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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!

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 = 760 mmHg
- 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

Please, sit in row G.

$\boxed{1\ pt}$ Are you sitting in the seat assigned?

1.A◯ Yes, I am.

$\boxed{4\ pt}$ A 210 kg satellite is orbiting on a circular orbit 5155 km above the Earth's surface. Determine the speed of the satellite. (The mass of the Earth is 5.97×10^{24} kg, and the radius of the Earth is 6370 km.)
(in km/s*)*

2.   **A**◯ 2.29   **B**◯ 2.68   **C**◯ 3.14   **D**◯ 3.67

     E◯ 4.29   **F**◯ 5.02   **G**◯ 5.88   **H**◯ 6.88

$\boxed{4\ pt}$ The paths of two small sattellites, $M_L = 6.00$ kg and $M_R = 9.00$ kg, are shown below, drawn to scale, with M_L corresponding to the orbit on the left hand side in the figure. They orbit in the same plane around a massive star, as shown below.
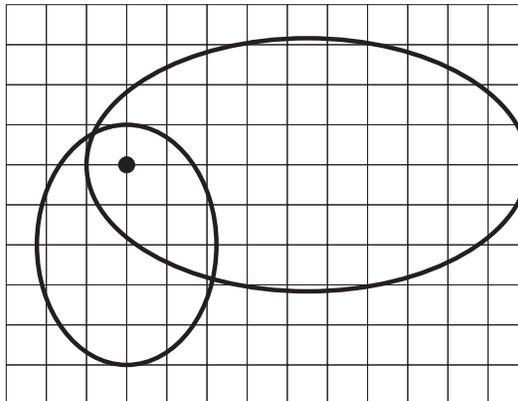
The period of M_L is 26.0 years. Calculate the period of M_R, in years.

3.   **A**◯ 4.45×10^1 **B**◯ 6.45×10^1 **C**◯ 9.36×10^1

     D◯ 1.36×10^2 **E**◯ 1.97×10^2 **F**◯ 2.85×10^2

     G◯ 4.14×10^2 **H**◯ 6.00×10^2

$\boxed{4\ pt}$ Glucose solution is administered to a patient in a hospital. The density of the solution is 1.336 kg/l. If the blood pressure in the vein is 39.2 mmHg, then what is the minimum necessary height of the IV bag above the position of the needle?
(in cm*)*

4.   **A**◯ 16.9   **B**◯ 22.5   **C**◯ 30.0   **D**◯ 39.9

     E◯ 53.0   **F**◯ 70.5   **G**◯ 93.8   **H**◯ 124.7

$3\ pt$ A large ice cube floats in a glass of water.
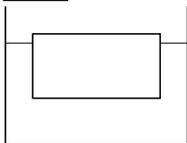
What happens to the water level, when the ice cube melts? (No water is lost due to evaporation.)

5.A◯ The water level will fall.
   B◯ The water level will rise.
   C◯ It depends on how much water we have in the glass, and how big the ice cube is.
   D◯ The water level will not change.

$3\ pt$ A large ice cube floats in a glass of water.
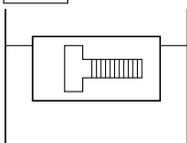
There is a steel bolt frozen inside the ice cube. What happens to the water level when all the ice melts? (No water is lost due to evaporation.)

6.A◯ The water level will fall.
   B◯ The water level will rise.
   C◯ Without knowing the mass of the bolt, we cannot answer this question.
   D◯ The water level will not change.

$8\ pt$ 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.
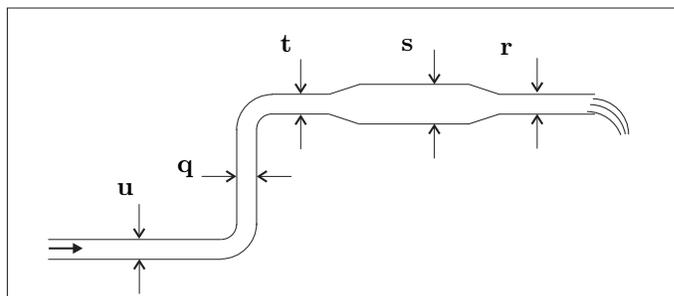
▷ p_r is .... p_s
7.   **A**◯ Greater than   **B**◯ Less than
         C◯ Equal to

▷ p_u is .... p_q
8.   **A**◯ Greater than   **B**◯ Less than
         C◯ Equal to

▷ v_q is .... $2v_s$
9.   **A**◯ Greater than   **B**◯ Less than
         C◯ Equal to

▷ v_u is .... v_r
10. **A**◯ Greater than   **B**◯ Less than
         C◯ Equal to

$4\ pt$ A rock band uses a wall built out of 37 identical speakers. If one single speaker can produce a sound level of 95.5 dB in the front row area, then what is the sound level produced by the whole wall?
(in dB*)*

11. **A**◯ 59.3   **B**◯ 69.4   **C**◯ 81.2   **D**◯ 95.0
     E◯ 111.2   **F**◯ 130.1   **G**◯ 152.2   **H**◯ 178.1

$4\ pt$ A stationary horn emits a sound with a frequency of 205 Hz. A car is moving away from the horn on a straight road with constant speed. If the driver of the car hears the horn at a frequency of 185 Hz, then what is the speed of the car? Use 340 m/s for the speed of the sound.
(in m/s*)*

12. **A**◯ 2.30×10^1 **B**◯ 2.60×10^1 **C**◯ 2.94×10^1
     D◯ 3.32×10^1 **E**◯ 3.75×10^1 **F**◯ 4.24×10^1
     G◯ 4.79×10^1 **H**◯ 5.41×10^1

$4\ pt$ A pipe is 1.70 m long and it is open at both ends. 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**◯ 100 Hz, 200 Hz, 300 Hz
   B◯ 100 Hz, 300 Hz, 500 Hz
   C◯ 50 Hz, 100 Hz, 150 Hz
   D◯ 50 Hz, 100 Hz, 200 Hz
   E◯ 50 Hz, 150 Hz, 250 Hz
   F◯ 200 Hz, 400 Hz, 600 Hz
   G◯ 200 Hz, 600 Hz, 1000 Hz
   H◯ 200 Hz, 300 Hz, 400 Hz

$\boxed{3\ pt}$ A bimetallic strip is held fixed at the bottom end as shown in the figure.
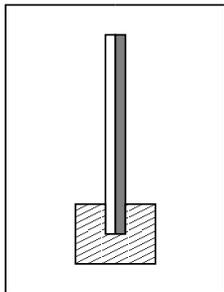
The metal on the left has a coefficient of linear heat expansion of $\alpha_{\text{left}} = 1.50 \times 10^{-5}$ 1/K, the metal on the right has $\alpha_{\text{right}} = 3.85 \times 10^{-5}$ 1/K. When the strip is heated, it will ... (complete the sentence)

14.A◯ ... bend right.
  B◯ ... remain straight.
  C◯ ... bend left.

$\boxed{4\ pt}$ 5.20 liters of Nitrogen gas at 70.0°C temperature and 2.90 atm pressure contains how many moles?

15. A◯ 0.257   **B**◯ 0.291   **C**◯ 0.329   **D**◯ 0.371
      E◯ 0.420   **F**◯ 0.474   **G**◯ 0.536   **H**◯ 0.605

$\boxed{2\ pt}$ A gas bottle contains 8.44×10^{23} Methane molecules at a temperature of 349 K. What is the thermal energy of the gas?
  (in J*)*

16. A◯ 1.22×10^4 **B**◯ 1.38×10^4 **C**◯ 1.56×10^4
      D◯ 1.76×10^4 **E**◯ 1.99×10^4 **F**◯ 2.25×10^4
      G◯ 2.54×10^4 **H**◯ 2.87×10^4

$\boxed{2\ pt}$ On average how much energy is stored by ONE degree of freedom for ONE single molecule?
  (in J*)*

17. A◯ 2.41×10^{-21} **B**◯ 3.01×10^{-21}
      C◯ 3.76×10^{-21} **D**◯ 4.71×10^{-21}
      E◯ 5.88×10^{-21} **F**◯ 7.35×10^{-21}
      G◯ 9.19×10^{-21} **H**◯ 1.15×10^{-20}