

Round 3

1. PHYSICS

Toss Up: Multiple Choice

A transverse traveling sinusoidal wave on a string has a frequency of 100Hz, a wavelength of 0.040m, and an amplitude of 2.0mm. The maximum velocity in m/s of any point on the string is

- W) 0.2
- X) 1.3
- Y) 4
- Z) 15

Toss Up Answer: X

Bonus: Multiple Choice

The time required for a small pulse to travel from A to B on a stretched cord shown is NOT altered by changing

- W) the linear mass density of the cord
- X) the length between A and B
- Y) the shape of the pulse
- Z) the tension in the cord

Bonus Answer: Y

2. PHYSICS

Toss Up: Multiple Choice

Find the angular frequency of oscillations in a LC circuit if the total inductance is 2 henry and the total capacitance is 8 farad.

- W) 1/4
- X) 1/2
- Y) 1/3
- Z) 1/5

Toss Up Answer: W

Bonus: Short Answer

An LC circuit has an inductance of 20mH and a capacitance of 5.0 μF . At time

$t = 0$ the charge on the capacitor is 3.0 μC and the current is 7.0mA. The total energy in joules is:

Bonus Answer: 9.0×10^{-7} (accept equivalent forms)

3. PHYSICS

Toss Up: Short Answer

A certain heat engine draws 500 cal/s from a water bath at 27° C and transfers 400 cal/s to a reservoir at a lower temperature. The efficiency of this engine is:

Bonus Answer: 20%

Bonus: Multiple Choice

An Carnot refrigerator runs between a cold reservoir at temperature T_C and a hot reservoir at temperature T_H . You want to increase its coefficient of performance. Of the following, which change results in the greatest increase in the coefficient? The value of ΔT is the same for all changes.

- W) Raise the temperature of the hot reservoir by ΔT
- X) Raise the temperature of the cold reservoir by ΔT
- Y) Lower the temperature of the hot reservoir by $1/2 \Delta T$ and raise the temperature of the cold reservoir by $1/2 \Delta T$
- Z) Lower the temperature of the cold reservoir by ΔT

Bonus Answer: X

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4. PHYSICS

Toss Up: Multiple Choice

Which of the following is NOT a state variable?

- W) Work
- X) Heat
- Y) Entropy
- Z) Pressure

Toss Up Answer: W

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Bonus: Short Answer

During an isobaric process, 80 joules of work is done on the surroundings by the gas. How much energy is added in joules?

Bonus Answer: 200 joules

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5. MATHEMATICS

Toss Up: Short Answer

What is the 3rd mercenne prime?

Bonus Answer: 31

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Bonus: Multiple Choice

How many terms does the 15th integral of $\sin x \, dx$ have?

- W) 1
- X) 2
- Y) 15
- Z) 16

Bonus Answer: Z

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6. MATHEMATICS

Toss Up: Multiple Choice

Given two attempts, what is the probability of getting a multiple choice question correct, if there are 5 choices?

- W) 1:3
- X) 1:4
- Y) 2:3
- Z) 2:4

Toss Up Answer: Y

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Bonus: Multiple Choice

What percentage of data falls within 2 standard deviations of the mean, assuming a normal distribution?

- W) 34.10%
- X) 47.70%
- Y) 68.20%
- Z) 95.40%

Bonus Answer: Z

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7. MATHEMATICS

Toss Up: Short Answer

What is the relationship between the surface area and the volume of a sphere?

Bonus Answer: The surface area is the derivative of the volume/ the volume is the integral of the surface area when the constant is 0

Bonus: Multiple Choice

When the inner diagonal of a cube is 7 times root 3 inches, what is the surface area of the cube?

- W) 216 square inches
- X) 294 square inches
- Y) 343 square inches
- Z) 512 square inches

Bonus Answer: X

8. MATHEMATICS

Toss Up: Short Answer

What is $(1000! + 999!)/(998!)$?

Bonus Answer: 999,999

Bonus: Short Answer

What is the first number with 5 distinct prime factors?

Bonus Answer: 2,310

9. BIOLOGY

Toss Up: Multiple Choice

Two bones that have prominent epicondyles are the...

- W) radius and ulna
- X) femur and humerus
- Y) femur and scapula
- Z) tibia and radius

Toss Up Answer: X

Bonus: Multiple Choice

The radial notch is found on the..

- W) ulna
- X) radius
- Y) carpals
- Z) humerus

Bonus Answer: W

10. BIOLOGY

Toss Up: Multiple Choice

The part of the scapula that articulates with the humerus is the...

- W) acromion process.
- X) glenoid fossa.
- Y) infraspinous fossa.
- Z) supraspinous fossa.

Toss Up Answer: X

Bonus: Multiple Choice

The clavicle articulates with what two bones?

- W) scapula and sternum
- X) humerus and vertebra
- Y) humerus and sternum
- Z) scapula and vertebra

Bonus Answer: W

11. BIOLOGY

Toss Up: Multiple Choice

In the sacrum, the landmark that separates the abdominal cavity from the pelvic cavity is the...

- W) alae
- X) median sacral crest
- Y) sacral promontory
- Z) sacral foramina

Toss Up Answer: Y

Bonus: Multiple Choice

Of the 12 pairs of ribs, how many pair(s) is/are vertebrochondral?

- W) 7
- X) 5
- Y) 3
- Z) 6

Bonus Answer: Y

12. BIOLOGY

Toss Up: Multiple Choice

The internal gelatinous portion of the intervertebral disk is called the...

- W) nucleus pulposus
- X) pedicle
- Y) inferior articular process
- Z) annulus fibrosus

Toss Up Answer: W

Bonus: Multiple Choice

The region of the vertebral column that is most susceptible to herniated disks is the...

- W) cervical region
- X) sacral region
- Y) lumbar region
- Z) coccygeal region

Bonus Answer: Y

13. BIOLOGY

Toss Up: Multiple Choice

The openings between vertebrae through which spinal nerves exit from the spinal cord are...

- W) transverse foramina
- X) intervertebral foramina
- Y) vertebral foramina
- Z) spinal foramina

Toss Up Answer: X

Bonus: Multiple Choice

The vertebral arch...

- W) consists of two laminae and two pedicles
- X) is anterior to the body of the vertebra
- Y) is the passageway for the vertebral arteries
- Z) is present only in the cervical vertebrae

Bonus Answer: W

14. CHEMISTRY

Toss Up: Multiple Choice

The number of degrees of freedom of a triatomic molecule is:

- W) 1
- X) 3
- Y) 6
- Z) 9

Toss Up Answer: Z

Bonus: Short Answer

The internal energy of an ideal gas depends on which of the following: temperature, pressure, volume.

Bonus Answer: Temperature

15. CHEMISTRY

Toss Up: Multiple Choice

If the molecules in a tank of hydrogen have the same rms speed as the molecules in a tank of oxygen, we may be sure that:

- W) the pressures are the same
- X) the hydrogen is at the greater pressure
- Y) the temperatures are the same
- Z) the oxygen is at the higher temperature

Toss Up Answer: Z

Bonus: Multiple Choice

The number of degrees of freedom of a rigid diatomic molecule is

- W) 2
- X) 3
- Y) 4
- Z) 5

Bonus Answer: Z

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16. CHEMISTRY

Toss Up: Multiple Choice

An adiabatic process for an ideal gas is represented on a p-V diagram by:

- W) a horizontal line
- X) a vertical line
- Y) a hyperbola
- Z) none of these

Toss Up Answer: Z

Bonus: Multiple Choice

Evidence that molecules of a gas are in constant motion is:

- W) winds exert pressure
- X) two gases interdiffuse quickly
- Y) warm air rises
- Z) gases are easily compressed

Bonus Answer: X

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17. CHEMISTRY

Toss Up: Multiple Choice

Which of the following is not a reason for the use of nitrogen in many explosives?

- W) these explosives form gases, which expand
- X) the bond between two nitrogen atoms is very strong
- Y) these explosives form toxic compounds such as cyanide
- Z) nitrogen is widely available

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following is closest to the bond angle in ammonia?

- W) 120 degrees
- X) 109.5 degrees
- Y) 107 degrees
- Z) 100 degrees

Bonus Answer: Y

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18. CHEMISTRY

Toss Up: Multiple Choice

Which of the following is more soluble in ethanol than in water?

- W) I₂
- X) HCl
- Y) AgNO₃
- Z) NH₃

Toss Up Answer: W

Bonus: Short Answer

Reactions of which order are typically associated with catalysts?

Bonus Answer: zeroth

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19. CHEMISTRY

Toss Up: Multiple Choice

Which one of the following has the greatest tendency to lose an electron?

W) Zn

X) Cl-

Y) Br₂

Z) A mixture of PbSO₄ and H₂O

Toss Up Answer: W

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Bonus: Short Answer

The wavelength of yellow light is 600 nanometers. What is the wavelength in centimeters: (use scientific notation)

Bonus Answer: 6.0×10^{-5}

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20. EARTH and SPACE

Toss Up: Multiple Choice

The time between two successive passages of the Sun across a given meridian is called a

W) civil day

X) conventional day

Y) mean solar day

Z) solar day

Toss Up Answer: Z

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Bonus: Short Answer

What is the time from when a star crosses an observers meridian until the same star next crosses the observer's meridian called?

Bonus Answer: sidereal day

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21. EARTH and SPACE

Toss Up: Multiple Choice

The best evidence of Earth's nearly spherical shape is obtained through

W) telescopic observations of other planets

X) photographs of Earth from an orbiting satellite

Y) observations of the Sun's altitude made during the day

Z) observations of the Moon made during solar eclipses

Toss Up Answer: X

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Bonus: Short Answer

Earth's spherical shape "bulges" very slightly at the Equator and is very slightly "flattened" at the poles. What is this shape called?

Bonus Answer: oblate spheroid

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22. EARTH and SPACE

Toss Up: Multiple Choice

Which observation provides the best evidence that Earth rotates?

W) The position of the planets among the stars changes during the year.

X) The location of the constellations in relationship to Polaris changes from month to month.

Y) The length of the shadow cast by a flagpole at noontime changes from season to season.

Z) The direction of swing of a freely swinging pendulum changes during the day.

Toss Up Answer: Z

Bonus: Multiple Choice

Earth's axis of rotation is tilted twenty three and a half degrees from a line perpendicular to the plane of its orbit. What would be the result if the tilt was increased to thirty three and a half degrees?

W) an increase in the amount of solar radiation received by Earth.

X) colder winters and warmer summers in New York State

Y) less difference between winter and summer temperatures in New York State

Z) shorter days and longer nights at the Equator

Bonus Answer: X

23. EARTH and SPACE

Toss Up: Multiple Choice

Earth is farthest from the Sun during the Northern Hemisphere's summer, and Earth is closest to the Sun during the Northern Hemisphere's winter. During which season in the Northern Hemisphere is Earth's orbital velocity greatest?

W) Winter

X) Spring

Y) Summer

Z) Fall

Toss Up Answer: W

Bonus: Multiple Choice

Which information about a nearby star must be known to determine its distance from an observer?

W) size

X) color

Y) temperature

Z) parallax

Bonus Answer: Z

24. EARTH and SPACE

Toss Up: Short Answer

What month does earth's perihelion occur in?

Bonus Answer: January

Bonus: Multiple Choice

What is the name of the supercontinent that formed about 600 million years ago, just before Pangaea?

W) Pannotia

X) Ur

Y) Laurentia

Z) Columbia

Bonus Answer: W

25. ENERGY

Toss Up: Multiple Choice

Oil, coal, and natural gas supply what percent of energy used in the US?

W) 10

X) 35

Y) 55

Z) 90

Toss Up Answer: Z

Bonus: Multiple Choice

A permeable rock that contains hydrocarbon fluids and gasses is called:

W) An oil trap

X) A source bed

Y) An oil reservoir

Z) An oil pocket

Bonus Answer: Y
