



# NATIONAL Science Bee

## National Science Bee – 2021-22 C Set Qualifying Exam

Name \_\_\_\_\_

School \_\_\_\_\_

Grade \_\_\_\_\_

Email address \_\_\_\_\_

**Instructions - Circle the correct answer or leave it blank. Correct answers are worth 2 points. Incorrect answers are worth -1 point. Questions left blank are worth 0 points.**

- What will happen to the magnitude of electric force between two particles if the distance between them is doubled and each charge is tripled?
  - it will be multiplied by a factor of  $3/4$
  - it will be multiplied by a factor of  $4/9$
  - it will be multiplied by a factor of  $9/4$
  - it will be multiplied by a factor of  $3/2$
- A strange phenomenon associated with waterspouts is
  - fish falling from the sky
  - the displacement of heat
  - the strengthening occurring when warm air enters the vortex
  - their lack of destructive power
- A positive integer that is equal to the sum of its proper positive divisors (excluding the number itself) is known by what term?
  - perfect
  - imaginary
  - prime
  - odd
- Which dwarf planet was discovered by Clyde Tombaugh while working at the Lowell Observatory in Flagstaff in 1930?
  - Pluto
  - Ceres
  - Haumea
  - Makemake
- The youngest rocks tend to be found in which of the following?
  - near the continental shelf
  - at the base of coral reefs
  - along spreading centers
  - at convergent zones
- Which of the following molecules orient themselves into sandwich-like membranes due to hydrophobic components within the molecule?
  - glycogen
  - phospholipids
  - cellulose
  - proteins
- The main components of a comet are the nucleus, tail, and which of the following?
  - Zenith
  - Coma
  - Umbra
  - Radiant
- A product of noncyclic photophosphorylation is
  - NADPH
  - water
  - carbon dioxide
  - ADP
- All of the following are homologous to each other EXCEPT which of the following?
  - a bird wing
  - a butterfly wing
  - a human arm
  - a penguin flipper
- What is the maximum number of electrons that can occupy the fourth main energy level in an atom?
  - 8
  - 14
  - 32
  - 18
- Which of these molecular formulae are also empirical formulae?
  - $C_2H_6O$
  - $C_2H_2O_2$
  - $C_5H_{12}$
  - I and II only
  - I and III only
  - II and III only
  - I, II and III

12. Forces of +35N, +12N, and -25N act on an object. What force will hold the object in equilibrium?
- +22 N
  - 22 N
  - 35 N
  - 12 N
13. What name is given to the following sequence:  
0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55...?
- Fibonacci sequence
  - Harmonic sequence
  - Newton's sequence
  - Geometric sequence
14. Which of the following represents a Newton in fundamental units?
- $(\text{kg}\cdot\text{m})/\text{s}$
  - $(\text{kg}\cdot\text{s}^2)/\text{m}$
  - $(\text{kg}\cdot\text{s})/\text{m}$
  - $(\text{kg}\cdot\text{m})/\text{s}^2$
15. Which flat image can be displayed in three dimensions?
- circle
  - line
  - projection
  - hologram
16. The planets make up what percentage of the mass in our solar system?
- 13.5%
  - 0.0135%
  - 1.35%
  - 0.135%
17. Which mathematician stated that “the deep study of nature is the most fruitful source of mathematical discovery”?
- Pierre de Fermat
  - Joseph Fourier
  - Alan Turing
  - Sophie Germain
18. A projectile is traveling in a parabolic path for a total of 6 seconds. How does the projectile's horizontal velocity after 1 second compare to its horizontal velocity after 4 seconds?
- Horizontal velocity is the same
  - Horizontal velocity greater at 4-s
  - Horizontal velocity is greater at 1-s slows over time
  - Horizontal velocity builds to peak mid-path, then slows
19. Which of the following is NOT a programming language?
- Java
  - Cantonese
  - C#
  - Python
20. The mathematician Pythagoras was born around 569 BCE. Where did Pythagoras live?
- Sicily
  - Malta
  - Samos
  - none of the above
21. Which of the following initiates an attack against a specific antigen or pathogen?
- complement
  - plasma cells
  - interferon
  - macrophages
22. For an ohmic conductor, doubling the voltage without changing the resistance will cause the current to
- decrease by a factor of 4
  - decrease by a factor of 2
  - remain unchanged
  - increase by a factor of 2
23. What is the sum, in degrees, of the internal angles of a hexagon?
- 360
  - 180
  - 720
  - 620
24. Which substance will not produce copper (II) chloride when added to dilute hydrochloric acid?
- $\text{Cu}(\text{s})$
  - $\text{Cu}(\text{OH})_2(\text{s})$
  - $\text{CuCO}_3(\text{s})$
  - $\text{CuO}(\text{s})$
25. The Tepula, Marcia, Alsietina, and Anio Novus are names for which important construct of the Roman age?
- colosseums
  - aqueducts
  - arches
  - guardwalls
26. The smooth endoplasmic reticulum does NOT conduct which of the following processes?
- assembling amino acids to make proteins
  - manufacturing lipids
  - manufacturing hormones
  - breaking down toxins

27. What is the role of the alcohol fermentation pathway?  
A. it produces ATP  
B. it produces lactate  
C. it produces ADP for electron transport chain  
D. it replenishes NAD<sup>+</sup> so glycolysis produces ATP
28. Which of these acids has the weakest conjugate base?  
A. CH<sub>3</sub>COOH  
B. NH<sub>4</sub>Cl  
C. HCl  
D. C<sub>6</sub>H<sub>5</sub>COOH
29. What term describes early scientists who attempted to turn base metals into noble metals?  
A. wizards  
B. alchemists  
C. philosophers  
D. blacksmiths
30. Which of Maxwell's equations states that a changing electric field produces a magnetic field?  
A. Gauss' Law  
B. Ampere-Maxwell Law  
C. Faraday's Law  
D. Biot-Savart Law
31. How many sides does a nonagon have?  
A. 6  
B. 12  
C. 9  
D. 10
32. On what day would the sun rise for someone at the Earth's South pole?  
A. March 21 (vernal equinox)  
B. September 23 (autumnal equinox)  
C. June 21 (summer solstice)  
D. December 21 (winter solstice)
33. In demographic transition theory, which stage is marked by high birth rates and falling death rates?  
A. Stage 1  
B. Stage 2  
C. Stage 3  
D. Stage 4
34. Who developed a namesake 'machine' and was instrumental in Allied code-breaking during World War II?  
A. Alan Turing  
B. Jane Goodall  
C. Marie Curie  
D. Samuel Morse
35. What year saw the first woman travel to space?  
A. 1968  
B. 1983  
C. 1963  
D. 1973
36. Which species is a Lewis acid but not a Brønsted–Lowry acid?  
A. NH<sub>4</sub><sup>+</sup>  
B. Cu<sup>2+</sup>  
C. Cu  
D. CH<sub>3</sub>COOH
37. Which of the following describes a resonance structure?  
A. bonds vibrate by absorbing IR radiation  
B. a double and a single bond in the molecule  
C. a Lewis structure  
D. double bond can be drawn in alternative positions
38. Which is an example of an amphiprotic species?  
A. Al<sub>2</sub>O<sub>3</sub>  
B. HPO<sub>4</sub><sup>2-</sup>  
C. CO<sub>3</sub><sup>2-</sup>  
D. P<sub>4</sub>O<sub>10</sub>
39. Which of the following is NOT an example of countercurrent exchange?  
A. movement of blood through the fins and tails of marine mammals  
B. the Loop of Henle in the nephron  
C. gas exchange in fish gills  
D. gas exchange in human lungs
40. Chemiosmosis describes how ATP is generated from ADP. Which of the following does not describe this process?  
A. electrons flowing through ATP synthase channel protein provide energy  
B. a proton gradient is created across the cristae membranes  
C. a voltage gradient is created across the cristae membranes  
D. H<sup>+</sup> accumulates in the area between the membranes of the cristae and mitochondria
41. Bees must collect nectar from approximately how many flowers to make one pound of honeycomb?  
A. 10,000  
B. 2,000,000  
C. 20,000,000  
D. 50,000,000

42. Which of the following is an example of a positive feedback loop that works to accelerate global warming, especially at the Earth's poles?
- Albedo Effect
  - Kyoto Theorem
  - Thermal Expansion
  - Sea Ice Expansion
43. The pollination of flowering plants by birds is known by what term?
- autogamy
  - ornithophily
  - entomophily
  - anemophily
44. A box of mass  $m$  slides down frictionless inclined plane of length,  $L$ . What is change in gravitational potential energy?
- $-mgL$
  - $-mgh$
  - $-mgh/L$
  - $-mgL/h$
45. The deepest crevice on Earth, the Marianas Trench, formed at which of the following?
- a divergent boundary between two oceanic plates
  - a convergent boundary between an oceanic and continental plate
  - intraplate hot spots
  - a convergent boundary between two oceanic plates
46. After strenuous exercise, a muscle cell would not contain increased amounts of which of the following?
- ADP
  - $\text{CO}_2$
  - Lactate (lactic acid)
  - Glucose
47. A ball, mass  $m$ , travels horizontally with velocity,  $v$ , strikes a vertical wall and rebounds back along original path with no change in speed. What is magnitude of impulse delivered by wall to the ball?
- $2mv$
  - $4mv$
  - $mv/2$
  - $mv$
48. Which series shows the correct order of metallic bond strength from strongest to weakest?
- $\text{Na} > \text{K} > \text{Rb} > \text{Mg}$
  - $\text{Mg} > \text{Rb} > \text{K} > \text{Na}$
  - $\text{Rb} > \text{K} > \text{Na} > \text{Mg}$
  - $\text{Mg} > \text{Na} > \text{K} > \text{Rb}$
49. How do icebergs lose salt?
- through convective pressure caused by cleaving
  - through variable melting at Earth's surface
  - icebergs don't have salt to lose
  - icebergs retain their salty water ratios
50. Which of the following molecules is the most polar?
- $\text{CHF}_3$
  - $\text{CF}_4$
  - $\text{CClF}_3$
  - $\text{CCl}_4$