

PROBLEM 1

Here is the translation:

eos 3 + 5 * 2 + 5 eos
SSLLLSSSSLLLSSSSSSLLLSSSSSS

In this, 'eos' means 'end of sequence' – i.e. 'end of this part of the message, 'or 'a break between segments.' It is like a period at the end of a sentence.

There's no real rule for finding the code here: it's a matter of trial and error.

② BTG engineering

③

(c) the volume \rightarrow the earth's

$$V = \frac{4}{3} \pi r^3 = 1.09 \times 10^{27} \text{ cm}^3$$

$$\text{Earth} = 6.378 \times 10^8 \text{ cm}$$

If we set this equal & the volume \rightarrow the ring we get $V = [\text{length} \rightarrow \text{strip}] \times [\text{width}] \times [\text{thickness}]$

$$1.09 \times 10^{27} \text{ cm}^3 = 2 \pi R \times h \times t$$

$$[1.476 \times 10^{13}] \times [1.609 \times 10^7 \text{ cm}]$$

$$\text{we find the thickness } 7.021 \times 10^{-5} \text{ cm} = 4.48 \text{ m/s}$$

(b) surface area \rightarrow inner surfaces

$$A_{\text{ring}} = [\text{length} \rightarrow \text{strip}] \times [\text{width} \rightarrow \text{strip}]$$

$$A_{\text{ring}} = 2 \pi R \times h = 1.51 \times 10^{-21} \text{ cm}^2$$

(c) surface area \rightarrow outer earth

$$A_{\text{earth}} = 4\pi \int_{\text{Earth}}^R r^2 \text{ d}r = 5.11 \times 10^{-18} \text{ cm}^2$$

$$S = \rho = A_{\text{ring}} / A_{\text{earth}} = 2.95$$

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(4) (a)

d) So the ring can support
 $2.95 \times 6.76 \text{ N/m} = 1.98 \times 10^{12} \text{ N-m}$

$$= 1.98 \times 10^{12} \text{ N-m per/m}$$

(e) $\frac{V^2}{R} = \text{Spec capacity}^2$

at r_1

$$\text{at } r_{\text{ring}} V = 1.21 \times 10^8 \text{ cm/sec} = 2.71 \text{ m/sec}$$

mass of earth $m_{\text{earth}} = 5.98 \times 10^{24} \text{ kg}$

(f) $K_E = \frac{1}{2} M v^2 = 4.37 \times 10^{43} \text{ ergs}$

$$5.974 \times 10^{27} \text{ ergs}$$

(g)

time

to accumulate that much energy

$$\frac{1.74 \times 10^{24} \text{ ergs}}{1.74 \times 10^{17} \text{ ergs/sec}} = 2.51 \times 10^{17} \text{ sec}$$

$$= 7.96 \text{ billion years}$$

(h) If we use $\tau \approx 2/\pi$ the sun's life span

$$\text{Time} = \frac{4.37 \times 10^{43} \text{ ergs}}{5.974 \times 10^{33} \text{ ergs/sec}} = 1.14 \times 10^{10} \text{ sec}$$

$$= [362 \text{ years}]$$

PROBLEM 3

(A) We can set up a correspondance:

$T_{\text{communicating}}$ is like 'the length of time she is awake.'
 T_{star} is like 'the length of time from midnight to 8 AM'

So, using the same logic as we did for SETI, the probability that she is awake at 3:15 AM is

Probability = 'the length of time she is awake' / 'the length of time from midnight to 8 AM'
 $= \frac{\text{half an hour}}{8 \text{ hours}} = \frac{1}{16}$

The real question is whether the situation is precisely analogous to the situation we discussed in class. It is, because in our class situation 'now' is a randomly chosen instant of time, and in the present situation 3:15 is too. The two situations would not be analogous if the time she wakes up were not random.

(B) The probability here is just the same, because when you wake up is also random.

(C) For both parts of this question, the answer is the same: the number of nights that must pass equals one divided by $1/16$ – i.e. 16. This is always true: if the probability of something happening is P , then on average one must repeat it $1/P$ times before there is a good chance of its coming to pass.

(D) Notice that, in our discussion of SETI, the length of time since we attained the ability to engage in interstellar communication (around 20 years) is tiny compared to the vast duration of cosmic time. This means that 'now' is a moment. In order for the questions considered in this problem to be analogous, it is necessary that you be awake only for an instant.

Look at it another way: if you stayed awake for a long time, there would be a greater chance of you being awake when she awakens. After all, if you awakened just after falling asleep, and if you then stayed awake all night, you would be guaranteed of being awake when she awakened!

(4)

Grossmann's Stabilizers

(5)

$\text{t} = \sqrt{\frac{C}{G}}$ the time it takes for $x = -R$ to occur is

$$t = \frac{\text{circumference of orbit}}{v}$$

$$t = \frac{2\pi R}{v} = 2\pi R \sqrt{\frac{C}{G}}$$

here R is the radius of the orbit, v the mass of the body at the center, C the constant of gravitation and t the escape velocity.

(b) If we take $L = k^2 R^2$ and $m = 2k^2 M$ we get $\Delta t = \frac{2\pi R}{v}$ and $\Delta x = 2k^2 C$. From Appendix A

$$\mu = 317.4 \quad h_{\text{max}} = 1.8 \times 10^{30} \quad t = 2 \times 10^{-3} \text{ sec}$$

we need to convert x to decimal hours:

50 minutes, is 5% hours = .033 hours

(6)

$$30 \text{ sec} = \frac{1}{2} \text{ min} = \frac{1}{12} \text{ hours} = .00833 \text{ hours}$$

so t hours + 50 mins + 30 sec = 15

so we could have converted every thing to sec

$$t = 9.841 \text{ hours} = 3.54 \times 10^4 \text{ sec}$$

and we set this equal to

$$2\pi R / v_{\text{car}} = t$$

and solve for R :

$$R = \left[\frac{t^2 G M}{4\pi^2 r^2} \right]^{\frac{1}{3}}$$

$$R = 1.5 \times 10^{-10} \text{ cm}$$

$$9.88 \times 10^{11} \text{ m/s}^2$$

(5) Cepheid Variable

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From the graph I estimate the $\log L$ is 8.05
 cepheid has $L/L_{\odot} = 410$

$$\text{So } L = (410)L_{\odot} = 3.83 \times 10^{33} = 1.57 \times 10^{35}$$

erg/sec

The distance to it in parsecs is

$$1/\text{parallax} = 1/0.02 = 50 \text{ parsecs}$$

$$= (50)(3.26) \text{ light years} = \boxed{163 \text{ light years}}$$

$$= 1.54 \times 10^{20} \text{ cm}$$

To find the flux use the inverse square law

$$f = \frac{L}{4\pi R^2}$$

Note: don't use the law for
beams: stars don't
emit beams!

$$\text{we get } f = \boxed{5.25 \times 10^{-6} \text{ erg/cm}^2 \text{ sec}^{-1}}$$

The 2nd reflected waves from

Sea level were same power

$$2/4\pi \times 3 \times 10^6 \text{ Xmas } \times \text{water } 1.75$$

distance squared must be $3 \times r_0^2$ times

factor [since $\lambda/4\pi$ is "number per unit area"]

to distance squared is the

distance must be $\sqrt{3 \times r_0^2}$ times

reflection i.e. $(1.73 \times r_0^3)/163 \times 4\pi \times 1.5$

$$= 2.82 \times r_0^5 / \text{light years}$$

its period in seconds is, distance in persons

$$(= d_{ref} / \lambda) / 3.20 = 8.65 \times r_0^4$$

$$\text{i.e. } 1.16 \times r_0 - 5 \text{ seconds} \rightarrow 2.82$$

th's

$$r_0 = 10^6 \text{ light years } c = 2 \times 10^8$$

and we get 2.82×10^{-6} sec

which is less than $c/2 = 10^{-6}$ sec