nagytibo@msu

Nagy,

Tibor

Please, sit in row L.

Keep this exam **CLOSED** until advised by the instructor.

50 minute long closed book exam.

Fill out the bubble sheet: last name, first initial, **student number (PID)**. Leave the section, code, form and signature areas empty.

Three two-sided handwritten 8.5 by 11 help sheets are allowed.

When done, hand in your **test** and your **bubble sheet**.

Thank you and good luck!

Posssibly useful constants:

- g = 9.81 m/s^2
- G = 6.67×10^{-11} Nm^2/kg^2
- ρ_{water} = 1000 kg/m^3 = 1 kg/l = 1 g/cm^3
- 1 atm = 101.3 kPa
- N$_A$ = 6.02×10^{23} 1/mol
- R = 8.31 J/(molK)
- k$_B$ = 1.38×10^{-23} J/K
- 0 °C = 273.15 K

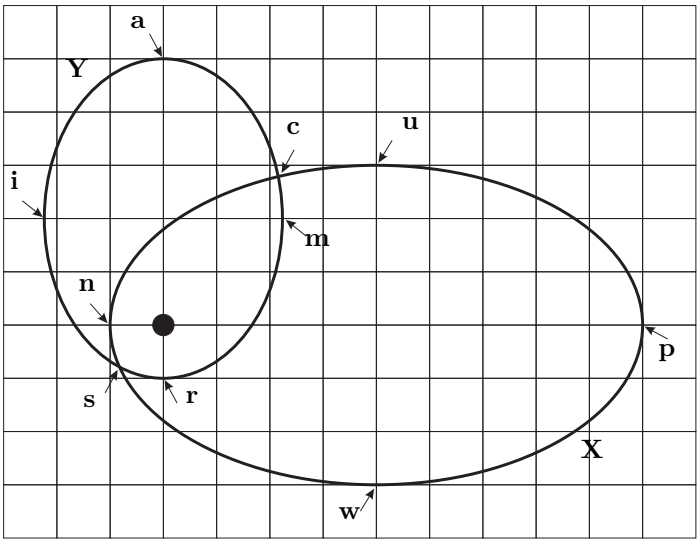
1 pt Are you sitting in the seat assigned?

1.**A**◯ Yes, I am.

3 pt Planet-X has a mass of 4.70×10^{24} kg and a radius of 8160 km. What is the Escape Speed *i.e.* the minimum speed required for a satellite in order to break free permanently from the planet?
(in `km/s`*)*

2. **A**◯ 5.61 **B**◯ 7.01 **C**◯ 8.77
D◯ 1.10×10^1 **E**◯ 1.37×10^1 **F**◯ 1.71×10^1
G◯ 2.14×10^1 **H**◯ 2.68×10^1

10 pt The paths of two small satellites, X and Y, of equal mass of 6.00 kg each, are shown below. They orbit around a massive star, as illustrated, with M = 7.20×10^{29} kg. The orbits are in the plane of the paper and are drawn to scale.



In the statements below KE is kinetic energy, PE is potential energy, and $|\mathbf{L}|$ is magnitude of the angular momentum.

▷ The PE of Y at a is .... the PE of X at p.
3. **A**◯ greater than **B**◯ less than
C◯ equal to

▷ The $|\mathbf{L}|$ of Y at a is .... that at r.
4. **A**◯ greater than **B**◯ less than
C◯ equal to

▷ The speed of X at p is .... that at u
5. **A**◯ greater than **B**◯ less than
C◯ equal to

▷ At s, the PE of X is .... that of Y.
6. **A**◯ greater than **B**◯ less than
C◯ equal to

▷ At s, the KE of X is .... that of Y.
7. **A**◯ greater than **B**◯ less than
C◯ equal to

2 pt Which one weighs more, one kilogram iron or one kilogram feather?

8.**A**◯ They weigh the same.
B◯ The feather weighs more.
C◯ The iron weighs more.
D◯ It depends on the type of the iron and the feather.

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2 pt Which one displaces more water, one kilogram wood or one kilogram styrofoam?

9.**A**◯ It depends on the type of the wood and the styrofoam.
B◯ They displace the same amount of water.
C◯ The styrofoam displaces more water.
D◯ The wood displaces more water.

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2 pt Which one displaces more water, one kilogram iron or one kilogram styrofoam?

10.**A**◯ It depends on the type of the iron and the styrofoam.
B◯ The styrofoam displaces more water.
C◯ They displace the same amount of water.
D◯ The iron displaces more water.

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4 pt An object weighs 73.8 N in air. When it is suspended from a force scale and completely immersed in water the scale reads 22.9 N. Determine the density of the object.
(in `kg/m^3`*)*

11. **A**◯ 1.45×10^3 **B**◯ 1.81×10^3 **C**◯ 2.27×10^3
D◯ 2.83×10^3 **E**◯ 3.54×10^3 **F**◯ 4.42×10^3
G◯ 5.53×10^3 **H**◯ 6.91×10^3

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3 pt What is the sound level of a sound with an intensity of $I = 1.00 \times 10^{-6}$ W/m^2? Give your answer in dB units.

12. **A**◯ 13.57 **B**◯ 19.68 **C**◯ 28.54
D◯ 41.38 **E**◯ 60.00 **F**◯ 87.00
G◯ 126.15 **H**◯ 182.92

3 pt Now the intensity of this sound is increased to a value of 44.0 times of its original intensity. What is the new increased sound level? Give your answer in dB units.

13. **A**◯ 32.49 **B**◯ 43.21 **C**◯ 57.47
D◯ 76.43 **E**◯ 101.66 **F**◯ 135.21
G◯ 179.82 **H**◯ 239.16

4 pt A truck horn emits a sound with a frequency of 235 Hz. The truck is moving on a straight road with a constant speed. If a person standing on the side of the road hears the horn at a frequency of 255 Hz, then what is the speed of the truck? Use 340 m/s for the speed of the sound.
(in `m/s`*)*

14. **A**◯ 1.51×10^1 **B**◯ 2.01×10^1 **C**◯ 2.67×10^1
D◯ 3.55×10^1 **E**◯ 4.72×10^1 **F**◯ 6.27×10^1
G◯ 8.34×10^1 **H**◯ 1.11×10^2

3 pt An organ pipe is 1.70 m long and it is open at one end and closed at the other end. What are the frequencies of the lowest three harmonics produced by this pipe? The speed of sound is 340 m/s. Only one answer is correct.

15. **A**◯ 50 Hz, 100 Hz, 150 Hz
B◯ 100 Hz, 300 Hz, 500 Hz
C◯ 50 Hz, 100 Hz, 200 Hz
D◯ 50 Hz, 150 Hz, 250 Hz
E◯ 200 Hz, 600 Hz, 1000 Hz
F◯ 200 Hz, 300 Hz, 400 Hz
G◯ 200 Hz, 400 Hz, 600 Hz
H◯ 100 Hz, 200 Hz, 300 Hz

3 pt The height of the Eiffel tower is 321 m during the Summer when the temperature is 28.2 °C. What is the magnitude of the change in the height of the tower, when the temperature cools down to -19.5 °C during the Winter? The coefficient of linear expansion of the tower's material is 1.10×10^{-5} 1/C°.
(in `cm`*)*

16. **A**◯ 6.90 **B**◯ 8.62 **C**◯ 1.08×10^{1}
D◯ 1.35×10^{1} **E**◯ 1.68×10^{1} **F**◯ 2.11×10^{1}
G◯ 2.63×10^{1} **H**◯ 3.29×10^{1}

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4 pt What is the pressure of 1.66 moles of Nitrogen gas in a 6.13 liter container, if the temperature of the gas is 31.6 °C?
(in `atm`*)*

17. **A**◯ 4.23 **B**◯ 4.95 **C**◯ 5.79 **D**◯ 6.77
E◯ 7.92 **F**◯ 9.27 **G**◯ 10.84 **H**◯ 12.69

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2 pt A gas bottle contains 5.12×10^{23} Hydrogen molecules at a temperature of 315 K. What is the thermal energy of the gas? (You might need to know Boltzmann's constant: $k_B = 1.38 \times 10^{-23}$ J/K.)
(in `J`*)*

18. **A**◯ 4.19×10^{3} **B**◯ 5.57×10^{3} **C**◯ 7.40×10^{3}
D◯ 9.85×10^{3} **E**◯ 1.31×10^{4} **F**◯ 1.74×10^{4}
G◯ 2.32×10^{4} **H**◯ 3.08×10^{4}

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2 pt What is the average energy of a single molecule?
(in `J`*)*

19. **A**◯ 1.17×10^{-21} **B**◯ 1.70×10^{-21}
C◯ 2.46×10^{-21} **D**◯ 3.57×10^{-21}
E◯ 5.17×10^{-21} **F**◯ 7.50×10^{-21}
G◯ 1.09×10^{-20} **H**◯ 1.58×10^{-20}

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2 pt On average how much energy is stored by ONE degree of freedom for ONE single molecule?
(in `J`*)*

20. **A**◯ 1.86×10^{-21} **B**◯ 2.17×10^{-21}
C◯ 2.54×10^{-21} **D**◯ 2.98×10^{-21}
E◯ 3.48×10^{-21} **F**◯ 4.07×10^{-21}
G◯ 4.77×10^{-21} **H**◯ 5.58×10^{-21}
