

## Exam January 22<sup>nd</sup> 2015. 8.45-11.45. NH 207

- **Philosophy of Engineering: Science (EE and AM and others)**
- **Philosophy and History of Science and Technology (PSTS)**

### Forms

- Please fill out on each form: Your name, student number, subject (Philosophy of Engineering: Science), Code:
  - **EE and AM: 191616040 (5EC; your mark will be send to BOZ/Osiris when Ethics part is completed)**
  - **PSTS: 201200061**
  - **Others: 191616043 (2.5 EC option).**

Please mark to **which BOZ office** this form needs to be send (MSc EE, MSc AM, PSTS, ..)!

- In case you have already passed the Ethics part of 19161640, please write on the grading form "My mark for ethics was ..."

### Regulations:

- Turn off your mobile phone etc.
- Place your student card visible on your desk.
- Clear your desk and put all your stuff on the floor (except pen, paper and forms).
- It is not allowed to use books, notes, etc.

### When finished: Check and hand in personally

1. Answer form for Philosophy part.
2. Forms (cijferbriefje).
3. This questionnaire (the exam).
4. The evaluation sheet (please fill out).

### Notes:

- Please use a clear handwriting
- Number your questions in accordance with the numbers on this questionnaire!
- Try to be concise and adequate in your answers, and make full sentences.
- Give arguments for your answers!
- Numbers in brackets are points that can be attained ('=number' signifies the total points of that question.)
- Total: 150 points. [See questions on the back!].
- It is allowed to answer in Dutch!

GOOD LUCK!

1. Scientific knowledge can be defined as being about the world 'behind' the phenomena', rather than about the observable (or perceivable) world. As scientific claims cannot be proven or checked by direct & straightforward observation, **we need a methodology that justifies the acceptance of knowledge**, that is, we need a methodology that justifies the attribution of the epistemological property – such as truth, or empirical adequacy – to scientific claims. (total 80 pt).
  - a. **Explain** the so-called Hypothetico-deductive method. (10 pt)
  - b. **Explain by means of logical analysis why** this method is problematic from a logical point of view. (10 pt)
  - c. **Explain Popper's method of falsification.** (10 pt)
  - d. **Explain by means of logical analysis why** this method solves the logical problem of the hypothetical-deductive method. (10 pt)
  - e. **Explain why falsification is not very satisfactory either.** [refers to Quine-Duhem]. (10 pt)
  - f. Induction as a scientific method didn't work either. **Why not, from a logical point of view?** (10 pt)
  - g. And how about **deductive reasoning as a scientific method?** (10 pt)
  - h. **Explain the difference** in character of the hypothesis in case of inductive reasoning versus abductive reasoning (or "inference to the best explanation") reasoning. **Use examples from science** to support your explanation (10 pt).
  
2. In everyday life, when speaking about science, people commonly believe that science has proven the truth of (at least some) theories. (total 20 pt)
  - a. **From a philosophical point of view**, what does it mean to say that a theory is true? [Hint: in explaining this, distinguish between 'Real world' and Language, and address their relationship]. **Explain** why saying that a theory is true, is philosophically problematic. [Hint: use Tarski's definition of truth in your analysis.] (10 pt).
  - b. What does it mean to say that a theory (or scientific model) is empirically adequate? In answering this question do the following: Aim to **formulate a precise definition of empirical adequacy**. **Explain** the difference between saying that a theory is true and a theory is empirically adequate. **Explain** how the empirical adequacy of a theory (or scientific model) can be tested? In other words, explain the **methodology** involved. In your opinion, does this methodology agree or disagree with actual scientific practices? Motivate your answer. (10 pt).
  
3. Thomas Kuhn was a scientist, a historian of science, and a philosopher of science. Based on closer study of episodes in the history of science, he found that revolutionary changes occur in science (e.g., between Aristotle and Newton). The conclusion he drew from this finding were devastating to a traditional picture of science. (total 50 pt).

- a. Compared to Kuhn, **Popper maintained a traditional picture of science** . Summarize Popper's traditional picture. (10 pt).
- b. **Explain Kuhn's criticism.** (10 pt).
- c. **Explain Kuhn's notion of paradigm** (in particular his **disciplinary matrix**). Which are the elements of this matrix and describe what they are? Use concrete examples from science in your explanation. (10 pt).
- d. **Describe a paradigm shift in the history of science.** EITHER USE Crosby Smith's article "**A Shift of Paradigm from Force to Energy.**" Describe this shift in 200-300 words. Use Kuhn's disciplinary matrix as an analytical framework for developing your explanation. (20 pt).
- d. OR USE Hasok Chang's article: "**The Persistence of Epistemic Objects through Scientific Change**" (who argues that there are other reasons for the change of scientific concept than those usually held; we usually believe that scientists discard of such a concept because they have proven that the kind of object to which the concept supposedly refers, does not exist. Chang argues that keeping some scientific concepts, such as phogiston, could have helped the progress of science). **Explain his idea(s) and/or argument in your own words.** What is the core of it? What did you learn from it? See whether you find it convincing. 200-300 words. (20 pt.).