

PHYSICS 6

HOUR EXAM 1

SPRING 2006

SOLUTIONS

I. 1d, 2a, 3c, 4d, 5e, 6b, 7c, 8b.

II. a. distance it falls = $(1/2) g t^2 = (1/2) \times (9.8 \text{ m/s}^2) \times (6 \text{ s})^2 = 4.9 \times 36 \text{ m} = 176 \text{ m}$

b. Ball takes 6 sec, so car travels horizontally a distance of

$$28 \text{ m/s} \times 6 \text{ s} = 168 \text{ m.}$$

c. Path is parabolic starting at height 176 m and falling to 168 m to the left on the graph

III. a. time for trip in Andy's frame = $8 \text{ c.yr} / 0.8 \text{ c} = 10 \text{ yr.}$

Andy's age = $20 + 10 = 30 \text{ yr}$

b. Judy's time for trip is $10 \text{ yr} / \text{gamma}$ and

$$\text{gamma} = 1 / \sqrt{1 - (0.8)^2} = 1 / \sqrt{0.36} = 1 / 0.6 = 5/3$$

So Judy's time is $10 / (5/3) = (3/5) 10 = 6 \text{ yr}$ and

Judy is $20 + 6 = 26 \text{ yr.}$

c. distance for Judy = distance for Andy/gamma

$$= 8 \text{ c yr} / (5/3) = 4.8 \text{ light years}$$

d. For Judy the distance was 4.8 c yr and the time was 6 yr, so the planet approached her at $4.8 \text{ c yr} / 6 \text{ yr} = 0.8 \text{ c.}$

IV. a. 235 grams is one "gram molecular weight" or 1 mole

b. 1 Mole has $N(\text{Avogadro}) = 6.0 \times 10^{23}$ nuclei of U.

$$\text{c. } E = mc^2 = 0.235 \text{ Kg} \times (3.0 \times 10^8 \text{ m/s})^2 = 2.12 \times 10^{16} \text{ J}$$

$$\text{d. Energy converted} = E/1000 = 2.12 \times 10^{13} \text{ J}$$

(at $4.2 \times 10^{12} \text{ J/ kiloton}$ that is equivalent to about 5 kilotons of TNT)