Name:

Your code is: JJJJGB

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
- $\sigma = 5.67 \times 10^{-8}$ 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: $V = \pi r^2 h$

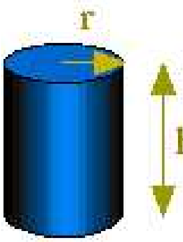
Latent Heats and Phase Change Temperatures of some Materials (at atmospheric pressure)

	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

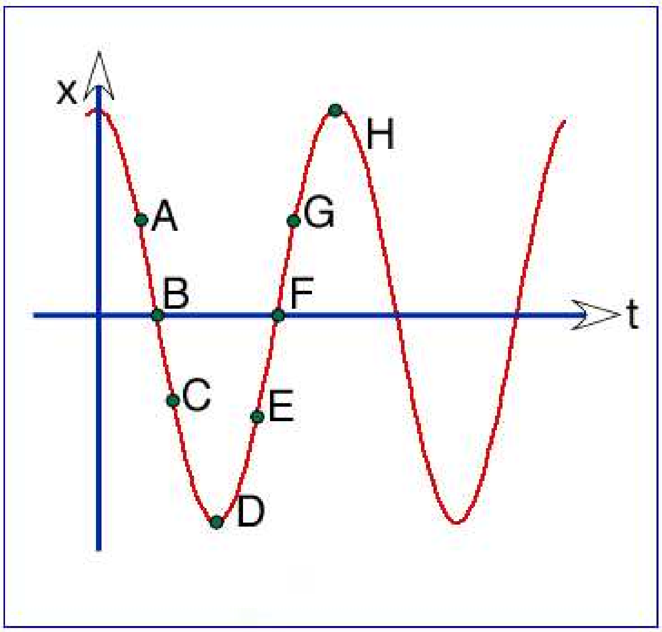
Specific Heats of some Materials (at room temperature and atmosperic pressure unless otherwise noted)

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)	2220	0.53
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

7 pt A right cylinder has a radius r of 14.2 cm and a height h of 42.1 cm. What is the volume of the cylinder in mm^3?



1. A◯ 2.67×10^1 B◯ 2.67×10^2 C◯ 2.67×10^3
D◯ 8.49×10^3 E◯ 2.67×10^4 F◯ 2.67×10^5
G◯ 2.67×10^6 H◯ 2.67×10^7



16 pt

The figure above is a position versus time graph of an object undergoing simple harmonic motion. Positive values of x are plotted above the t axis. For each statement below, answer True or False.

▷ The acceleration has its largest positive value at D.
2. A◯ True B◯ False

▷ The velocity at F is zero.
3. A◯ True B◯ False

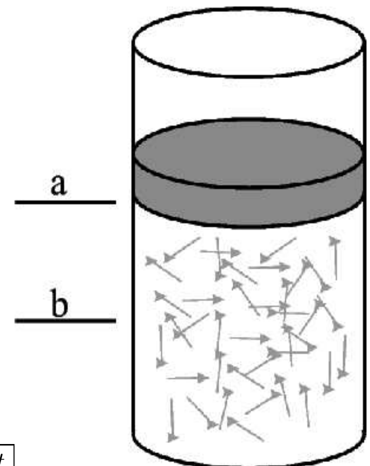
▷ The velocity has its largest negative value at B.
4. A◯ True B◯ False

▷ The acceleration at B is zero.
5. A◯ True B◯ False

8 pt

▷ Can a system of two or more objects have a total momentum that is not zero but a total kinetic energy that is zero?
6. A◯ Yes B◯ No

▷ Can a system of two or more objects have a total kinetic energy that is not zero but a total momentum that is zero?
7. A◯ Yes B◯ No



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 slowly so that the system remains at room temperature. Eventually the gas is compressed to half of its original volume (b). The internal energy of the gas at "b" is ______ the internal energy of the gas at "a".
8. 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. Weight is then added to the piston adiabatically 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".
9. A◯ greater than B◯ equal to
C◯ less than

A sample of helium-4 behaves as an ideal gas as it is heated at constant pressure from 300 K to 410 K. If 37 J of work is done by the gas during this process, what is the mass of helium present?

7 pt

(in g*)*

10. A◯ 1.38×10^{-1} B◯ 1.62×10^{-1} C◯ 1.89×10^{-1}
D◯ 2.22×10^{-1} E◯ 2.59×10^{-1} F◯ 3.03×10^{-1}
G◯ 3.55×10^{-1} H◯ 4.15×10^{-1}

$\boxed{\textit{7 pt}}$ A gas is compressed at a constant pressure of 0.891 atm from 7.01 L to 4.96 L. During the process, 500 J of energy leaves the gas by heat. What is the change in the internal energy of the gas? (in J)

11.A◯ -105 **B**◯ -123 **C**◯ -144 **D**◯ -168
E◯ -197 **F**◯ -230 **G**◯ -269 **H**◯ -315

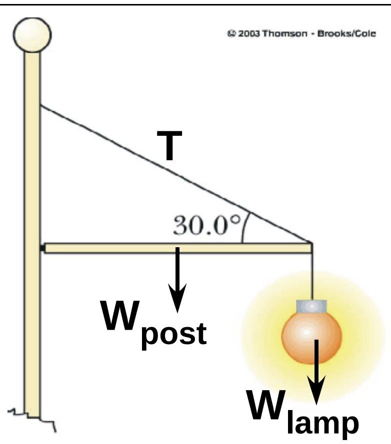
$\boxed{\textit{7 pt}}$ A metal wire is in thermal contact with two heat reservoirs at both of its ends. Reservoir 1 is at a temperature of 606 K, and reservoir 2 is at a temperature of 284 K. What is the total change in entropy (in J/K) arising from the conduction of 1483 J of heat through the wire.

12.A◯ 1.732 **B**◯ 2.027 **C**◯ 2.371 **D**◯ 2.775
E◯ 3.246 **F**◯ 3.798 **G**◯ 4.444 **H**◯ 5.199

$\boxed{\textit{7 pt}}$

A pendulum has a period on the earth of 1.58 s. What is its period on the surface of Mars where g = 3.73 m/s^2?

13.A◯ 2.56 **B**◯ 2.90 **C**◯ 3.27 **D**◯ 3.70
E◯ 4.18 **F**◯ 4.72 **G**◯ 5.33 **H**◯ 6.03



$\boxed{\textit{7 pt}}$

A lamp hangs from end of a post whose weight is 398 N. If the tension in the wire is 810 N, what is the weight of the lamp? *(in* `N`*)*

14.A◯ 142 **B**◯ 206 **C**◯ 299 **D**◯ 433
E◯ 628 **F**◯ 911 **G**◯ 1320 **H**◯ 1915

$\boxed{\textit{12 pt}}$ John is listening to a horn. He knows the frequency of the horn is 300 Hz when both he and the horn are at rest. If he hears a pitch of 330 Hz, there are clearly several possibilities. Answer True or False to each staement below.

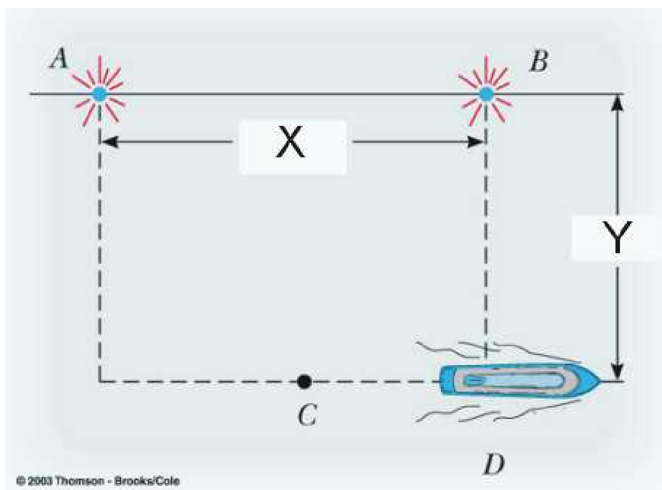
▷ The horn can be moving towards the John who is at rest.
15. **A**◯ True **B**◯ False

▷ John can be moving away from the horn which is at rest.
16. **A**◯ True **B**◯ False

▷ Both can be moving and have different speeds.
17. **A**◯ True **B**◯ False

$\boxed{\textit{7 pt}}$ The speed of sound in air is 339 m/s. If an audible sound has a frequency of 8900 Hz, what is its wavelength in meters?

18.A◯ 7.99×10^{-3} **B**◯ 9.99×10^{-3} **C**◯ 1.25×10^{-2}
D◯ 1.56×10^{-2} **E**◯ 1.95×10^{-2} **F**◯ 2.44×10^{-2}
G◯ 3.05×10^{-2} **H**◯ 3.81×10^{-2}



**The ship in the figure above travels along a straight line parallel to the shore and is a distance Y=620 m from the shore. The ship's radio receives simultaneous signals of the same frequency from antennas at points A and B which are separated by X=870 m. The signals interfere constructively at point C, which is equidistant from A and B. The signal goes through the first minimum at point D which is even with B. Determine the wavelength of the radio waves.

$\boxed{\textit{7 pt}}$

(in `m`*)*

19.A◯ 702.2 **B**◯ 793.5 **C**◯ 896.6
D◯ 1013.2 **E**◯ 1144.9 **F**◯ 1293.7
G◯ 1461.9 **H**◯ 1652.0
