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Nagy,

Tibor

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!

Possibly useful constants:

- $g = 9.81 \text{ m/s}^2$
- $G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$
- $\rho_{\text{water}} = 1000 \text{ kg/m}^3 = 1 \text{ kg/l} = 1 \text{ g/cm}^3$
- $1 \text{ atm} = 101.3 \text{ kPa}$
- $N_A = 6.02 \times 10^{23} \text{ 1/mol}$
- $R = 8.31 \text{ J/(molK)}$
- $k_B = 1.38 \times 10^{-23} \text{ J/K}$
- $0 \text{ }^\circ\text{C} = 273.15 \text{ K}$

Please, sit in row C.

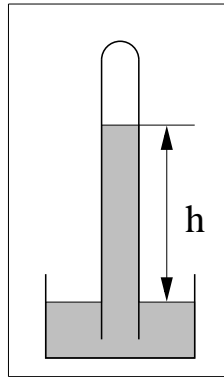
1 pt Are you sitting in the seat assigned?

1.A Yes, I am.

4 pt Planet-X has a mass of 4.32×10^{24} kg and a radius of 5060 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** 4.87 **B** 5.70 **C** 6.66
 D 7.80 **E** 9.12 **F** 1.07×10^1
 G 1.25×10^1 **H** 1.46×10^1
-

The height of the Mercury column in the Toricelli barometer is $h = 760$ mm here on Earth at sea level. See figure.



3 pt What would be the height of the Mercury column on the surface of the Moon? The Moon has no atmosphere, and the gravitational field is six times weaker on the Moon than here on Earth.

3. **A** 0 mm.
 B 127 mm, six times shorter.
 C 760 mm, same as on Earth.
 D 4560 mm, six times higher.
-

3 pt What would be the height of the Mercury column inside a Moon-base where an Earth-like air atmosphere is maintained for comfortable living? (The Toricelli barometer has sufficient amount of Mercury, and the glass tube can be extended, if necessary.)

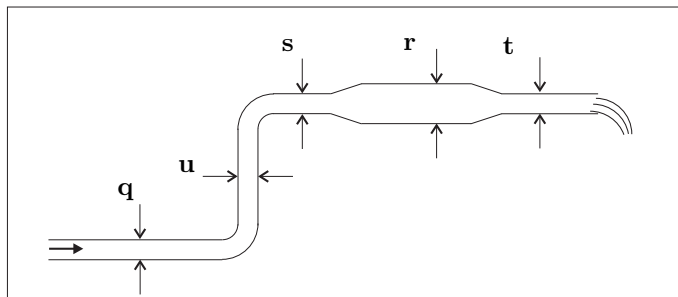
4. **A** 0 mm.
 B 4560 mm, six times higher.
 C 127 mm, six times shorter.
 D 760 mm, same as on Earth.
-

4 pt An object weighs 87.9 N in air. When it is suspended from a force scale and completely immersed in water the scale reads 18.4 N. Determine the density of the object.

(in kg/m^3)

5. **A** 6.48×10^2 **B** 8.09×10^2 **C** 1.01×10^3
D 1.26×10^3 **E** 1.58×10^3 **F** 1.98×10^3
G 2.47×10^3 **H** 3.09×10^3

8 pt The figure illustrates the flow of an ideal fluid through a pipe of circular cross section, with diameters of 1 cm and 2 cm and with different elevations. p_x is the pressure in the pipe, and v_x is the speed of the fluid at locations $x = q, r, s, t,$ or u .



- ▷ v_q is $2v_r$
 6. **A** Greater than **B** Less than
C Equal to

- ▷ p_q is p_u
 7. **A** Greater than **B** Less than
C Equal to

- ▷ p_t is p_r
 8. **A** Greater than **B** Less than
C Equal to

- ▷ v_q is v_s
 9. **A** Greater than **B** Less than
C Equal to

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

10. **A** 37.46 **B** 43.83 **C** 51.28
D 60.00 **E** 70.20 **F** 82.13
G 96.10 **H** 112.43
-

3 pt Now the intensity of this sound is increased to a value of 34.0 times of its original intensity. What is the new increased sound level? Give your answer in dB units.

11. **A** 24.70 **B** 35.82 **C** 51.94
D 75.31 **E** 109.21 **F** 158.35
G 229.61 **H** 332.93
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4 pt A truck horn emits a sound with a frequency of 200 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 225 Hz, then what is the speed of the truck? Use 340 m/s for the speed of the sound.
(in m/s)

12. **A** 3.78×10^1 **B** 4.27×10^1 **C** 4.82×10^1
D 5.45×10^1 **E** 6.16×10^1 **F** 6.96×10^1
G 7.87×10^1 **H** 8.89×10^1
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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.

13. **A** 200 Hz, 300 Hz, 400 Hz
B 50 Hz, 100 Hz, 150 Hz
C 100 Hz, 300 Hz, 500 Hz
D 50 Hz, 100 Hz, 200 Hz
E 100 Hz, 200 Hz, 300 Hz
F 200 Hz, 600 Hz, 1000 Hz
G 50 Hz, 150 Hz, 250 Hz
H 200 Hz, 400 Hz, 600 Hz
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4 pt The height of the Eiffel tower is 321 m during the Summer when the temperature is 25.3 °C. What is the magnitude of the change in the height of the tower, when the temperature cools down to -12.0 °C during the Winter? The coefficient of linear expansion of the tower's material is $1.18 \times 10^{-5} \text{ 1/C}^\circ$.
(in cm)

14. **A** 1.06×10^1 **B** 1.41×10^1 **C** 1.88×10^1
D 2.50×10^1 **E** 3.32×10^1 **F** 4.42×10^1
G 5.88×10^1 **H** 7.82×10^1
-

3 pt What is the pressure of 1.07 moles of Nitrogen gas in a 4.71 liter container, if the temperature of the gas is 40.2 °C?
(in atm)

15. **A** 1.32 **B** 1.92 **C** 2.78 **D** 4.03
E 5.84 **F** 8.47 **G** 12.28 **H** 17.80
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4 pt A 24.5 l gas bottle contains 9.87×10^{23} Radon molecules at a temperature of 312 K. What is the thermal energy of the gas? (You might need to know Boltzmann's constant: $k_B = 1.38 \times 10^{-23} \text{ J/K}$.)
(in J)

16. **A** 6.38×10^3 **B** 9.25×10^3 **C** 1.34×10^4
D 1.94×10^4 **E** 2.82×10^4 **F** 4.09×10^4
G 5.93×10^4 **H** 8.59×10^4
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3 pt The diameter of the Hydrogen atom is almost exactly one angstrom which is 10^{-10} meter. How many Hydrogen atoms do we need to place next to each-other side by side to form a one millimeter long chain?

17. **A** one hundred
B one thousand
C one million
D ten million
E hundred million
F one billion
G one trillion
H 6×10^{23}
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