

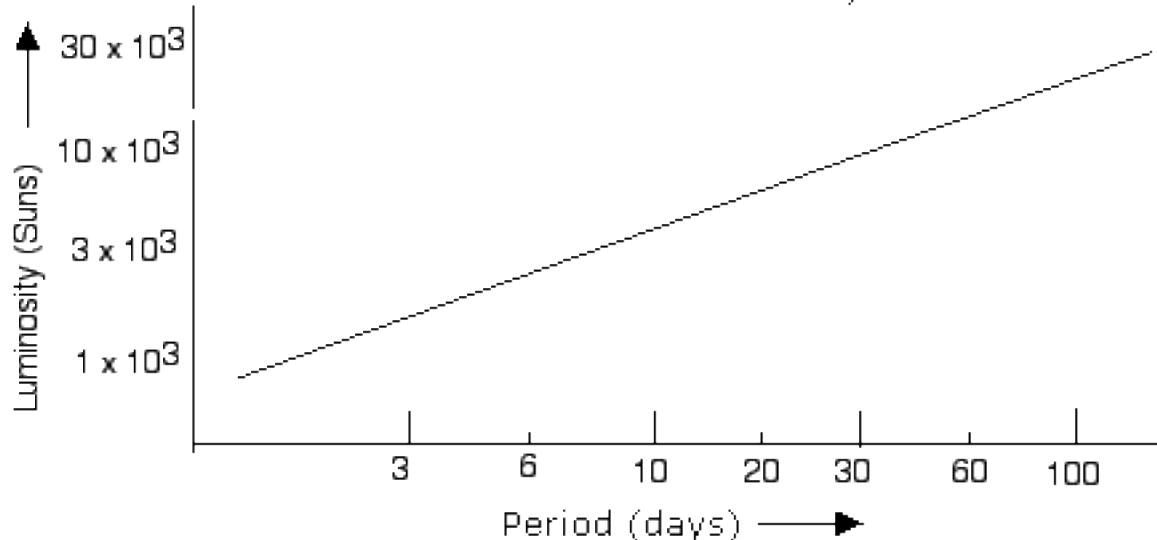
NAME(S) _____
ASTRONOMY 25

CLASS DAY/TIME _____
LLOYD

PROBLEM SET #2
THE P-L RELATIONSHIP
FORCES AND PARTICLES
DOPPLER EFFECT

Part I: The P-L Graph

The Period – Luminosity relation



The P-L graph shows the relationship between period and luminosity of Cepheid variable stars. The **period** is the amount of time the star takes to go from maximum brightness to minimum brightness to maximum again. The **luminosity** is the total light output of the star — its true brightness. Use the graph to answer the following questions:

1. A Cepheid star with a period of 30 days is _____ times brighter than the Sun.
2. A, B, and C are Cepheid variable stars. Their periods are:
A: 10 days B: 30 days C: 5 days

Arrange the stars A, B, and C in order of luminosity, from lowest luminosity to highest:

3. Fill in the blank in this sentence:

The longer the period of the star the _____ the luminosity.

Part II: The Doppler Effect

An important dark line in the spectrum of stars occurs at a wavelength of 656 nm at rest (nm = nanometer = billionth of a meter). (It's the **hydrogen alpha** line.) Imagine that you study five stars (A–E) from Earth and discover that this dark line is observed at the wavelength shown in the table below for each of the 5 stars. In the last column, subtract the rest wavelength of the line from the observed wavelength.

STAR	Observed wavelength	Observed wavelength – rest wavelength
A	650 nm	
B	663 nm	
C	656 nm	
D	657 nm	
E	646 nm	

1. **Ranking Instructions:** Rank the size of the Doppler shift (from largest change to smallest change, without regard to direction) observed for the light from each star (A–E).

Ranking order:

largest 1_____ 2_____ 3_____ 4_____ 5_____ smallest

Or, the Doppler shift of the light from the stars would all be the same.

(check the box)

Carefully explain your reasoning:

2. **Ranking Instructions:** Rank the speed of the stars (A–E) from moving fastest toward Earth, to moving fastest away from Earth. Circle the letter of any star that is not moving towards or away.

Ranking order:

fastest toward Earth 1_____ 2_____ 3_____ 4_____ 5_____ fastest away

Or, all the stars are the same speed (check the box)

Carefully explain your reasoning:

Part III Forces & Particles

1. Consider the four forces: gravity, electromagnetism, the strong force and the weak force.

Ranking instructions: Order the forces according to strength, from weakest to strongest.

Ranking order:

weakest 1_____ 2_____ 3_____ 4_____ strongest

OR they are all the same strength (check the box)

Carefully explain your reasoning.

2. **Ranking instructions:** Order the forces according to the **distance** over which they are felt, from shortest to longest distances.

Ranking order:

shortest distance 1_____ 2_____ 3_____ 4_____ longest distance

OR they are all have the same range (check the box)

Carefully explain your reasoning.

3. The four fundamental **matter** particles are the up quark, down quark, electron, and neutrino. The table shows whether or not the particle is affected by each of the forces. Put the right particle in each empty box.

STRONG	WEAK	E-M	GRAVITY	CHARGE	PARTICLE
no	yes	no	yes	neutral	
yes	yes	yes	yes	positive	
yes	yes	yes	yes	negative	
no	yes	yes	yes	negative	