

## Round 12

### 1. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

The collision between a photon and a free electron was first explained by which of the following scientists?

- W) Compton
- X) Hertz
- Y) Einstein
- Z) Newton

Toss Up Answer: W

---

Bonus: Multiple Choice

The Tesla and the Gauss are units of measure of

- W) magnetic field strength
- X) conductance
- Y) light
- Z) electrical current

Bonus Answer: W

---

### 2. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

Whose principle or law states that each point on a wavefront may be considered a new wave source?

- W) Snell's Law
- X) Huygen's principle
- Y) Young's Law
- Z) Hertz's Law

Toss Up Answer: X

---

Bonus: Multiple Choice

The wave nature of light is demonstrated by which of the following?

- W) Diffraction
- X) Color
- Y) Length
- Z) Speed of light

Bonus Answer: W

---

### 3. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

Given that the specific heat capacity of water is 11 times that of copper, calculate the mass of copper at a temperature of 100 °C required to raise the temperature of 200 g of water from 20.0 °C to 24.0 °C, assuming no energy is lost to the surroundings.

Bonus Answer: 0.116 kg

---

**Bonus: Short Answer**

1 kg of water at a temperature of 45 °C is mixed with 1.5 kg of alcohol at 20 °C. Find the final temperature of the mixture.

Take the specific heat capacity of water to be 4200 J kg<sup>-1</sup> K<sup>-1</sup> and the specific heat capacity of alcohol to be 2400 J kg<sup>-1</sup> K<sup>-1</sup>. Assume no other exchange of heat occurs.

**Bonus Answer: 33°C**

=====

## 4. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Short Answer**

What is the resulting electrical potential, in volts, when a charge of 12 coulombs is applied to a 1 farad capacitor?

**Bonus Answer: 12 volts**

=====

**Bonus: Short Answer**

If 1000 pounds is applied to a spring with spring constant of 100 pounds per inch on top of a hydraulic piston, how many pounds of force is transferred to the piston?

**Bonus Answer: 1,000**

=====

## 5. PHYSICS

**Writer: Mohammed Jamil**

**Toss Up: Multiple Choice**

Which statement describes a situation when polarization could not occur?

- W) Light waves are reflected.
- X) Light waves are scattered.
- Y) Microwaves pass through a metal grid.
- Z) Sound waves pass through a metal grid.

**Toss Up Answer: Z**

=====

**Bonus: Multiple Choice**

An electromagnetic wave has a wavelength that is numerically of the same order of magnitude as the diameter of a nucleus.

In which region of the electromagnetic spectrum does the wave occur?

- W) Gamma ray
- X) X-ray
- Y) Visible light
- Z) Infra-red

**Bonus Answer: W**

=====

## 6. MATHEMATICS

**Writer: Aaron Gee**

**Toss Up: Multiple Choice**

Solve the following equation for x:

$$x^2 - 20x + 19 = 0$$

- W) 9, 10
- X) 10 and 9
- Y) 21 and 19

Z) 19 and 1

**Toss Up Answer: Z**

---

**Bonus: Short Answer**

Convert log base 4 of 53 into a base 10 expression:

**Bonus Answer:  $\log 53 / \log 4$**

---

## 7. MATHEMATICS

**Writer: William Xiang**

**Toss Up: Short Answer**

Find the integral of  $2x^3 + 2$  with respect to  $x$  in simplest terms.

**Bonus Answer:  $(x^4)/2 + 2x$**

---

**Bonus: Multiple Choice**

Which of the following is a conic section?

W) Cylinder

X) Triangle

Y) Hyperbola

Z) Asymptote

**Bonus Answer: Y**

---

## 8. MATHEMATICS

**Writer: William Xiang**

**Toss Up: Short Answer**

Find the first derivative of  $10x^3 + 3x^2 + 3$  in the simplest form.

**Bonus Answer:  $30x^2 + 6x$**

---

**Bonus: Short Answer**

How many points of inflection does the graph  $x^3 + 5$  have?

**Bonus Answer: 1**

---

## 9. MATHEMATICS

**Writer: Larry Wong**

**Toss Up: Short Answer**

What is the value of 125 to the  $\frac{2}{3}$  power?

**Bonus Answer: 25**

---

**Bonus: Short Answer**

What is the argument of  $1 + \sqrt{3}i$ ?

**Bonus Answer: 60**

---

## 10. BIOLOGY

**Writer: Henry Zheng**

**Toss Up: Short Answer**

What is another name for the voice box?

**Bonus Answer: Larynx**

---

**Bonus: Short Answer**

Which part of the larynx is responsible for sound production?

Bonus Answer: Intrinsic laryngeal muscles (accept intrinsic, intrinsic muscles)

=====

## 11. BIOLOGY

Writer: Henry Zheng

Toss Up: Short Answer

What state was the first to use DNA to exonerate an accused serial rapist/murderer?

Bonus Answer: Virginia

-----

Bonus: Short Answer

Who was the first person to be exonerated based on contradictory DNA evidence?

Bonus Answer: David Vasquez

=====

## 12. BIOLOGY

Writer: Henry Zheng

Toss Up: Short Answer

What state was the first to use DNA to capture a serial rapist/murderer?

Bonus Answer: Virginia

-----

Bonus: Short Answer

Who was the first murderer to be convicted on the basis of DNA evidence?

Bonus Answer: Timothy Wilson Spencer (accept Spencer, Timothy Spencer, Southside Strangler"

=====

## 13. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

What light-sensitive cells in the eye detect colors?

W) Rods

X) Cones

Y) Retina

Z) Lens

Toss Up Answer: X

-----

Bonus: Short Answer

What are the three types of cones?

Bonus Answer: blue, green, red (accept in any order)

=====

## 14. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

What is it called when a protein loses its 3-dimensional shape?

Bonus Answer: Denatured

-----

Bonus: Short Answer

Of the 4, name all the following that are not common amino acids: histidine, isoleucine, glutamine, isovaline

Bonus Answer: Isovaline

=====

## 15. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

Which human organ, comprised mostly of lymphoid, is essential for the growth of T cells?

**Bonus Answer: Thymus**

---

**Bonus: Short Answer**

What cells are responsible for forming blood platelets?

**Bonus Answer: Megakaryocytes**

---

## 16. BIOLOGY

**Writer: Jason Weng**

**Toss Up: Multiple Choice**

Which of the following blood types has blood cells that possess antibodies for type A antigens?

W) A

X) AB

Y) B

Z) O

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

Which molecule produced by alveolar cells cause the decrease in surface tension within alveoli?

**Bonus Answer: Pulmonary surfactant**

---

## 17. BIOLOGY

**Writer: Mohammed Jamil**

**Toss Up: Multiple Choice**

Which type of cell has a large number of glycoproteins on the cell surface membrane?

W) Ciliated cell

X) Goblet cell

Y) Lymphocyte

Z) Red blood cell

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

Name the bond that forms between glucose molecules in polysaccharides, such as amylose.

**Bonus Answer: Glycosidic bond**

---

## 18. CHEMISTRY

**Writer: Jason Weng**

**Toss Up: Multiple Choice**

How much heat, in kJ, is needed to heat 1 kg of water 1 Kelvin if the specific heat of water is 4.18?

W) 4.18 kJ

X) 41.8 kJ

Y) 418 kJ

Z) 4180 kJ

**Toss Up Answer: Z**

---

**Bonus: Multiple Choice**

What is the molecular geometry of phosphorous trifluoride according to the VSEPR theory?

W) Bent

X) Seesaw

Y) Trigonal pyramid

Z) T-shape

**Bonus Answer: Y**

=====

## 19. CHEMISTRY

**Writer: Jason Weng**

**Toss Up: Multiple Choice**

According to the VSEPR theory, what shape does methane assume?

- W) Trigonal pyramid
- X) Linear
- Y) Tetrahedron
- Z) Octahedron

**Toss Up Answer: Y**

=====

**Bonus: Multiple Choice**

How many pi and sigma bond are present in hexene, respectively?

- W) 17 pi, 1 sigma
- X) 1 pi, 17 sigma
- Y) 2 pi, 16 sigma
- Z) 16 pi, 2 sigma

**Bonus Answer: X**

=====

## 20. CHEMISTRY

**Writer: Mohammed Jamil**

**Toss Up: Short Answer**

What is the chemical equation(s) for the reversible reaction(s) in the contact process

**Bonus Answer:  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$**

=====

**Bonus: Multiple Choice**

Which set of conditions would promote the fastest rate for the converter reaction in the contact process?

- W) No catalyst, high pressure, low temperature. Catalyst, high pressure, high temperature. Catalyst, low pressure, low temperature. Catalyst, low pressure, high temperature.
- X) Catalyst, high pressure, high temperature.
- Y) Catalyst, low pressure, low temperature
- Z) No catalyst, high pressure, low temperature. Catalyst, high pressure, high temperature. Catalyst, low pressure, low temperature. Catalyst, low pressure, high temperature.

**Bonus Answer: X**

=====

## 21. CHEMISTRY

**Writer: Mohammed Jamil**

**Toss Up: Multiple Choice**

What suggests that metal, M, is not in Group I of the Periodic Table?

- W) M has a bright, silvery appearance and is a good conductor of electricity.
- X) M is hard and difficult to cut
- Y) M produces an alkaline solution when it reacts with water.
- Z) M produces hydrogen gas when it reacts with water.

**Toss Up Answer: X**

---

**Bonus: Multiple Choice**

Lactic acid,  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$ , causes pain when it builds up in muscles.

Which reagent reacts with both of the  $-\text{OH}$  groups in lactic acid?

W) acidified potassium dichromate(VI)

X) ethanol

Y) sodium

Z) sodium hydroxide

**Bonus Answer: Y**

---

## 22. CHEMISTRY

**Writer: Andrew Chen**

**Toss Up: Short Answer**

What is the common name of the simplest molecule with a carbonyl group?

**Bonus Answer: formaldehyde**

---

**Bonus: Multiple Choice**

What would be the best indicator for the titration of a weak base with a strong acid?

W) phenolphthalein

X) bromothymol blue

Y) methyl yellow

Z) methyl violet

**Bonus Answer: Y**

---

## 23. EARTH and SPACE

**Writer: Mohammed Haque**

**Toss Up: Multiple Choice**

What metal is Mercury mainly comprised of ?

W) Lithium

X) Magnesium

Y) Iron

Z) Lead

**Toss Up Answer: Y**

---

**Bonus: Multiple Choice**

How long is Mercury's orbital period (Earth days)?

W) 88 days

X) 165 days

Y) 49 days

Z) 57 days

**Bonus Answer: W**

---

## 24. EARTH and SPACE

**Writer: Mohammed Haque**

**Toss Up: Multiple Choice**

Which of the 3 following components needed for the formation of a star?

- W) Helium, lithium, and pressure.
- X) Helium, pressure, and time.
- Y) Hydrogen, pressure, and time.
- Z) Magnesium, pressure, and time.

**Toss Up Answer: Y**

---

**Bonus: Multiple Choice**

What gas is Venus's atmosphere mainly composed of?

- W) Carbon Monoxide
- X) Hydrogen Gas
- Y) Carbon Dioxide
- Z) Carbon is a gaseous form

**Bonus Answer: Y**

---

## 25. EARTH and SPACE

**Writer: Henry Zheng**

**Toss Up: Short Answer**

What is the most abundant gas in the atmosphere?

**Bonus Answer: Nitrogen**

---

**Bonus: Multiple Choice**

An example of a density-dependent factor is

- W) weather
- X) climate
- Y) air
- Z) food

**Bonus Answer: Z**

---