Name:

Your code is: AAAAAA

Put your name here:

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

60 minute long closed book exam.

Fill out the bubble sheet: last name, first initial, student number, section number and **code**.

A two-sided 8.5 by 11 handwritten help sheet is allowed.

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

Thank you and good luck!

Possibly useful constants:

- g = 9.81 m/s^2
- G = 6.67×10^{-11} Nm^2/kg^2
- σ = 5.67 × 10^{-8} W/(m^{2}K^4)
- R= 0.0821 L*atm/(mol*K) = 8.31 J/(mol*K)
- density of fresh water = 1000 kg/m^3

Possibly useful Moments of Inertia:

- Solid homogeneous sphere: $I_{CM} = (2/5)MR^2$
- Thin spherical shell: $I_{CM} = (2/3)MR^2$
- Thin uniform rod, axis perpendicular to length: $I_{CM} = (1/12)ML^2$
- Solid homogeneous cylinder or disk, axis through center of mass and parallel to length: $I_{CM} = (1/2)MR^2$

Useful information for Geometry:

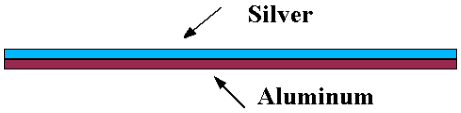
- Volume of a sphere: $V = (4/3)\pi r^3$
- Volume of a cylinder: $V = \pi r^2 h$

Latent Heats and Phase Change Temperatures of some Materials (at atmospheric pressure)

	Melting		**Boiling**	
Material	**T_f (K)**	**L_f(J/g)**	**T_v (K)**	**L_v(J/g)**
Alcohol	159	100	351	850
Copper	1356	207	2868	4730
Gold	1336	64.5	2933	1580
Helium	-	-	4	21
Hydrogen	14	58.0	20	455
Lead	601	23.2	2017	858
Mercury	234	11.4	630	296
Nitrogen	63	26	77	200
Oxygen	54	13.9	90	213
Silver	1235	105	2323	2336
Tungsten	3783	180	6170	4820
Water	273	333	373	2263

Specific Heats of some Materials (at room temperature and atmosperic pressure unless otherwise noted)

Material	**c [J/kg· C]**	**c [kcal/kg· C]**
Air (at 50 ·C)	1050	0.25
Alcohol	2430	0.58
Aluminum	920	0.22
Copper	390	0.093
Glass	840	0.20
Granite	790	0.19
Ice (at -10 ·C)	2090	0.50
Iron, Steel	460	0.11
Lead	130	0.031
Mercury	140	0.033
Seawater	3900	0.93
Silver	240	0.056
Soil, Dirt	1000	0.24
Steam (110 ·C)	2010	0.48
Tungsten	135	0.032
Water	4186	1 exactly
Wood	1680	0.40



4 pt

The bimetallic strip above is made of aluminum (coefficient of liner expansion= 24 $\times 10^{-6}$ $^{\circ}C^{-1}$) and silver (coefficient of liner expansion= 19 $\times 10^{-6}$ $^{\circ}C^{-1}$).
When this strip is held down at the left end and heated, it will _____

▷

1. **A**◯ bend downward **B**◯ bend upward
C◯ remain straight, while stretching its length

---

9 pt A constant volume gas thermometer has a pressure of 7940 Pa at 18 °C. What would the pressure be for -99 °C (in Pa)?

2.**A**◯ 2.26×10^3 **B**◯ 3.28×10^3 **C**◯ 4.75×10^3
D◯ 6.89×10^3 **E**◯ 9.99×10^3 **F**◯ 1.45×10^4
G◯ 2.10×10^4 **H**◯ 3.04×10^4

---

9 pt

Two blocks of metal come into contact with one another. Given the following data:

Block one
Specific heat = 0.111 kcal/(kg°C)
Mass = 0.188 kg
Initial temperature = 17 °C

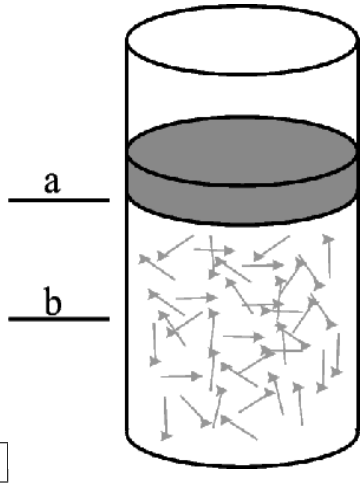
Block two
Specific heat = 0.19 kcal/(kg°C)
Mass = 0.101 kg
Initial temperature = 71 °C
What is the final temperature (in °C) of the two blocks after they reach equilibrium?

3.**A**◯ 34.1 **B**◯ 35.9 **C**◯ 40.7 **D**◯ 42.9
E◯ 44.0 **F**◯ 45.0 **G**◯ 54.0 **H**◯ 88.0

---

9 pt A metal wire is in thermal contact with two heat reservoirs at both of its ends. Reservoir 1 is at a temperature of 484 K, and reservoir 2 is at a temperature of 323 K. What is the change in entropy (in J/K) of Reservoir 1 arising from the conduction of 1134 J of heat through the wire.

4.**A**◯ -3.51 **B**◯ -2.34 **C**◯ -1.17 **D**◯ 0.00
E◯ 1.17 **F**◯ 2.34 **G**◯ 3.51 **H**◯ 5.85



8 pt

▷ A massive piston traps a fixed amount of helium gas as shown. After being brought to point (a) the system equilibrates at room temperature. Weight is then added to the piston adiabatically compressing the gas to half of its original volume (b). The internal energy of the gas at "b" is _____ the internal energy of the gas at "a".

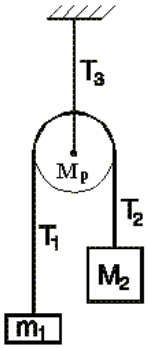
5. **A**◯ greater than **B**◯ equal to
C◯ less than

▷ A massive piston traps a fixed amount of helium gas as shown. After being brought to point (a) the system equilibrates at room temperature. The gas is then cooled isobarically compressing the gas to half of its original volume (b). The entropy of the gas at "b" is _____ the entropy of the gas at "a".

6. **A**◯ greater than **B**◯ equal to
C◯ less than

---

8 pt A uniform frictionless pulley is attached to the ceiling, in a gravity field of 9.81 m/s^2. The mass of the pulley is M_p.



Mass M_2 is greater than mass m_1. The quantities T_1, T_2, T_3 and g are magnitudes. Select greater than, less than or equal to.

▷ T_2 is _____ T_1.

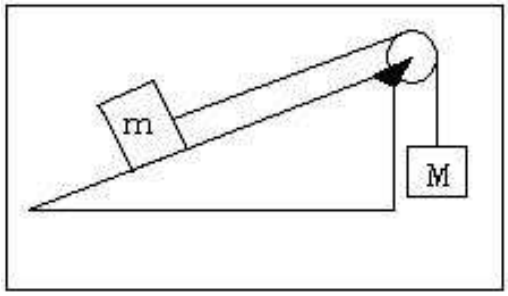
7. **A**◯ Greater than **B**◯ Less than **C**◯ Equal to

▷ If clockwise is defined as the positive direction for rotational motion, then the angular acceleration of the pulley will be _____ zero.

8. **A**◯ Greater than **B**◯ Less than **C**◯ Equal to

---

8 pt A 7.160 kg block is on a ramp and is attached to a 2.487 kg mass by a light string as shown in the diagram below. The string passes over a pulley and the ramp is inclined at an angle of 10 degrees aith reaspect to the horizontal.

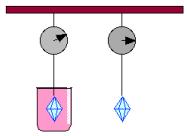


If the block on the ramp is moving **UP** the ramp at constant velocity, what is the coefficient of kinetic friction between the block on the ramp and the ramp?

9.**A**◯ 0.094 **B**◯ 0.110 **C**◯ 0.129 **D**◯ 0.151
E◯ 0.176 **F**◯ 0.206 **G**◯ 0.241 **H**◯ 0.282

---

9 pt

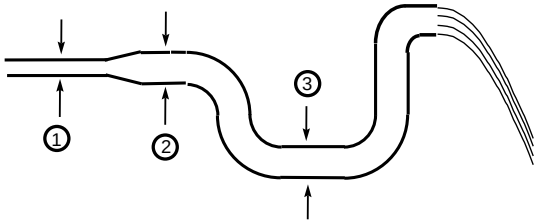


A piece of moon rock reads 4.095 N on a scale when in air, but 0.891 N in a fluid having a density of 730 kg/m^3. What is the density of the moon rock in kg/m^3?

10.**A**◯ 2.24×10^2 **B**◯ 2.98×10^2 **C**◯ 3.97×10^2
D◯ 5.27×10^2 **E**◯ 7.01×10^2 **F**◯ 9.33×10^2
G◯ 1.24×10^3 **H**◯ 1.65×10^3

---

12 pt The side view of a pipe is shown. The pipe diameter increases and then remains constant. P_i is the pressure, and v_i is the speed of a non-viscous incompressible fluid, at locations i = 1,2,3.



▷ v_2 is .... v_3.

11. **A**◯ Greater than **B**◯ Less than **C**◯ Equal to

▷ v_1 is .... v_2.

12. **A**◯ Greater than **B**◯ Less than **C**◯ Equal to

▷ P_2 is .... P_1.

13. **A**◯ Greater than **B**◯ Less than **C**◯ Equal to

▷ P_2 is .... P_3.

14. **A**◯ Greater than **B**◯ Less than **C**◯ Equal to

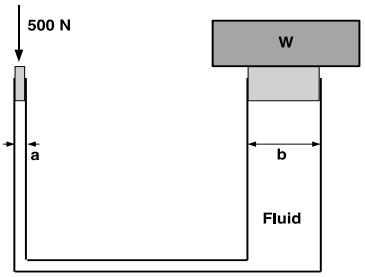
---

8 pt An ideal heat engine absorbs 85.2 kJ of heat and exhausts 70.4 kJ of heat in each cycle. What is the efficiency of the engine?

15.A◯ 2.71×10^{-2} **B**◯ 3.93×10^{-2} **C**◯ 5.70×10^{-2}
D◯ 8.26×10^{-2} **E**◯ 1.20×10^{-1} **F**◯ 1.74×10^{-1}
G◯ 2.52×10^{-1} **H**◯ 3.65×10^{-1}

8 pt How much work is done in a cycle?
(in kJ*)*

16.A◯ 7.04 **B**◯ 1.02×10^{1} **C**◯ 1.48×10^{1}
D◯ 2.15×10^{1} **E**◯ 3.11×10^{1} **F**◯ 4.51×10^{1}
G◯ 6.54×10^{1} **H**◯ 9.49×10^{1}



8 pt
Consider the hydraulic system shown above. A force of 500 N is applied as shown on the piston to the left which has a diameter of a=2 cm. The piston on the right has a diameter b=7 cm. What weight W (in N) can be lifted with this force? (Ignore friction and the weights of the piston)

17.A◯ 3757 **B**◯ 4245 **C**◯ 4797 **D**◯ 5420
E◯ 6125 **F**◯ 6921 **G**◯ 7821 **H**◯ 8838