AP Quiz 2: Mathematical Kinematics

Your name-period here:

0 Constants

- $g = 10\ \frac{\text{m}}{\text{s}^2}$

1 Dropping the ball, twice

1. You drop a ball on earth and then drop **a different ball** on an unknown planet in another star's orbit. Each time you drop the ball exactly the same unknown distance. On Earth it takes exactly 1s to hit the ground. On the unknown planet it takes exactly 2s to hit the ground. Below is a table of the surface acceleration of each planet.

   - Planet A: $2\frac{\text{m}}{\text{s}^2}$
   - Planet B: $2.5\frac{\text{m}}{\text{s}^2}$
   - Planet C: $4\ \frac{\text{m}}{\text{s}^2}$
   - Planet D: $5\frac{\text{m}}{\text{s}^2}$

   (a) (2.5 pt) Which planet are you on?

   A. A
   B. B
   C. C
   D. D
   E. There is no way to determine this with the given information

   (b) (2.5 pt) What is the ratio of the masses of the balls?

   A. 1:1
   B. 3:1
   C. 9:1
   D. 27:1
   E. There is no way to determine this with the given information

(0pt) Does your name and period appear at the top of the paper? If not, explain why limerick that includes your name and the word "beagle."

2 Braking or breaking

1. (5pt) A ship is traveling 30 $\frac{\text{m}}{\text{s}}\hat{x}$ when it spots a lighthouse 200 m ahead. If it can accelerate at $-3\ \frac{\text{m}}{\text{s}^2}\hat{x}$, does the ship hit the lighthouse?

3 Two blind mice

Two mice are running across an open field. One of them has an initial position vector of

$$\vec{r}_{1,0} = 10 \text{ m}\hat{\text{x}} - 6 \text{ m}\hat{\text{y}}$$

and a velocity of

$$\vec{v}_1 = -8 \frac{\text{m}}{\text{s}}\hat{\text{x}} + 4 \frac{\text{m}}{\text{s}}\hat{\text{y}}$$

The other has a position vector of

$$\vec{r}_{2,0} = -18 \text{ m}\hat{\text{x}} + 10 \text{ m}\hat{\text{y}}$$

and a velocity of

$$\vec{v}_2 = 6 \frac{\text{m}}{\text{s}}\hat{\text{x}} - 4 \frac{\text{m}}{\text{s}}\hat{\text{y}}$$

1. (5pt) Do they collide? If so, at what time? Show all work!

4 Woolley's nightmare

1. (5pt) A fighter pilot is flying at a constant velocity of 300 $\frac{\text{m}}{\text{s}}\hat{\text{x}}$ when an unseen aircraft 500 m behind the first, and traveling at the same velocity, fires a short-range missile at the first aircraft. The missile's acceleration is 10 $\frac{\text{m}}{\text{s}^2}\hat{\text{x}}$ and the missile's maximum range when fired from a stationary platform is 1000 m. Does the missile hit the aircraft before running out of fuel? If so, at what time? Ignore air resistance and show all work.