Modern Physics Chapter 1-2. Solutions to exercises.

2.1.1 $v = s/t = \dfrac{2\pi R}{T} = \dfrac{2\pi \times 6.3\times 10^9}{365\times 60\times 60} m/s = 30.1 km/s$ Answer: 30 km/s

2.4.1 $L = L_0\sqrt{1-(v/c)^2} = L_0\sqrt{1-0.8^2} = L_0\sqrt{1-0.64} = L_0\sqrt{0.36} = L_0 0.6$ Answer: $0.6L_0$

2.6.1 $m = m_0/\sqrt{1-(v/c)^2} = m_0/\sqrt{1-0.6^2} = m_0/\sqrt{0.64} = m_0/0{,}8 = 1.25m_0$ Answer: 1.25 m_0.

2.7.1 Relativistic Doppler: $f = f_0\sqrt{\dfrac{1-v/c}{1+v/c}}$ Med $c = f\lambda$ fås $\dfrac{\lambda}{\lambda_0} = \sqrt{\dfrac{1-\beta}{1+\beta}}$ where $\beta = v/c$

We insert the wavelengths 500nm och 600nm and square the expression

$\dfrac{25}{36} = \dfrac{1-\beta}{1+\beta} \Rightarrow \dfrac{25}{36} = \dfrac{1-\beta}{1+\beta}\times\dfrac{1-\beta}{1-\beta} \Rightarrow \dfrac{25}{36} = \dfrac{1-2\beta+\beta^2}{1-\beta^2} \approx \dfrac{1-2\beta}{1}$ where we neglect β^2 that has become small. We get

$2\beta = 1-\dfrac{25}{36} \Rightarrow \beta = \dfrac{1}{8}$ why v = 0.8c Answer: v = 0.8c

2.8.1 $\dfrac{F_E}{F_G} = \dfrac{ke^2}{r^2}/\dfrac{Gm^2}{r^2} = \dfrac{ke^2}{Gm^2} = \dfrac{9.0\times 10^9\left(1.6\times 10^{-19}\right)^2}{6.67\times 10^{-11}\left(9.1\times 10^{-31}\right)^2} = 4.17\times 10^{42}$ Answer: $4.2\text{x}10^{42}$

2.8.2 $F_B = evB$ magnetic force, $F_C = mv^2/R$ Centripetal force. At equilibrium
$B = mv/eR = 9.1\text{x}10^{-31}$ x $3\text{x}10^6/(1{,}6\text{ x}10^{-19}$ x $5\text{x}10^{-2})$ T = $3.4\text{x}10^{-4}$ T
Answer: $3.4\text{x}10^{-4}$ T

2.8.3 The same derivation $B=mv/eR = 1.67\text{x}10^{-27}$ x $3\text{ x}10^6/(1.6\text{x}10^{-19}$ x $5\text{x}10^{-2})$ T = 0.62 T
Answer: 0.62 T