upwards and the north pole is on the left.

(b) the current in the wires on the side closest to you is directed downwards and the north pole is on the left.

(c) the current in the wires on the side closest to you is directed upwards and the north pole is on the right.

(d) the current in the wires on the side closest to you is directed downwards and the north pole is on the right.

Part B: Short Answer Questions

Please submit answers for this section electronically.

1. Match each word with the most appropriate choice by filling in the correct number. (9 marks)

| ___ current | 1. the type of circuit that contains an electrical gap so that no current can flow |
| ___ volt | 2. flow of current in one constant direction |
| ___ load | 3. the flow of current occurs back and forth with a regular frequency |
| ___ ampere | 4. the metric unit for electric potential difference |
| ___ short | 5. a medium that allows current to flow |
| ___ conductor | 6. a device that transforms electrical energy into other forms of energy |
| ___ DC | 7. the metric unit of electrical current |
| ___ AC | 8. the flow of electric charge |
| ___ open | 9. the type of circuit that contains a continuous path with no load |
2. Explain the best type of connection for the following parts within an electrical circuit: series or parallel. Provide reasons for your answers. (4 marks)

(a) lights in your house

(b) 1.5 V batteries to power a 6.0 V electronic device

3. (a) Label the parts of the DC motor. (5 marks)

1. ____________
2. ____________
3. ____________
4. ____________
5. ____________

(b) Explain the Motor Principle in relation to the operation of the DC motor. (2 marks)

(c) Explain the role of the commutator in the DC motor. (2 marks)

Part C: Problem Solving

For this section, you must print the test to fully complete all questions showing complete solutions with proper communication. You must also submit final answers electronically as you complete the test.

1. Use the circuit below to answer the following questions. (7 marks)

(a) What is the potential difference across R1?

(b) If 10 A flows out of the battery, what is the current through R1?

(c) What is the resistance of R1?

(d) What is the resistance of the 7 V load?

2. Use the circuit below to answer the following questions. (9 marks)
(a) What is the potential difference across R1?
(b) What is the potential difference across R2?
(c) If 20 A flows through R1, what is its resistance?
(d) If 10 A flows through R2, what is its resistance?
(e) Given the currents in (c) and d), what is the current coming out of the power source or dry cell?

Unit 5: Hydraulic and Pneumatic Systems
Part A: Multiple Choice Questions

1. Which of the following is an acceptable unit for density?
   (a) g / mL
   (b) mL / g
   (c) L / m³
   (d) g / kg

2. When area doubles for a constant applied force, the pressure:
   (a) doubles
   (b) halves
   (c) becomes 4 × the original pressure
   (d) becomes ¼ the original pressure

3. The force applied to an object that experiences 30 kPa of pressure over 0.02 m² is:
   (a) 600 N
   (b) 0.6 N
   (c) 1500 N
   (d) 0.0007 N

4. A 2-cylinder system is constructed so that the output force is 10 times the input force. How does the input cylinder area compare to the output cylinder area?
   (a) The input cylinder’s area is 1/10th the area of the output cylinder.
   (b) The input cylinder’s area is 10 times the area of the output cylinder.
   (c) The input cylinder’s area is 1/100th the area of the output cylinder.
   (d) The input cylinder’s area is 100 times the area of the output cylinder.

5. When the cross-sectional area of a fluid-carrying pipe decreases, the flow speed of the fluid will:
   (a) increase
   (b) decrease
   (c) stay the same
   (d) change unpredictably

6. The state of matter that has the least force of attraction between its particles is:
   (a) solid
   (b) liquid
   (c) gas
   (d) Neither. They all have the same force of attraction between their particles.

7. Which of the following substances would likely have the best laminar flow?
   (a) water
   (b) cool honey
   (c) warm honey
8. In terms of the air flow around an airplane wing, it is true that underneath the wing:
(a) Air flows more slowly and there is lower pressure than above the wing.
(b) Air flows more quickly and there is lower pressure than above the wing.
(c) Air flows more slowly and there is higher pressure than above the wing.
(d) Air flows more quickly and there is higher pressure than above the wing.

9. The correct order of the following substances from least to maximum compressibility is:
(a) wood, oil, oxygen
(b) oil, wood, oxygen
(c) oxygen, wood, oil
(d) oxygen, oil, wood

10. If the gauge pressure is 150 kPa and the atmospheric pressure is 100 kPa, the absolute pressure is:
(a) 250 kPa
(b) 50 kPa
(c) 150 kPa
(d) 100 kPa

Part B: Short Answer Questions

1. Match each word with the most appropriate description by putting the correct number in the blank.
(6 marks)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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<tbody>
<tr>
<td></td>
<td>1. a measure of how closely particles are packed together.</td>
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<td></td>
<td>2. a force that resists the motion of an object through a fluid</td>
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<td></td>
<td>3. a force of 1 newton per square metre</td>
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<td></td>
<td>4. experiences attractive forces while constantly in motion</td>
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<td></td>
<td>5. the process of minimizing resistance to motion</td>
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<td>6. a system that works using liquid under pressure</td>
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<td></td>
<td>7. the amount of space a substance takes up</td>
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<td></td>
<td>8. the study of the motion of fluids and the factors that affect that motion</td>
</tr>
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</table>

2. Explain the meaning of fluid viscosity and its relation to laminar flow. (2 marks)

3. State Bernoulli’s Principle. Describe how it contributes to the design of an airplane’s wing. (3 marks)

Part C: Problem Solving
1. Explain (with calculations) why a person with a weight of 500 N gets punctured when resting on a single nail, but remains unharmed when lying on a bed of nails. Let the area of one nail be 0.00005 m² and use a bed of about x nails. (3 marks)

SPH4C: Physics, Grade 12, College Preparation – Full/Mixed Review

PART A: Short Answer Questions

a. 1. State Newton’s Three Laws of motion. For each law, describe a situation that demonstrates the law. [6]

2. Describe an example to explain the difference between the definition of work used by physicists and that of the average “person on the street”. [2]

3. Describe the motion shown in the following graph. Include at least two pieces of information and the reason for your conclusions. [2]

4. When applying force on a lever, what two things can you do to maximize torque? [2]

5. (a) Give the energy transformation equation for one complete ball bounce. [2]

(b) Explain how you could determine the efficiency with which the mechanical energy of a ball bounce is conserved. [3]

6. (a) Show the location of the north and south poles for this electromagnet. [1]

(b) Show the direction of force on this current-carrying conductor. [1]
7. (a) Label the parts of the DC motor. [5]

1. ____________
2. ____________
3. ____________
4. ____________
5. ____________

(b) Explain the operation of the DC motor. Also, which way, clockwise or counter-clockwise, will the above motor rotate? [2]

**PART B: Problems**

1. A receiver on a football team runs 8.0 m [E] and then turns abruptly to run 12.0 m [W]. If the entire motion takes 5.0 s, determine the receiver's
   (a) total distance travelled. [2]
   (b) total displacement. [2]
   (b) average speed. [2]
   (c) average velocity. [2]

2. Ms. Fizics pushed a large crate of textbooks (75 kg) down the hall to her office. She pushed as hard as she could and the crate accelerated down the hall at a rate of 1.5 m/s². There was a coefficient of kinetic friction of 0.48 between the crate and the floor.
   (a) Draw a free-body diagram for the crate. [2]
   (b) Determine the net force on the crate. [2]
   (c) Determine the crate's normal force. [2]
   (d) Determine the force of friction on the crate. [2]
   (e) Determine the force exerted by Ms. Fizics. [2]

3. A 2.0 m first-class lever has a load of 600 N located 0.5 m from the fulcrum.
   (a) State the Law of the Lever. [1]
   (b) Draw a diagram of the lever, showing the load, effort, fulcrum, effort arm, and load. [2]
(c) Determine the effort force needed to balance the load. [2]

(d) If this lever has an actual mechanical advantage of 2, determine the percent efficiency of the lever. [2]

b. 4. A 60 kg snowboarder (including equipment) heads down a very slippery slope starting at a height of 100 m, from rest, above the flat surface at the bottom. Use the Law of Conservation of Energy to determine the speed she could attain by the time she hits the flat (at the bottom of the hill). [4]

5. Use the circuit diagram below to answer the questions that follow.

![Circuit Diagram]

(a) What is the resistance of R₁? [2]

(b) What is the current through R₂? [2]

(c) What is the current through the energy source? [2]

(d) What is the total resistance in the circuit? [2]

6. A certain hydraulic jack has been built such that the maximum force that can be exerted on the small piston, of surface area 0.15 m², is 2500 N. If the surface area of the large piston is 2.0 m², calculate:
   (a) the maximum force that can be generated on the large piston to lift a load, [2]
   (b) the mass of that load. [2]

PART C: Multiple Choice Questions
1. A net force acts on an object. The object will likely:
   a. move at constant speed
   b. remain stationary
   c. accelerate
   d. come to a stop and remain stationary
   e. move at constant velocity

2. In Newton’s Third Law, the action and reaction forces:
   a. are only equal if the object is moving with constant velocity
   b. are only equal if the object is experiencing a net force
   c. are only equal if the object is stationary
   d. act on the same object
   e. act on different objects

3. A vector is different from a scalar because:
   c. A vector has a number and a unit, whereas a scalar has a number only.
   d. A vector has direction, whereas a scalar does not have direction.
   e. A vector has mass, whereas a scalar does not have mass.
   f. A vector measures speed, whereas a scalar measures velocity.
   g. A vector does not have a number, whereas a scalar does have a number.

4. Which of the following statements about motion graphs is incorrect?
   a. The slope of a position-time graph gives velocity.
   b. The slope of a velocity-time graph gives acceleration.
   c. The area under a velocity-time graph gives displacement.
   d. The area under a position-time graph gives velocity.
   e. The slope of an acceleration-time graph is zero when there is uniform velocity.

5. Robert left home and went for a jog. He jogged 2.0 km [N], and then 3.0 km [S] followed by 4.0 km [N]. What is Robert’s final position from home?
   a. 0.0 km
   b. 3.0 km [N]
   c. 9.0 km [N]
   d. 3.0 km [S]
   e. 9 km [S]

6. If a box has a weight of 1000 N, its mass is:
   a. 1000 kg
   b. 102 kg
   c. 9800 kg
   d. 1000 kg [down]
   e. unrelated to its weight, but dependent on the amount of matter

7. A 30 kg box is lifted from the ground to a height of 1.5 m. The work done is:
   a. 441 J
   b. 45 J
   c. 20 J
d. 4.6 J  
e. 294 J

8. If the amount of friction present in a moving machine decreases:

a. The AMA decreases (in relation to the IMA) and the percent efficiency decreases.  
b. The AMA increases (in relation to the IMA) and the percent efficiency increases.  
c. The AMA increases (in relation to the IMA) and the percent efficiency decreases.  
d. The AMA decreases (in relation to the IMA) and the percent efficiency increases.  
e. More information is required.

9. The turning effect on a rigid bar around a pivot point is referred to as

a. applied force  
b. tension  
c. torque  
d. normal force  
e. effort

10. A moveable pulley system has three support strings pulling up on the moving pulley. The ideal mechanical advantage of this system is:

a. 1  
b. 3  
c. 4  
d. 50%  
e. 100%

11. If a 1.5 kg chicken is running with a speed of 10.0 m/s, its kinetic energy is:

a. 150 J  
b. 7.5 J  
c. 75 J  
d. 6.7 J  
e. 15 J

12. A ball is dropped from a height of 3.0 m. As it falls:

a. Its gravitational potential energy increases and its kinetic energy increases.  
b. Its gravitational potential energy increases and its kinetic energy decreases.  
c. Its gravitational potential energy decreases and its kinetic energy increases.  
d. Its gravitational potential energy decreases and its kinetic energy decreases.  
e. There is no change to either its gravitational potential or its kinetic energy.

13. If done long enough, rubbing two sticks together can produce enough heat to start a fire. If 100.0 J of thermal energy is required to start the fire and the average frictional force between the sticks is 20.0 N, the distance the sticks must slide past one other is:

a. 2.00 m  
b. 5.00 m  
c. 10.0 m  
d. 100.0 m  
e. $2.00 \times 10^3$ m

14. The amount of energy used by a 100 W light bulb in 1 minute is:
15. Which of the following energy transformations best describes the operation of a battery powered flashlight?

a. electrical energy --> thermal energy --> kinetic energy
b. nuclear energy --> potential energy --> chemical energy
c. thermal energy --> elastic potential energy --> electrical energy
d. radiant energy --> electrical energy --> chemical potential energy
e. chemical energy --> electrical energy --> radiant energy

16. If two 100 Ω resistors are placed in parallel, their total resistance changes by what factor compared to the same two 100 Ω resistors placed in series with each other:

a. the same
b. twice
c. half
d. one quarter
e. 1/200

17. How will the current in the first ammeter compare with the reading in the second?

a. $A_1$ has a current reading while $A_2$ has a reading of zero.
b. $A_1$ and $A_2$ are equal.
c. $A_1$ is less than $A_2$.
d. $A_1$ is greater than $A_2$.
e. More information is necessary.

18. What is the direction of the magnetic field inside and outside a bar magnet?

<table>
<thead>
<tr>
<th>Inside the Magnet</th>
<th>Outside the Magnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. north to south</td>
<td>north to south</td>
</tr>
<tr>
<td>b. north to south</td>
<td>south to north</td>
</tr>
<tr>
<td>c. south to north</td>
<td>north to south</td>
</tr>
<tr>
<td>d. south to north</td>
<td>south to north</td>
</tr>
<tr>
<td>e. field does not exist</td>
<td>north to south</td>
</tr>
</tbody>
</table>

19. If the compass in the diagram below is placed directly ABOVE the conductor when the switch is closed, in what direction will the compass point?
20. In a single coil DC motor, when is the direction in a coil reversed?

a. after each 1/2 revolution
b. after each 1/4 revolution
c. after each 3/4 revolution
d. after each revolution
e. Never. The direction of the current does not change in the coil.

21. When the cross-sectional area of a fluid-carrying pipe increases, the flow speed of the fluid will:

a. increase
b. decrease
c. stay the same
d. change unpredictably
e. It depends on viscosity.

22. Which of the following substances would likely have the least laminar flow?

a. water
b. cool honey
c. warm honey
d. vegetable oil
e. molasses

23. A 2-cylinder system is constructed so that the output cylinder’s area is 5 times bigger than the area of the input cylinder. How does the input force compare to the output force?

a. The input force is 1/5th the output force.
b. The input force is 5 times the output force.
c. The input force is 1/10th the output force.
d. The input force is 10 times the output force.

24. Bernoulli’s Principle states that:

a. Pressure is high when flow rate is high.
b. Pressure is low when flow rate is high.
c. Pressure is the same regardless of flow rate.
d. Pressure increases if force increases.
e. The same force on a larger area results in less force per area.

25. The force applied to an object that experiences 30 kPa of pressure over 0.02 m² is:

a. 600 N
b. 0.6 N
c. 1500 N
d. 0.0007 N