Physics 90 — HW 3

Passed out, Friday, 2020-02-21. Due Monday, 2020-02-24.

> *e.g.* is Latin for “for example” and *i.e.* is Latin for “in other words”
>
> Standard prefixes:
>
> k = kilo = 10^3 = “a thousand”
> M = mega = 10^6 = “a million”
> G = giga = 10^9 = “a billion”
> T = tera = 10^{12} (but do not confuse this with temperature which is also *T*)
> c = centi = 10^{-2} (but do not confuse it this with the speed of light which is also *c*)
> m = milli = 10^{-3} (but do not confuse this with meters which is also m)
> μ = micro = 10^{-6}
> n = nano = 10^{-9}
> p = pico = 10^{-12}
>
> Common unit abbreviations:
>
> m is the usual abbreviation for meters, but in right ascension it is used for minutes
> s is the usual abbreviation for seconds
> Hz is for Hertz which is $\frac{1}{\text{second}}$

Apparent Magnitude (or just “Magnitude”)

1. Apparent Magnitude

> One of these is **NOT** true:
>
> (A) Hipparchus set up the magnitude system.
> (B) The brightest stars in his system had magnitude 1 and the dimmest stars had magnitude 6.
> (C) With modern measuring techniques, thousands of stars are known to be brighter than magnitude 1.
> (D) The brightest star in the sky is Sirius and a modern measurement using a digital camera of its magnitude gives -1.46.

2. Apparent Magnitude

In the modern system, each magnitude step (e.g., mag 3 → 4) is about 2.5 times dimmer. So two steps would be about:

(A) about 5 times dimmer
(B) about 6.25 times dimmer
(C) about 10 times dimmer

3. Apparent Magnitude

In the modern system, 5 steps dimmer is (e.g., mag 13 → 18) is:

(A) about 2.5 times dimmer
(B) about 6.25 times dimmer
(C) a little less than 100 times dimmer
(D) by definition exactly 100 times dimmer
(E) none of the above

4. Apparent Magnitude

Venus is currently at magnitude -4.22. The brightest star in the sky, Sirius, has magnitude -1.46. Venus is currently:

(A) brighter than Sirius
(B) dimmer than Sirius

5. Apparent Magnitude — with Important Formula

$$\frac{B_2}{B_1} = 10^{0.4\,(m_1 - m_2)}$$

As an example of two steps dimmer, put in $m_2 = 4$ and $m_1 = 2$. Fill in your answer here:

_____

Make sure this agrees with the answer to Problem 2. If you are confused and it does not seem to agree, try also computing $10^{0.4\,(m_2 - m_1)}$. That's:

$$\frac{B_1}{B_2} = 10^{0.4\,(m_2 - m_1)}$$

Now is it clear that your answer is in agreement with Problem 2?!?

6. Apparent Magnitude

Use in $m_1 = 13$ and $m_2 = 18$ in

$$\frac{B_2}{B_1} = 10^{0.4\,(m_1 - m_2)}$$

What is this ratio? Fill in your answer here:

_____

Does this agree with Problem 3?!?

Wave, Wave Speed, Period and Frequency

The relationship between period and frequency is

$$P = \frac{1}{f}$$

which you can rearrange to get

$$f = \frac{1}{P}$$

The main formula for waves of light is

$c = \frac{\lambda}{P}$ where the speed of light $c = 3 * 10^8$m/s

From this and the definition of frequency, you can also get $c = \lambda f$, and then from that you can also get,

$\lambda = \frac{c}{f}$ and $f = \frac{c}{\lambda}$

7. Frequency and Period

The usual units of frequency and period are

(A) Hz for frequency and seconds for period
(B) seconds for frequency and Hz for period
(C) Hz for both frequency and period
(D) seconds for both frequency and period

8. Frequency and Period

The redline on a typical car engine is about 6000 rpm. In revolutions per second, that is 100 $\frac{\text{rev}}{\text{sec}}$ or we could just write 100 Hz.

What period corresponds to 100 Hz?

(A) 0.006 seconds
(B) 0.01 seconds
(C) 10^{-2} seconds
(D)10 ms
(E) B, C and D, because they are all three correct and equivalent

9. Frequency from Wavelength

Microwaves ovens have wavelength 12 cm. What is the frequency (choose the one that is **WRONG**):

(A) 2.5 GHz
(B) 2.5 MHz
(C) 2500 MHz
(D) 2,500,000,000 Hz

10. Wavelength from Frequency

We command nuclear submarines to come to the surface using ultra-low frequency waves. The frequency f = 10 Hz. These waves have wavelength:

(A) 3 x 10^4 m
(B) 3 x 10^4 km
(C) 3 x 10^7 km
(D) 3 x 10^8m