Question 1:

Dear Cheap Astronomy – Is there such a thing as infinity plus one?

A common problem with infinity is that people think that it's a number. It isn't.

You can confuse a non-mathematician by asking them to imagine a set of integers counting up from zero – one, two, three and so on. There is no limit to how far you can count, since you just keep adding one. So this counting process progresses to infinity, but at no point do you ever reach infinity. You can always add another 1.

You can further confuse said person by asking them to imagine a second set of integers that commences up from one – two, three, four, five and so on. Since there's no limit to how many times you can add 1, this counting process also progresses to infinity. But won't this infinity always be one less than the previous infinity that started from zero?

The answer to this seeming conundrum, is an emphatic no. Because an unreasonable premise has been proposed. You can't treat infinity as though it is a number. It's a conceptual symbol that is meant to express the concept of limitlessness.

Saying that one infinity is one less than another infinity is like saying that you are less of a person after you have cut your fingernails. You are trying to mix the quantifiable with the unquantifiable.

Now you can compare infinites if you treat them as sets rather than numbers. So for example the set of integers I, 2, 3 and so on is infinite and the set of real numbers, 1, 1.1, two thirds, 2, then 2.1, two and a half, 3, pi and so on is also infinite.

The set of real numbers is clearly bigger than the set of integers, since there are many real numbers in between each of those single integers. But you can't quantify that difference, you just know one set is bigger than the other.

Of course there are some instances where infinity does appear to be a number. Some say that if you divide any number by zero, you get infinity. This is not correct. And if you try to do this on most modern calculating devices you will get what is called a "div zero error". And here the machines seem a bit smarter than the humans – dividing anything by zero is just an error, not a solution.

Think of it this way. If you divide six by three you get two. Right? This is just another way of saying that there are two threes in six. If you divide six by zero and declare that the answer is infinity, then you are suggesting there are an infinite number of zeros in six. But no: There aren't any zeros in six. Once you have six, or three or twenty-three, you don't have zero anymore.

Now, it's true that you also see something like infinity when you start dividing a number by progressively smaller numbers. If you divide six by 3 you get two. If you divide six by 0.3 you get 20. If you divide six by 0.000003 you get 2 million.

In other words, as the dividing number, the denominator, approaches zero, the answer to the equation grows unbounded – it goes to infinity. But does it ever get to infinity? Well no, because infinity isn't something you ever get to. And that's because infinity isn't a number.

Question 2:

Dear Cheap Astronomy: Will the universe look younger when you are moving near the speed of light.

Well, yes and no. When you start moving at close to the speed of light, any light that is coming towards you will become blue-shifted. This is the Doppler Effect. When an ambulance is approaching you, the frequency of its siren becomes higher pitched, because the peaks of the individual sound waves are reaching your ear more frequently. For sound, higher frequency equals higher pitch.

It's much the same with light, although you don't notice it in your normal daily affairs, since the speed of light is a darn sight faster than the speed of sound. If you move towards a light source, its wavelength frequency increases – and for light higher frequency equals more energy. So not only is the light shifted towards the blue – and ultimately towards the gamma ray end of the spectrum – but it gets hotter as well. You have to move at a nearly the speed of light to see this effect, but you would see it, and feel it, if you could.

We know that the original blast of the CMB, the cosmic microwave background, probably was in gamma rays and probably was in the order of thousands of Kelvin in temperature. The fact that it is now just 3.7 Kelvin and is vastly red-shifted into microwave is how we can deduce that our universe is 13.8 billion years old and how we can also deduce the rate at which our universe is expanding.

So, this brings us to the point of today's question – which is, that if you look ahead at the cosmic microwave background, the CMB, when you are moving at close to the speed of light, the CMB won't stay in the microwave frequency and it will start getting hotter than 3.7 Kelvin. Indeed if you went fast enough, the CMB might be shifted into gamma rays and be hot enough to vaporise your spacecraft. This, by-the-way, is why the Starship Enterprise needs a deflector dish, whether or not Gene Rodenberry realised it at the time.

So, if we are moving at relativistic speeds and we look ahead and see that the CMB is blue-shifted, would we necessarily deduce that the universe is younger? Well, we might if all we did was look ahead. But if you look back behind you, as you are approaching the speed of light, any light you see, including the CMB, is red-shifted. So from a rear view the CMB would fade out of sight.

The moral of the story is – to make a good scientific observation you should always take a good look around. In fact, the CMB is a tiny bit blue-shifted in our direction of motion because we are progressing around the Milky Way at over 800,000 kilometres an hour. We take an average estimate of the CMB temperature to get the age of the universe.

So, even near the speed of light, if you took an average of the CMB temperature from all directions you could still correctly deduce the age of the universe.

You just need to remember that in your relativity spacecraft, the universe around you is aging at a much faster rate than it was when you were back on Earth. In other words, if you choose to live near the speed of light, the universe won't last nearly as long for you. So, why rush? Take it slow – and why not even stop sometimes to smell the roses.