

AP PHYSICS C

Summer Assignment

All parts of this assignment are due at the beginning of the first day of class, or you will earn a zero. Parts 1 & 3 will be graded for correctness; Part 2 will be graded for completeness.

NOTE: You must show all of your work to receive full credit (formulae, substitutions, answers, units, graphs etc.)

PART 1: Review of Motion in 1-D

Read Ch. 1-2, and do the problems listed below, starting on p.32 in the Problems section.

Problem	Answer
2	1.75 m/s, 2.14 m/s, graphs
30	2.5 s, graphs
41	40m
54	12.3 m/s, graphs
63	2.34m
74	1.29 s
78	crash, red: 0m/s, green: 10m/s
100	17 s, 290 m

We'll discuss this material the first few class periods and then dive into derivatives. You can expect a test on 1-D motion within the first week of school.

PART 2: Unit Vector Notation and Motion in 2-D

1. Read 3.1-3.2. Some of this will be new to you, but it is relevant to our second unit.
2. Answer the following questions in writing.
 - a. What do \hat{i} , \hat{j} , and \hat{k} represent?
 - b. What is the advantage of using unit vector notation instead of magnitude-angle notation?
3. Read 4.1-4.4. You will learn the calculus in class, but you need to arrive well-versed in projectiles.
4. Do the problems listed below, starting on p.84 in the Problems section of Ch. 4. Put them on a separate piece of paper from your Ch. 2 work.

Problem	Answer
2	$-5\hat{i}+8\hat{j}$, 9.4m, 122° , out, $8\hat{i}-8\hat{j}$, 11m, -45°
21	0.18m, 1.9m
28	0.84m, 79° south of east
30	5.8m/s
43	11m, 23m, 17m/s, -63°
97	0.062s, 482m/s

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PART 3: Ranking Tasks

Compelling arguments in any discipline make a claim, provide supporting evidence, and articulate the reasoning linking the claim to the evidence. In this part of the assignment, you will construct a series of such arguments. Your work will be evaluated on a 0-6 point scale per the rubric below.

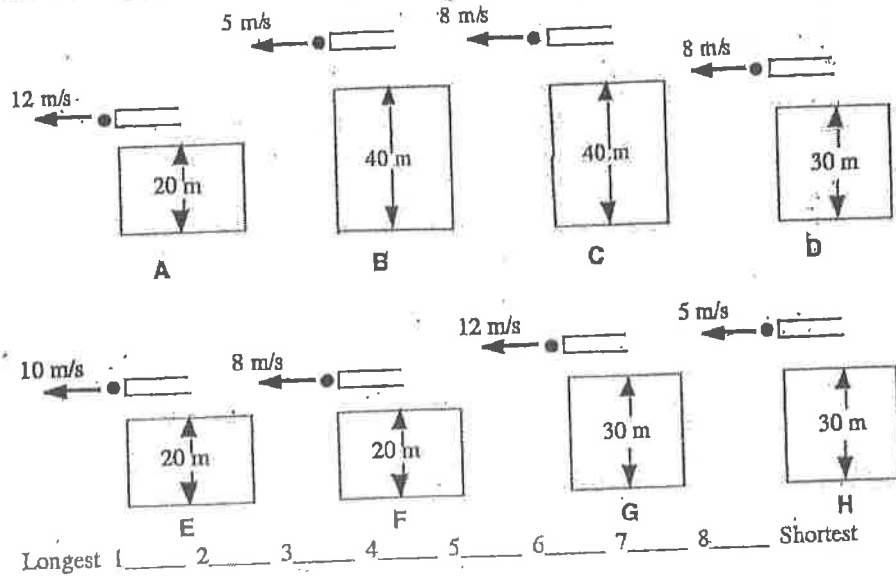
Rank each scenario based on the criteria given (i.e. make a claim). Provide a written justification of your rankings, including any ties. Include references to the information given in the problem statement and/or diagrams (i.e. evidence) and make explicit connections to relevant physics principles (i.e. reasoning).

Component	Level 1 (0 pts)	Level 2 (1 pt)	Level 3 (2 pts)
<i>Claim:</i> a response to the question asked or the problem posed.	Does not make a claim, or makes an inaccurate claim.	Makes an accurate but incomplete claim.	Makes an accurate and complete claim.
<i>Evidence:</i> use of data to support the claim.	Does not provide evidence, or provides inappropriate or irrelevant data in support of the claim.	Provides appropriate, but insufficient evidence to support the claim. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support the claim.
<i>Reasoning:</i> use of scientific principles to show why data count as evidence to support the claim.	Does not provide reasoning, or provides reasoning that does not link evidence to the claim.	Provides reasoning but repeats the evidence and/or includes insufficient reference(s) to relevant scientific principles.	Provides reasoning that clearly and logically links evidence to the claim. Includes appropriate and sufficient references to scientific principles.

Rifle Shots—Time to Hit Ground ⁴⁶

The eight figures below show rifles that are being fired horizontally, i.e., straight out, off platforms. The bullets fired from the rifles are all identical, but the rifles propel the bullets at different speeds. The specific speed of each bullet and the height of each platform is given. All of the bullets miss the targets and hit the ground.

Rank these bullets, from longest to shortest, on the basis of how long it takes a bullet to hit the ground. That is, put first the bullet that will take the longest time from being fired to hitting the ground, and put last the bullet that will take the shortest time.



CLAIM:

BC
TIE

D, G, H
TIE

A, E, F
TIE

Justify your rankings.

EVIDENCE:

B & C START FROM AN ELEVATION OF 40M, THE HIGHEST OF THE CLIFFS DEPICTED

D, G, H ARE RELEASED FROM 30M-TALL CLIFFS

A, E, F ARE ALL FALLING FROM 20 M CLIFFS

REASONING:

THE ONLY FACTOR THAT AFFECTS TIME IN THE AIR FOR HORIZONTALLY LAUNCHED PROJECTILES IS INITIAL ELEVATION. HORIZONTAL VELOCITY AFFECTS ONLY HORIZONTAL MOTION, IE THE RANGE. SINCE ALL HAVE INITIAL VERTICAL VELOCITY OF ZERO & A VERTICAL ACCELERATION DUE TO GRAVITY, HIGHER VERTICAL DISPLACEMENT REQUIRES MORE TIME TO FALL

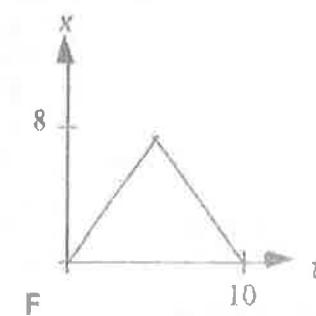
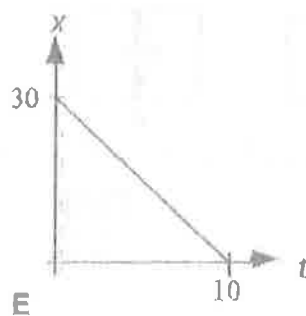
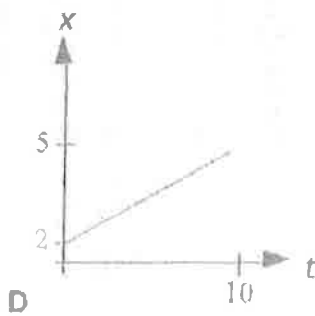
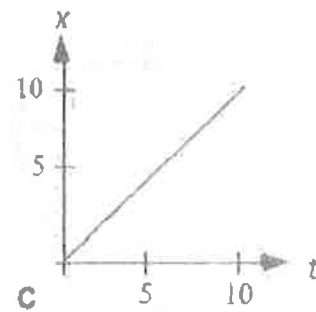
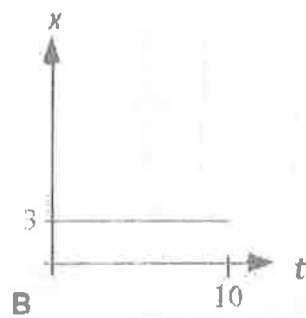
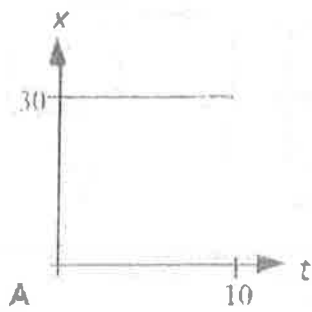
$$\Delta x = v_{0y}t + \frac{1}{2}at^2$$

$$\therefore \Delta x \propto t^2$$

EXAMPLE

Position Time Graphs—Average Speed ¹⁰

In the position vs. time graphs below, all the times are in seconds (s), and all the positions are in meters (m). Rank these graphs on the basis of which graph indicates the greatest average speed, where the average speed is calculated from the beginning to the end of motion. Give the highest rank to the one(s) with the greatest average speed, and give the lowest rank to the one(s) indicating the least average speed. If two graphs indicate the same average speed, give them the same rank.



Greatest 1 2 3 4 5 6 Least

Or, none of these are moving at all.

Or, the average speed is the same for all of these.

Please carefully explain your reasoning.

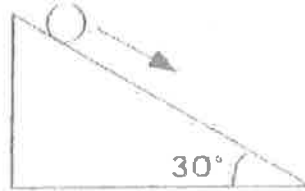
Objects in Different Situations—Accelerations ⁵

The following objects are sitting, falling, rolling, swinging, or just going in circles, as indicated in the different situations below. Each has an acceleration in some direction or another. You are to rank them from greatest to least on the basis of the magnitude of acceleration. If two or more objects have the same acceleration, rank them the same.

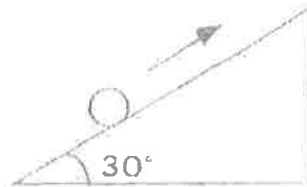
A. Object dropped from the top of a building.



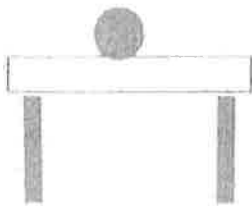
B. Object rolling from rest down an inclined plane.



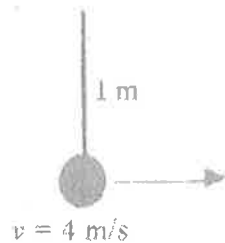
C. Object rolling up a inclined plane after being given an initial velocity of 4 m/s.



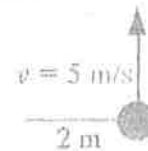
D. Object sitting on table top motionless.



E. Object attached to a string at the bottom of the swing.



F. Object traveling in a circle with constant speed



Greatest 1 2 3 4 5 6 Least

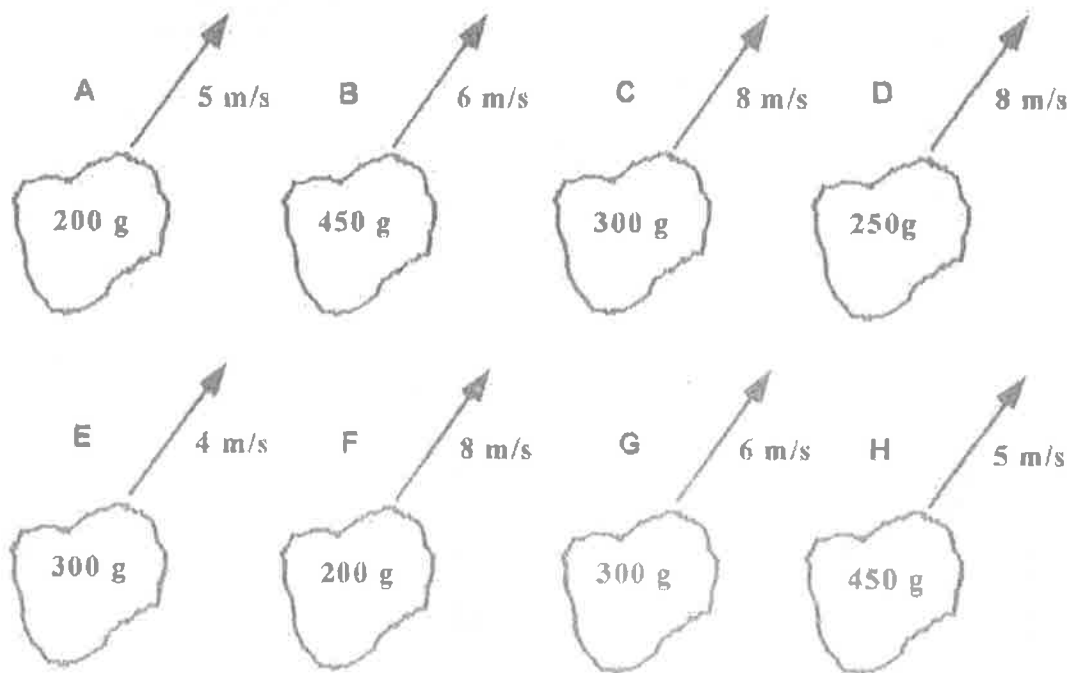
Or, all of these have the same magnitude of acceleration. _____

Please carefully explain your reasoning.

Rock Throw—Maximum Heights ⁶⁰

Shown below are eight rocks that have been thrown into the air. The rocks all have the same shape, but they have different masses. The rocks are all thrown at the same angle, but at different speeds. The masses of the rocks and their speeds, when released, are given in the figures. (We assume for this situation that the effect of air resistance can be ignored.) All start from the same height.

Rank these rocks from greatest to least on the basis of the maximum heights the rocks reach.



Highest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____ Lowest

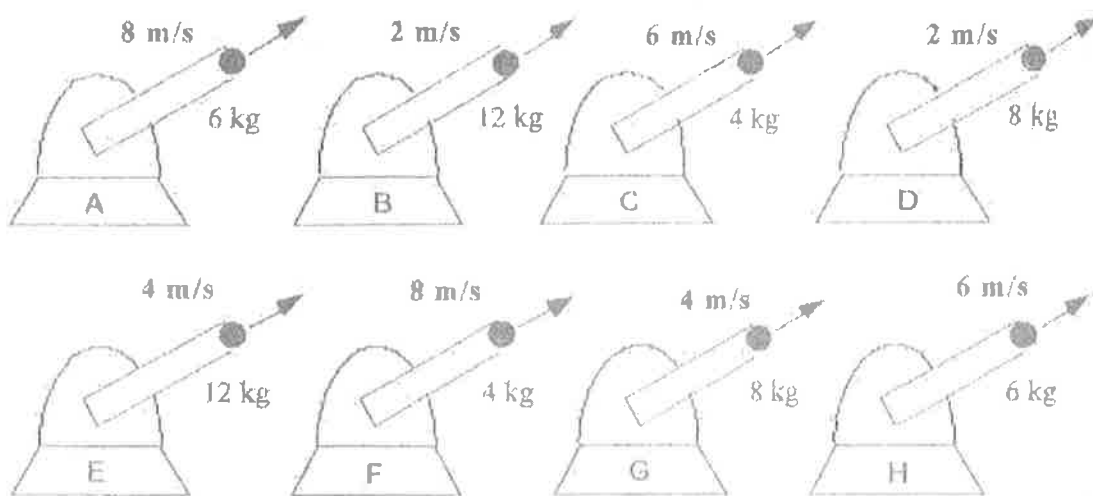
Or, all rocks reach the same height. _____

Please carefully explain your reasoning.

Cannon Shots—Acceleration at the Top ⁵²

The figures below depict eight cannons shooting shells into the air. All of the cannons are aimed at the same angle of 35 degrees. All of the cannons are identical. The shells are all the same size and shape, but the masses of the shells, as well as their speeds as they leave the cannons, are different. The values of these variables are specified in the figures.

Rank these situations from highest to lowest on the basis of the acceleration at the highest point reached by the shells. (We assume for this situation that the effect of air resistance can be ignored.)



Highest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____ Lowest

Or, all of the shells have the same (nonzero) acceleration at the top. _____

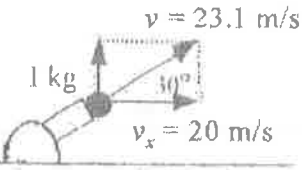
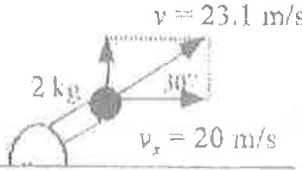
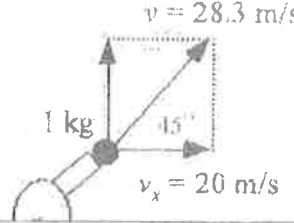
Or, all of the shells have the zero acceleration at the top. _____

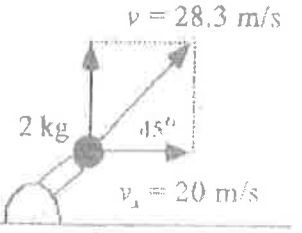
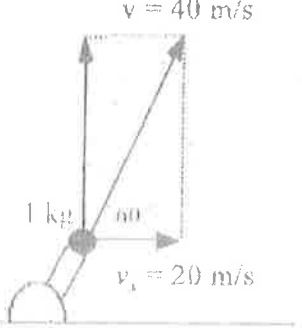
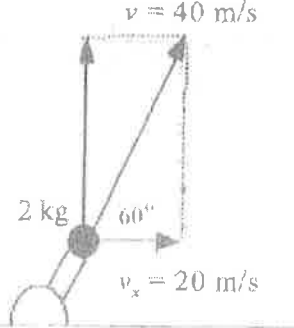
Please carefully explain your reasoning.

Projectile—Horizontal Distance ⁵⁴

The pictures below depict cannonballs of two different masses projected upward and forward. The cannonballs are projected at various angles above the horizontal, but all are projected with the same horizontal component of velocity.

Rank according to the horizontal distance traveled by the balls.

A  **B**  **C** 

D  **E**  **F** 

Largest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Smallest

All distances traveled are the same.

Please carefully explain your reasoning.

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PART 4: Filling in some gaps

If AP Physics 1 was not your first-year physics course, you likely have not been exposed to rotation and simple harmonic motion. AP Physics C assumes students have a working background knowledge of these topics, so you will need to build that over the summer.

I will share powerpoints and practice problems on these topics with you. Email me after you try them and I will send you the solutions.

I would also recommend that you explore the following resources:

- Flipping Physics on YouTube <https://www.youtube.com/user/flippingphysics/videos>
- Khan Academy
 - <https://www.khanacademy.org/science/physics/torque-angular-momentum>
 - <https://www.khanacademy.org/science/ap-physics-1/simple-harmonic-motion-ap>
- The Physics Classroom
 - <https://www.physicsclassroom.com/Physics-Interactives/Balance-and-Rotation>
 - <https://www.physicsclassroom.com/class/waves/Lesson-0/Motion-of-a-Mass-on-a-Spring>
 - <https://www.physicsclassroom.com/class/waves/Lesson-0/Pendulum-Motion>

YOU ONLY NEED TO DO **Part 4** IF AP PHYSICS 1 WAS NOT YOUR FIRST-YEAR PHYSICS COURSE.

