FORT LEWIS COLLEGE
DEPARTMENT OF PHYSICS AND ENGINEERING

SUBMITTING PROBLEMS

(Summarized from Engineering: Principles and Problems by Lee H. Johnson)

Homework problems must be neatly and legibly done. Use one side of 8 ½ " x 11" paper only. Do NOT submit problems on paper torn from a spiral notebook.

The engineer eventually has to present his or her work to someone; a client, a colleague, or boss. Stated another way, the engineer must constantly be communicating what they are doing to someone else. The success of a particular piece of work, and indeed the success of his or her entire career, depends upon their effectiveness in communication.

The following rules are offered as highly desirable suggestions which represent good engineering practice and will produce good presentations.

1. Problems should always be presented in a neat and orderly fashion.

2. Always put the date and your name on your problem (on every page). It is surprising how frequently an engineer wishes to know the date on which work was done and how significant this can be.

3. Use good quality paper. It is often desirable to use coordinate paper – such as engineering computation paper. Horizontal lines help keep writing in line, and coordinate lines aid in drawing diagrams.

4. Print all the words and letters neatly in preference to writing unless the problem involves much English prose. It is desirable for the student to develop a neat style of printing using regular engineering letters.

5. Use pencil only, erasing errors instead of crossing them out. The one exception to this rule is in recording observed data in the laboratory or field; where crossing out inaccurate or unused data is the standard.

6. Use only one side of each sheet of paper and STABLE all sheets together.

7. Neither crowd nor spread the work too far apart.

8. Do not use short cuts or skip steps in presenting a solution, but include all significant calculations and explanations. Show controlling equations used in the solution approach.

9. Designate significant answers by underlining, and a final answer outlined with a box. Units MUST be indicated on all numerical results. For example, the number 35 by itself means nothing, since it could be gallons, feet per second, or dollars.

10. An example illustration of "Engineering Format" is attached and should be used as a guide.

Illustration of "ENGINEERING FORM" for the solution of engineering problems.

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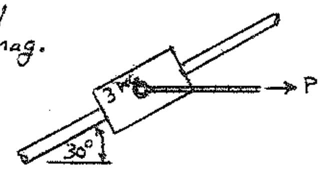
PROB. #(12.10)

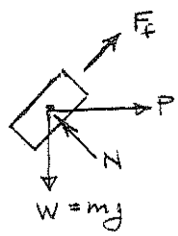
<u>GIVEN</u>: The 3KG collar shown moving down rod with speed of 3 m/s when force of mag. P is applied to horiz. cable. Assume coeff. of friction of 0.2 between rod & collar.



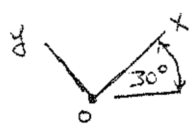
<u>DETERMINE</u>: The magnitude P of the force required to bring the collar to rest if it moves through a distance of 1 meter before coming to rest.

SOLUTION:

F.B.D. of collar:



CO-ORD. SYSTEM USED:



origin at CM of collar when force P is applied. Co-ord. system fixed w.r.t. earth

Apply N.S.L. to solve problem

$$\Sigma \vec{F} = m\vec{a}$$

⇒ 2 scaler eqns in x-y co-ord. system,

$$\Sigma F_y = m a_y = 0 \text{ since no motion in y-dir.}$$

$$N - W\cos 30° - P\sin 30° = 0$$

eqn ①
$$N = W\cos 30° + P\sin 30°$$

$$\Sigma F_x = m a_x$$

eqn ②
$$F_f + P\cos 30° - W\sin 30° = m a_x$$

Use the force law for kinetic friction force

eqn ③
$$F_f = \mu N$$

Subst. eqn ③ into eqn. ② and get

eqn ④
$$\mu N + P\cos 30° - W\sin 30° = \left(\frac{W}{g}\right) a_x$$

Subst. eqn ① for N into eqn. ④ to get

$$\mu\left[W\frac{\sqrt{3}}{2} + \frac{P}{2}\right] + P\frac{\sqrt{3}}{2} - \frac{W}{2} = \frac{W}{g} a_x$$

or, solving for P

eqn ⑤
$$P = \left(\frac{1}{\mu + \sqrt{3}}\right)\left[W\left(1 - \mu\sqrt{3} + \frac{2}{g} a_x\right)\right]$$

Need a_x & since all forces are constant, a_x is also constant & can be found from

$$V_{fx}^2 - V_{ox}^2 = 2a_x(x_f - x_o)$$

$$0 - (-3\,m/s)^2 = 2a_x(-1 - 0)$$

$$a_x = 4.5\ m/s^2$$

Subst. of a_x & $\mu = 0.2$ then gives from eqn. ⑤:

$$\boxed{P = 23.92\ N}$$ ← Answer