Your code is: AAGDDJ

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

9 pt Identify the statements as being either True or False.

▷ Consider two planets orbiting a star. If one planet has eight times the period of another, it must also have four times the average orbital distance.

1. **A**◯ True **B**◯ False

▷ An object moving in a circle with constant speed has zero acceleration.

2. **A**◯ True **B**◯ False

▷ If two planets have the same mass, but the second has twice the gravity, the second planet must also have half the radius.

3. **A**◯ True **B**◯ False

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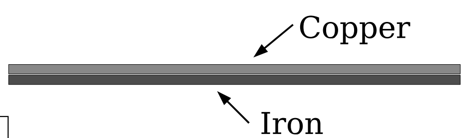
7 pt An object is thrown directly downward from the top of a very tall building. The speed of the object just as it is released is 27.3 m/s. After being thrown, the object falls freely due to gravity. Neglect air resistance and calculate the distance, in meters which the object covers between times t1 = 2.47 s and t2 = 5.49 s after it is thrown.

4.A◯ 123 **B**◯ 139 **C**◯ 157 **D**◯ 177
E◯ 200 **F**◯ 226 **G**◯ 256 **H**◯ 289



4 pt
The bimetallic strip above is made of copper ($\alpha = 12 \times 10^{-6}\ {}^{\circ}\mathrm{C}^{-1}$) and iron ($\alpha = 17 \times 10^{-6}\ {}^{\circ}\mathrm{C}^{-1}$).
When this strip is held down at the left end and heated, it will ____________________________

▷

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

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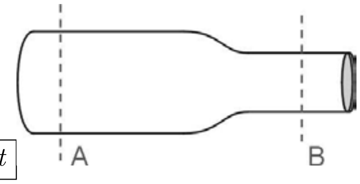
8 pt The height of the Eiffel tower is 321 m during the Summer when the temperature is 29.7 °C. What is the magnitude of the change in the height of the tower, when the temperature cools down to -19.8 °C during the Winter? The coefficient of linear expansion of the tower's material is 1.10×10^{-5} 1/C°. *(in* `cm`*)*

6.A◯ 1.75×10^{1} **B**◯ 2.32×10^{1} **C**◯ 3.09×10^{1}
D◯ 4.11×10^{1} **E**◯ 5.47×10^{1} **F**◯ 7.27×10^{1}
G◯ 9.67×10^{1} **H**◯ 1.29×10^{2}



12 pt
An incompressible fluid moves through the pipe shown above from RIGHT to LEFT. The pipe widens from a diameter of 3 cm at "B" to a diameter of 5 cm at "A". (Assume non-viscous laminar flow)

▷ The speed of the fluid at "A" is ____________________ the speed of the fluid at "B".

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

▷ The amount of fluid that passes "A" in one second is ______________________ the amount of fluid that passes "B" in one second.

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

▷ The pressure at "A" is _______________ the pressure at "B".

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

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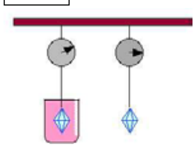
7 pt



A piece of moon rock reads 43.6 grams on a scale when in air, but 20.4 grams in a fluid having a specific gravity of 0.86. What is the density of the moon rock in kg/m^3?

10.A◯ 4.24×10^{2} **B**◯ 5.30×10^{2} **C**◯ 6.62×10^{2}
D◯ 8.27×10^{2} **E**◯ 1.03×10^{3} **F**◯ 1.29×10^{3}
G◯ 1.62×10^{3} **H**◯ 2.02×10^{3}

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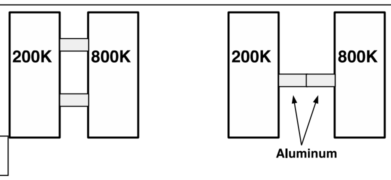
7 pt The pressure inside a gas bottle at 23.5 °C is 3540 kPa. What will be the pressure inside the bottle, if 36.0 percent of the gas is released while the temperature drops to 8.8 °C? *(in* `kPa`*)*

11.A◯ 1.69×10^{3} **B**◯ 1.91×10^{3} **C**◯ 2.15×10^{3}
D◯ 2.43×10^{3} **E**◯ 2.75×10^{3} **F**◯ 3.11×10^{3}
G◯ 3.51×10^{3} **H**◯ 3.97×10^{3}



8 pt

A hot (800 °K) and a cold (200 °K) object are connected by two aluminum bars as shown.

▷ Considering the left configuration only, lowering the temperature of the 800 °K block to 400 °K will reduce the rate of heat transfer by a factor of ________________________.

12. **A**◯ one fourth **B**◯ one half
C◯ one third

▷ Compared to the configuration on the left, the rate of heat transferred in configuration shown the right is _______________ as high.

13. **A**◯ one fourth **B**◯ one half
C◯ one third

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8 pt 0.16 kg of water at 85.0^o C is poured into an insulated cup containing 0.206 kg of ice initally at 0^o. Calculate the mass of liquid when the system reaches thermal equilibrium.

(in kg*)*

14. **A**◯ 2.93×10^{-1} **B**◯ 3.31×10^{-1} **C**◯ 3.74×10^{-1}
D◯ 4.23×10^{-1} **E**◯ 4.78×10^{-1} **F**◯ 5.40×10^{-1}
G◯ 6.10×10^{-1} **H**◯ 6.89×10^{-1}

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16 pt A figure skater is spinning with her arms and one leg extended as far as she can. She then pulls them in tight to her body. As her position contracts,

▷ her angular momentum ___________.

15. **A**◯ decreases **B**◯ increases
C◯ remains the same

▷ her moment of inertia _______________.

16. **A**◯ decreases **B**◯ increases
C◯ remains the same

▷ her rotational kinetic energy _________________.

17. **A**◯ decreases **B**◯ increases
C◯ remains the same

▷ her angular velocity ___________.

18. **A**◯ decreases **B**◯ increases
C◯ remains the same

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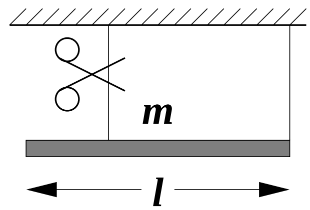
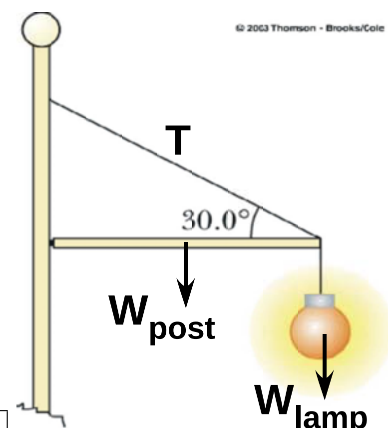
7 pt A uniform rod with length l and mass m is suspended by two thin strings as shown in the figure.



The rod is in horizontal position. Which of the equations represents the initial angular acceleration α of the rod when the string on the left is cut? (Hint: Use the parallel axis theorem.)

19. **A**◯ $(3mg)/(2l)$
B◯ $(3ml)/(2g)$
C◯ $(3l)/(2g)$
D◯ $(3g)/l$
E◯ $l/(2g)$
F◯ $(3g)/(2l)$
G◯ g/l
H◯ $(12l)/mg$



7 pt

A lamp hangs from end of a post whose weight is 318 N. If the tension in the wire is 720 N, what is the weight of the lamp? *(in* N*)*

20. **A**◯ 66 **B**◯ 82 **C**◯ 103 **D**◯ 129
E◯ 161 **F**◯ 201 **G**◯ 251 **H**◯ 314