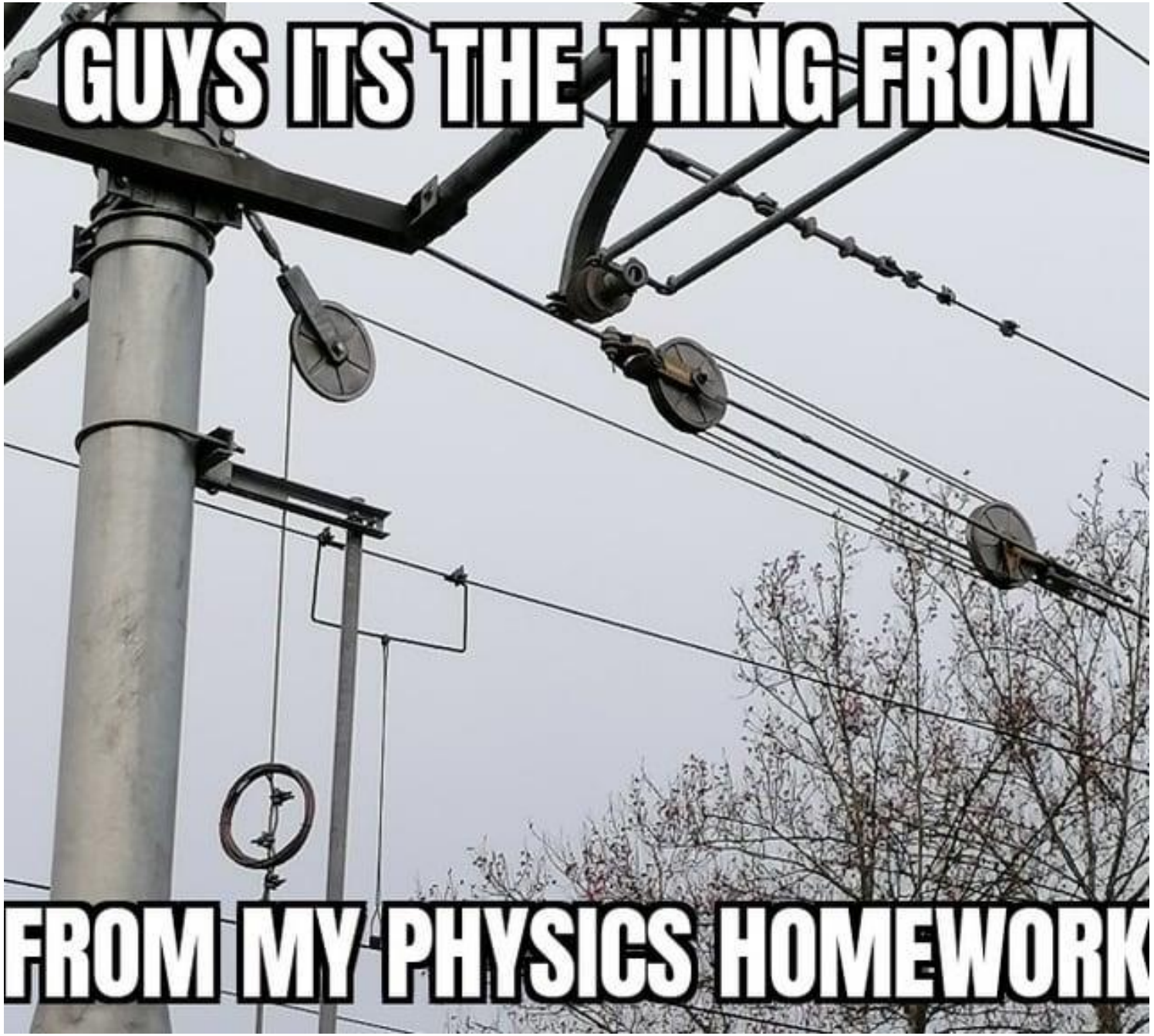
SQUARECAP



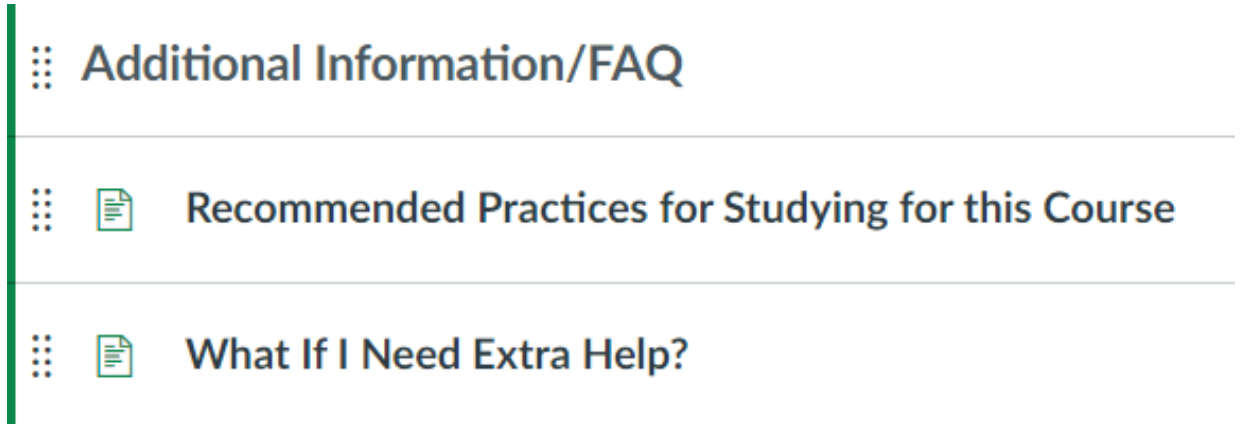
Relatable?

Which problem(s)?

Notes

- As you prepare for Midterm II:
  - Post questions to EdDiscussion! Fastest way to get an answer. (Turn on notifications to see other's questions/answers)
  - Reminder: Office hours of LA's and TA!

- Exam Corrections: You **must** follow **the 4-step method** or you'll need to do it over again.



Notes

Instructor of Record:

Andrew Loveridge

Office: PMA 12.224

Drop In Hours: Thursday 1:30-2:30 (in Office), Friday 4pm-5pm (in CPE 2.216)

Graduate Teaching Assistant:

Katie Rink

Drop In Hours: Mondays 5-6 pm in PMA 11.204

Undergraduate Learning Assistant: Megan McAfee

Drop In Hours: Tuesday and Thursday 4pm-5pm @ ASE 1.124

Undergraduate Learning Assistant: Sushmit Gupta

Office Hours: Tuesday 1pm-2pm (PMA 6.112) and Friday 2pm-3pm (CPE 2.212)

Recap: Types of Collisions

- Elastic vs. Inelastic (elastic will conserve mechanical energy)

- Isolated vs. not isolated (external forces mean momentum is not conserved)

→If external forces do no work, energy can still be conserved. An isolated inelastic collision would still conserve momentum

Recap: My Comments and Questions

- Comment: Some values of momentum for comparison. Notice there's no unit

Cargo ship: about 10^9 kgm/s

Protons at LHC: 10^-17 kgm/s

New Idea: Impulse

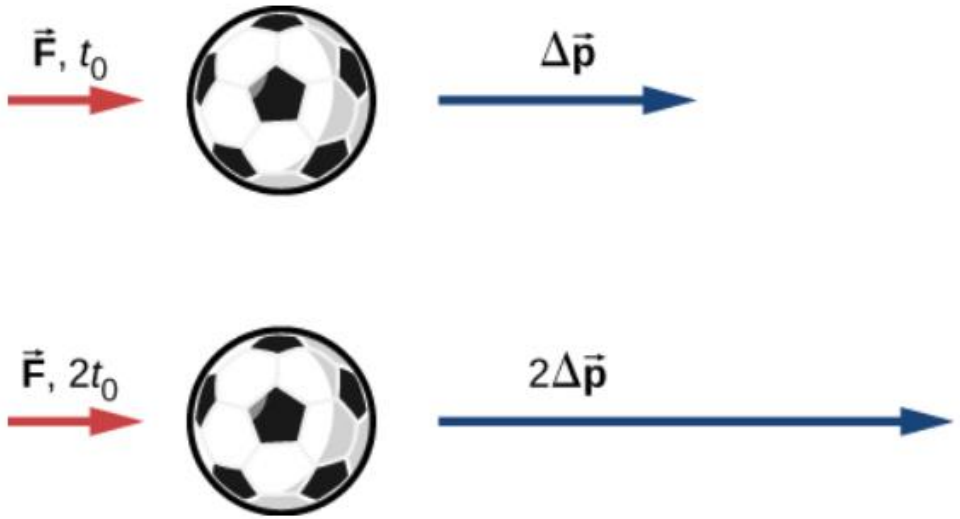
- When a force acts through a distance, we call that work, and it represents a transfer of energy.

$$W = \int F \cdot dr = \Delta E$$

- When a force acts for some duration of time, we call that an impulse, and it represents a transfer of momentum

$$\vec{I} = \int \vec{F} dt = \Delta \vec{p}$$

$$since\ \vec{F} = \frac{d\vec{p}}{dt}$$



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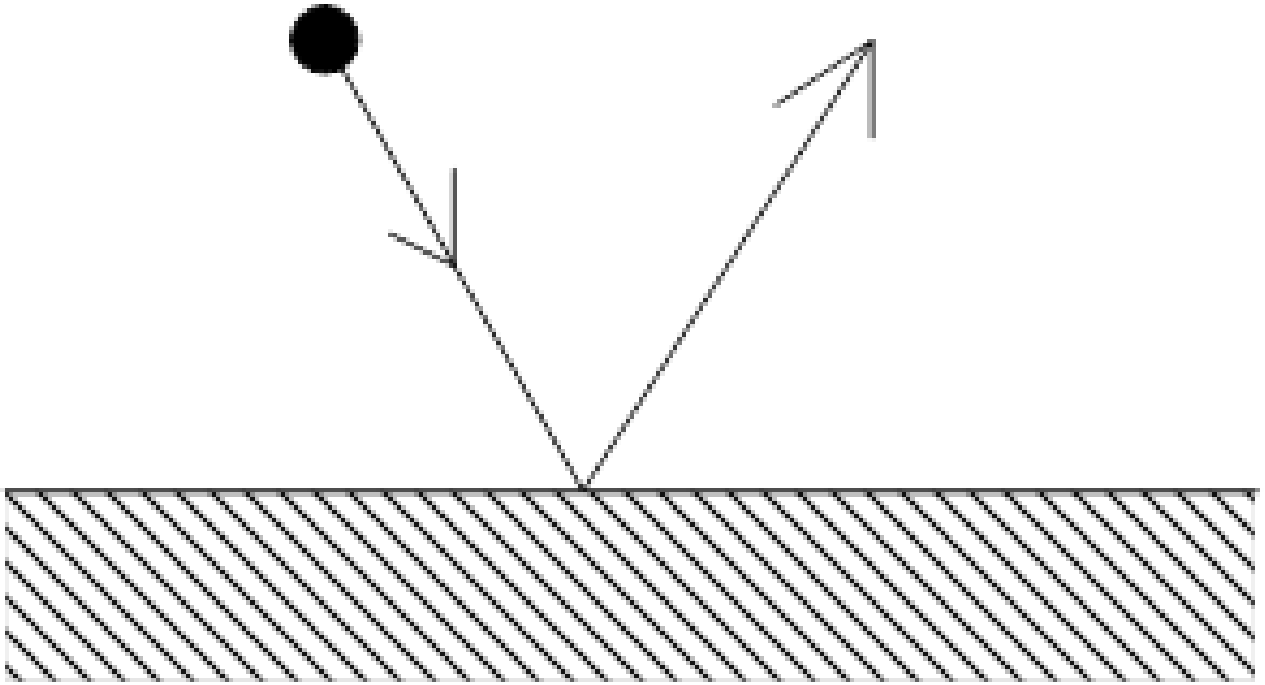
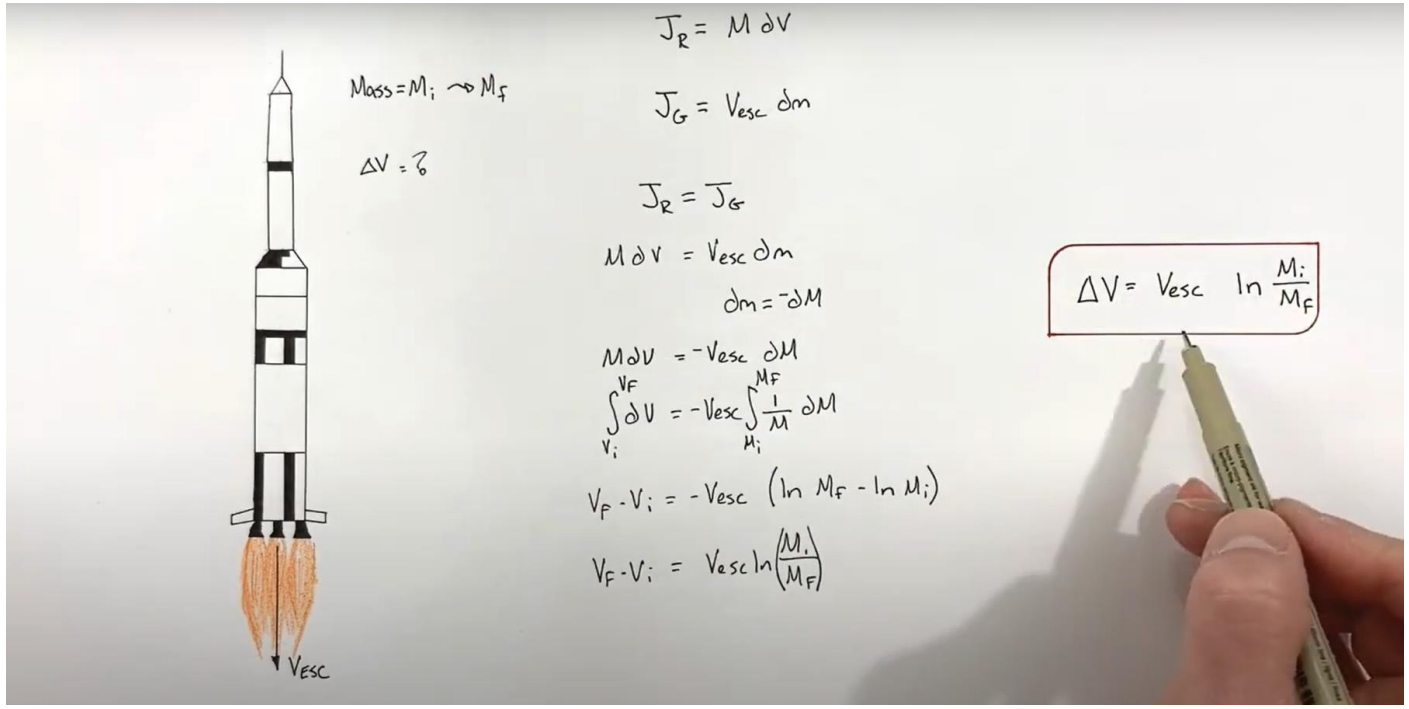
Discuss and Answer:

A ball bounces off the floor as shown.
The direction of the impulse on the ball,
is ...



A: straight up
B: straight down
C: to the right
D: to the left
E: up and to the right
F: up and to the left
G: down and to the right
H: down and to the left
I: Impossible to determine

Prelecture Review: The Rocket Equation



What are our comments and questions?

- In a rocket, both the mass of the rocket and the velocity of the rocket are changing. $F = ma$ is not sufficient.

$$\frac{dP_R}{dt} = -\frac{dp_e}{dt}$$

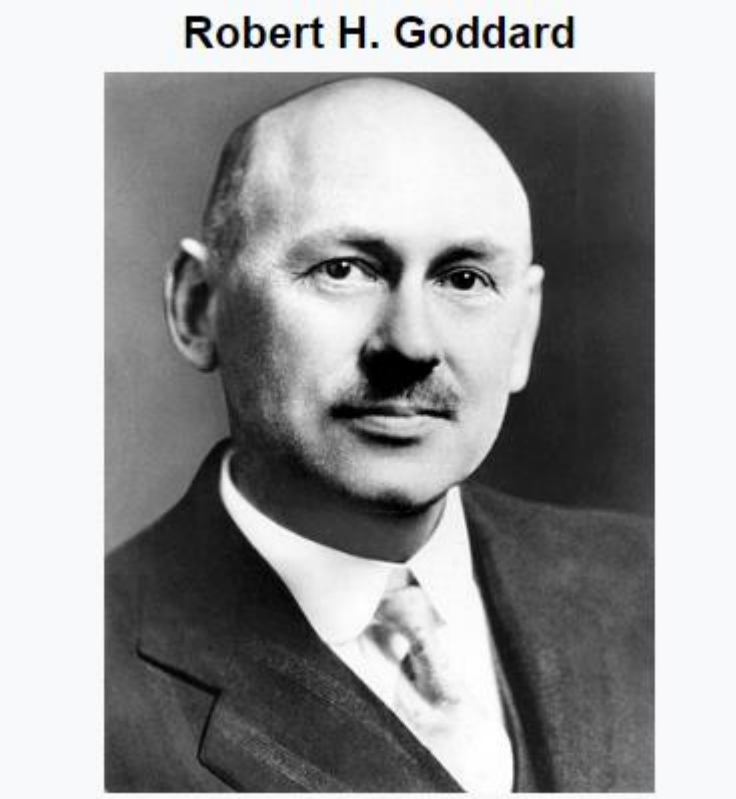
- We are ignoring gravity and other forces.
- The result is the Tsiolkovsky rocket equation $\Delta V = V_e \ln M_i/M_f$

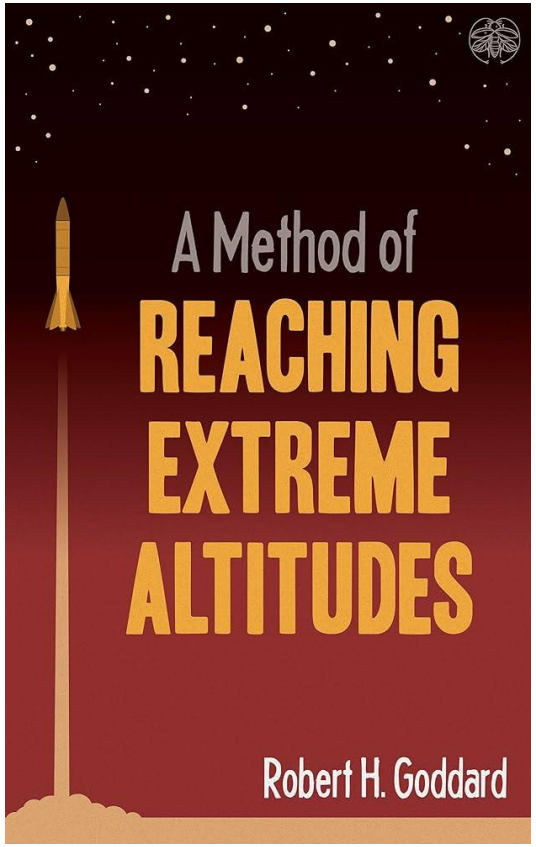
Comments and Questions

- Would the force remain constant and the acceleration change as a result of the mass decresing? Or would it be the other way around?
- So what would a real life example of the equation look like for Newton's Second Law where F=dp/dt. Are you able to use this when m is constant? Or is F=ma the only equation you can use when m is constant?
- How does the relationship between the mass, velocity, and the change of velocity impact the efficieny of a rocket, before traveling into space?

My Comments and Questions

- Comment: Although classical mechanics was worked out in the 1600's and 1700's, it is sufficient to land a person on the moon, and the detailed equations were not worked out until 1900-1950.





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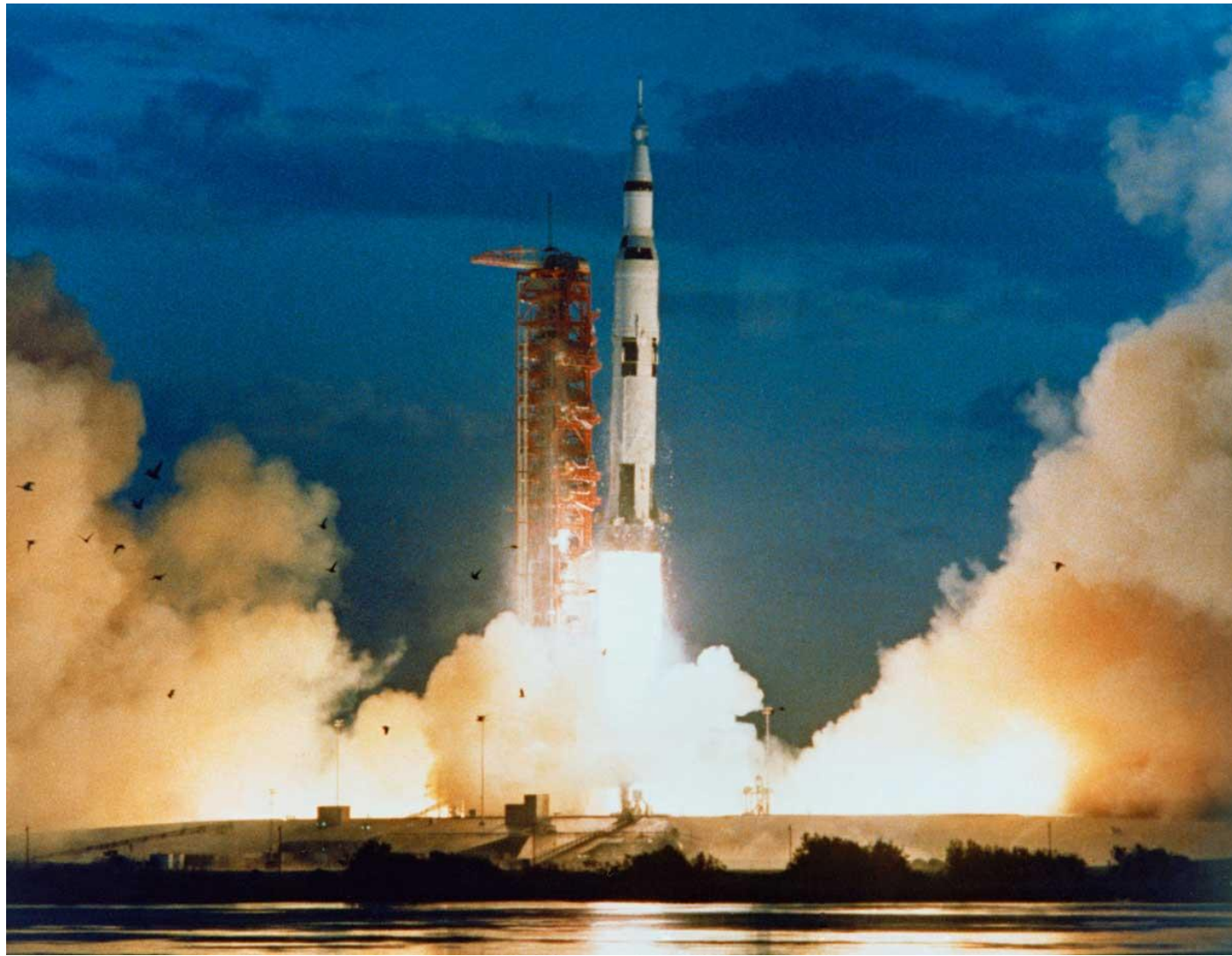
Discuss and Answer:

- How much fuel does a rocket need to reach twice the speed of its exhausted fuel?

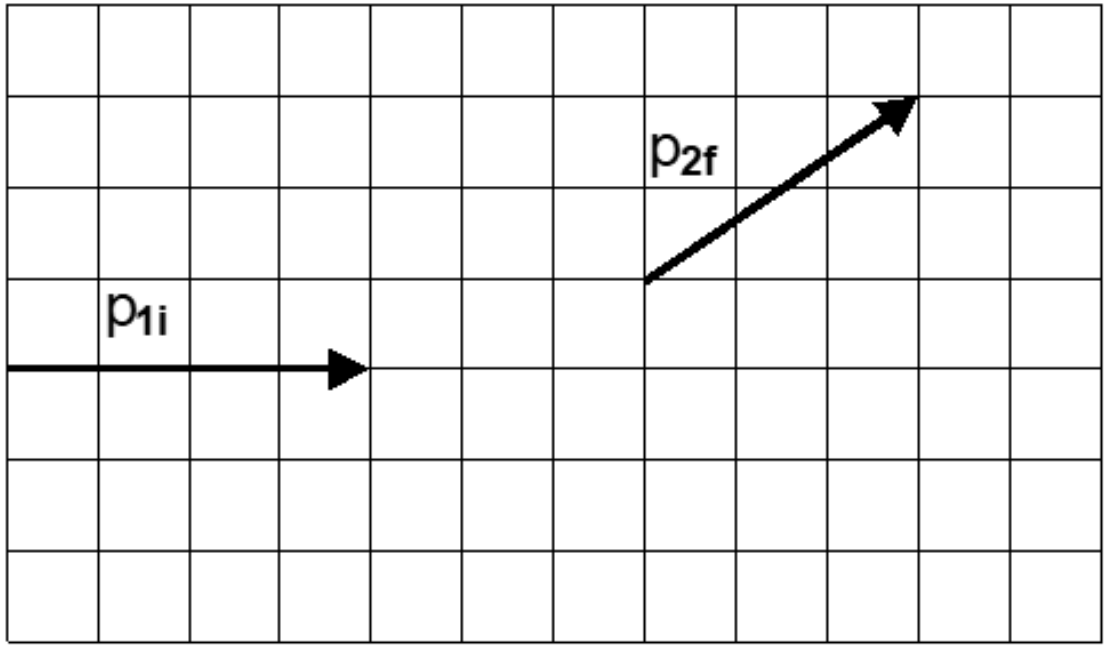
- For Saturn IV the final speed is almost 4 times the exhaust speed. What does this mean for Rocket design?



SQUARECAP

Discuss and Answer:

Ball 1 strikes stationary Ball 2 in 2D collision. The initial momentum of Ball 1, $\vec{p}_{1i}$, and the final momentum of Ball 2, $\vec{p}_{2f}$, are shown on the graph.



Assuming both balls have the same mass, what's the final momentum of the first ball?

Is Energy Conserved?