

**Physical Science DTAMS Assessment – Version 1**  
Diagnostic Teacher Assessments in Mathematics and Science—Middle School

Date \_\_\_\_\_ Start time \_\_\_\_\_ Finish time \_\_\_\_\_

**Please provide the following information about yourself:**

Years teaching experience (0 if preservice) _____	Last 4 digits of Social Security number (or any 4-digit number you'll remember) _____  (used as identifier on score report)
Check grade level(s) <b>currently</b> <b>teaching</b> (or will be teaching if preservice). Mark one or more that best describes your situation.  <i>(please describe below if "other")</i>	Check current (or future if preservice) <b>teaching certificate</b> <b>grade level(s)</b> . Mark one or more that best describes your situation.  <i>(please describe below if "other")</i>
Number of college & graduate <b>earth science courses</b> _____	Number of college & graduate <b>life science courses</b> _____
Number of college & graduate <b>physical science courses</b> _____	Sex (M/F) _____
<b>Content area of teaching certificate</b>	
Mark one or more that best describes your situation.  If your certificate is a <u>general education certificate</u> that covers all subjects (e.g. as many elementary certificates do) but doesn't specifically include a separate science certification, please <u>mark "not science"</u> .  If your certificate includes content areas in addition to science, please choose from the list on the right based on the science content portion only and <u>do not mark</u> the "not science" category.	not science _____ general science _____ biology/life science _____ chemistry _____ physics _____ physical science _____ earth science _____ astronomy _____ geology _____ other science _____ <i>(please describe "other science")</i>

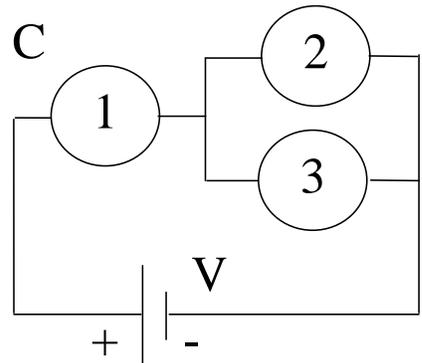
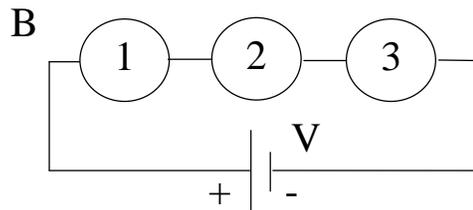
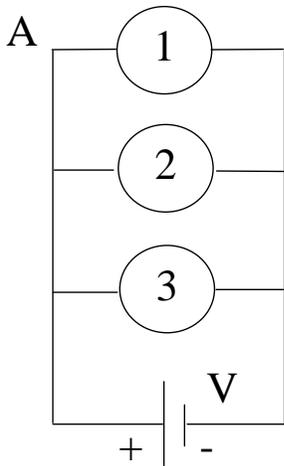
**Multiple Choice**

*Identify and write in the space the letter of the choice that best completes the statement or answers the question.*

- \_\_\_\_\_ 1. A teacher wraps a classroom thermometer in a fur-lined mitten. Which of the following would she expect to observe on the thermometer and why?
- Temperature increases quickly (less than a minute) and stops at a higher temperature because fur acts as an insulator.
  - Temperature increases gradually (longer than a minute) and stops at a higher temperature because fur acts as an insulator.
  - Temperature decreases gradually and stops at a lower temperature because fur removes heat by entrapping it.
  - Temperature stays the same because the ambient temperature isn't affected by the fur.
- \_\_\_\_\_ 2. Modern technology can now insulate a home to the point where relatively little heating or cooling is needed. Part of this is accomplished by using Styrofoam insulation which has a shiny metallic coating that looks like foil. Why is this shiny coating useful, even though the insulation is eventually covered over by an outer layer of material once the house is finished?
- The shiny metallic coating decreases the flow of heat through the wall by blocking ultraviolet and infrared radiation from penetrating the walls.
  - The shiny metallic coating decreases the flow of heat through the wall by blocking convection of heat through the walls.
  - The shiny metallic coating decreases the flow of heat through the wall by blocking conduction of heat through the walls.
  - The shiny metallic coating provides an airtight covering over the porous Styrofoam to reduce heat transfer.
- \_\_\_\_\_ 3. In a darkened room, a student shined a bright pure green light on a red object during an experiment. Her results showed that the object appeared
- black because no light is reflected.
  - brown because red and green mixed make brown.
  - red because red objects always reflect that color.
  - green because the object reflects the green light.
- \_\_\_\_\_ 4. You have two identical steel balls; the first will be dropped from rest straight down off a platform about 2 m high, and the second will be given a horizontal push at the time of the release so that it falls in an arc. You release both balls simultaneously. What will happen and why?
- The time that it takes the second ball to drop will depend on how hard it was pushed.
  - The ball that is dropped straight down will hit the ground first because it travels in a straight line.
  - The pushed ball will hit the ground before the dropped one because it is going faster.
  - The balls will both hit the ground at the same time because gravity is the same for both.

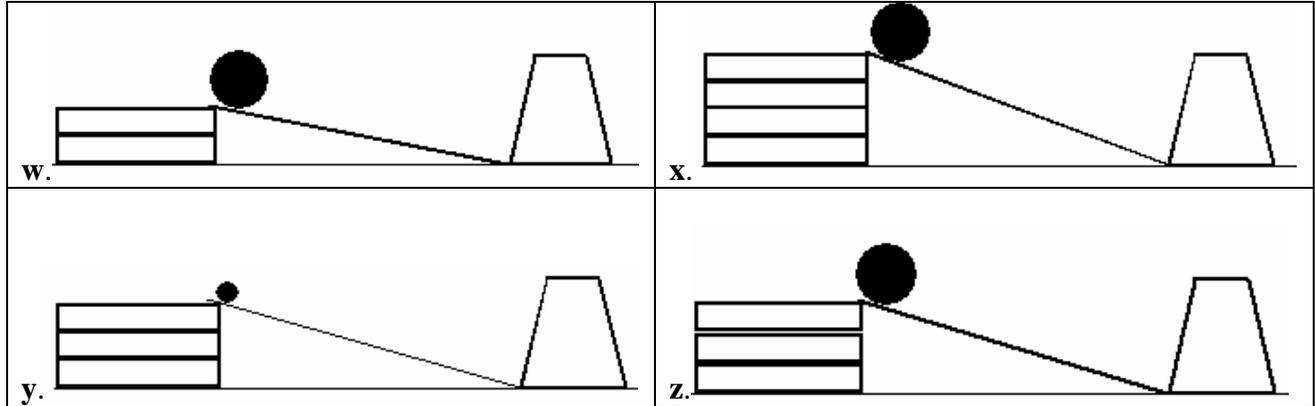
- \_\_\_\_\_ 5. If you crush Alka-Seltzer® (a commercial antacid) tablets for use in an experiment with water compared to using the whole tablets, the variable you are testing is
- the proportions of chemicals in the reaction.
  - the chemical composition of the reactant.
  - the concentration of the solution of Alka-Seltzer® and water.
  - the amount of exposed surface area of the reactant.
- \_\_\_\_\_ 6. The Sun's source of energy comes from
- nuclear fission.
  - nuclear fusion.
  - nuclear explosions.
  - chemical reactions.
- \_\_\_\_\_ 7. The average speed of an object is measured by its
- magnitude of momentum at a given time.
  - total distance and direction traveled.
  - amount of acceleration over a period of time.
  - distance traveled over a period of time.
- \_\_\_\_\_ 8. In a mixture made by dissolving salt in water, salt is identified by which scientific term?
- solute
  - substance
  - solution
  - solvent
- \_\_\_\_\_ 9. When elements were first being organized into what we now call the periodic table of the elements, what determined the arrangement of the elements?
- They were placed so that the vertical columns all belonged to one category (metals, nonmetals, transition metals, etc.) and the horizontal rows all shared the same number of electrons.
  - They were placed according to the order in which they were discovered, which is why new elements being discovered today are always placed at the end.
  - They were placed in vertical columns according to similar reactivity, and in horizontal rows based on increasing weight from left to right.
  - They were placed so that elements were adjacent to others that they tended to bond with most strongly.

10. A student says "It is easier to loosen a tight bolt with a long-handled wrench because the long handle allows more energy to transfer to the bolt than the energy you put in at the handle." Why is this a misconception?
- There is more energy transferred to the bolt; the misconception is that this is a function of the length of the handle of the wrench. Any length wrench will transfer more energy to the bolt, but the advantage of the long handle is that it gives you more leverage for this energy transfer.
  - The misconception is that the energy transfer is the key concept to loosening the tight bolt in this scenario. Instead, the advantage of the long-handled wrench is that it permits a much better grip on the bolt head so that no energy is lost in slippage.
  - The misconception is that energy is amplified when actually the energy output is essentially equal to the energy input. The advantage gained is that more torque is available with the longer handle, but at the expense of greater travel distance needed.
  - The misconception is that the energy transfer is the key concept when in fact it is the power that is the critical concept for this situation. The long-handled wrench amplifies the power applied to the bolt which is why it is useful in this scenario.
11. Students are assigned the task of designing electrical circuits with prescribed properties in a laboratory activity. In which of the following wiring diagrams with three identical bulbs and a power source would AT LEAST ONE bulb stay lit if bulb #2 burned out?



- Circuits A and B.
- Circuits A and C.
- Circuits B and C.
- Circuits A, B, and C.

12. The diagrams below show different experimental setups of a board propped up on a stack of books. All books are the same thickness. A plastic cup is placed at the bottom of the ramp. Balls of two different weights (shown as small and large balls) are used in the experiments shown.



- A student wants to use a controlled experiment to find out if the cup will move further when struck by a larger force. Which of the trials would be best for the student to test this idea?
- Trials w and y
  - Trials w, x, and z
  - Just trial x
  - The student should compare all 4 trials (w, x, y, and z)
13. As an ice cube changes phase from a solid to a liquid,
- vibrations between molecules are faster and faster.
  - its temperature rises.
  - vibrations between molecules are slower and slower.
  - it gains volume.
14. In a laboratory experiment, you would like to compare the electrical conductivity of aluminum, steel, and tin wires. You plan on using each wire connected in parallel to a voltage source (e.g. a 9-volt battery) with an identical ammeter in each branch to measure current. Which of the following represents the independent variable in this experiment?
- The parallel structure of the circuit.
  - The ammeter readings.
  - The composition of the wires.
  - The voltage of the battery.

- \_\_\_\_ 15. You would like to compare the thermal conductivity of copper, tin and aluminum. You plan on putting equal amounts of water in copper, tin and aluminum containers of equal volume, shape, and thickness. You will then simultaneously subject them to identical heat sources and measure the temperature of the water in each container after 5 minutes.  
In this experiment, the temperatures of the water in the three containers represent
- independent variables.
  - scientific variables.
  - dependent variables.
  - control variables.
- \_\_\_\_ 16. A dehumidifier is a technological device designed to remove excess humidity from the air, for example to reduce the possibility of mold growth. This device relies on changing water vapor in the air from the gaseous state to liquid water which can be poured down the drain. This change of state is possible because a dehumidifier
- draws air in over a cold coil, and the colder air can't hold as much moisture so the moisture condenses out of the air and drips into a catch basin.
  - chemically separates the air gases (primarily oxygen and nitrogen) from the chemically distinct water (H<sub>2</sub>O) and routes the water to a catch basin.
  - filters the humid air through a dry, absorbent material that captures the heavier water vapor particles and only allows the dry air to pass through.
  - heats the air it draws in, evaporating the water vapor from the air and causing condensation to drip into the catch basin.
- \_\_\_\_ 17. Sitting in a classroom studying the electromagnetic spectrum on a rainy day, a student notices that when a ray of sunlight breaks through the clouds and hits her glass watch, a small rainbow is formed on the wall. She proposes that this is because there is water in the air from the rain, which is the only time rainbows form. To investigate this “water in the air” hypothesis, the teacher could lead students to develop an investigation with the following characteristics:
- Experiment with making rainbows with a variety of watches (glass, plastic, metal, etc.) on a rainy day.
  - Experiment with making rainbows with a variety of watches in sealed containers containing varying amounts of atmospheric gases.
  - Experiment with making rainbows using the same glass watch repeatedly in different locations on a rainy day.
  - Experiment with making rainbows using the same glass watch repeatedly in different locations on both rainy and sunny days.
- \_\_\_\_ 18. Which is an example of kinetic energy?
- Pushing against a wall.
  - Rolling in a chair across the floor.
  - Holding a stretched spring.
  - Holding a baseball over your head.

- \_\_\_\_\_ 19. Friction is a force that
- increases linearly as the speed of an object increases.
  - cannot be changed.
  - opposes the motion of an object.
  - acts in the direction of the motion of an object.
- \_\_\_\_\_ 20. A technological device designed to separate solid blood components (platelets) from liquid blood components is a centrifuge; this device functions by whirling tubes of blood horizontally around in a tight circle very quickly. A centrifuge is able to separate the components of blood because
- the energy added to the system by the whirling motion is unequally distributed across the components, causing the high energy platelets to absorb more energy and separate themselves.
  - the whirling motion causes the liquid bonds to break apart but isn't strong enough to break the solid bonds of the platelets, thus leaving the platelets intact without the liquid.
  - liquid mixes readily when whirled about because of the fluidity of the liquid state, leaving the solid platelets unmixed and thus easily skimmed off the top.
  - the heavier components, such as platelets, have more inertia than the liquid components and thus migrate to the outer end of the whirling tubes.

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### Open Response Directions

Write responses to parts (a) and (b) in the space provided. If more space is needed, please use the back of the paper and indicate that your response continues on the back.

#### Directions for part (a):

*In each question, students expressed a misconception. Please describe the currently accepted scientific explanation of the phenomenon that the students are not understanding. Explain the science in as much depth as possible, even if that level of depth would be inappropriate to expect middle school students to know. Your explanation should demonstrate a thorough knowledge of the underlying science – simply stating the opposite of the students' misconception without further explanation is not sufficient.*

#### Directions for part (b):

*Explain how you would address this misconception using best instructional practices. Please describe the classroom instruction, including what the students and teacher are doing, in enough detail so that the reader can envision what is happening. For example, if you refer to a specific lesson, textbook, activity, piece of equipment, or media, assume the reader is not familiar with it and explain how it is used to support student learning. Assume you have access to any equipment that would be available in a reasonably well-funded K-12 school setting so that your proposed instruction is feasible to implement.*









