Exam #2 Resources (more practice questions)

PHYS 161
Disclaimer

I don’t see the test until you all take it. These questions are not meant to replicate what you’ll see on the exam.

They should be a good test of your knowledge of the topics and your ability to work problems. In that respect I hope these problems are useful in your studying.
How to use these slides

• For each question:
  • First slide poses the question
  • Second slide has a hint, plus a link to the answers

• Look at the hint only if you don’t know how to get started after a minute or two. Then click the link to check your answer and thought process

• If you couldn’t do the problem without any help, try it again in a day or two to see if you can solve the problem on your own

• Use links for more practice problems
What does the test cover?

- Chapters 9-13
- Primarily lectures 11-18
**Ideal Gas Law**

- If I have an unknown quantity of O$_2$ gas (16 g/mol) at a pressure of 1.2 atm, a volume of 31 liters, and a temperature of 87 °C, what is the density of the gas?
If I have an unknown quantity of O₂ gas (16 g/mol) at a pressure of 1.2 atm, a volume of 31 liters, and a temperature of 87 °C, what is the density of the gas?

- Hint: find moles of gas first
- Answer: 0.650 g/L (practice conversions by converting to kg/m³)

Specific Heat and Latent Heat

How much heat must be removed by a refrigerator from 2 kg of water at 70 °C to convert it to ice cubes at -11°C? [Specific heat capacity of water = 4200 J kg\(^{-1}\) °C\(^{-1}\); Specific latent heat of fusion of ice = 334,000 J kg\(^{-1}\), specific heat capacity of ice = 2100 J/(kg °C)]
How much heat must be removed by a refrigerator from 2 kg of water at 70 °C to convert it to ice cubes at -11°C? [Specific heat capacity of water = 4200 J kg⁻¹ °C⁻¹; Specific latent heat of fusion of ice = 334,000 J kg⁻¹, specific heat capacity of ice = 2100 J/(kg K)]

Hint: need to remove heat to cool water to 0 degrees, complete phase transition, then cool ice to -11 degrees.

Floating objects

A standard basketball (mass = 624 grams; 24.3 cm in diameter) is held fully under water. When released, does the ball sink to the bottom or float to the surface? If it floats, what percentage of it is sticking out of the water? If it sinks, what is the normal force, $F_N$ with which it sits on the bottom of the pool?
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**Hint:** calculate buoyant force and weight

http://physics.highpoint.edu/~jregester/potl/Matter/Buoyancy/BuoyancyProbSolns.htm
Archimedes/Pascal

- A barber raises his customer’s chair by applying a force of 150N to a hydraulic piston of area 0.01 m². If the chair is attached to a piston of area 0.1 m², how massive a customer can the chair raise? Assume the chair itself has a mass of 5 kg.

- Use link for a diagram

- https://www.aplusphysics.com/courses/honors/fluids/Pascal.html
• A barber raises his customer’s chair by applying a force of 150N to a hydraulic piston of area 0.01 m². If the chair is attached to a piston of area 0.1 m², how massive a customer can the chair raise? Assume the chair itself has a mass of 5 kg.

• Hint: use Pascal’s principle. The 5 kg chair mass should be subtracted at the end.

• This question is a bit tricky!

• https://www.aplusphysics.com/courses/honors/fluids/Pascal.html
Simple Harmonic Motion

5. Which of the following mass-spring systems will have the highest frequency of vibration?
   
   Case A: A spring with a $k=300$ N/m and a mass of 200 g suspended from it.
   Case B: A spring with a $k=400$ N/m and a mass of 200 g suspended from it.

6. Which of the following mass-spring systems will have the highest frequency of vibration?
   
   Case A: A spring with a $k=300$ N/m and a mass of 200 g suspended from it.
   Case B: A spring with a $k=300$ N/m and a mass of 100 g suspended from it.
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- Hint: the frequency of vibration is given by $\omega$

- [Physics Classroom: Lesson-0/Motion-of-a-Mass-on-a-Spring](https://www.physicsclassroom.com/class/waves/Lesson-0/Motion-of-a-Mass-on-a-Spring)
Simple Harmonic Motion

- A block of mass 100g is stretched 8cm and released from rest. Find the following when the mass is 2cm from equilibrium. The spring constant is 500 N/m.
  - Net force (magnitude and direction)
  - Instantaneous velocity
A block of mass 100g is stretched 8cm and released from rest. Find the following when the mass is 2cm from equilibrium. The spring constant is 500 N/m.

- Net force
  - $|F| = kx = 10N$; direction is toward equilibrium (-x direction)

- Instantaneous velocity
  - Use conservation of energy between first and second states
  - Answer: 5.48 m/s
• A note about that problem: you can use $v = \sqrt{\frac{k}{m}(A^2-x^2)}$ (from your textbook)
  • However, try to rely on your knowledge of basic concepts (conservation of energy) as opposed to random equations (that one above, which comes from conservation of energy)
  • The temptation is to write down as many equations as possible on your sheet, but using fewer equations is better. You will feel lost if you rely solely on your equation sheet. Everything stems from the major equations. Identify and focus on these.
Vertical springs

- Look at vertical spring problem from HW
- Draw FBD for these problems, and you might want to use conservation of energy (remember there are now two potential energies and one kinetic energy present)
P-V Diagrams

- Rank the work done by the gas from point a to b (they can be equal)
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Work done by gas is \(-P \Delta V\), given by area under the curve: \(2 > 3 > 1\)
Other tips for studying

- Use resources like HyperPhysics to understand concepts
- Look at Google Images for diagrams
- Focus on the most important equations!!
- Study with friends to work through difficult concepts and problems
GOOD LUCK!!