201 Review

2,3,4 Kinematics, vectors, circular motion

5-6 Newton's laws

$\vec{F} = m\vec{a}$

$\vec{F}_{12} = -\vec{F}_{21}$

7-8 Work-kinetic energy theorem

power

potential energy

9) conservation of momentum

- collisions
- impulse ($\int F\,dt = \Delta p$)
- center of mass

10-11) rigid body motion

rotation about fixed axis

angular position
velocity
acceleration

rotational kinetic energy

moment of inertia

torque

angular momentum $\tau = I\alpha = \frac{dL}{dt}$

rolling motion

12) static equilibrium

- balance forces and torques
- elasticity { Young's / bulk } moduli

13) gravitation

- acceleration in circular orbits
- Newton's universal grav. law

$$\vec{F}_1 = -G\frac{m_1 m_2}{r_{12}^2}\hat{r}_{12}$$

14) fluid mechanics

pressure

Archimedes' principle

Fluid dynamics – Bernoulli's principle $\frac{1}{2}\rho v^2 + \rho g h + P = cst$

15) Simple harmonic motion

16-18 – waves (202)

Heat & thermo.

19) temperature

heat transport

heat conduction

heat conduction mechanisms

20) heat and 1st law of thermodynamics

$$\Delta E = \Delta Q + \Delta W$$

E = internal energy; ΔQ = heat added; ΔW = work done on system

E = state variable – given P, T, V, etc
ΔE doesn't depend on path
but ΔQ and ΔW do depend on path

Q, W transfer variables

Specific heat: $C \Rightarrow C_V$ vs C_P, $\gamma = C_P/C_V$

ideal gas $PV = nRT$
eq'n of state

$$C_P = C_V + R$$

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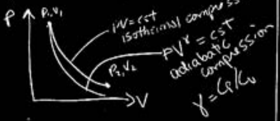
isothermal vs adiabatic expansion for ideal gas



21) Kinetic theory of dilute gases

$\frac{1}{2} m\overline{v^2} = \frac{3}{2} nRT$ for ideal gas

$E_{Trans} = \frac{3}{2} nRT$ $\left[C_v \left(\begin{matrix} \text{monatomic} \\ \text{gas} \end{matrix} \right) = \frac{3}{2} R \right]$

discussed qualitatively diatomic gases (air)

in practice, at ~300K

$C_v = \frac{3}{2} R + R$ ← 2 degrees of freedom from rotations

$\gamma(\text{air}) = 7/5$

$\gamma(\text{argon}) = 5/3$

22) Heat engines + entropy.

heat engine vs refrigerator.

· efficiency of engine

Carnot engine $\varepsilon = 1 - T_C/T_H$

Entropy $\Delta Q = T \Delta S$ — S state variable, $-\int \frac{dQ}{T}$ ... measure of randomness