In the table below you will find information about the communication satellites that were launched in 2005. Assume that each satellite will survive until the year when its lifespan expires. Most are designed to last 15 years before needing replacement. Solar storms and cosmic rays damage the satellite solar panels and cause a 2% decrease in electrical power. Assume that this means that the satellite loses 2% of its transponders each year. Each satellite transponder can carry 2 channels of regular (analog) TV programs, or 6 channels of digital TV programs.

Name	Lifespan In years	Number of Transponders	Cost (million $)	Retire year	Revenue (million $)	Break even year
Hotbird-7A	15	38	200			
Arabsat 4A	15	40	200			
AMC-12	16	72	280			
StarOne C2	13	44	150			
Insat-4A	12	24	67			
Intelsat IA-8	13	64	320			
Spaceway-2	13	48	250			
DirecTV-8	12	32	260			
AMC-23	15	38	280			
Anik F1R	15	56	250			
Echostar 10	15	32	250			
Chinasat-8	15	52	100			
Telkom-2	15	24	150			
Thaicom-4	12	38	400			
Galaxy-14	15	24	270			
Galaxy-15	15	24	270			
Apstar-6	14	50	225			
Asiasat-6	12	50	200			
Express AM3	12	28	290			
Express AM2	12	28	290			
Measat-3	15	48	132			

Question 1) A) What is the total number of transponders carried by these satellites? B) How many analog satellite TV channels can be supported by these satellites? C) How many digital TV channels can be supported by these satellites?

Question 2) In Column 4, determine the retirement year of the satellite given its launch year and lifespan. A) What is the earliest year when this group of satellites will begin to retire? B) What year will the oldest satellites retire? C) How old will you be when the last satellite is retired?

Question 3) Satellite transponders are rented by the satellite owner to TV companies to carry their programs. A typical transponder costs $1.2 million to lease each year, and this represents income to the satellite owner. In Column 6, calculate the annual revenue from each satellite's transponders in millions of dollars. A) What is the total revenue each year from these satellites? B) Which satellite makes the most money each year? C) Which satellites make the least money each year?

Question 4) For each satellite, by what year will its cumulative revenue equal the cost of the satellite? This is the 'break even' year when the satellite has paid for itself and from this year on is producing a net profit to the owner. Enter the break-even year in Column 7.

For Experts: A) If the Hotbird-7A satellite actually loses 3% of its transponders each year, how much money will the satellite have lost by the break-even year because of space weather? Assume it loses the same number of transponders each year beginning with its first year.

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Name	Lifespan In years	Number of Transponders	Cost (million $)	Retire year	Revenue (million $)	Break even year
Hotbird-7A	15	38	200	2020	45.6	2010
Arabsat 4A	15	40	200	2020	48.0	2010
AMC-12	16	72	280	2021	86.4	2009
StarOne C2	13	44	150	2018	52.8	2008
Insat-4A	12	24	67	2017	28.8	2008
Intelsat IA-8	13	64	320	2018	76.8	2010
Spaceway-2	13	48	250	2018	57.6	2010
DirecTV-8	12	32	260	2017	38.4	2012
AMC-23	15	38	280	2020	45.6	2012
Anik F1R	15	56	250	2020	67.2	2009
Echostar 10	15	32	250	2020	38.4	2012
Chinasat-8	15	52	100	2020	62.4	2007
Telkom-2	15	24	150	2020	28.8	2011
Thaicom-4	12	38	400	2017	45.6	2014
Galaxy-14	15	24	270	2020	28.8	2015
Galaxy-15	15	24	270	2020	28.8	2015
Apstar-6	14	50	225	2019	60.0	2009
Asiasat-6	12	50	200	2017	60.0	2009
Express AM3	12	28	290	2017	33.6	2014
Express AM2	12	28	290	2017	33.6	2014
Measat-3	15	48	132	2020	57.6	2008

Question 1) A) What is the total number of transponders carried by these satellites? B) How many analog satellite TV channels can be supported by these satellites? C) How many digital TV channels can be supported by these satellites? Answer; A) 854 transponders; B) About 854 x 2 = 1708 analog TV channels. C) About 854 x 6 = 5124 digital TV channels.

Question 2) In Column 4, determine the retirement year of the satellite given its launch year and lifespan. A) What is the earliest year when this group of satellites will begin to retire? B) What year will the oldest satellites retire? C) How old will you be when the last satellite is retired? Answer: A) The year 2017. B) The year 2020 C) For a 14-year old student in 2005, you will be 14+15 = 29 years old when the oldest satellite retires.

Question 3) Satellite transponders are rented by the satellite owner to TV companies to carry their programs. A typical transponder costs $1.2 million to lease each year, and this represents income to the satellite owner. In Column 6, calculate the annual revenue from each satellite's transponders in millions of dollars. A) What is the total revenue each year from these satellites? B) Which satellite makes the most money each year? C) Which satellite makes the least money each year? Answer: A) 1.0248 billion dollars. B) AMC-12, C) Insat-4A, Telkom-2, Galaxy-14 and Galaxy-15.

Question 4) For each satellite, by what year will its cumulative revenue equal the cost of the satellite? This is the 'break even' year when the satellite has paid for itself and from this year on is producing a net profit to the owner. Enter the break-even year in Column 7. Answer Example: Hotbird-7a makes $45.6 million each year. It cost $200 million, so it will take (200/45.6) = 4.4 years. Rounding-up, it was launched in 2005, so by 2005+5 = 2010 it will have paid for itself. Rounding-down, students may also use 2005+4 = 2009.

For Experts. A) If the Hotbird-7A satellite loses 3% of its transponders each year how much money will the satellite have lost by its break-even year because of space weather? Assume it loses the same number of transponders each year beginning with its first year. Answer: Hotbird-7A reaches its break-even year 4 years after launch. It will lose 38 x 0.03 = 1 transponder the first year, and the same number for each of the remaining 3 years. The cumulative transponder loss for each year is 1 ,2, 3 ,4. for a cumulative loss of 1.2 + 2.4 + 3.6 + 4.8 = $12 million. Select some other satellites to do the same calculation. You may also want to do this on a spreadsheet! What will be the total loss of revenue due to space weather for this entire collection of satellites?