

PHYSICS - NICASTRO NAME_____Block____
 NUMBER CRUNCHING LAB DATE_____Block____
 PART I: VERIFICATION OF PLANETARY AVERAGE ORBITAL SPEEDS BY KINEMATICS AND DYNAMICS. USE THE VELOCITY EQUATIONS DEVELOPED IN CLASS. SHOW CALCS ON A SEPARATE SHEET OF PAPER. DON'T FORGET TO CONVERT TO mi/hr.

PLANET	$v_k(\text{miles/hr})$	$v_d(\text{miles/hr})$
MERCURY		
VENUS		
EARTH		
MARS		
JUPITER		
SATURN		
URANUS		
NEPTUNE		
PLUTO		

PART II: DRAW A GRAPH OF THE ABOVE SPEEDS AS A FUNCTION OF DISTANCE FROM THE SUN.
 USE A SCALE OF 1 BLOCK = 5000 MI/HR; 1 BLOCK = 1 ASTRONOMICAL UNIT.
 YOU WILL HAVE TO ESTIMATE FRACTIONS OF A BLOCK ON YOUR GRAPH PAPER.

1. ON THE BASIS OF THIS GRAPH, WHAT IS THE MATHEMATICAL RELATIONSHIP BETWEEN THE DISTANCE OF A PLANET FROM THE SUN AND ITS ORBITAL SPEED?
2. a. WHAT IS CENTRIPETAL FORCE?
- b. WHAT TYPE OF FORCE IS THE CENTRIPETAL FORCE IN THIS APPLICATION?
- c. IS THE CENTRIPETAL FORCE ACTING ON A PLANET CLOSER TO THE SUN GREATER THAN, LESS THAN, OR EQUAL TO THE CENTRIPETAL FORCE ACTING ON A PLANET FARTHER AWAY FROM THE SUN? EXPLAIN WHY.
- d. IF A CIRCULAR ORBIT IS ASSUMED FOR EACH PLANET, WILL THE CENTRIPETAL FORCE ACTING ON THAT PLANET CHANGE AS IT IS ORBITING THE SUN? EXPLAIN.
- e. IF THE ORBIT OF A PLANET WERE NOT REALLY CIRCULAR, HOW WOULD THIS AFFECT

THE CENTRIPETAL FORCE ACTING ON THAT PLANET? HOW WOULD IT AFFECT ITS SPEED AS IT ORBITED THE SUN?

PART III: VERIFICATION OF KEPLER'S 3RD LAW OF PLANETARY MOTION.

“ THE CUBE OF THE AVERAGE RADIUS OF A PLANET'S ORBIT IS DIRECTLY PROPORTIONAL TO THE SQUARE OF THAT PLANET'S AVERAGE PERIOD OF REVOLUTION. ”

$$R^3 \propto T^2$$

$$R^3 = k T^2$$

$$k = R^3 / T^2$$

THIS VALUE OF “k” SHOULD BE THE SAME FOR ALL NINE PLANETS! PROVE IT BELOW.

EXPRESS ALL R'S IN ASTRONOMICAL UNITS; EXPRESS ALL T'S IN EARTH YEARS.

PLANET	R^3 / T^2 (SHOW NUMBERS)	“k” (CALCULATED- 4 SIG FIGS)
MERCURY		
VENUS		
EARTH		
MARS		
JUPITER		
SATURN		
URANUS		
NEPTUNE		
PLUTO		

PART IV: FOLLOW-UP QUESTIONS:

3. a. WHAT DOES KEPLER'S FIRST LAW SUGGEST ABOUT THE CENTRIPETAL FORCE KEEPING THE PLANETS IN ORBIT?

b. WHAT DOES THIS IMPLY, THAT IS LATER VERIFIED BY KEPLER'S 2ND LAW?