BPhO 1 2017 Section 1 AF Solutions

a) Physicists sometimes use the approximation that light travels in a vacuum at a speed of 1 foot in 1 ns. What is the percentage error in using this value?

(1.000 m = 1.094 yards and 1.000 yard = 3.000 feet)

[3]

According to the list of constants provided in the paper:

$$\boxed{c = 3.00 \times 10^8 \text{ m/s}}$$

$$1 \text{ ft/ns} = \frac{\frac{1.000}{3 \times 1.094} \text{ m}}{10^{-9} \text{ s}}$$

$$= \boxed{3.047 \times 10^8 \text{ m/s}}$$

So % error is $\frac{3.047 - 3.00}{3.00}$

$$= \boxed{1.56\%}$$

(3 s.f. appropriate precision here)

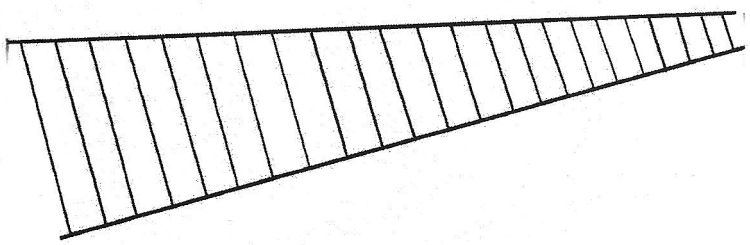
{ if you use $c = 2.998 \times 10^8$ m/s
then % error is $\boxed{1.63\%}$ }

b) A window cleaner's ladder shown in **Figure 1** is narrower at the top than the bottom. It has a weight of 350 N and a length of 5.0 m. When it lies flat on the ground, a force of 80 N is needed to lift the narrow end off the ground.

(i) How far is the centre of mass from the narrow end? y

(ii) What force is required to lift the wide end of the ladder off the ground?

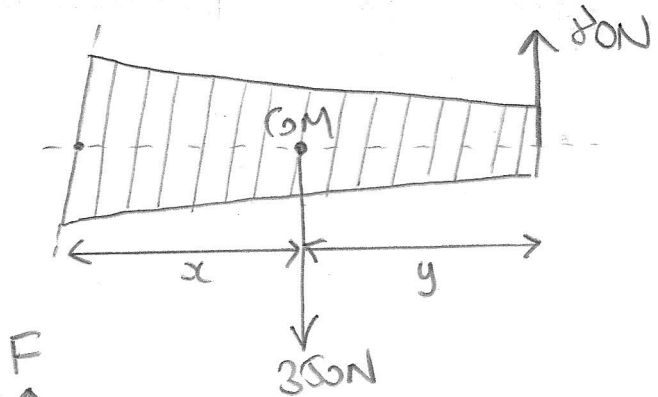
F



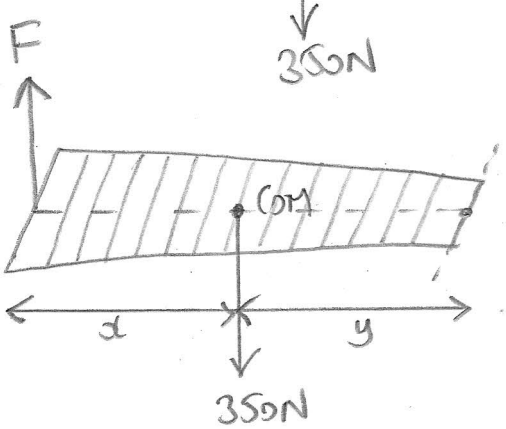
Is this supposed to be a 3D projection?!

Figure 1

[5]



Pivoting about wide end (narrow end rises)



Pivoting about narrow end (wide end rises)

So $80(x+y) = 350x$ ① (Narrow end just lifted)

$F(x+y) = 350y$ ② (wide end just lifted)

Now $\boxed{x+y = 5.0}$ So in ①: $x = \frac{80}{350} \times 5.0$

$\boxed{x = 1.14\text{m}}$

∴ (i) $y = 5.0 - 1.14 = \boxed{3.86\text{m}}$

(ii) $F = \frac{350y}{5} = \boxed{270\text{ N}}$

(2)