PHYS1120
Summer 2025

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**Show all work for credit!**
Due Date: 8 August

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1. A metal rod 25 cm long connects two conducting rails in a region with magnetic field $B = 2.5$ **T** directed into the page. The rod is pulled by an external force so that it moves at constant velocity $v = 2.35$ **m s^{-1}**. A resistor of 12 Ω connects the two parallel rails. Find the applied force required to keep the bar moving at constant speed.

2. Sailors on a ship use a laser to communicate with a submarine on the floor of the ocean. The laser is on the deck of the ship 8 m above the surface of the water, and the laser beam strikes the ocean 24 m from the side of the ship. If the ocean is 82 m deep and the ocean water has an index of refraction of 1.33, find the lateral distance between the ship and the submarine.
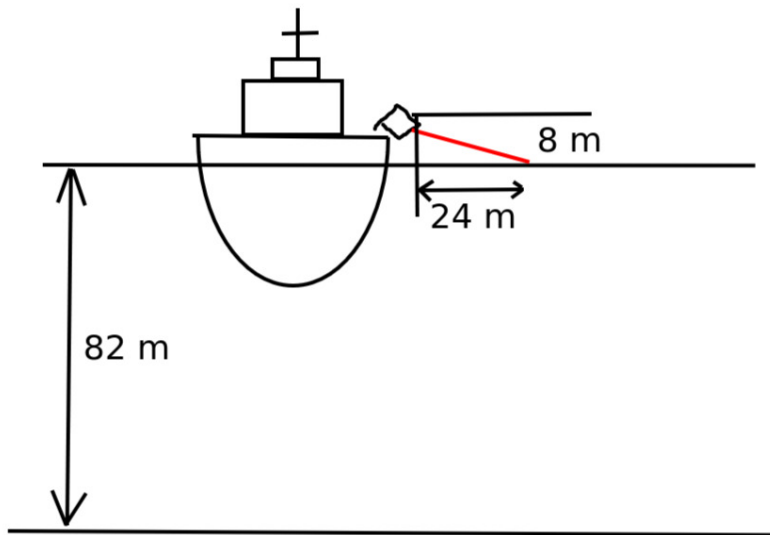
3. A convex lens, with focal length $f_2 = 150$ cm, is 90 cm to the right of a concave lens, of unknown focal length. If a point source 72 cm to the left of the concave lens produces parallel rays to the right of the convex lens, find the focal length of the concave lens.

f1 = ? f2 = 150 cm

72 cm

90 cm
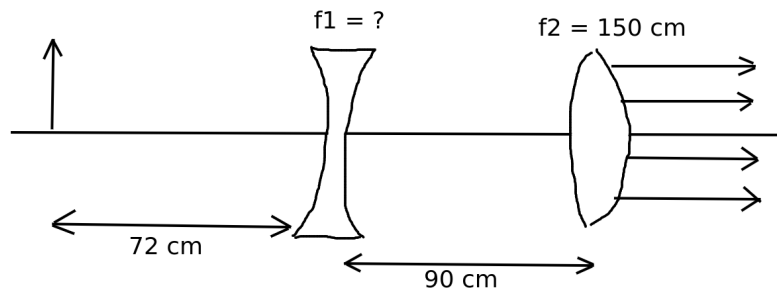
4. A diffraction grating of unknown grating spacing is used to study the emission spectrum of a particular gas.

   (a) If light of wavelength 632.8 nm is deflected by $43.2\,°$ in second order, and light of the target wavelength is deflected by $48.4\,°$ in second order, find the target wavelength.

   (b) Calculate the grating spacing.

Answer key: (1) 0.0765 **N; (2)** 107.5 **m; (3)** -360 **cm; (4a)** 691 **nm; (4b)** $1.85\ \mu\mathrm{m}$

How many hours (approximately) did it take you to complete this assignment?