

**TMSCA MIDDLE SCHOOL  
SCIENCE  
TEST #4 ©  
NOVEMBER 12, 2022**

**GENERAL DIRECTIONS**

1. About this test:
  - A. You will be given 40 minutes to take this test.
  - B. There are 50 problems on this test.
2. All answers must be written on the answer sheet/Scantron form/Chatsworth card provided. If you are using an answer sheet be sure to use **BLOCK CAPITAL LETTERS**. Clean erasures are necessary for accurate grading.
3. If using a Scantron answer form, be sure to correctly denote the number of problems not attempted.
4. You may write anywhere on the test itself. You must write only answers on the answer sheet.
5. You may use additional scratch paper provided by the contest director.
6. All problems have **ONE** and **ONLY ONE** correct [BEST] answer. There is a penalty for all incorrect answers.
7. On the back of this page is a copy of the periodic table of the elements as well as a list of some potentially useful information in answering the questions.
8. A simple scientific calculator with the following keys is sufficient for the science contest: +, -, %, ^, log x, e<sup>x</sup>, ln x, y<sup>x</sup>, sin x, sin<sup>-x</sup>, cos x, cos<sup>-x</sup>, tan x, tan<sup>-x</sup>, with scientific notation and degree/radian capability. The calculator must be silent, hand-held and battery operated. The calculator cannot be a computer or cannot have built-in or stored functionality that provides scientific information and cannot have communication capability. If the calculator has memory, it must be cleared. Each student may bring one spare calculator. **NO GRAPHING CALCULATORS ARE PERMITTED.**
9. All answers within  $\pm 5\%$  will be considered correct.
10. All problems answered correctly are worth **FIVE** points. **TWO** points will be deducted for all problems answered incorrectly. No points will be added or subtracted for problems not answered.
11. In case of ties, percent accuracy will be used as a tie breaker.

# Periodic Table of the Elements

|                    |                    |                   |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |         |         |         |           |                 |                 |                   |                   |                  |                   |                   |                   |
|--------------------|--------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------|---------|---------|-----------|-----------------|-----------------|-------------------|-------------------|------------------|-------------------|-------------------|-------------------|
| 1A<br>1            |                    |                   |                    |                    |                    |                    |                    |                    |                    |                    | 2A<br>2            |                    |                    |                    |                    |                    |                    |         |         |         |           | 3A<br>13        | 4A<br>14        | 5A<br>15          | 6A<br>16          | 7A<br>17         | 8A<br>18          |                   |                   |
| 1<br>H<br>1.01     |                    |                   |                    |                    |                    |                    |                    |                    |                    |                    | 2<br>He<br>4.00    |                    |                    |                    |                    |                    |                    |         |         |         |           | 5<br>B<br>10.81 | 6<br>C<br>12.01 | 7<br>N<br>14.01   | 8<br>O<br>16.00   | 9<br>F<br>19.00  | 10<br>Ne<br>20.18 |                   |                   |
| 3<br>Li<br>6.94    | 4<br>Be<br>9.01    |                   |                    |                    |                    |                    |                    |                    |                    |                    |                    | 11<br>Na<br>22.99  | 12<br>Mg<br>24.31  | 3B<br>3            | 4B<br>4            | 5B<br>5            | 6B<br>6            | 7B<br>7 | 8B<br>8 | 9B<br>9 | 10B<br>10 | 1B<br>11        | 2B<br>12        | 13<br>Al<br>26.98 | 14<br>Si<br>28.09 | 15<br>P<br>30.97 | 16<br>S<br>32.07  | 17<br>Cl<br>35.45 | 18<br>Ar<br>39.95 |
| 19<br>K<br>39.10   | 20<br>Ca<br>40.08  | 21<br>Sc<br>44.96 | 22<br>Ti<br>47.87  | 23<br>V<br>50.94   | 24<br>Cr<br>52.00  | 25<br>Mn<br>54.94  | 26<br>Fe<br>55.85  | 27<br>Co<br>58.93  | 28<br>Ni<br>58.69  | 29<br>Cu<br>63.55  | 30<br>Zn<br>65.38  | 31<br>Ga<br>69.72  | 32<br>Ge<br>72.64  | 33<br>As<br>74.92  | 34<br>Se<br>78.96  | 35<br>Br<br>79.90  | 36<br>Kr<br>83.80  |         |         |         |           |                 |                 |                   |                   |                  |                   |                   |                   |
| 37<br>Rb<br>85.47  | 38<br>Sr<br>87.62  | 39<br>Y<br>88.91  | 40<br>Zr<br>91.22  | 41<br>Nb<br>92.91  | 42<br>Mo<br>95.94  | 43<br>Tc<br>(98)   | 44<br>Ru<br>101.07 | 45<br>Rh<br>102.91 | 46<br>Pd<br>106.42 | 47<br>Ag<br>107.87 | 48<br>Cd<br>112.41 | 49<br>In<br>114.82 | 50<br>Sn<br>118.71 | 51<br>Sb<br>121.76 | 52<br>Te<br>127.60 | 53<br>I<br>126.90  | 54<br>Xe<br>131.29 |         |         |         |           |                 |                 |                   |                   |                  |                   |                   |                   |
| 55<br>Cs<br>132.91 | 56<br>Ba<br>137.33 | 57<br>La<br>138.9 | 72<br>Hf<br>178.49 | 73<br>Ta<br>180.95 | 74<br>W<br>183.84  | 75<br>Re<br>186.21 | 76<br>Os<br>190.23 | 77<br>Ir<br>192.22 | 78<br>Pt<br>195.08 | 79<br>Au<br>196.97 | 80<br>Hg<br>200.59 | 81<br>Tl<br>204.38 | 82<br>Pb<br>207.20 | 83<br>Bi<br>208.98 | 84<br>Po<br>(209)  | 85<br>At<br>(210)  | 86<br>Rn<br>(222)  |         |         |         |           |                 |                 |                   |                   |                  |                   |                   |                   |
| 87<br>Fr<br>(223)  | 88<br>Ra<br>(226)  | 89<br>Ac<br>(227) | 104<br>Rf<br>(261) | 105<br>Db<br>(262) | 106<br>Sg<br>(266) | 107<br>Bh<br>(264) | 108<br>Hs<br>(277) | 109<br>Mt<br>(268) | 110<br>Ds<br>(281) | 111<br>Rg<br>(281) | 112<br>Cn<br>(285) | 113<br>Nh<br>(286) | 114<br>Fl<br>(289) | 115<br>Mc<br>(289) | 116<br>Lv<br>(293) | 117<br>Ts<br>(293) | 118<br>Og<br>(294) |         |         |         |           |                 |                 |                   |                   |                  |                   |                   |                   |

|                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|
| 58<br>Ce<br>140.1 | 59<br>Pr<br>140.9 | 60<br>Nd<br>144.2 | 61<br>Pm<br>(145) | 62<br>Sm<br>150.4 | 63<br>Eu<br>152.0 | 64<br>Gd<br>157.3 | 65<br>Tb<br>158.9 | 66<br>Dy<br>162.5 | 67<br>Ho<br>164.9 | 68<br>Er<br>167.3  | 69<br>Tm<br>168.9  | 70<br>Yb<br>173.0  | 71<br>Lu<br>175.0  |
| 90<br>Th<br>232.0 | 91<br>Pa<br>231.0 | 92<br>U<br>238.0  | 93<br>Np<br>(237) | 94<br>Pu<br>(244) | 95<br>Am<br>(243) | 96<br>Cm<br>(247) | 97<br>Bk<br>(247) | 98<br>Cf<br>(251) | 99<br>Es<br>(252) | 100<br>Fm<br>(257) | 101<br>Md<br>(258) | 102<br>No<br>(259) | 103<br>Lr<br>(262) |

## OTHER USEFUL INFORMATION

Acceleration of gravity at Earth's surface,  $g = 9.81 \text{ m/s}^2$

Avogadro's Number,  $N = 6.02 \times 10^{23}$  molecules/mole

Planck's constant,  $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$

Planck's reduced constant,  $\hbar = h/2\pi = 1.05 \times 10^{-34} \text{ J}\cdot\text{s}$

Standard temperature and pressure (STP) is  $0^\circ\text{C}$  and 1 atmosphere

Gram molecular volume at STP = 22.4 liters

Velocity of light,  $c = 3.0 \times 10^8 \text{ m/sec}$

Absolute zero =  $0 \text{ K} = -273.15^\circ\text{C}$

Gas constant,  $R = 1.986 \text{ cal/K}\cdot\text{mole} = 0.082 \text{ liter}\cdot\text{atm/K}\cdot\text{mole}$

One Faraday = 96,500 coulombs ( $9.65 \times 10^4 \text{ C}$ )

Dulong and Petit's constant =  $6.0 \text{ amu}\cdot\text{cal/gram}\cdot\text{K}$

Electron rest mass,  $m_e = 9.11 \times 10^{-31} \text{ kg}$

Atomic mass unit,  $m_u = 1.66 \times 10^{-27} \text{ kg}$

Boltzmann constant,  $k_B = 1.38 \times 10^{-23} \text{ J/K}$

Permittivity of free space  $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$

Permeability of free space  $\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}$

1 Atmosphere =  $1.02 \times 10^5 \text{ N/m}^2 = 760 \text{ Torr} = 760 \text{ mmHg}$

1 Electron Volt =  $1.6 \times 10^{-19} \text{ Joules}$

Charge of an electron =  $-1.6 \times 10^{-19} \text{ coulombs (C)}$

1 horsepower (hp) =  $746 \text{ W} = 550 \text{ ft}\cdot\text{lb/s}$

Neutron Mass = 1.008665 au

Proton Mass = 1.007277 au

1 au = 931.5 MeV

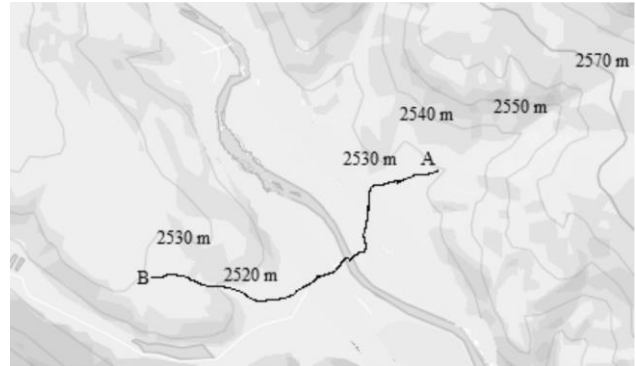
1 calorie = 4.184 Joules (J)

Specific heat of water =  $4.18 \text{ J/g}\cdot^\circ\text{C}$

**2022-2023 TMSCA Middle School Science Test #4**

- Which of the following is not evidence toward the theory of plate tectonics?
  - complementary coastlines
  - matching preserved remains of plants and animals
  - the layering of the mantle
  - distinctive landforms and rocky debris left behind by glacial movement

2. Justin hiked from point A to point B on this map. How many meters did he gain in elevation from beginning to end?



- 10 m
- 20 m
- 30 m
- 0 m

3. What year did Thomas Alva Edison invent the first practical light bulb?

- 1779
- 1776
- 1879
- 1903

4. Elaine took a metal spoon and put a drop of wax at 2 cm intervals along the handle of the spoon and let the drop harden. Next, she arranged the spoon so that it was suspended over but not touching a small candle's flame. She watched the 5 wax drops fall one by one, and recorded when the wax dripped to the table.

Here is her data chart:

|        |            |
|--------|------------|
| Drop 1 | 3 seconds  |
| Drop 2 | 6 seconds  |
| Drop 3 | 9 seconds  |
| Drop 4 | 12 seconds |
| Drop 5 | 15 seconds |



Which statement below explains what happened as the wax dropped?

- the wax was just not sticky enough to stay on the spoon
- the heat transferred from the candle to the metal spoon by convection and then travelled down the spoon by conduction to cause the drops to melt as the heat progressed down the spoon.
- the heat from the candle's flame moved to the spoon by radiation transfer and then through the spoon by convection
- convection guided the wax drops to eventually warm and drop.

5. What was the rate of wax falling?

- 1 drop per 10 seconds
- 1 drop per 1/3 seconds
- 1 drop per second
- 1 drop per 3 seconds

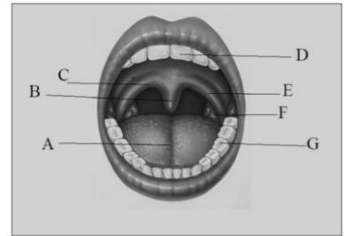
6. Purpose(s) of using a geodesic dome in buildings would be which of the following?
- A. to save energy in heating/cooling
  - B. to increase strength of building structure
  - C. to use largest volume of space with the least materials needed
  - D. all of these
7. What year did Wilbur and Orville Wright launch their airplane?
- A. 1803
  - B. 1903
  - C. 1943
  - D. 1983
8. What type of blood cells are specialized to fight disease?
- A. white blood cells
  - B. plasma
  - C. platelets
  - D. red blood cells
9. Small rocky bodies that orbit the sun are called what?
- A. nebulae
  - B. asteroids
  - C. meteorites
  - D. craterite
10. The theoretical Hertzsprung-Russell diagram shows the relationship between what?
- A. a planet's luminosity and temperature
  - B. a star's color and distance from Earth
  - C. a moon's temperature and color spectrum
  - D. a star's temperature and luminosity
11. Animals that hunt other animals to eat them are called what?
- A. prey
  - B. predators
  - C. parasites
  - D. primary consumers
12. Which of the following is the outer layer of the skin that includes the sense organs?
- A. outerderm
  - B. ectoderm
  - C. endoderm
  - D. mesoderm
13. Which statement below is correct when discussing mutations?
- A. Mutation rates in nature happen at a fast rate.
  - B. Mutation is a source of variation in organisms.
  - C. Mutation makes evolution impossible.
  - D. Mutations never result in phenotypic changes.
14. Most of the water exits a plant through the stomata as it changes from a liquid form to a gas form. This is an example of what?
- A. vaporation
  - B. sublimation
  - C. transpiration
  - D. condensation
15. A radio was turned on and working. What energy transformations make this happen?
- A. chemical energy (battery) to electrical energy to sound energy
  - B. mechanical energy to sound energy to electrical energy
  - C. electrical energy to light energy to sound energy
  - D. chemical energy (battery) to sound energy to light energy



17. An area where fresh water from a river flows to the salty water of an ocean is called a what?  
 A. estuary                      B. bay                      C. lagoon                      D. all of these

18. What part of this diagram is used in speech, swallowing, tasting, and assisting with mastication?

A. Part A                      B. Part B                      C. Part C                      D. Part D



19. Kinetic energy depends on what two factors?

A. mass and volume  
 B. speed and mass  
 C. weight and height  
 D. speed and weight

20. Which of these would be the best definition of energy?

A. particle motion  
 B. the transfer of work from a machine to an object  
 C. the capacity to do work  
 D. something that makes you feel healthy

21. What type of stream only flows in direct response to precipitation and may be dry for many parts of the year? (they have no spring or continuous surface water source)

A. ephemeral                      B. intermittent                      C. perennial                      D. deltoid

22. A flashlight is turned on and is shining its light. What energy transformations make this happen?

A. chemical energy (battery) to potential energy to light energy  
 B. mechanical energy to light energy  
 C. electrical energy to chemical energy to heat energy to light energy  
 D. chemical energy(battery) to electrical energy to light energy

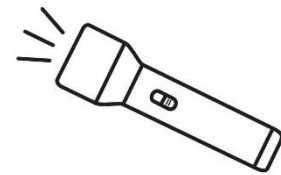


Diagram 1

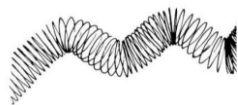


Diagram 2

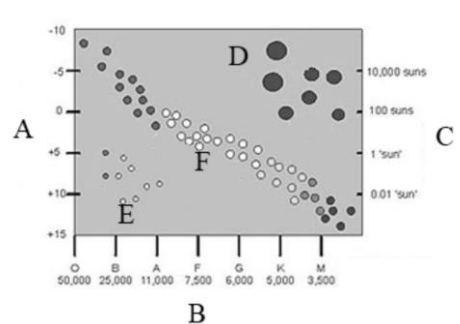


23. Which diagram above shows a “slinky” demonstrating transverse waves?

A. Diagram 1                      B. Diagram 2                      C. Both A and B                      D. none of these

24. Which of the following is a correct label on this HR Diagram?

A. A- spectral class  
 B. B- luminosity  
 C. C- temperature  
 D. D- supergiants



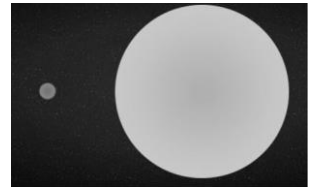
25. Which of the following is a correct label?

A. F- supergiants                      B. E- white dwarfs                      C. C – temperature                      D. B – luminosity

26. Which of the following types of cells contain mitochondria?
- only animal cells
  - animal and plant cells
  - animal, plant, fungi, most protists
  - only plant cells
27. A cell has a nucleus, ribosomes, mitochondria, Golgi complex, endoplasmic reticulum, and a vacuole. What type of cell would it be?
- prokaryotic
  - multicellular
  - eukaryotic
  - cyanobacteria
28. The sites where amino acids are linked together to form proteins are called what?
- ribosomes
  - lysosomes
  - vacuoles
  - cytoskeletons
29. How are mitochondria and chloroplasts similar?
- They are both surrounded by two membranes.
  - They both have their own DNA.
  - They are both found in animal cells.
  - Both A and B
30. Which of the following organisms have amniotic eggs?
- reptiles
  - sharks
  - bony fishes
  - invertebrates

31. If the circle on the right represents the size of Jupiter, what would the circle on the left represent according to relative size?

- the sun
- Saturn
- Earth
- Pluto



32. The distance north or south of the equator is known as what?
- longitude
  - latitude
  - axis tilt
  - tropic of Cancer
33. Eratosthenes, a Greek librarian, set out to find the circumference of the Earth by using what information?
- how far he traveled around the Earth
  - the sun's relative position at two different locations on Earth's surface
  - the time it took Earth to rotate on its axis
  - Both A and C
34. In 1859, some settlers released about a dozen rabbits in Australia. Rabbits were not a native species in Australia. What statement below is true about this event?
- The rabbits, being a prey species, could not survive in this ecosystem without help from people.
  - The rabbits did very well and caused no problems because they are endemic.
  - The rabbits were overrun by the native species and eliminated quickly.
  - The rabbits were not adapted to live in Australia and caused problems in the balance of environment.



46. Rashad recently read an article on hydroponics. He wanted to find out if this method of growing plants was better than the traditional method. He set up an experiment to test which method would grow “tastier” vegetables. First, he set up a hydroponic system to grow cucumbers. He also set up a garden with soil to grow cucumbers. He planned on growing the cucumbers and then he would conduct taste tests with a random group of people to rate the taste on a scale of 1 to 10. What might be a testable hypothesis for his experiment?



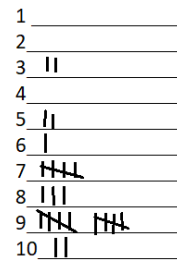
- A. The hydroponic grown cucumbers will be better than the traditional soil grown cucumbers.
- B. The hydroponic grown cucumbers will have a higher rating average on the taste tests than the traditional soil grown cucumbers.
- C. The people will eat more of the hydroponic grown cucumbers because they taste better.
- D. The people will want the traditional soil grown cucumbers because that’s what they are used to.

47. Rashad tallied the taste test surveys for the hydroponic grown cucumbers. Here are his results:

What is the average rating for the hydroponic grown cucumbers?

- A. 9
- B. 3.5
- C. 7.64
- D. 8.25

Ratings for Hydroponic Grown Cucumbers



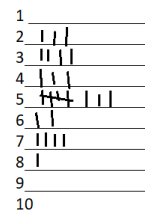
48. What was the mode of the ratings according to this chart?

- A. 7
- B. 8
- C. 9
- D. 10

49. If this chart shows the ratings for the traditional soil grown cucumbers, what is the average rating for these?

- A. 2.5
- B. 3.57
- C. 5
- D. 4.72

Ratings for Traditional Soil Grown Cucumbers



50. What would be a reasonable evidence-based conclusion for his investigation?

- A. According to the data collected, people preferred the traditional soil grown cucumbers taste over the hydroponic grown cucumbers taste.
- B. According to the data collected, most people thought that the hydroponic grown cucumbers had an advantage because of the water used.
- C. According to the data collected, on average, the hydroponic grown cucumbers were rated higher than the traditional soil grown cucumbers by the 25 people who participated.
- D. Growing cucumbers is a fun and rewarding experience no matter how they taste.



**2022 - 2023 TMSCA Middle School Science Test #4- Key**

|       |       |       |
|-------|-------|-------|
| 1. C  | 18. A | 35. A |
| 2. D  | 19. B | 36. B |
| 3. C  | 20. C | 37. C |
| 4. B  | 21. A | 38. B |
| 5. D  | 22. D | 39. D |
| 6. D  | 23. A | 40. B |
| 7. B  | 24. D | 41. B |
| 8. A  | 25. B | 42. A |
| 9. B  | 26. C | 43. B |
| 10. D | 27. C | 44. C |
| 11. B | 28. A | 45. C |
| 12. B | 29. D | 46. B |
| 13. B | 30. A | 47. C |
| 14. C | 31. C | 48. C |
| 15. A | 32. B | 49. D |
| 16. B | 33. B | 50. C |
| 17. A | 34. D |       |