Some Puzzling Thoughts about Space Radiation

We have all heard, since grade school, that **1**___________ affects living systems by causing cell mutations. The particles such as fast-moving ions or **2**____________ strike particular locations in the **3**_________ of a cell, causing the cell to malfunction, or **4**______________ and pass-on a **5**______________ to its progeny. Sometimes the mutations are not beneficial to an organism, or to the evolution of its species. When this happens you can get **6**________________.

Cancer risks are generally related to the total amount of lifetime radiation exposure. The studies of **7**________________ survivors, however, still show that there is much we have to learn about just how radiation delivers its harmful impact. Very large **8**______________ over a short period of time seem not to have quite the deleterious affect that, say, a small dosage delivered steadily over many years does.

The National Academy of Sciences has looked into this issue rather carefully over the years to find a relationship between **9**________________ cancer risks and low-level radiation exposure. What they concluded was that you get up to 100 cancers per 100,000 people for every 1000 **10**_____________ of additional dosage per year above the natural **11**_______________ rate. If a dosage of 1000 millirems extra radiation per year, adds 100 extra deaths per 100,000, then as little as one extra millirem per annum could cause cancer in one person per **12**_______________. Although it's just a **13**_________________ estimate, if you happen to be that 'one person' you will be understandably **14**_________________. No scientific study, by the way, has shown that radiation has such a **15**________________impact at all levels below 100 millirem, but that's what the **16**_________________ application of arithmetic shows.

Government safety regulations now require that people who work with radiation, such as **17**__________, nuclear medicine technologists, or nuclear power plant operators, are given a maximum permissible dose limit of 500 millirems per year above the prevailing **18**_____________ background rate. For you and me doing ordinary work in the office, factory or store, the acceptable maximum dose is 1000 milliRems/year above the 350 milliRem you get each year from natural sources. As a comparison, if you lived within 20 miles of the **19**__________ nuclear power **20**_____________ at the time of its **21**_________ meltdown, your annual dose would have been about 1500 milliRem/year during the first year, declining slowly as the radioactive **22**_____________ in the environment decay

(Excerpted from 'The 23rd Cycle", Sten Odenwald, Columbia University Press)

Solve for X in each equation, and select the correct word from the pair of solutions for X, to fill-in the indicated blanks from 1 to 22 in the essay above.

1) $x^2 - 2x - 3 = 0$
2) $x^2 + 4x - 5 = 0$
3) $x^2 - 3x + 2 = 0$
4) $x^2 - x - 12 = 0$
5) $2x^2 - 12x + 10 = 0$
6) $x^2 - 2x - 24 = 0$
7) $x^2 + 5x + 6 = 0$
8) $x^2 - 9 = 0$
9) $2x^2 + 4x - 30 = 0$
10) $3x^2 + 3x - 6 = 0$
11) $x^2 - 6x - 16 = 0$
12) $x^2 - 3x - 88 = 0$
13) $x^2 - 4x - 21 = 0$
14) $x^2 - x - 30 = 0$
15) $x^2 - 9x - 36 = 0$
16) $x^2 - 16x + 63 = 0$
17) $x^2 + 16x + 63 = 0$
18) $x^2 + 14x + 48 = 0$
19) $x^2 + 19x + 90 = 0$
20) $x^2 + 8x - 33 = 0$
21) $x^2 - 100 = 0$
22) $x^2 - 8x = 0$

<u>Word bank - factor list</u>

-11	plant	-4	cancer	3	lifetime	10	1986
-10	2005	-3	dosages	4	survive	11	hundred
-9	Chernobyl	-2	Hiroshima	5	mutation	12	linear
-8	million	-1	radiation	6	upset		
-7	dentists	0	isotopes	7	statistical		
-6	natural	1	milliRems	8	background		
-5	neutrons	2	DNA	9	blind		

Here are the correct words added:

We have all heard, since grade school, that **1-radiation** affects living systems by causing cell mutations. The particles such as fast-moving ions or **2-neutrons** strike particular locations in the **3-DNA** of a cell, causing the cell to malfunction, or **4-survive** and pass-on a **5-mutation** to its progeny. Sometimes the mutations are not beneficial to an organism, or to the evolution of its species. When this happens you can get **6-cancer**.

Cancer risks are generally related to the total amount of lifetime radiation exposure. The studies of **7-Hiroshima** survivors, however, still show that there is much we have to learn about just how radiation delivers its harmful impact. Very large **8-dosages** over a short period of time seem not to have quite the deleterious affect that, say, a small dosage delivered steadily over many years does.

The National Academy of Sciences has looked into this issue rather carefully over the years to find a relationship between **9-lifetime** cancer risks and low-level radiation exposure. What they concluded was that you get up to 100 cancers per 100,000 people for every 1000 **10-millirems** of additional dosage per year above the natural **11**-**background** rate. If a dosage of 1000 millirems extra radiation per year, adds 100 extra deaths per 100,000, then as little as one extra millirem per annum could cause cancer in one person per **12-million**. Although it's just a **13-statistical** estimate, if you happen to be that 'one person' you will be understandably **14-upset**. No scientific study, by the way, has shown that radiation has such a **15-linear** impact at all levels below 100 millirem, but that's what the **16-blind** application of arithmetic shows.

Government safety regulations now require that people who work with radiation, such as **17-dentists**, nuclear medicine technologists, or nuclear power plant operators, are given a maximum permissible dose limit of 500 millirems per year above the prevailing **18-natural** background rate. For you and me doing ordinary work in the office, factory or store, the acceptable maximum dose is 1000 milliRems/year above the 350 milliRem you get each year from natural sources. As a comparison, if you lived within 20 miles of the **19-Chernobyl** nuclear power **20-plant** at the time of its **21-1986** meltdown, your annual dose would have been about 1500 milliRem/year during the first year, declining slowly as the radioactive **22-isotopes** in the environment decay away.

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1)	$(x - 3)(x + 1)$	3, **-1**	radiation	12)	$(x + 8)(x - 11)$	**-8**, 11	million
2)	$(x + 5)(x - 1)$	**-5**, 1	neutrons	13)	$(x - 7)(x+3)$	**7**, -3	statistical
3)	$(x - 2)(x - 1)$	**2**, 1	DNA	14)	$(x - 6)(x + 5)$	-5, **6**	upset
4)	$(x - 4)(x + 3)$	**4** ,-3	survive	15)	$(x - 12)(x + 3)$	**12**, -3	linear
5)	$(2x - 2)(x - 5)$	1 , **5**	mutation	16)	$(x - 7)(x - 9)$	7, **9**	blind
6)	$(x - 6)(x + 4)$	6, **-4**	cancer	17)	$(x + 7)(x + 9)$	**-7**, -9	dentists
7)	$(x + 2)(x + 3)$	**-2**, -3	Hiroshima	18)	$(x + 6)(x + 8)$	**-6**, -8	natural
8)	$(x + 3)(x - 3)$	**-3**, 3	dosages	19)	$(x + 10)(x + 9)$	-10, **-9**	Chernobyl
9)	$(2x - 6)(x + 5)$	**3**, -5	lifetime	20)	$(x + 11)(x - 3)$	**-11**, 3	plant
10)	$(3x + 6)(x - 1)$	2, **1**	milliRems	21)	$(x + 10)(x - 10)$	-10, **10**	1986
11)	$(x - 8)(x + 2)$	**8**, -2	background	22)	$x(x - 8)$	**0**, 8	isotopes

<u>Word bank - factor list</u>

-11	plant	12	linear
-10	2005	11	hundred
-9	Chernobyl	10	1986
-8	million	9	blind
-7	dentists	8	background
-6	natural	7	statistical
-5	neutrons	6	upset
-4	cancer	5	mutation
-3	dosages	4	survive
-2	Hiroshima	3	lifetime
-1	radiation	2	DNA
0	isotopes	1	milliRems