1. A surface to air missile (SAM) site is receiving position information about your aircraft. Jamming seems like a good idea, so you turn on your jamming equipment. The parameters for the radio transmitter and your jamming equipment are given below. If the SAM site needs a signal to noise ratio of 0.06 to process and receive the communication signal, is your jamming effective?

SAM radio communications	**Your jamming equipment**
Power transmitted = 1 kW	Power transmitted = 2.0 kW
Transmit Antenna Gain = 3	Transmit Antenna Gain = 20
Receive Antenna Gain = 3	
Frequency = 750 MHz	Frequency = 750 MHz
Distance = 80 km	Distance = 75 km

(a) What is the wavelength of the signal? $\lambda =$ ☐

(b) What is $P_{received}$ of the SAM radio without jamming, i.e. the signal power? Hint: Use Friis. $P_R =$ ☐

(c) What is $P_{received}$ of the SAM site due to the jammer transmission, i.e. the noise power? Hint: Use Friis. $P_R =$ ☐

(d) What is the SNR at the SAM site? SNR = $\boxed{}$

2. An adversary parabolic antenna at sea level is scanning the area for your aircraft flying at 30,000 feet MSL. Jamming seems like a good idea, so you turn on your jamming equipment. The parameters for the ground antenna and your jamming equipment are given below. If the ground antenna needs a signal to noise ratio of 0.01 to process and receive information about your aircraft, is your jamming effective *at the max LOS range*?

Ground Antenna	**Your jamming equipment**
Power transmitted = 20 kW	Power transmitted = 200 W
Transmit Antenna Gain = 2500	Transmit Antenna Gain = 10
Frequency = 9 GHz	RCS = 3 m^2

(a) What is the max LOS range? $R_{LOS} =$ ____

(b) What is $P_{received}$ of the transmitting ground antenna without jamming, i.e. the signal power? Hint: Use Radar Equation. $P_R =$ ____

(c) What is $P_{received}$ of the transmitting ground antenna due to the jammer transmission, i.e. the noise power? Hint: Use Friis. $P_R =$ ____

(d) What is the SNR at the transmitting ground antenna, i.e. the signal-to-jammer ratio S/J?

SNR = $\boxed{}$

3. A fire control RADAR at sea level is tracking your aircraft, which is flying at 15,000 feet MSL. Jamming seems like a good idea, so you turn on the jamming equipment your aircraft carries. The parameters for the RADAR and your aircraft are given below. The RADAR needs a signal to noise ratio of 1.5 to detect your aircraft.

Fire Control RADAR	**Your aircraft**
Power transmitted = 450 kW	Jammer power transmitted = 15 W
Transmit Antenna Gain = 4200	Jammer Transmit Antenna Gain = 2
Frequency = 5.5 GHz	RCS = 12 m^2

(a) What is the burn-through range, i.e. the range at which the SNR at the RADAR reaches the SNR it needs? $R_{BT} =$ ____

(b) You are never closer to the RADAR than your altitude. Can the RADAR ever burn through your jamming? Answer = ____