

## TIME AND SPACE

„ If you know Time as well as I do, I wouldn't talk about wasting it.  
It's him (...). Now, if you only kept on good terms with him,  
he'd do almost anything you liked with the clock. For instance,  
suppose it were 9 o'clock in the morning, just time to begin lessons;  
you'd only have to whisper a hint to Time, and around goes the clock  
in a twinkling: Half past one, time for dinner!“

Lewis Carroll, *Alice in Wonderland*

### I. Discuss the questions below

1. Do you believe that the place and time you were born influence your whole life?
2. What do you think about the idea of Daylight Saving Time?
3. If time travel were possible, which period of world history would you like to return to? Why?
4. Are you good at getting things done on time?
5. Would you rather have more time or more money?
6. If you had extra 2 hours a day, what would you do with it?

### II. Read the text and fill in the gaps with appropriate words and expressions

#### Philosophy of Space and Time

Time and space are two of few fundamental quantities which cannot be defined in terms of other quantities. Thus, they are both defined via measurement. Currently, the standard time interval (called „1. \_\_\_\_\_ second“ or simply „second“) is defined as 9,192,631,770 oscillations of a hyperfine transition in the 133 caesium atom. Time can be combined mathematically with the fundamental quantities of space and mass to 2. \_\_\_\_\_ concepts such as velocity, momentum, 3. \_\_\_\_\_ and fields. The space interval, called a standard meter or simply a meter, is defined as the distance travelled by light in a 4. \_\_\_\_\_ during a time interval of 1/299792458 of a second. This definition 5. \_\_\_\_\_ the present definition of time makes special relativity theory to be absolutely correct by definition.

In classical physics, space is a three-6. \_\_\_\_\_ Euclidean space where any position can be described using three coordinates. Special and general relativity uses spacetime rather than space, and it is modelled as a four-7. \_\_\_\_\_ space (with the 8. \_\_\_\_\_ being imaginary in special relativity and real in general relativity, and currently there are many theories which use more than 4-dimensional spaces).

Some theories, most notably special and general relativity, 9. \_\_\_\_\_ suitable geometries of spacetime may allow time travel into the past and future. Albert Einstein's special theory of relativity predicts time 10. \_\_\_\_\_ that could be interpreted as time travel. It states that, relative to a stationary 11. \_\_\_\_\_, time appears to pass more slowly for faster-moving bodies. For example, a moving clock will appear to run slow; as the clock approaches the speed of light its hands will appear to nearly stop moving. A second type of travel is 12. \_\_\_\_\_ general relativity. In this type a distant observer sees time passing more slowly for a clock at the bottom of a deep gravity 13. \_\_\_\_\_, and a clock lowered into it and pulled back up will indicate that less time has passed compared to a stationary clock that stayed with the distant observer. These effects are to some degree similar to 14. \_\_\_\_\_, (which slows down the rates of chemical processes in the subject) almost indefinitely suspending their life thus resulting in „time travel“ 15. -----the future, but never backward.

Many in the scientific community believe that time travel is unlikely, because it violates 16. \_\_\_\_\_, i.e. the logic of cause and effect. For example, what happens if you attempt to go back in time and kill yourself at an earlier stage of your life? Stephen Hawking once suggested that the absence of 17. -----from the future constitutes a strong argument 18. ----- the existence of time travels.

*time axis, hibernation, dimensional x2, tourists, energy, suggest that, permitted by, conventional, observer, toward, causality, coupled with, dilation, against, derive, well, vacuum*

**III. Now answer questions about the text.**

- a) How can space and time be defined?
- b) What is the space interval?
- c) What is space in classical physics?
- d) How is it different from spacetime?
- e) How do some theories explain the possibility of time travel?
- f) How did Steven Hawking challenge the theory of time travel?

**1. Watch the video Arrow of time and complete the statements.**

<https://www.youtube.com/watch?v=9VFGuupXwng>

1. The arrow of time is .....
2. The feature of Newton's Laws of motion is that .....
3. Simple systems are, for example, .....
4. The problem is to reconcile the absence ..... with the obvious presence .....
5. The feature of the fundamental laws of physics is that .....
6. In the macroscopic world people see only .....
7. The ..... says that entropy increases towards the future.
8. Near the Big Bang the level of entropy was .....
9. It is hard to understand why .....
10. The speaker thinks that both directions of time .....

**Listen for the second time and write down words that are formed from these expressions.**

- a) *direct*                      *directedness*                      .....
- b) *reverse*                      .....                      .....
- c) *order*                      .....                      .....
- d) *chaos*                      .....                      .....
- e) *observe*                      .....                      .....

**2. Match the terms with the sentences relating to them;**

1. meridians	6. Greenwich Mean Time	11. autumnal/vernal equinox
2. latitude	7. Coordinated Universal Time	12. equator
3. Greenwich (prime) meridian	8. International Date Line	13. longitude
4. solar day	9. sidereal day	14. Gregorian calendar
5. winter solstice	10. summer solstice	15. precession

- a) when the sun reaches its southernmost point
- b) the zero meridian
- c) when the night and day is of approximately equal length all over the earth
- d) angular measurement in degrees east or west of the prime meridian
- e) elapsed time between two successive crossings of the same meridian by a star other than the Sun
- f) an imaginary line around the earth at an equal distance from the North and South Poles
- g) when the sun reaches its northernmost point on the celestial sphere
- h) time referenced to atomic clocks
- i) angular measurement in degrees north and south of the equator
- j) when crossed travelling west, the date is advanced; antemeridian zig-zag
- k) half circles that are portions of a great circle
- l) elapsed time between two successive crossings of the same meridian by the Sun
- m) skips 3 leap years every 400 years
- n) the slow rotation of the Earth's axis
- o) universal time

### 3. Tenses review – present perfect and past. Complete the sentences with correct verb forms.

- a) In 2005 scientists (measure) \_\_\_\_\_ a land temperature of 70.0°C in the Lut Desert of Iran. This is the only time scientists (record) \_\_\_\_\_ such a temperature.
- b) A team of Russian scientists just (complete) \_\_\_\_\_ a five-year study of the behavioural patterns of three Siberian wolf packs.
- c) Research (demonstrate) \_\_\_\_\_ that people can delay the onset of type two diabetes by losing weight.
- d) Stephen Hawking (write) \_\_\_\_\_ many books, exploring profound questions about the universe.
- e) Richard Feynman (try) \_\_\_\_\_ to explain the mysterious forces behind ordinary things.
- f) Many important scientists, like Faraday, Tyndall or Rutherford (give) \_\_\_\_\_ public speeches at the Royal Institution in London.
- g) Professor Bernard (know) \_\_\_\_\_ immediately that her team (make) \_\_\_\_\_ a significant discovery.
- h) The report (conclude) \_\_\_\_\_ that no side effects were apparent in the patients who (receive) \_\_\_\_\_ low doses of the new medicine.
- i) Researchers (hope) \_\_\_\_\_ to complete their study by 2010, but (find) \_\_\_\_\_ that they (not have) \_\_\_\_\_ sufficient data.
- j) The team just (leave) \_\_\_\_\_ the lab when the fire (break) \_\_\_\_\_ out, so there were no injuries.
- k) The professor (describe) \_\_\_\_\_ a graph on the slide when a mobile (ring) \_\_\_\_\_. Somebody (forget) \_\_\_\_\_ to switch it off.
- l) Petroleum Products finally (admit) \_\_\_\_\_ that the crude oil (leak) \_\_\_\_\_ from their tanker for more than a week.
- m) The researchers (make) \_\_\_\_\_ excellent progress when the government (cut) \_\_\_\_\_ the grant.

### 4. Complete the following idioms by adding the correct preposition;

1. \_\_\_\_\_ the dot
2. \_\_\_\_\_ the nick of time
3. \_\_\_\_\_ the crack of dawn
4. \_\_\_\_\_ this day and age
5. \_\_\_\_\_ donkeys' years
6. \_\_\_\_\_ due course

now use them with the sentences:

1. I expect you to be here at 8 \_\_\_\_\_.
2. For the big number of applicants, your request will be dealt with \_\_\_\_\_.
3. It is unbelievable that there are so many people suffering from hunger \_\_\_\_\_.
4. He loves to wake up \_\_\_\_\_ and have a cup of coffee in bed and read some papers before everybody else in the house gets up.
5. I'm never early and I'm never late, but I do admit to doing things \_\_\_\_\_.
6. I fully trust him, we've known each other \_\_\_\_\_.

Sources:

(adapted from) <http://iteslj.org/questions/> accessed on 14 April, 2012

(adapted from) [www.wikipedia.org](http://www.wikipedia.org) visited on April 14, 2012

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