AP Physics I: 2019 Summer Assignment Sample Problems

Note: My solutions to the following problems are provided so you have an idea of the quality of work that is expected of you. All of these problems are similar to those you are asked to do in your summer assignments, so you might find them to be a helpful reference for the content as well.

1. Suppose that a mechanics problem is solved and results in the system of equations

$$2T - mg\sin\theta + P\cos\theta = 0$$
$$5T + mg\cos\theta + P\sin\theta = ma_t$$

In the problem, suppose that the quantities, m, g, θ, and P are all known, and quantities T and a_t are unknown. Solve for a_t in terms of only the known quantities.

$$2T - mg\sin\theta + P\cos\theta = 0 \quad (i)$$
$$5T + mg\cos\theta + P\sin\theta = ma_t \quad (ii)$$

← Equations numbered for clarity

Use EQN (i) to solve for "T": ← Brief explanation of work done, as necessary.

$$2T - mg\sin\theta + P\cos\theta = 0$$
$$+mg\sin\theta - P\cos\theta \qquad +mg\sin\theta - P\cos\theta$$

$$\frac{2T}{2} = \frac{mg\sin\theta - P\cos\theta}{2}$$

$$T = \frac{1}{2}(mg\sin\theta - P\cos\theta)$$

Plug this into EQN (ii) and solve for "a_t":

$$5T + mg\cos\theta + P\sin\theta = ma_t$$
$$(5) \times \frac{1}{2}(mg\sin\theta - P\cos\theta) + mg\cos\theta + P\sin\theta = ma_t$$
$$\frac{5}{2}mg\sin\theta - \frac{5}{2}P\cos\theta + mg\cos\theta + P\sin\theta = ma_t$$
$$\Rightarrow a_t = \frac{\frac{5}{2}mg\sin\theta - \frac{5}{2}P\cos\theta + mg\cos\theta + P\sin\theta}{m}$$

Looks nicer if we factor and get rid of fractions:

$$\boxed{a_t = \frac{(5mg + P)\sin\theta + (5P - mg)\cos\theta}{2m}}$$

← Boxed final answer

2. Convert 5 meters per second squared (m/s^2) to feet per minute squared (ft/min^2).

1 meter = 3.28 feet , 1 minute = 60 seconds

$$5\,m/s^2 = \frac{5 \text{ meters}}{(\text{second})^2} \times \frac{3.28 \text{ feet}}{1 \text{ meter}} \times \left(\frac{60 \text{ seconds}}{1 \text{ minute}}\right)^2$$

← Units shown clearly, aligned to cancel

$$= \frac{5 \cdot \text{meters}}{\text{second}^2} \times \frac{3.28 \text{ feet}}{1 \text{ meter}} \times \frac{3600 \text{ seconds}^2}{1 \text{ minute}^2}$$

$$= \frac{(5)(3.28)(3600) \text{ feet}}{\text{minute}^2} = 59040.00 \text{ ft/min}^2$$

↑ Correct units on final answer

$$\boxed{5\ m/s^2 = 59040.00\ ft/min^2}$$

← Final answer boxed

3. The equation for the gravitational force between two particles of masses m_1 and m_2 at a distance r away from each other is

$$F_{1-2} = \frac{Gm_1m_2}{r^2}$$

where G is the gravitational constant ($G = 6.67408 \times 10^{-11}$ m^3 kg^{-1} s^{-2}). By what factor does the force F_{1-2} increase if the distance r is halved?

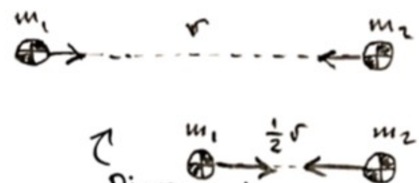
$$F_{1-2} = \frac{Gm_1m_2}{(\frac{1}{2}r)^2}$$

← Each step clearly shown.

$$= \frac{Gm_1m_2}{\frac{1}{4}r^2}$$

$$= \frac{4Gm_1m_2}{r^2}$$

$$= 4 \times \underbrace{\frac{Gm_1m_2}{r^2}}_{F_{1-2}} = 4F_{1-2}$$



↑ Diagrams drawn clearly labeled

When the distance "r" is halved, the force F_{1-2} increases by a factor of 4.

← Final answer boxed, complete sentence!