

Physical Science DTAMS Assessment – Version 3
 Diagnostic Teacher Assessments in Mathematics and Science—Middle School

Date _____ Start time _____ Finish time _____

Please provide the following information about yourself:

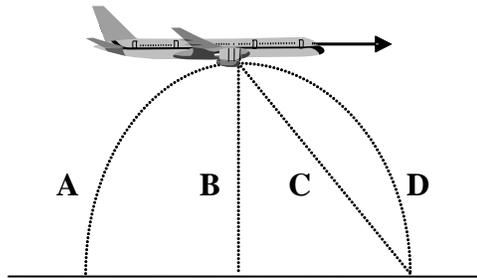
Years teaching experience (0 if preservice) _____	Last 4 digits of Social Security number (or any 4-digit number you'll remember) _____ (used as identifier on score report)
Check grade level(s) currently teaching (or will be teaching if preservice). Mark one or more that best describes your situation. (please describe below if "other")	Check current (or future if preservice) teaching certificate grade level(s) . Mark one or more that best describes your situation. (please describe below if "other")
Number of college & graduate earth science courses _____	Number of college & graduate life science courses _____
Number of college & graduate physical science courses _____	Sex (M/F) _____
Content area of teaching certificate	
<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 takes two thermometers out of her desk drawer and wraps one thermometer in fur and leaves the second thermometer without any wrap. She places both of them back in the desk drawer. Which of the following would she expect to observe several hours later?
- The fur-wrapped thermometer would show a lower temperature than the plain one which stayed at room temperature because the fur removes heat by entrapping it.
 - The fur-wrapped thermometer would show a higher temperature than the room and the plain one would show a lower temperature than the room because fur acts as an insulator whereas the plain one is cooled by air currents.
 - The fur-wrapped thermometer would show a higher temperature than the plain one which stayed at room temperature because fur acts as an insulator.
 - They both would be the same temperature as when the experiment started because the ambient temperature isn't affected by the fur.
- _____ 2. When building or remodeling houses, people are generally advised to put more insulation in the ceilings than in the walls, primarily to increase efficiency for heating the houses in the winter. What is the primary reason that it is usually more economical to spend extra money on ceiling insulation instead of wall insulation?
- It is easier and thus less expensive to install insulation in ceilings because it can be laid down either flat or at a slight angle, whereas insulation in walls costs more to install because it is vertical and gravitational effects complicate the installation.
 - Ceiling and roof lumber tends to be thicker than in walls because of the structural need to span long distances, whereas walls are vertical and thus carry their own weight easily in a gravitational field. This means that there is more room for insulations in ceilings without the large increase in cost that would be needed if the walls were unnecessarily thick to accommodate more insulation.
 - Ceilings tend to encompass much more surface area than walls, and since heat loss in winter is a function of surface area of the heated space, extra insulation in the ceilings has the greatest impact on reducing heat loss.
 - Since hot air rises, much of the loss of heated air in the winter would be from the ceilings and roof unless there is extra ceiling insulation to prevent that heated air from escaping easily. Thus extra ceiling insulation is more effective than wall insulation for retaining heat.
- _____ 3. In sunlight, a shirt that appears blue is
- absorbing only the blue portion of the visible spectrum.
 - amplifying only the blue portion of the visible spectrum.
 - reflecting only the blue portion of the visible spectrum.
 - shifting the other visible colors into the frequency that we perceive as blue.

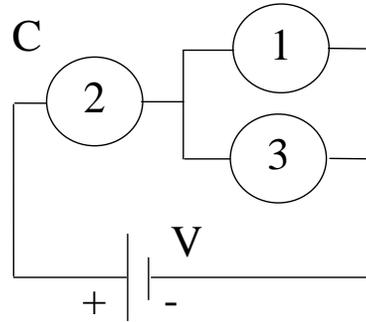
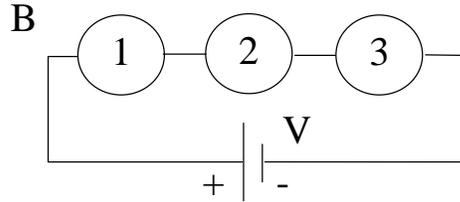
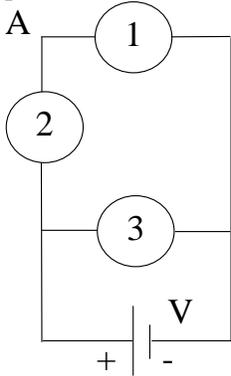
4. A bowling ball accidentally falls out of the cargo bay of an airliner as it flies along in a horizontal direction (to the right in diagram). As observed by a person standing on the ground and viewing the plane from the side, which of the paths would the bowling ball most closely follow after leaving the airplane and why? (*Ignore effects of air resistance for this question.*)



- a. A, because the bowling ball will fall behind the plane since the plane continues on at full speed.
- b. B, because the bowling ball will fall straight down in the gravitational field.
- c. C, because the bowling ball will continue to move forward as if falls down in a straight line.
- d. D, because of the combination of forward motion that is relatively constant and vertical motion that is under the acceleration of gravity.
5. You use crushed Alka-Seltzer® (a commercial antacid) tablets in water compared to using the whole tablets in an experiment of the effect of reactant particle size on the rate of a chemical reaction. One of the control variables is
- a. the amount of exposed surface area of the reactant.
- b. the time of day the experiment is performed.
- c. the size of the crushed particles.
- d. the temperature of the water.
6. The process by which two hydrogen atomic nuclei combine to form a helium nucleus is called
- a. radioactive decay.
- b. nuclear fusion.
- c. chemical bonding.
- d. nuclear fission.
7. Knowledge of the total distance traveled and the time interval to do so permits you to compute an object's
- a. average momentum.
- b. average acceleration.
- c. kinetic energy.
- d. average speed.

- _____ 8. When salt is dissolved in water, the resulting mixture is called a
- solution.
 - solute.
 - solvent.
 - substance.
- _____ 9. The periodic table of the elements is arranged so that elements (ignoring the transition metals) in a horizontal row
- have the same number of protons as each other.
 - tend to combine easily with each other.
 - have the same number of electron shells as each other.
 - exhibit similar reactivity as each other.
- _____ 10. A student says “It is easier to pull out a stuck nail with a long handled hammer because the long handle allows more energy to transfer to the nail than the energy you put in at the handle. Why is this a misconception?
- There is more energy transferred to the nail; the misconception is that this is a function of the length of the handle of the hammer. Any length handle will transfer more energy to the nail, but the advantage of the long handle is that it gives you more leverage for this energy transfer.
 - 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 force 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 handle amplifies the power applied to the nail which is why it is useful in this scenario.
 - The misconception is that the energy transfer is the key concept to pulling the stuck nail in this scenario. Instead, the advantage of the long handle is that it permits a much better grip on the handle for both hands so that no energy is lost in slippage.

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?



- Circuit A.
 - Circuit B.
 - Circuit C.
 - Circuits A and C.
12. The diagrams below each show a board propped up on a stack of 3 equal-sized blocks; demonstration 1 uses a small marble and demonstration 2 uses a ball that is four times heavier. Your students are designing an experiment to test which type of cup, a plastic cup or a styrofoam cup, reacts more strongly to an impulse force applied to it. Which experimental procedure would allow the students to answer this question?



Demonstration 1



Demonstration 2

- Test the plastic cup in demonstration 1 and the styrofoam cup in demonstration 2 because the greater roughness of styrofoam will need a larger impulse.
- Test the plastic cup in demonstration 1 and test the styrofoam cup by adding a block to the ramp in demonstration 1 and using the same marble to control for different sized balls.
- Put the plastic cup in front of the styrofoam cup at the bottom of ramp 2, and then exchange their places for the next trial, so that the large ball causes both of them to move simultaneously.
- Test the plastic cup with demonstration 1, and then exchange it with the styrofoam cup for the next trial, to control for the other possible variables that may affect experimental results.

- ___ 13. As steam changes phase from a gas to a liquid,
- vibrations between molecules are slower and slower.
 - its temperature falls.
 - its molecules change shape.
 - vibrations between molecules are faster and faster.
- ___ 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 dependent variable in this experiment?
- The ammeter readings.
 - The voltage of the battery.
 - The parallel structure of the circuit.
 - The composition of the 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.
- In this experiment, the amount of water put into each container represents a(n)
- outcome variable.
 - control variable.
 - dependent variable.
 - independent variable.
- ___ 16. Window air conditioning (AC) units in houses and apartments are often seen to be dripping water outside when they are running. The reason for this water is
- the AC cools the air by passing it through water, and the dripping is the excess water left from this process.
 - the AC evaporates water vapor from the outside air in order to cool it, and some of this excess water vapor drips onto the ground.
 - the AC cools the air significantly, and the colder air can't hold as much moisture so the moisture condenses out of the colder air and drips onto the ground.
 - the AC filters the outside air before it is blown into the house, and this filter captures humidity in the air which builds up on the filter until it drips off.

- _____ 17. During a lab activity, a student notices that a triangular glass prism put into sunlight creates a small rainbow on the wall, but when put into a beam of laser light it does not produce a rainbow. He proposes that this is because the laser light is too intense and you need more gentle light like sunlight for this to work. To investigate this hypothesis, the teacher could lead students to develop an investigation with the following characteristics:
- Experiment with triangular prisms made out of different translucent materials to be put into the sunlight and laser light to determine if they can produce rainbows.
 - Experiment with the triangular prism in sunlight focused through a magnifying glass and in laser light attenuated through use of half-silvered mirrors.
 - Experiment with differently shaped prisms in sunlight and laser light to determine which shapes can produce a rainbow.
 - Experiment with putting the triangular shaped prism into differently-colored laser lights to see if it can produce a rainbow.
- _____ 18. Mechanical potential energy can be defined as
- motion energy.
 - stored energy.
 - vibration energy.
 - action energy.
- _____ 19. The frictional force on an object resting on a floor
- can cause the object to move if it is big enough.
 - opposes any nonzero horizontal net force.
 - doesn't exist until the object is moving.
 - acts in the same direction as gravity.
- _____ 20. If you whirl an open bucket of water around in a vertical circle at a high enough speed, the water will not come out of the open bucket even when the bucket is upside down at the top of its circle. What is preventing this water from falling out of the upside down bucket?
- A new force is created because of the circular motion that cancels out the gravitational force so that the water doesn't fall.
 - The water has inertia which resists a change in direction, but the circular motion of the bucket means that the bottom of the bucket must constantly push against the water to keep changing the water's direction.
 - The circular motion of the ride changes the direction of gravitational acceleration so that gravity pushes the water up at the top of its circle when it is whirling at a high speed.
 - A centrifugal force is created by the circular motion which pushes all objects away from the center of rotation, and at the top of the circle this centrifugal force is pushing the water up.

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.

