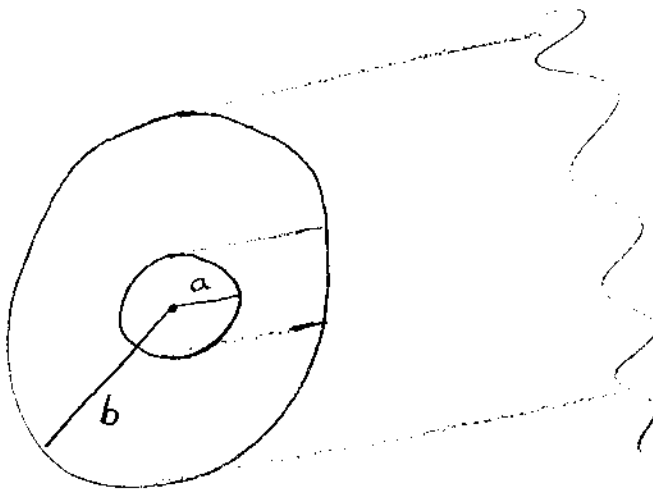


PRELIMINARY EXAMINATION
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Part C, 20 August 2001, 09:00 - 12:00

- C1. A rocket is heading directly towards the earth at a speed of $0.9c$, where $c = 3.0 \times 10^8$ m/s is the velocity of light in empty space. In its own reference frame, the rocket is 75 m long and has a diameter of 10 m. At a certain moment, the tail of the rocket emits a pulse of light which lasts 0.1 s, as measured on the rocket.

In the earth's reference frame . . .

- (a) (3 points) what is the length of the rocket?
 - (b) (2 points) what is the diameter of the rocket?
 - (c) (2 points) how long does the light pulse last?
 - (d) (3 points) how long after the start of the pulse does light first reach the nose of the rocket?
- C2. (10 points) Derive an expression for the self-inductance, L , per unit length, ℓ , for a long coaxial cable with solid inner conductor of radius a and outer conductor of radius b .



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C3. A block of mass m slides down a frictionless incline. The block is released a height h above the bottom of the loop, as shown in the figure. Neglect any wind resistance.

- (a) (3 points) What is the force of the track on the block at the block at Point A?
- (b) (2 points) What is the force of the track on the block at Point B?
- (c) (2 points) At what speed does the block leave the track?
- (d) (3 points) How far away from Point A does the block land on level ground?

