Round 37

1. PHYSICS

Writer: Yevgeniy Gorbachev

Toss Up: Short Answer

If a rocket has a specific impulse of 800 seconds, what is its exhaust velocity, in m/s? Assume standard gravity to be 10 m/s^2.

Bonus Answer: Answer: 8000 m/s (also acceptable: 8 km/s). Exhaust velocity is the product of specific impulse as a unit of time and standard gravity.

Bonus: Short Answer

If an engine has a specific impulse of 500 seconds and a thrust of 10 kN, how long will it take the engine to burn 50 kg of fuel? Assume standard gravity to be 10 m/s^2.

Bonus Answer: Answer: 25 seconds.

Since Fthrust = Gstandard×Isp×R, where

Fthrust = instantaneous thrust of the engine (in newtons)

Gstandard = standard gravity (usually 9.81 m/s^2, but for simplicity we round to 10)

Isp = specific impulse of the engine in seconds

R = mass flow rate in kg/s

10000 = 10×500×R, so R = 2 kg/s

50kg/2kg/s = 25s

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2. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A military cannon fires a boy into the air at an angle of 45° above the horizontal, reaching a max height y above his original launch height. The cannon is now aimed so that it fires straight up into the air at an angle of 90° to the horizontal. What is the maximum height reached by the same boy now? (let y represent height)

Bonus Answer: 2y

Bonus: Short Answer

a

Bonus Answer: a

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3. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What is the S.I. unit for luminous intensity?

W) Lumen

X) Candela

Y) Newton

Z) Watts

Toss Up Answer: X

Bonus: Multiple Choice

For an isotropic source how many candelas equals 3 lumens?

W) 12π

X) 10π

Y) 4π

Z) 2π

Bonus Answer: W

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4. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

If the sound intensity is 10,000 times the threshold of hearing then what is the intensity in decibels?

Bonus Answer: 40dB

Bonus: Short Answer

At what standard frequency would 60 decibels have a loudness of 60 phons?

Bonus Answer: 1000Hz

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5. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What is the relativistic mass of a particle with a rest mass of 8g traveling at a speed of .6c?

W) 4g

X) 8g

Y) 10g

Z) 12g

Toss Up Answer: Y

Bonus: Multiple Choice

What is the length of a 1 meter rod traveling on a spaceship going at .8c, as measured by an astronaut on the ship?

W) .8m

X) .6m

Y) 1m

Z) 1.25m

Bonus Answer: Y

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6. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the amplitude of y=4sin(5x+3)

Bonus Answer: 4

Bonus: Short Answer

What is the period of y=4sin(5x+3) rounded to the nearest 100th

Bonus Answer: 1.26

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7. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is tan(arcsin(9/41))

Bonus Answer: 9/40

Bonus: Short Answer

What is sin(arccot(tan(arccos(3/5))))

Bonus Answer: 3/5

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8. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

How many seconds are in a day

Bonus Answer: 86400

Bonus: Multiple Choice

How many days are in a second

W) 1.16*10^-3

X) 1.16*10^-4

Y) 1.16*10^-5

Z) 1.16*10^-6

Bonus Answer: Y

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9. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

How many distinct roots does x^3-6x^2+32 have

Bonus Answer: 2

Bonus: Short Answer

What is the remainder when x^3-6x^2+32 is divided by x-1

Bonus Answer: 27

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10. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Neurotransmitters are received by which kinds of receptors?

W) G protein coupled receptors

X) receptor tyrosine kinases

Y) ion gated channels

Z) intracellular receptors

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following is the immediate effect of a signal molecule binding to a receptor tyrosine kinase molecule?

W) It forms a dimer with another receptor tyrosine kinase.

X) It initiates a phosphorylation cascade.

Y) It becomes activated with phosphate groups.

Z) It attaches to a scaffolding protein.

Bonus Answer: W

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11. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Which of the following intermolecular interactions is not exclusive to a single polypeptide's tertiary structure?

W) hydrophobic interactions

X) polar interactions

Y) hydrogen bonding

Z) disulfide bridges

Toss Up Answer: Y

Bonus: Short Answer

Polypeptide folding is aided by which type of cavity-structured proteins?

Bonus Answer: Chaperonins

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12. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Cellulose and glycogen differ in

W) their alpha/beta glucose configurations

X) branching

Y) their ability to be metabolized

Z) all of the above

Toss Up Answer: Z

Bonus: Short Answer

N-Acetylglucosamine is the monomer of which common polysaccharide?

Bonus Answer: Chitin

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13. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Name all of the following that are amphipathic: integral proteins, cholesterol, phospholipids, triacylglycerol, mannose

Bonus Answer: integral proteins ad phospholipids

Bonus: Multiple Choice

Which of the following is not true about a part of the phospholipid?

W) They contain two fatty acid chains.

X) Their heads contain a net charge.

Y) They have a phosphate group in their heads.

Z) They have a choline group in their heads.

Bonus Answer: X

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14. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Exocytotic vesicles are most frequently exported via the

W) endoplasmic reticulum

X) the nuclear envelope

Y) the trans Golgi

Z) the cis Golgi

Toss Up Answer: Y

Bonus: Multiple Choice

Endosomes formed as a result of receptor-mediated endocytosis are most frequently coated with which type of proteins?

W) G proteins

X) clathrins

Y) pseudopodium

Z) microtubules

Bonus Answer: X

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15. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

What transmissible agent causes Mad Cow Disease (BSE)?

W) Viron

X) Virus

Y) Bacteria

Z) Prion

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following are prions made up of?

W) Proteins, only

X) Nucleic Acids, only

Y) Proteins and Nucleic Acids, only

Z) Proteins and Carbohydrates, only

Bonus Answer: W

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16. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is present in plant cells but not animal cells?

W) Nuclei

X) Plasmodesmata

Y) Mitochondria

Z) Vacuoles

Toss Up Answer: X

Bonus: Short Answer

What is the name of the theory that explains the existence of mitochondria (and why they have their own DNA)?

Bonus Answer: Endosymbiotic Theory

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17. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is a retrovirus?
W) HIV
X) Hepatitis B virus
Y) Poliovirus
Z) Influenza A virus
Toss Up Answer: W

Bonus: Short Answer
Where do DNA viruses usually replicate?
Bonus Answer: In the nucleus.

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18. CHEMISTRY

Writer: Calvin Vuong
Toss Up: Multiple Choice
The relation between pressure and temperature of two ideal gases is stated in
W) Gay-Lussac's Law
X) Boyle's Law
Y) Charles's Law
Z) Avogadro's Law
Toss Up Answer: W

Bonus: Short Answer
What are the dimensions of the gas constant R in SI base units?
Bonus Answer: kg m^2 mol^−1 K^−1 s^−2 (accept as a fraction)

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19. CHEMISTRY

Writer: Jason Weng
Toss Up: Short Answer
How many hydrogen atoms does a molecule of acetone have?
Bonus Answer: 6

Bonus: Short Answer
What is the electron configuration of Cr3+ using noble gas notation?
Bonus Answer: [Ar]3d^3

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20. CHEMISTRY

Writer: Jason Weng
Toss Up: Multiple Choice
What is the most reasonable pH of the solution when the salt formed by reacting hydrochloric acid and aluminum hydroxide is dissolved in water?
W) 7
X) 4
Y) 10
Z) 0
Toss Up Answer: X

Bonus: Short Answer
125 mL from a 4M perchloric acid stock solution is reacted with excess sodium hydroxide. How many moles of the salt are formed if the system is 50% efficient?
Bonus Answer: 0.25 mol; 1/4 mol

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21. CHEMISTRY

Writer: Jason Weng

Toss Up: Short Answer

What is the oxidation number of chromium in the dichromate ion?

Bonus Answer: +6

Bonus: Short Answer

Name the following: $CuCr_2O_7$.

Bonus Answer: Copper (II) dichromate; or Cupric dichromate

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22. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

Which of the following substances cannot be decomposed further chemically?

W) Carbon Dioxide

X) Water

Y) Silicon

Z) Ammonia

Toss Up Answer: Y

Bonus: Short Answer

If 0.5 moles of NaCl are dissolved in 2 kg of water, what is the molality of the resulting solution?

Bonus Answer: 0.25 or 1/4

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23. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What spectral type does the star Betelgeuse fall into?

Bonus Answer: M

Bonus: Multiple Choice

When was the last major supernova in the Milky Way detected?

W) 1604

X) 1863

Y) 1973

Z) 1989

Bonus Answer: W

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24. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

If we could observe all forms of radiation, what would the brightest star be?

Bonus Answer: Betelgeuse

Bonus: Multiple Choice

In 12000 years, which star will take the place of our North Star?

W) Aldebaran

X) Vega

Y) Sirius
Z) Rigel

Bonus Answer: X

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25. EARTH and SPACE

Writer: Shantanu Jha

Toss Up: Short Answer

What phenomena best explains why the sky is blue?

Bonus Answer: Rayleigh Scattering

Bonus: Short Answer

What are the high intensity spots of light at the horizontal points of the 22 degree halo that may form around the sun due to ice crystals in the air called?

Bonus Answer: Parhelia (ALSO ACCEPT: Sun Dogs, Parhelion)

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