



SOLUTION

TQ1 [5 points]

1.1 Based on Einstein's relationship, $E=mc^2$. The relationship is Doing a mass-energy balance:

$$35M_{\odot}C^2 + 30M_{\odot}C^2 = 62M_{\odot}C^2 + E_{GW} \quad [1 \text{ point}]$$

$$3M_{\odot}C^2 = E_{GW} \quad [1 \text{ point}]$$

$$M_{\odot} = 1.988 \times 10^{30} \text{ kg}$$

$$E_{GW} = 3(1.988 \times 10^{30} \text{ kg})(9 \times 10^{16} \frac{\text{m}^2}{\text{s}^2}) \quad [1 \text{ point}]$$

$$E_{GW} = 5.36 \times 10^{47} \text{ J} \quad [1 \text{ point}]$$

Now using $E_{SN} = 2 \times 10^{44} \text{ J}$ we have the ratio:

$$\frac{E_{SN}}{E_{GW}} = 3.7 \times 10^{-4} \quad [1 \text{ point}]$$

GW150914 released approximately 2865 times more energy than a supernova explosion. $E_{SN} \ll E_{GW}$.