

Your solutions should be neat, correct and complete. Same instructions as Mission 1 apply here.

Recommended Homework from Textbook: problems:

2.1, 2.8, 2.10, 2.14, 2.23, 2.31, 2.41, 2.47, 2.53, 2.58, 2.77, 2.79, 2.80,

3.8, 3.9, 3.13, 3.22, 3.25, 3.29, 3.31, 3.37, 3.46, 3.51, 3.65, 3.77, 3.84

4.9, 4.10, 4.14, 4.20, 4.29, 4.30, 4.31, 4.43, 4.56, 4.58

I also recommend you work on understanding whatever details of lecture seem mysterious at first.

Required Reading 2 [1pt] Your signature below indicates you have read:

(a.) I read Lectures 5, 6, 7 and 8 by Cook as announced in Blackboard: _____.

(b.) I read Chapters 2, 3 and 4 of the required text: _____.

Problem 11 [3pts] You throw a rock vertically upward. It leaves your hand a distance $1.00m$ above the ground. When does the rocket hit the ground? How far did the rock travel? What is the magnitude of its displacement? You are on Earth and may ignore air friction.

Problem 12 [3pts] A rocket car accelerates at $a = 3g$ over a distance of L . Then the car applies brakes which give $a = -g$ until the car comes to rest. Find the total distance the car travels.

Problem 13 [3pts] Suppose you launch a water balloon at speed $v_o = 20m/s$ from the top of a $200m$ building at an angle of inclination β . The building is on a level plane on earth and air friction is negligible. Use calculus to find β which gives the maximum range. You may use some numerical method to solve the algebraic problem which arises in the analysis.

Problem 14 [3pts] You shoot a cannon on earth (ignore friction). The cannon ball lands $1000m$ away and you hear the explosion of the cannon ball hitting the level ground some $7.0s$ later than what speed and angle of inclination did you shoot the cannon? You are given that the speed of sound is $333.3m/s$ in the given atmospheric conditions.

Problem 15 [3pts] Suppose $x = R \cos \theta$ and $y = R \sin \theta$ and $z = z_o - \frac{g}{2}t^2$ where θ is a function of time such that $\theta(0) = 0$ and R, z_o, g are constants. Find the position, velocity and acceleration vectors. Also, find the displacement vector from time zero to time t .

Problem 16 [3pts] Suppose $\vec{a} = 6t\vec{c}$ where \vec{c} is a constant vector. Find the position, velocity, and position in terms of the position \vec{r}_o and velocity \vec{v}_o at $t = 0$. Also, find an integral which gives the distance travelled.

Problem 17 [3pts] A ninja uses a slingshot which allows him to spin explosive clay in a circle of radius $1.25m$. If he is able to spin the slingshot 10 times per second then how far can we shoot the clay? (give it the best angle, assume a level-playing field and no friction)

Problem 18 [3pts] A man has a rocket-boots which produce a thrust of twice his weight. If he turns on his boots and rockets at an angle of 45 degrees from the horizontal for 3 seconds then how high does the man fly ?

Problem 19 [3pts] A ninja on horseback throws a shuriken horizontally to hit a target $1.25m$ below the release point. If the horse is galloping at $15m/s$ then how far from the target must he throw the shuriken?

Problem 20 [3pts] Let $\vec{\mathbf{a}}, \vec{\mathbf{v}}, \vec{\mathbf{r}}$ denote acceleration, velocity and position of a cat in coordinate system S . Let $\vec{\mathbf{a}}', \vec{\mathbf{v}}', \vec{\mathbf{r}}'$ denote acceleration, velocity and position of a cat in coordinate system S' . Furthermore, suppose that $\vec{\mathbf{v}} = \alpha t(\hat{\mathbf{x}} + \hat{\mathbf{z}})$ whereas in another coordinate system $\vec{\mathbf{v}}' = \beta(\hat{\mathbf{x}}' + \hat{\mathbf{y}}')$. Given that α, β are constants and S is an inertial frame of reference, what can we say about the given coordinate system S' ? Do Newton's Laws hold in S' ?

Bonus A ninja hound may run a total distance of 51.749 kilometers from where it was summoned by Kakashi. Let us suppose Kakashi gives it instructions to run along a spiral with equations $x = t \cos(t), y = t \sin(t)$ (these are implicitly in kilometers and minutes). How long does Kakashi's hound run before it must return to the dog world from whence it came? Assume the motion starts at $t = 0$. You may use technology to perform the needed integration.