



TJSBT 2025

Round Robin 2

Tossup

1. Biology – *Multiple Choice* For human cells, how many sister chromatids are in a cell during metaphase I and metaphase II of meiosis, respectively?

- W) 46, 46
- X) 46, 23
- Y) 92, 46
- Z) 92, 92

Answer: Y) 92, 46

Bonus

1. Biology – *Short Answer* By name or number, identify all of the following 3 hormones that utilize G-protein coupled receptors in their signal transmission sequence:

- 1) Insulin
- 2) Epinephrine
- 3) Estrogen

ANSWER: 2

Tossup

2. Chemistry – *Multiple Choice* Which of the following compounds has the highest lattice energy?

- W) NaCl
- X) NaBr
- Y) MgCl₂
- Z) MgO

Answer: Z) MgO

Bonus

2. Chemistry – *Short Answer* What is the hybridization of the central xenon atom in the molecule xenon tetrafluoride with a chemical formula of XeF₄?

Answer: sp³d² (accept: d²sp³)

Tossup

3. Earth and Space – *Multiple Choice* Which of the following types of moraines is created by the merging of two glaciers?

- W) Terminal
- X) Lateral
- Y) Medial
- Z) Zonal

Answer: Y) Medial

Bonus

3. Earth and Space – *Short Answer* Rishabh is a deep-sea diver who has swum down to the ocean floor, and notices many different substances present. By name or number, identify all of the following 3 substances that would be classified as lithogenous sediments:

- 1) Red clay
- 2) Beach sand
- 3) Volcanic ash

Answer: All

Tossup

4. Math – *Multiple Choice* A triangle with all integer side lengths has two sides of length 100 and 101. How many possible lengths are there for the 3rd side?

- W) 196
- X) 197
- Y) 198
- Z) 199

Answer: Z) 199

Bonus

4. Math – *Short Answer* What are all of the roots of the polynomial $x^3 - 3x^2 - 4x + 12$?

Answer: -2, 2, and 3

Tossup

5. Physics – *Multiple Choice* Lucas is calculating the speed of sound. In which of the following mediums would Lucas expect the speed of sound to be the lowest?

- W) Partial vacuum
- X) Water
- Y) Ice
- Z) Aluminum

Answer: W) Partial vacuum

Bonus

5. Physics – *Short Answer* Lucas then drops a block off of a cliff with height 80 meters. In seconds and to one significant figure, how much time does the block take to reach the ground?

Answer: 4

Tossup

6. Energy – *Multiple Choice* Students at Thomas Jefferson are studying the OneR algorithm for classification. Which of the following answer choices is a disadvantage of using the OneR classification model?

- W) It is computationally expensive
- X) It only uses a single attribute to make decisions, which may oversimplify the model
- Y) It is difficult to interpret the results
- Z) It may struggle with handling large datasets

Answer: X) It only uses a single attribute to make decisions, which may oversimplify the model

Bonus

6. Energy – *Short Answer* What phenomenon occurs when distant galaxies appear distorted due to the gravitational influence of massive objects?

Answer: Gravitational lensing

Tossup

7. Biology – *Short Answer* What name is given to organisms that are the first to colonize an area after an ecological disturbance?

Answer: Pioneer species

Bonus

7. Biology – *Multiple Choice* Which of the following organisms would contain flame bulb cells in their excretory system?

- W) Desert locust
- X) Giant Gippsland earthworm
- Y) New Zealand flatworm
- Z) Blue dragon sea slug

Answer: Y) New Zealand flatworm

Tossup

8. Chemistry – *Multiple Choice* Which of the following plots would produce a linear graph for a second order reaction?

- W) Concentration vs time
- X) Natural logarithm of concentration vs time
- Y) One over concentration vs time
- Z) One over the natural logarithm of concentration vs time

Answer: Y) One over concentration vs time

Bonus

8. Chemistry – *Short Answer* Suppose photons with a kinetic energy of K are being shot at a metal with work function W, with K being less than W. In terms of K and W, what will be the energy of the electrons that are ejected?

Answer: 0

Tossup

9. Earth and Space – *Short Answer* Located on Mars, what is the name given to the largest volcano in the solar system?

Answer: Olympus Mons

Bonus

9. Earth and Space – *Short Answer* Aarushi is transferring her 6th grade Reach for the Stars knowledge to Sophia by taking her stargazing. By name or number, identify all of the following 3 constellations that Sophia could see at night from her house in Virginia during wintertime:

- 1) Orion
- 2) Canis Major
- 3) Sagittarius

Answer: 1, 2

Tossup

10. Math – *Multiple Choice* The standard deviation of a set of numbers is σ (read as: *sigma*) and the mean is \bar{x} (read as: *x bar*). If 3 is added to every number in the set, which of the following represents the new standard deviation and mean, respectively?

- W) σ, \bar{x}
- X) $3\sigma, \bar{x}$
- Y) $\sigma+3, \bar{x}$
- Z) $\sigma, \bar{x}+3$

Answer: Z) $\sigma, \bar{x}+3$

Bonus

10. Math – *Short Answer* Consider all possible triangles that can be formed by selecting three vertices of a regular decagon. What is the smallest possible angle that one of these triangles can have?

Answer: 18°

Tossup

11. Physics – *Multiple Choice* Which of the following laws in electromagnetism gives an expression for the magnetic field produced at a point in space by a segment of a current-carrying wire?

- W) Gauss's law
- X) Ampere's law
- Y) Biot-Savart law
- Z) Faraday-Lenz law of induction

Answer: Y) Biot-Savart law

Bonus

11. Physics – *Multiple Choice* Aaryan is digging a hole to the other side of the Earth. If he drops a penny through the hole, what will happen to the penny?

- W) The penny will get stuck at the center of the Earth
- X) The penny will get stuck between where it was dropped and the center of the Earth
- Y) The penny will oscillate between the two ends of the Earth
- Z) The penny will oscillate between where it was dropped and the center of the Earth

ANSWER: Y) The penny will oscillate between the two ends of the earth.

Halftime

Tossup

12. Energy – *Multiple Choice* As the number of degrees of freedom in a t-distribution approaches infinity, which of the following distributions does the t-distribution get closer and closer to?

- W) Chi-square
- X) Poisson (read as: pwah-son)
- Y) Normal
- Z) Binomial

Answer: Y) Normal

Bonus

12. Energy – *Short Answer* Students at Thomas Jefferson are studying machine learning. Patrick’s machine learning model has a training accuracy of 99%, while his testing accuracy was only 63%. What phenomenon is Patrick’s model experiencing?

Answer: Overfitting

Tossup

13. Biology – *Multiple Choice* Rishabh keeps getting himself into accidents where he's losing a lot of blood. Fed up, his doctor sends him to the pharmacy with an order to purchase a certain fat-soluble vitamin so he does not bleed out as frequently. Which of the following vitamins has Rishabh been ordered to purchase?

- W) Vitamin A
- X) Vitamin D
- Y) Vitamin E
- Z) Vitamin K

Answer: Z) Vitamin K

Bonus

13. Biology – *Short Answer* By name or number, order the following 4 layers of stem tissue from innermost to outermost:

- 1) Primary phloem
- 2) Secondary phloem
- 3) Primary xylem
- 4) Secondary xylem

Answer: 3, 4, 2, 1

Tossup

14. Chemistry – *Short Answer* By name or number, identify all of the following 3 changes that will cause more ammonia to be produced in the reaction $3\text{H}_2 + \text{N}_2 \rightarrow 2\text{NH}_3$ (**read as: three H–2 plus N–2 yields 2 N–H–3**) with a negative ΔH (delta H):

- 1) Increasing the temperature of the reaction
- 2) Adding inert helium gas to the reaction vessel
- 3) Increasing the pressure of the reaction vessel

Answer: 3 only

Bonus

14. Chemistry – *Multiple Choice* Which of the following terms best describes the conversion of H_2O and Cl_2 to HCl and HClO ?

- W) Comproportionation
X) Disproportionation
Y) Nucleophilic substitution
Z) Single replacement

ANSWER: X) Disproportionation

Tossup

15. Earth and Space – *Multiple Choice* Which of the following forces is most typical of a transform fault?

- W) Shear force
- X) Compressional force
- Y) Extensional force
- Z) Drag force

Answer: W) Shear force

Bonus

15. Earth and Space – *Multiple Choice* Which air mass serves as the primary source for Nor'easter storms that bring heavy snow and coastal flooding to the northeastern United States?

- W) Continental arctic
- X) Continental polar
- Y) Maritime polar
- Z) Maritime tropical

Answer: Y) Maritime polar

Tossup

16. Math – *Short Answer* What is $\csc(690^\circ)$ (read as: the cosecant of 690 degrees)?

Answer: -2

Bonus

16. Math – *Short Answer* By name or number, identify all of the following 3 cross-sections that could be created when a plane intersects a cube:

- 1) Scalene triangle
- 2) Pentagon
- 3) Hexagon

Answer: All

Tossup

17. Physics – *Short Answer* What equation in quantum mechanics describes how the wave function of a particle changes over time?

ANSWER: Schrödinger equation

Bonus

17. Physics – *Short Answer* On planet XYZ, Sophia throws a ball straight up and it reaches a maximum height of 50 meters above Sophia. Furthermore, it takes 4 seconds for the ball to land back in Sophia’s hand. To the nearest meter per second squared, what is the magnitude of the acceleration due to gravity on XYZ?

ANSWER: 25 m/s^2

Tossup

18. Energy – *Multiple Choice* Students at Thomas Jefferson’s Quantum Lab are studying Shor’s algorithm. Shor’s algorithm has the potential to crack what encryption method, relying on the difficulty of factoring large prime numbers?

- W) Symmetric encryption
- X) ECC encryption
- Y) RSA encryption
- Z) Blowfish encryption

Answer: Y) RSA encryption

Bonus

18. Energy – *Short Answer* Students at Thomas Jefferson’s Geosystems Lab are studying biomes. By name or number, identify all of the following 3 biomes for which the average temperature difference between winter and summer is greater than 10° C:

- 1) Tropical rainforest
- 2) Desert
- 3) Chaparral

Answer: 2, 3

Tossup

19. Biology – *Multiple Choice* Eshaan is working with a model cell and plans to reinforce its cell wall by adding structural polysaccharides. Which of the following is NOT a structural polysaccharide?

- W) Cellulose
- X) Chitin
- Y) Peptidoglycan
- Z) Glycogen

Answer: Z) Glycogen

Bonus

19. Biology – *Multiple Choice* If the body detects certain genetic abnormalities within a cell, it may arrest the cell at a certain phase in its life cycle. If a cell fails to replicate its chromosomes, during what stage of the cell cycle will it become arrested?

- W) G1
- X) G2
- Y) M
- Z) S

Answer: W) G1

Tossup

20. Chemistry – *Multiple Choice* Which of the following silver salts is the most soluble in water?

- W) Silver iodide
- X) Silver bromide
- Y) Silver chloride
- Z) Silver fluoride

Answer: Z) Silver fluoride

Bonus

20. Chemistry – *Short Answer* To one significant figure, what is the pH of a solution of a binary acid with pKa of 4 and a concentration of 10^{-2} M [read as molar]?

ANSWER: 3.0

Tossup

21. Earth and Space – *Multiple Choice* Which of the following prevents a white dwarf from collapsing?

- W) Nuclear fusion
- X) Electron degeneracy pressure
- Y) Neutron degeneracy pressure
- Z) Electromagnetic radiation

Answer: X) Electron degeneracy pressure

Bonus

21. Earth and Space – *Short Answer* Rishabh is a star on the H-R diagram and is hoping to live forever. Which type of star should Rishabh hope to emulate, as it has the longest main-sequence lifetime?

Answer: Type-M (accept: Red dwarf)

Tossup

22. Math – *Multiple Choice* Alan writes the positive integers 1 through 100 on a chalkboard. He first erases all the perfect squares. Then, he erases all the perfect cubes. After this process, how many numbers are left?

- W) 87
- X) 88
- Y) 89
- Z) 90

Answer: X) 88

Bonus

22. Math – *Multiple Choice* In base 10 representation, how many trailing zeros does $200!$ (read as: 200 factorial) have?

- W) 45
- X) 47
- Y) 49
- Z) 51

Answer: Y) 49

Tossup

23. Physics – *Short Answer* For an object spinning about a fixed axis, the object’s torque is equal to the time derivative of what quantity?

ANSWER: Angular momentum

Bonus

23. Physics – *Short Answer* A 4 coulomb particle is moving at 5 meters per second at an angle of 30° with a uniform magnetic field with field strength 1.2 teslas. In newtons, what is the magnitude of the magnetic force acting on the object?

Answer: 12

End of packet