

Final Exam Outline

new stuff

Energy

- Energy is conserved. (What does that mean?)
- What is the SI unit of energy?

Work

- Energy transfer involving forces
- Positive work: object gives energy away
- Negative work: object steals energy
- If I do positive work on an object, it does negative work on me
- $W = \vec{F} \cdot \Delta \vec{r}$

Dot Product

- Takes two vectors, returns a scalar
- $\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$
- $\vec{A} \cdot \vec{B} = AB \cos \theta$ where θ is the angle between the vectors
- $\vec{A} \cdot \vec{B} > 0$ if in same-ish direction, negative if in opposite-ish directions. 0 if perpendicular.

Power

- Rate of energy transfer
- What are the units of power?

Kinetic Energy

Potential Energy

- What sorts of forces have potential energy?
- What happens to the potential energy of a system if it does what it “likes”?

Springs

- What is the *natural length* L_0 of a spring?
- What does the spring constant k measure?
- What is the force exerted by a spring?

- Calculate the elastic potential energy in a spring.

Gravitational Potential Energy

- Calculate the gravitational potential energy.
- Where is the height h measured from?

Energy Problems

- Energy conservation problem: $E_f = E_i + W$
- Strategy: find the initial and final energies, and the work done on the object

Thermodynamics

- Why do we often try to prevent *thermal energy* from being generated? What makes it different from other types of energy?
- What is *efficiency* and how is it calculated?
- What is the relationship between efficiency and power?
- What is *thermal energy*? Where is it stored microscopically?
- How is *temperature* related to thermal energy? How are they different?
- What is an *absolute temperature scale*?
- What is *absolute zero*?
- What is *heat*?
- What is *thermal equilibrium*?
- What are the three types of heat?
- What is the *First Law of Thermodynamics*?
- What is a *heat engine*? What are some real-life examples?
- How does energy flow in a heat engine?
- How do you calculate the efficiency of a heat engine? What is the maximum efficiency such an engine can have?
- What is a *refrigerator*? A *heat pump*? How are they related?
- How does energy flow in a refrigerator or heat pump?
- What is the *coefficient of performance* of a heat pump, and of a refrigerator?
- What is the maximum C.O.P.?
- What is an *irreversible process*?
- What is *entropy*?
- What is the *Second Law of Thermodynamics*?
- How are entropy and equilibrium related?
- How is entropy related to heat flow?
- Use entropy to explain why an engine can't be 100% efficient.

Fluids

- What is *density*, and how is it calculated?
- What is the density of water? (Might as well write it down, it shows up a lot!)
- What is *pressure*? Pressure is always a push perpendicular to the surface
- What are the units of pressure?
- What is atmospheric pressure P_0 ?
- How does “suction” actually work?
- Find the pressure in a fluid as a function of depth from the surface.
- What is *gauge pressure*?
- What is Pascal’s principle? Why do car mechanics find it useful?
- How can you tell whether an object will float or sink?
- Find the buoyancy force on an object that is completely submerged in a fluid.
- Find the buoyancy force on an object that is partially submerged.
- How can a boat float, even if it’s made out of steel?
- What is flux Φ ? What does “flux is conserved” mean?
- Use flux conservation to calculate the speed of a fluid in part of a pipe.
- What is *Bernoulli’s Principle*? What are some examples of it in action?
- What is Bernoulli’s Equation and how is it used?
- What is *viscosity*?
- When a viscous fluid flows through a pipe, where is its speed the largest?