

'It's About Time' – Sheet 2

Time dilation

If person A travels at speed v relative to person B, the amount of time T' that A experiences relative to the time person B experiences, T , is as follows:

$$T = \gamma T', \text{ where } \gamma = 1/\sqrt{1 - (v/c)^2}$$

Some Examples

- 1) Trau Morgus travels from the planet Androzani Major to its twin planet Androzani Minor and back again in beta drive. If the distance between the two planets remains constant at one light year, how much younger is Morgus than he would have been if beta drive is 99% of the speed of light?
- 2) On the planet Apulapuchia, sufferers of the terminal illness Chen 7 (which kills within one day) are placed in 'accelerated time streams' so that they do not die prematurely relative to their relatives experiencing time at the normal speed. If Apulapuchians live for around 30000 days when healthy, how fast should the time stream accelerator be? (Assuming any sick Apulapuchians would wish to see the entire lifetimes of any newborns who are born just before their diagnosis.)
- 3) After failing to build a time machine based off the principle of reflection, scientists Maxtible and Waterfield attempt to construct a centrifuge (like a giant rotating wheel) in space that will achieve high velocities close to the speed of light. The radius of the centrifuge is constructed as being 100km across, and Maxtible wants the centrifuge to transport users of mass 80kg 5 years into the future in just one hour (in the user's time). What force acts on the user? Is this a more viable method time travel than using reflected images? Is it less likely to produce spontaneous apparitions of Daleks?
- 4) After a Weeping Angel sends the Doctor back in time from 2007 to 1969, he is forced to build an accelerator to take him forwards in time to his TARDIS (after dismissing the idea of sending messages forward in time as preposterous). If it takes him 5 years to build the accelerator, and he can 'only' achieve a speed of $v=0.999c$ for 1 year, how many years in total will he have to wait for his TARDIS?

Other questions, hopefully for your enjoyment...

- 5) On Peladon, the Federation of Planets is attempting to construct a timeline of the monarchs who have ruled the planet since its unification. They have the following information, carved upon a recent stone tablet:

'It was Blor who was the first king of all Peladon and all others are descended from him and his only child. Years later, his grandson and fellow king would share his name, although he would die childless and be succeeded by his sister, who also had a son called Blor. Twice in our history have the reigns of two Kings by the name of Ortron been consecutive: one pair were nephew and uncle, the other were father and son. Two of these Ortrons were sons of Blor, and two of these Ortrons died childless, however the current monarch is the grandchild of King Ortron the Fourth. King Peladon, who had no siblings, was a son of Ortron and had only one child, Queen Thalira. The other Queen in Peladon's history, Ysanne, was the daughter of Ortron and the granddaughter of Blor.'

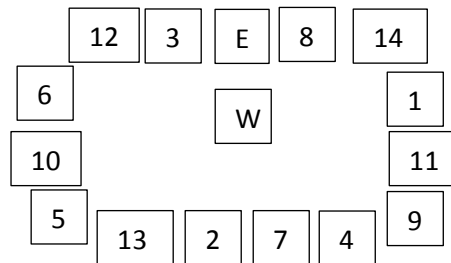
In what order did these ten monarchs rule Peladon?

- 6) After a fit of meglomaniac, Erik Kleig (EK) awakens the Cyber Controller who had been in hypersleep in the cybertombs on the planet Telos. The tombs are laid out as an 8 x 8 chessboard, with Erik Kelig on the square in the bottom left hand corner, and the way out (E) in the top right hand corner, and the Cyber Controller (CC) has spawned on the fifth square of the long diagonal between them, as shown overleaf:

							E
				CC			
EK							

Erik moves by moving one square either horizontally or vertically or diagonally. The Controller moves in the same way, although he cannot diagonally. Both must move at the same time and neither can stay still. Erik must avoid the Controller in order to prevent conversion to a Cyberman. Can he guarantee that he'll reach the exit as a human?

- 7) The Wirrn Queen (W) has invaded the human Ark above the Earth, and has entered a circular room containing fifteen humans in cryogenic sleep arranged in a circle (of sorts). The humans are numbered, and the Wirrn Queen eats them under the rule that when one is eaten, she travels a number of live humans clockwise, stopping when she has fulfilled the number of moves inscribed on the previous human. She wants to end at the human marked E. Where should she start?



- 8) On Terra Alpha, there are three groups of people: The Happiness Patrol, Killjoys and Inspectors from Earth. In order to enforce the no-sadness rule, members of the Patrol will always lie, while Killjoys will always tell the truth, and Inspectors will attempt to offer any helpful advice, and thus lie or tell the truth completely at random. While being chased by the Kandy Man, you happen across three people in different uniforms at a fork in the road. One way leads to a vast quantity of lemonade which can disable the Kandy Man (being made mainly of glucose), while the other leads straight to the Kandy Man's kitchen – and certain death. You may ask three yes/no questions (not necessarily one to all three people), but you have no way of knowing who is who. What should your strategy be?
- 9) The Rills are constrained by their preference to remain in groups of 13, which proves a military issue when the Drahvins invade. The Rills construct Chumblies, robots who are constrained to remain in groups of 11. What is the largest group size which cannot be made from Rills and Chumblies?
- 10) In the far future, the 50 richest aliens in the cosmos have come to Platform One to watch the Earth be consumed by the Sun. Each had a preallocated ticket corresponding to one of the reserved 50 seats on the observation deck; however the first alien has forgotten his ticket and doesn't know where to sit, so sits in a random seat. From then on, each alien entering the room will sit in the seat as allocated by their ticket if it is available, and if it isn't will out of politeness sit in a random remaining seat. What is the probability that the fiftieth alien will sit in the seat originally allocated to her?
- 11) A sentient spaceship Hyperion III is tasked with transporting three Vervoids and three Humans to Earth from a nearby planet. However, the ship has space for only two and requires at least one being to be on board in case of the need to correct a systems failure mid-flight. It is well known that if Vervoids outnumber humans (whether in the presence of the ship or not), they will kill any humans present. It takes one fuel rod to make the trip from the nearby planet to the Earth (and another to come back). What is the minimum number of fuel rods that will need to be used?
- 12) Which Doctor's era has been represented twice? Which hasn't been represented at all?