

Round 7

1. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A horse moves a sleigh 1.00 kilometer by applying a horizontal 2,000-newton force on its harness for 45 minutes. What is the power of the horse?

Bonus Answer: 741 watts

Bonus: Short Answer

A force of 100 newtons is used to move an object a distance of 15 meters with a power of 25 watts. Find the work done and the time it takes to do the work.

Bonus Answer: work = 1,500 joules; time = 60 seconds

2. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the name of the principle that states that 5 avocados cannot be placed in 4 holes without 2 of them being placed in the same one?

Bonus Answer: Pigeonhole Principle

Bonus: Short Answer

In triangle ABC with integer side lengths, $AB = 7$, $BC = 14$, and $AC < 9$. Find AC.

Bonus Answer: 8 (Triangle Inequality)

3. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A bullet travels through the air, it slows down due to air resistance. How does the bullet's momentum change as a result?

Bonus Answer: The bullet's momentum decreases as its speed decreases.

Bonus: Short Answer

How can a small force produce a large change in momentum ?

Bonus Answer: A small force can produce a large change in momentum if the force acts on an object for a long period of time.

4. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

If 8 moles dig 8 holes in 8 years, how many holes can 4 moles dig in 1461 days?

W) 1

X) 2

Y) 4

Z) 8

Toss Up Answer: X

Bonus: Short Answer

If 9 moles dig 24 holes in 10 days, how many holes can 3 moles dig in 5 days?

Bonus Answer: 4

5. PHYSICS

Writer: Mohammed Jamil

Toss Up: Multiple Choice

A loaded freight car A with a mass of 14,000 kg moves at a constant velocity of 15 m/s on a horizontal railroad track and collides with an empty car B with a mass of 6,000 kg moving at 5 m/s. After the collision the cars stick to each other and moves like one object. What is the velocity of two cars after the collision?

- W) 6 m/s
- X) 8 m/s
- Y) 10 m/s
- Z) 12 m/s

Toss Up Answer: Z

Bonus: Multiple Choice

When two objects collide elastically the momentum is conserved. Which of the following is true about the kinetic energy during the collision?

- W) The kinetic energy is lost
- X) The kinetic energy is gained
- Y) The kinetic energy is conserved
- Z) The kinetic energy completely transforms into thermal energy

Bonus Answer: Y

6. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the smallest even triangular number?

Bonus Answer: 6

Bonus: Multiple Choice

If p and q are inversely proportional, and $p = 7$ when $q = 24$, then find p when $q = 12$.

- W) 3.5
- X) 7
- Y) 12
- Z) 14

Bonus Answer: Z

7. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

Which of the following is a process used to produce an alternating current in an electric generator?

- W) a loop of wire is spun in a magnetic field
- X) a loop of wire is pushed in the direction of a magnetic field
- Y) a loop of wire is pushed perpendicular to a magnetic field
- Z) a magnet is pushed towards a wire

Toss Up Answer: W

Bonus: Short Answer

What is the SI unit for magnetic flux?

Bonus Answer: weber

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8. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is a triangular number?

W) 2

X) 6

Y) 9

Z) 11

Toss Up Answer: X

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Bonus: Short Answer

What is the greatest common factor of 456 and 460?

Bonus Answer: 4

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9. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

An object slides across a horizontal surface and eventually comes to a stop. What is true of the object?

W) its kinetic energy was converted to thermal energy

X) the energy related to the motion of the object was destroyed

Y) the kinetic energy of the object stayed constant

Z) the potential energy of the object increased

Toss Up Answer: W

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Bonus: Short Answer

What unit is defined as the energy needed to raise the temperature of a gram of liquid water by 1 degree Celsius?

Bonus Answer: calorie

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10. BIOLOGY

Writer: Kerwin Chen

Toss Up: Short Answer

What are the names of the two bones in your forearm?

Bonus Answer: radius and ulna

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Bonus: Short Answer

How many carpal bones does a person have in each arm?

Bonus Answer: 8

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11. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the electron configuration of $Mg(2+)$?

Bonus Answer: $1s^2 2s^2 2p^6$

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Bonus: Short Answer

What is the electron configuration of $Cu(2+)$?

Bonus Answer: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9$

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12. BIOLOGY

Writer: Kerwin Chen

Toss Up: Short Answer

The vision of a person with myopia can be corrected with which type of lens?

Bonus Answer: diverging, concave

Bonus: Short Answer

What is the name of the surgical procedure in which cuts are made around the cornea to allow for the correction of myopia?

Bonus Answer: Radial keratotomy

13. CHEMISTRY

Writer: Mohammed Jamil

Toss Up: Short Answer

Copper sulfate can be made by warming copper oxide with sulfuric acid. The equation for the reaction is:



Calculate the maximum mass of copper oxide which can react with 9.8 g of sulfuric acid in this reaction.

(Relative atomic masses: H=1, O=16, Cu=64)

Bonus Answer: 8g

Bonus: Short Answer

It takes 83ml of a 0.45M NaOH solution to neutralize 235mL of an HCl solution. What is the concentration of the HCl solution ?

Bonus Answer: 0.16 M

14. BIOLOGY

Writer: Nten Nylam

Toss Up: Multiple Choice

From where do autotrophs obtain their carbon, nutrients, and minerals?

W) From the sun

X) From human activities

Y) The inorganic environment

Z) From the atmosphere

Toss Up Answer: Y

Bonus: Short Answer

What is the name of the parasite that causes malaria?

Bonus Answer: Plasmodium parasites (also accept plasmodium)

15. CHEMISTRY

Writer: Brian Lim

Toss Up: Short Answer

What is the term for the conditions at which a substance begins to behave as a supercritical fluid?

Bonus Answer: critical point

Bonus: Multiple Choice

For a sample of a liquid, what is true about the relationship between temperature and vapor pressure?

W) the relationship depends on the substance

X) vapor pressure increases with temperature

- Y) vapor pressure decreases with temperature
Z) vapor pressure is unaffected by changes in temperature

Bonus Answer: X

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16. BIOLOGY

Writer: Nten Nylam

Toss Up: Multiple Choice

All of the following processes involve hydrogen bonding except

- W) DNA replication
X) Protein folding
Y) Formation of ice crystals
Z) Binding of an enzyme and substrate

Toss Up Answer: Z

Bonus: Multiple Choice

Which of these is not an example of eukaryotic post-transcriptional modification?

- W) The 3' end of the growing strand is cleaved
X) After splicing, exons are rejoined to make a final mRNA transcript
Y) Exons, non-coding regions, are removed via splicing
Z) A poly-A tail is added to the 5' end

Bonus Answer: Y

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17. CHEMISTRY

Writer: Nten Nylam

Toss Up: Short Answer

Boyle's Law describes the relationship between what qualities of a gas/container?

Bonus Answer: Pressure and volume (accept in any order)

Bonus: Short Answer

What are acids with more than 2 ionizable hydrogens called?

Bonus Answer: polyprotic acids

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18. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

Some birds, such as pigeons and doves secrete "milk" that they feed to their children. From which of the following organs does it come from?

- W) Crop
X) Gizzard
Y) Mammary Gland
Z) Stomach

Toss Up Answer: W

Bonus: Short Answer

What is the common name for Columba livia?

Bonus Answer: Feral/City/Street pigeon

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19. CHEMISTRY

Writer: Brian Lim

Toss Up: Multiple Choice

Iron is in which category of elements?

- W) alkali metals
- X) alkaline metals
- Y) transition metals
- Z) metalloids

Toss Up Answer: Y

Bonus: Short Answer

What is the term for the temperature and pressure at which a substance exists at three phases at once in thermal equilibrium?

Bonus Answer: triple point

20. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

What is the name of the first livestock virus eradicated by a vaccine?

- W) Smallpox
- X) Polio
- Y) Rinderpest
- Z) Mumps

Toss Up Answer: Y

Bonus: Short Answer

By mass, what element makes up most of the human body?

Bonus Answer: Oxygen

21. EARTH and SPACE

Writer: Banpreet Singh

Toss Up: Short Answer

Maritime air masses form over

Bonus Answer: water

Bonus: Short Answer

The biosphere may be broken up into about a dozen broad groupings of plants and animals that spread across the Earth at characteristic latitudes and altitudes. These groupings are called

Bonus Answer: biomes

22. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

When the temperature increases, which of the following statements is not true?

- W) Dissolved oxygen decreases at higher temperatures and higher salinity.
- X) Many corals die when the temperature exceeds 86°F.
- Y) Metabolic reactions are less likely to achieve their activation energy.
- Z) The amount of carbon dioxide that can be absorbed by the ocean decreases.

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following carbohydrates contain α -1, 4-linkages?

- W) amylose
- X) Cellulose
- Y) Deoxyarabinose
- Z) Glucose

Bonus Answer: W

23. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

What is the driving force present in a supernova explosion?

- W) electromagnetic force
- X) strong nuclear force
- Y) gravitational force
- Z) weak nuclear force

Toss Up Answer: Y

Bonus: Short Answer

What gas is the Mars atmosphere primarily made up of?

Bonus Answer: Carbon dioxide

24. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

The chemical EDTA is routinely used in many experiments. For example, EDTA is used in electrophoresis buffer solutions. Which of the following statements is not true?

- W) EDTA has a strong binding affinity for divalent and some trivalent cations.
- X) EDTA is a catalyst for polymer formation and essential for protein and nucleic acid polymerization.
- Y) EDTA is a chelator.
- Z) EDTA is used to help denature proteins and weaken cell membranes.

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following statements is not true?

- W) Insects, birds, and many reptiles excrete nitrogenous waste in the form of urea.
- X) Neurons have evolved to speed the communication between distant cells in multi-cellular organisms.
- Y) Synapses are specialized connections between neurons to facilitate the formation of complex neuronal networks.
- Z) The regulatory proteins tropomyosin and troponin control the contraction of contractile filaments, actin and myosin.

Bonus Answer: W

25. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

To the nearest day, how long is the sidereal period of the moon?

Bonus Answer: 27 days

Bonus: Short Answer

The only supernova explosion in modern times visible in the sky to the naked eye became visible in which year?

Bonus Answer: 1987
