

**TMSCA MIDDLE SCHOOL
SCIENCE
REGIONAL TEST ©
MARCH 4, 2023**

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

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

1. Who patented the geodesic dome in the United States?

- A. Steve Jobs B. Isaac Newton C. Buckminster Fuller D. Elon Musk

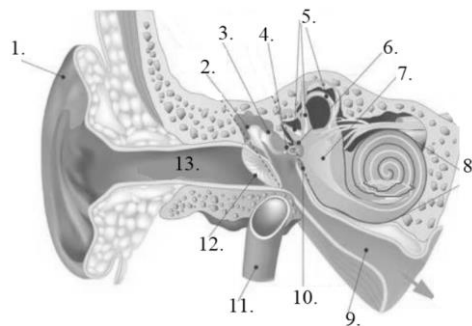


How many atoms make up the reactants in the above chemical equation?

- A. 2 B. 3 C. 4 D. 5

3. A positively charged ion has more _____ than _____. Fill in the blanks correctly.

- A. protons than electrons
 B. protons than neutrons
 C. neutrons than electrons and protons
 D. electrons than protons



4. Look at the diagram of the human ear.

What part of this diagram is the cochlea?

- A. 1 B. 13 C. 8 D. 5

5. What parts of this diagram are the ossicles?

- A. 2,3,4 B. 5,6,7 C. 9,10,11 D. 1,2,3

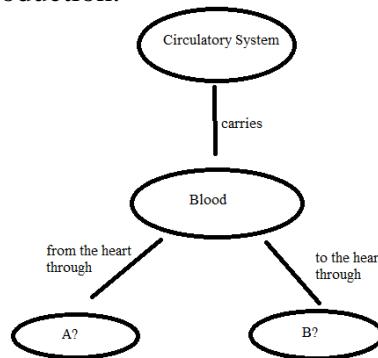
6. In this diagram, what describes what is happening with this mushroom?

- A. Insects are being lured to the mushroom to be devoured.
 B. The mushroom is collecting nutrients from the air around it.
 C. The mushroom is feeding on dead and decaying organisms.
 D. The mushroom is releasing spores as a part of reproduction.



7. In this concept map, what word would go best in circle A?

- A. capillaries
 B. arteries
 C. cells
 D. veins



8. What word would go best in circle B?

- A. capillaries B. arteries C. cells D. veins

9. Which of the following is about how many bee species that have been identified in the world?

- A. 200 B. 2,000 C. 20,000 D. 200,000

10. What is a main difference between bees and flies?
- Bees have four wings and flies have two wings.
 - Bees have short antennae and flies have longer antennae.
 - Flies have pollen collecting hairs and bees do not.
 - Flies have eyes on the side of their heads and bees have large eyes facing forward.
11. DNA molecules have rungs that are composed of two bases that pair with each other. Which combination of these base pairings below is correct?
- Adenine - Thymine
 - Thymine - Cytosine
 - Cytosine - Adenine
 - Guanine - Thymine
12. What is the least amount of moving water needed to knock a human off his/her feet?
- 1 cm
 - 15 cm
 - 30 cm
 - 1 m

13. The tree in the photo on the right has an unusual growth on it called a “burl”. What causes this to happen?



- The tree’s DNA is mutated by pollution in the air and grows a bump.
- This is an insect home that the insect builds on the tree.
- The tree responds to environmental injury by forming callus tissue in the area.
- The burl only grows on a burl tree. It is part of the fruit of the tree.

14. The asteroid belt falls between which planets in our solar system?

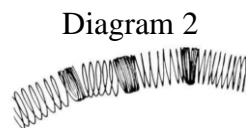
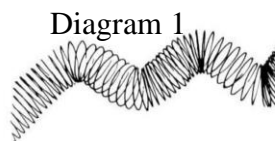
- the 4th and 5th planets from the sun
- the 3rd and 4th planets from the sun
- the 6th and 7th planets from the sun
- the 2nd and 3rd planets from the sun

15. The closest point that Earth is from the sun is called what?

- aphelion
- perihelion
- apogee
- perigee

16. Which of the following people is known for his contributions to quantum mechanics and for winning the Nobel Prize in Physics in 1922?

- J.J. Thomson
- Ernest Rutherford
- John Dalton
- Niels Bohr



17. Which diagram above shows a “slinky” demonstrating longitudinal waves?

- Diagram 1
- Diagram 2
- Both A and B
- none of these

18. Organic matter that comes from plants, such as wood, stems, dried leaves, or from animals, such as dung are all known as what?

- abiotic factors
- sediments
- ecological succession
- biomass

19. Which of the following measurements would most likely be for a jet airplane takeoff?
 A. 150 dB B. 65 dB C. 400 dB D. 1,000 dB
20. One example of a third-class lever is a what?
 A. wheelbarrow B. oar on a boat C. fishing rod D. bottle opener
21. A repeating pattern that can transfer energy from one place to another is called what?
 A. wave B. prism C. torque D. scalar
22. To be classified as a “derecho”, a wind event must be what?
 A. long-lived B. cover less than 50 miles C. gusts of 74 mph D. all of these

23. The Earth’s atmosphere is composed of a mixture of gases, including water vapor.

At times, the amount of water vapor changes, usually up to 4%. This chart shows how the atmospheric composition changes with the inclusion of water vapor to the mix.

Water Vapor	Nitrogen	Oxygen	Argon
0%	78.084%	20.947%	0.934%
1%	77.30%	20.70%	0.92%
2%	76.52%	20.53%	0.91%
3%	75.74%	20.32%	0.90%
4%	74.96%	20.11%	0.89%

When the water vapor content is up to 4%, how does that change the oxygen content?

- A. it increases slightly
 B. it decreases slightly
 C. it has no change
 D. it increases and decreases

24. About how much does the percentage of nitrogen in the atmosphere change with 2% water vapor included?
 A. it increases 1.564%
 B. it decreases 1.564%
 C. it decreases 0.784%
 D. it increases 3.124%

25. When precipitation contains a large amount of harmful chemicals from the burning of fossil fuels, it is called what?

- A. acid rain B. desertification C. yellow snow D. ozone

26. When a species’ population becomes so few that they may not exist anymore, this is called what?

- A. endangered B. sustainable C. inevitable D. disposable

27. What term is used for the number and variety of plant and animal species that are found in an area?

- A. biodiversity B. biodegradable C. sustainability D. community

28. Dinosaur footprints found in a stream bed were said to be about 113 million years old. How do the paleontologists know this?
- A. there is no way to tell if they are that old
 - B. by measuring the depth and width of each step
 - C. by testing the water around the footprints for ions
 - D. by knowing the age of the rock in which the footprints were found.



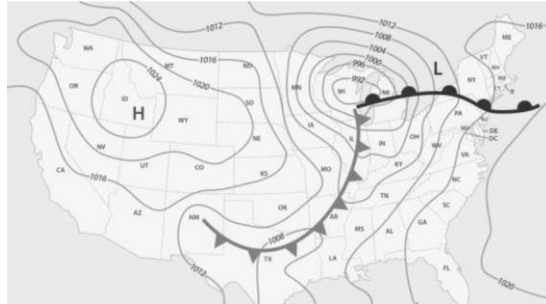
29. Elaine's science class has been studying about density. In class, they tested to see how much salt was needed in water before an object with a density of 1.05 g/cm^3 will float. What would they need to do?
- A. Add only enough salt to the water to make the mass of the water equal to 1.05 grams.
 - B. Add salt to the water that is less than 1.05 grams.
 - C. Add enough salt to the water and mix so that the water's density is more than 1.05 g/cm^3 .
 - D. It will be impossible to make this object float with that density.
30. Most mother bats give birth to how many pups each year?
- A. 3
 - B. 1
 - C. 4
 - D. 5
31. Which of the following shows the correct order from smallest to largest?
- A. cell, organelle, tissue, system, organ, organism
 - B. organelle, tissue, cell, organ, system, organism
 - C. cell, tissue, organelle, organ, system, organism
 - D. organelle, cell, tissue, organ, system, organism
32. What is used to describe the behavior of waves and particles at an atomic scale?
- A. Newton's laws
 - B. Planck's constant
 - C. Bohr's model
 - D. Maxwell's equation
33. Which statement below is an agricultural benefit offered by bats?
- A. Bats provide millions of pounds of meat for human consumption.
 - B. Bats eat harmful insects to agricultural crops, such as corn.
 - C. Bats migrate from cold to warm places each year.
 - D. Bats carry disease that help control populations of other animals.
34. Erythrocytes are also called what?
- A. red blood cells
 - B. nerve cells
 - C. skin cells
 - D. bone marrow cells
35. Which statement below about fire is true?
- A. Fire only needs heat and oxygen to burn.
 - B. Fire is a physical change.
 - C. Earth is the only known planet in our solar system where we can enjoy a campfire burning on the surface.
 - D. Metals cannot catch on fire, instead they will melt.

36. What desert is found in the state of Texas?

- A. Mohave B. Chihuahuan C. Sahara D. Sonoran

37. In this weather map, what direction is the cold front moving?

- A. north, northwest
B. east, southeast
C. northwest
D. south only



38. In the spring and fall, some big cities are pledging to “turn off the lights” at night to help birds during migration. Which of the following is not a benefit for turning off the lights at night?

- A. many birds migrate at night and the lights off will keep them flying steady
B. saves energy and money
C. birds rest at night and the lights disturb their sleep patterns
D. removes hazards of light disorientation when birds fly

39. Look at this photo to the right. This shower curtain lets some light through, but not all. What is the word to describe the shower curtain?

- A. opaque
B. transparent
C. translucent
D. none of these



40. Which statement below is not true about the Northern Mockingbird?

- A. Its species name is “polyglottos” which means “many-tongued”
B. It does not defend its territory like most birds.
C. It can imitate 12 different species of frogs and toads.
D. It is the state bird of Texas.



41. Consider this scenario – if an object is traveling in a straight line through a vacuum of space and no force is acting upon it to stop the object, then this is an example of what?

- A. Newton’s First Law of Motion
B. Law of Inertia
C. Law of Momentum
D. Both A and B

42. What is the volume of the water in a box with the dimensions of 10 by 10 by 8 cm?

- A. 8 L³ B. 800 cm C. 1,120 cm³ D. 800 mL

43. A sports scientist wanted to find out if running barefoot or running with shoes was less harmful on the human body. He set up an experiment in which he studied the force applied to the foot when running barefoot and the force applied to the foot when wearing shoes. One discovery during the experiment was that runners land on the heels more when wearing shoes and land on the ball of the foot when running barefoot. What would be the independent variable in this investigation?

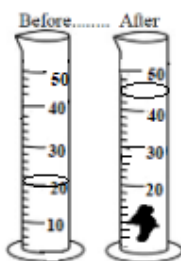
- A. the amount of force applied to the foot
- B. the part of the foot that touches the ground
- C. the type of shoe
- D. whether the runner has shoes or is barefoot

44. What is an achene in the world of plants?

- A. a small, one-seeded fruit that does not open to release the seed
- B. a large, fleshy enlarged fruit with seeds
- C. a fruit with a hard, stony covering enclosing the seed
- D. a small, winged, one-seeded fruit

45. By using displacement, approximately what is the volume of this irregular shaped object that was placed in the graduated cylinder?
(units shown are in milliliters)

- A. 10 cm³
- B. 24 mL
- C. 5 mL
- D. 73 mL



46. Jarrett hammered a nail into a wooden board. The hammer pushed on the nail and the nail pushed back on the hammer. The harder Jarrett hammered, the further the nail went into the board. There was an action and reaction. This is an example of what?

- A. Newton's First Law of Motion
- B. Newton's Second Law of Motion
- C. Newton's Third law of Motion
- D. none of these



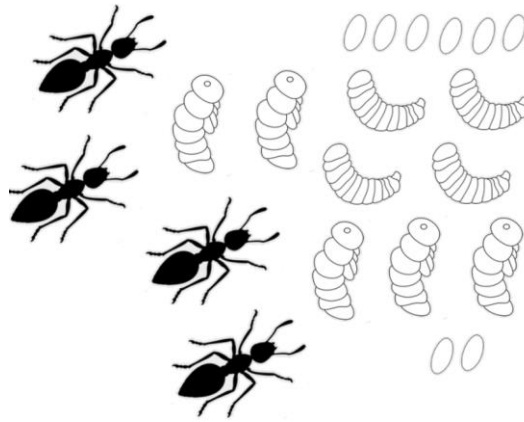
47. If a student's clothes caught on fire during a lab investigation, what safety procedure should be followed?

- A. have the student run down the hallway to the restroom
- B. get the fire extinguisher and spray the student with it
- C. immediately tell the teacher and get the fire blanket to put over the student.
- D. put her head in the eye-wash station and pour water on her.

48. The amount of energy (4.1868 J) needed to change the temperature of 1 gram of water by 1 degree Celsius is known as a what?

- A. thermos
- B. kilo
- C. dynamo
- D. calorie

49. During a research study on ants, the scientist needed to count the number of worker ants, eggs, larva, and pupa found in a sample taken. Which of the following tables below matches the sample?



A.

Stage	#
Egg	8
Larva	6
Pupa	5
Adult	5

B.

Stage	#
Egg	7
Larva	5
Pupa	4
Adult	4

C.

Stage	#
Egg	8
Larva	4
Pupa	5
Adult	4

D

Stage	#
Egg	6
Larva	5
Pupa	4
Adult	4

50. How long does it take Earth to revolve around the sun?

A. 56 weeks

B. 365.25 days

C. 24 hours

D. All of these

2022 - 2023 TMSCA Middle School Science Regional Test - Key

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