

AAE 340
Dynamics and Vibrations
Exam 2

Instructions:

The exam is worth a total of 100 points. Work as quickly and accurately as you can.

Write your name at the bottom of this page.

DO NOT TURN THE PAGE UNTIL

INSTRUCTED TO DO SO

Note: Partial Credit can only be given for

1. Correct partial steps toward the complete solution, which are
2. Clearly labeled in a logical and **systematic** manner.

Name

Solution

I. Thrusting Rocket Problem (35 points)

A rocket is designed so that the exit pressure, P_e , is zero. Assume that the vehicle is operated in deep space where gravitational and other forces can be neglected.

Ia. Using a system of particles approach, show that the force exerted by the rocket is

$$F = \dot{m}_{\text{prop}} v_e$$

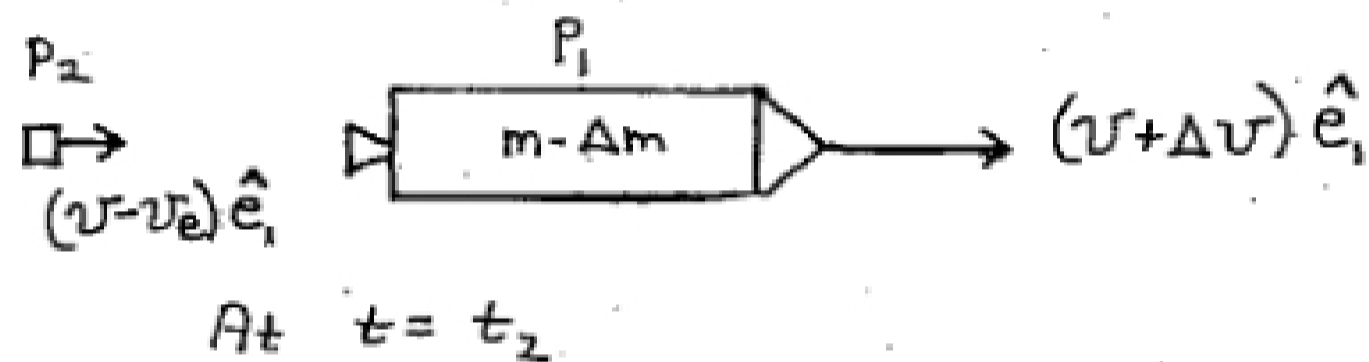
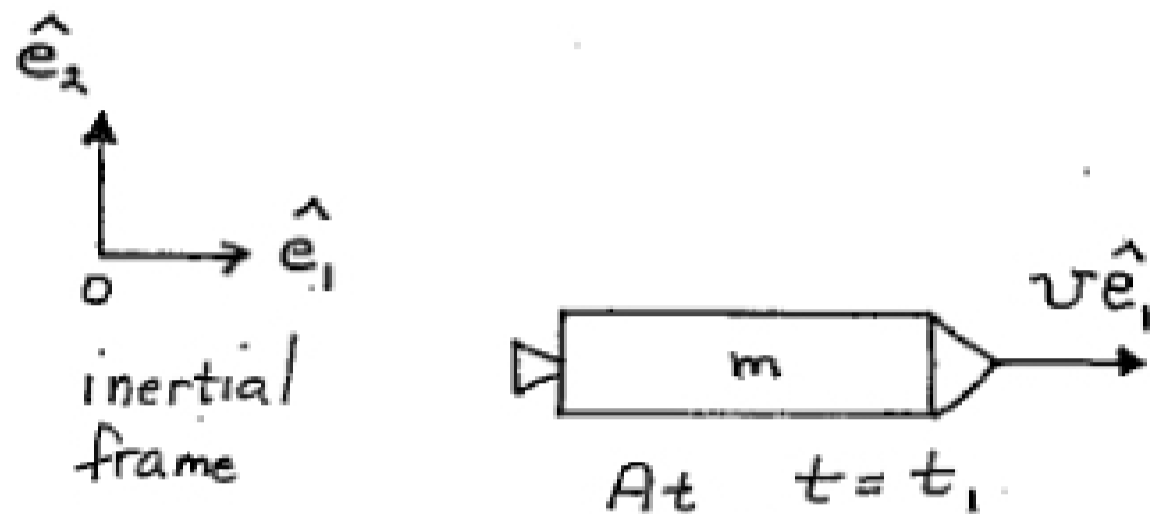
where \dot{m}_{prop} is the mass flow rate of propellant and v_e is the exhaust velocity.

Ib. Using the definition of specific impulse, I_{sp} (in seconds), show that

$$I_{\text{sp}} = v_e / g$$

I. Solution

(Ia)



Using the Principle of Linear Impulse and Linear Momentum for a System of Particles,

$$\vec{0} = \int_{t_1}^{t_2} \vec{F} dt = m \vec{v} \Big|_{t_1}^{t_2} = \sum_{i=1}^2 m_i \vec{v}^{OP_i} \Big|_{t_1}^{t_2}$$

= 0 because
no external
forces act on
the system

$$\vec{0} = (m - \Delta m)(v + \Delta v)\hat{e}_1 + \Delta m (v - v_e)\hat{e}_1 - mv\hat{e}_1$$