

**Physical Science DTAMS Assessment – Version 5**  
 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.  (please describe below if "other")	Check current (or future if preservice) <b>teaching certificate</b> <b>grade level(s)</b> . Mark one or more that best describes your situation.  (please describe below if "other")
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>	
<p>Mark one or more that best describes your situation.</p> <p>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>.</p> <p>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.</p>	<p>not science _____</p> <p>general science _____</p> <p>biology/life science _____</p> <p>chemistry _____</p> <p>physics _____</p> <p>physical science _____</p> <p>earth science _____</p> <p>astronomy _____</p> <p>geology _____</p> <p>other science _____</p> <p>(please describe "other science")</p>

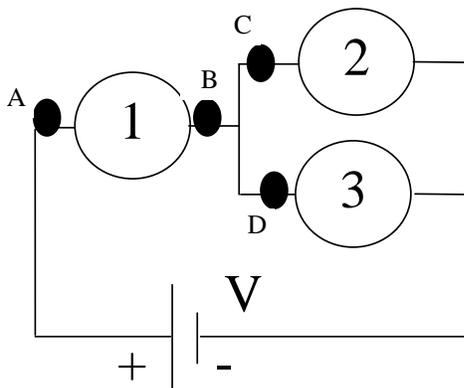
**Multiple Choice**

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

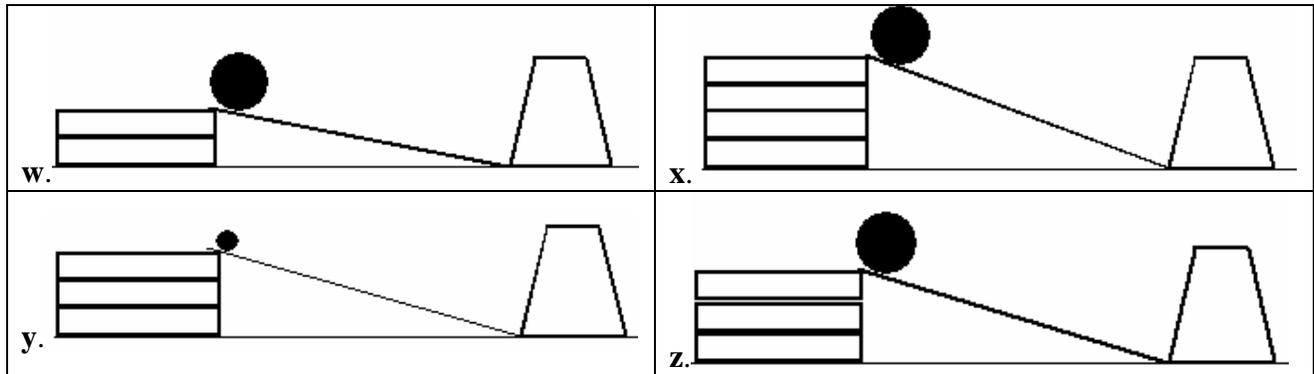
- \_\_\_\_\_ 1. A teacher has two identical beakers of ice water each at 0 degrees Celsius. She wraps one beaker of ice water in fur and the other beaker of ice water in aluminum foil and leaves them setting on a lab bench. Which of the following would she expect to observe a half-hour later?
- The fur-wrapped beaker would show a higher temperature than the room and the aluminum foil-wrapped one would show a lower temperature than the room because fur acts as an insulator whereas the aluminum foil conducts heat away from the second beaker.
  - The fur-wrapped beaker would show a lower temperature than the aluminum foil-wrapped one because the fur acts as a much better insulator than aluminum foil.
  - The fur-wrapped beaker would show a higher temperature than the aluminum foil-wrapped one because fur acts as a much better insulator than aluminum foil.
  - They both would be the same temperature as each other since the ambient temperature of the room isn't affected by the type of wrap.
- \_\_\_\_\_ 2. During cold winter months, Styrofoam® insulation used in the walls and roof of an outdoor doghouse
- is not really helpful to keep the dog warm because the doghouse has no furnace to generate warm air that the insulation could retain.
  - helps to keep the dog warm because Styrofoam® does not conduct heat easily and thus helps maintain a temperature gradient across the walls.
  - helps to keep the dog warm because Styrofoam® generates warmth that radiates from the walls and roof to heat the air inside the doghouse.
  - is not really helpful to keep the dog warm because the small size of a doghouse means that not enough insulation can be used to be effective.
- \_\_\_\_\_ 3. In red light, a white T-shirt appears
- white because red is in the visible spectrum and thus reflects the true color.
  - red because that is the only light available for it to reflect.
  - black because no light is reflected.
  - orange because the white dilutes the red color toward the middle of the visible spectrum.
- \_\_\_\_\_ 4. Standing at the top of a tall vertical cliff with flat ground below, the first rock is thrown horizontally as hard as possible while a second identical rock is simultaneously dropped. Which rock will have the greater vertical velocity component when they hit the ground?
- The second, dropped rock because gravity isn't diluted by horizontal motion and is able to accelerate it more.
  - The first, thrown rock because its starting velocity is greater by the efforts of the person throwing it.
  - They will be approximately the same since the vertical velocity is independent of the rocks' horizontal motion.
  - It depends on how high the cliff is since gravity for the dropped rock will need enough time to catch up and surpass the initial velocity of the tossed rock.

- \_\_\_\_\_ 5. Antacids are bases that react with stomach acids to neutralize them. If the goal is to find out which of three antacids is the best at neutralizing acid, the best experimental setup to compare them is to
- give equal quantities of the three antacids to three different people on the same day and compare the effects.
  - put equal quantities of the antacids into identical acetic acid (vinegar) solutions and measure the temperatures of the three reactions.
  - put equal quantities of the antacids into identical volumes of acetic acid (vinegar) and measure the pH of the results.
  - give equal quantities of the three different antacids to the same person on three different days to compare the effects.
- \_\_\_\_\_ 6. When supernovae explode, they spew out huge amounts of heavy elements such as iron, carbon, and many others; this is the primary source of all the matter that makes up the earth, including people. These heavy elements, produced primarily from hydrogen by the massive star prior to going supernova, were created through the process of
- nuclear fission.
  - nuclear fusion.
  - radioactive decay.
  - chemical bonding.
- \_\_\_\_\_ 7. Knowledge of a car's instantaneous speed allows you to know (or compute)
- the time duration of the trip up to that moment.
  - how fast it is going at that moment.
  - the time you will arrive at a predetermined destination.
  - how far it has traveled up to that point.
- \_\_\_\_\_ 8. When creating a solution by dissolving a solid in a liquid, the liquid is identified by which of the following scientific terms?
- solute
  - solvent
  - substance
  - solution
- \_\_\_\_\_ 9. In a vertical column of the periodic table of the elements (ignoring the transition metals), all of the elements in that column are organized in order of increasing
- number of electron shells from top to bottom.
  - number of valence electrons from top to bottom.
  - chemical reactivity from top to bottom.
  - chemical bonding from top to bottom.

10. When casting a fishing lure tied to the end of a string on a fishing pole, there is a need for high casting speed in order to have the lure fly far out over the water. A student says, "It is easier to cast a lure at high speed with a long fishing rod rather than a short one because the long rod allows more energy to transfer to the lure on the end of the string than the energy you put in at the handle." Why is this a misconception?
- 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 speed is available with the longer rod, but at the expense of greater force input 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 fishing rod amplifies the power applied to the lure which is why it is useful in this scenario.
  - There is more energy transferred to the lure; the misconception is that this is a function of the length of the fishing rod. Any fishing rod will transfer more energy to the lure, but the advantage of the long rod is that it gives you more leverage for this energy transfer.
  - The misconception is that the energy transfer is the key concept to casting at high speed in this scenario. Instead, the advantage of the long rod is that it permits a better angle of lure release so that no energy is lost in poor trajectories.
11. Students are assigned the task of designing electrical circuits with prescribed properties in a laboratory activity. In the following wiring diagram with three identical bulbs and a power source, where would you install switches so that you could independently turn bulbs 1 and 3 on or off without affecting any other bulb?
- None of these choices.
  - Locations B and D.
  - Locations A and C.
  - Locations A and D.



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 pair of experimental setups is used to test the weight of the ball as the variable?

- y and z
  - w and y
  - x and z
  - x and y
13. During the process of water vapor in the air condensing on a cold glass of ice water, the droplets being formed experience
- vibrations between molecules that are faster and faster.
  - vibrations between molecules that are slower and slower.
  - a drop in temperature.
  - their molecules changing shape.
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. Why is the parallel structure of the circuit a good choice to make for this experiment?
- The parallel structure ensures that
- there will be enough connection points for each test wire to have its own ammeter.
  - all the test wire lengths will have to be the same.
  - the voltage applied to each of the test wires will be identical.
  - one test wire put first in the circuit will not get more of the initial current than the other test wires.

- \_\_\_\_\_ 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.  
Which quantity represents a dependent variable for this experiment?
- type of metal used to make each container
  - thermal conductivity
  - amount of water in each container
  - temperature of the water after 5 minutes
- \_\_\_\_\_ 16. In some developing countries with hot, desert-like climates, people are able to keep foodstuffs cool without electricity. One technique is to put the food into a tub of water and cover the tub with a loosely-woven cloth, such as cheesecloth, which is draped so that part of it dips into the water. How does this device help keep the food cool?
- Dry desert air evaporates the water which wicks into the loosely-woven cloth, removing heat from the air inside the tub and keeping the inside substantially cooler than the outside temperature.
  - Draping the cloth over the tub provides continuous shade for the food and water inside so that the water doesn't evaporate and continuously keeps the food wet.
  - Keeping the food wet with the water helps keep it cooler because water is an effective coolant in desert climates.
  - The relatively low amount of humidity in the hot desert air means that the hot outside air can't penetrate through the loosely-woven cloth, keeping the hot air outside so that the inside of the tub stays relatively cool.
- \_\_\_\_\_ 17. During a lab activity, students were investigating the refraction of laser light through rectangular glass prisms. One student hypothesized that this refraction was possible because laser light has enough intensity to push its way through several centimeters of glass and come out the other side. To investigate this hypothesis, the teacher could lead students to develop an investigation with the following characteristics:
- Experiment with laser light passing through prisms made of different translucent materials other than glass to see if refraction still occurs.
  - Experiment with laser light of different colors passing through the rectangular prism to see if refraction still occurs.
  - Experiment with laser light passing through prisms of different shapes to see if refraction still occurs.
  - Experiment with the rectangular prism in sunlight focused through a magnifying glass and in laser light attenuated through use of half-silvered mirrors.
- \_\_\_\_\_ 18. A distinction between kinetic energy (KE) and gravitational potential energy (GPE) is
- KE is greater for the faster of two objects and GPE is greater for the bigger of two objects.
  - KE is created by GPE, but not vice versa.
  - KE is a negative quantity whenever an object is moving to the left, but GPE is negative whenever an object is below ground level.
  - KE is related to an object's motion whereas GPE is related to its position.

- \_\_\_\_\_ 19. One of the primary factors contributing to the frictional force on an object on a floor is the object's
- surface characteristics in contact with the floor.
  - shape.
  - speed of motion.
  - surface area touching the floor.
- \_\_\_\_\_ 20. While playing on a merry-go-round on the playground (a ride that rotates horizontally about a fixed center and is pushed by children to move), a child lays down his ball near the center while other children are pushing the merry-go-round at a high rate of speed. The ball doesn't stay near the center but instead migrates outward to the edge of the ride until it flies off. Why would the ball move away from the center when no one was pushing it?
- In addition to the existing gravitational force, a centrifugal force is created by the circular motion which pushes all objects away from the center of rotation and toward the outer edge of the ride.
  - The ball's inertia resists a change in direction, but the circular motion of the ride means that the motion of the ball tangential to the circular motion results in the ball moving farther from the center.
  - Because of the circular motion, a new force cancels out the gravitational force, and this new force pushes everything away from the center of rotation.
  - The circular motion of the ride changes the direction of gravitational acceleration so that gravity pushes toward the outer edge of the ride when it is rotating at a high speed.

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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.*









