

**Final Exam, ENSC 100, 3:30-6:30, Dec 8, 2003**

Name:

Group:

Student Number:

This is a closed-book exam. You may not consult any written material of any kind during the examination.

All questions are multiple choice and are worth three points. There is exactly one correct answer to each question. One point will be deducted for each incorrect answer.

Mark your answers directly on the exam sheet.

1. According to the first few lectures in the course, how far back does the history of engineering go?
  - a) About a million years
2. A heat pump is a device that:
  - b) Uses mechanical power to move heat from a cold object to a hot object
3. Henry Hollerith adapted the punched card to store information about:
  - b) the 1890 US population
4. One cause suggested in lectures for the re-awakening of technology in Europe in the fourteenth century was:
  - d) the Black Death
5. In what profession were the Luddites employed?
  - b) Weavers
6. Which of the following 20-th century inventions was *not* developed during the Second World War?
  - b) the transistor
7. The traveller Lemuel Gulliver encountered a community of absurdly impractical scientists during his voyage to:
  - c) Laputa
8. According to the 'laws of engineering' suggested in the course, when an item is mass-produced, then as the number of items produced tends to infinity,
  - b) the unit cost of each item tends to the cost of the raw materials used in its manufacture
9. Imagine we have an empty cardboard box, well insulated, so that no heat or electric current can pass through the walls. Which of the following scenarios necessarily violates the First Law of Thermodynamics (also known as the Law of Conservation of Energy)?
  - b) A bucket of lukewarm water is placed in the box. When the box is opened, the bucket is found to be full of ice.

10. Imagine we have an empty cardboard box, well insulated, so that no heat or electric current can pass through the walls. Which of the following scenarios does *not* necessarily violate the Second Law of Thermodynamics?
  - c) A bucket of boiling water is placed in the box and a lump of ice added. When the box is opened, the bucket is found to be full of luke-warm water.
11. What is the information content of a picture on a megapixel computer screen, if each pixel can have any one of 256 colours?
  - c)  $8 * 10^6$  bits
12. Which of the following passages (which are of equal length) has the highest information content?
  - c) Passage 3

Passage 1

I think that I shall never see  
 A poem lovely as a tree  
 Poems are made by fools like me  
 But only God can make a tree.

Passage 2

|  |              |
|--|--------------|
| Mizutani, S 2626 Melfa Lane . . . . .  | 604 221 2268 |
| Mizutani, T 1201-600 Drake . . . . .   | 604 899 4021 |
| Mizuumi, M 1007-1255 Bidwell . . . . . | 604 331 0707 |

Passage 3

Deyy1 3eTY EEcpgrt ,21 ssDef  
 O12S, 3.wrr Gzdyu WefDs  
 33 DFE 1,gh rkXitysfG,F dx465  
 fhrT6l dE3g7a, xxG bk1d Xf gg1r4d

13. The philosopher John Searle has advanced an argument known as the ‘Chinese Room Argument’, in which he invites us to imagine a non-Chinese-speaking man inside a room, following a set of written rules to generate answers (in Chinese) to questions, written in Chinese, that are passed through a slit into the room. The purpose of this argument is to convince us that:
  - c) Passing the Turing test is not evidence of intelligence
14. Marvin Minsky’s use of ‘frames’ to solve problems in AI can be seen as a contributor to which of the following programming methods?
  - c) Object-oriented programming
15. Dr John Bird’s views on artificial intelligence can be summarised as:
  - c) Computers are certainly not intelligent, whereas human beings may or may not be.
16. The literal meaning of ‘Technocracy’ is:
  - c) Rule by experts
17. There was a surge of public interest in the technocracy movement in the early 1930’s. This may have been an expression of disenchantment with the existing economic and political system resulting from:

- b) The Great Crash
18. In *The Wealth of Nations*, Adam Smith observes that the efficiency of production can be increased by dividing the production task into many steps and making each worker responsible for a single step. He illustrates this with a description of a visit to:
- d) A pin factory
19. The situation of the workers in a factory organised according to Adam Smith's observation has been described as follows:

*"Owing to the extensive use of machinery and to the division of labour, work ... has lost all individual character, and, consequently, all charm for the workman. He becomes an appendage of the machine, and it is only the most simple, most monotonous and most easily acquired knack that is required of him."*

The author of this description was:

- c) Karl Marx, in *The Communist Manifesto*.
20. The total number of landmines in the world is approximately:
- c) 60,000,000
21. According to Dr Jones's lecture on the environment, the ecosystem that best prevents global warming is:
- b) the peat bog
22. The web text on 'Engineering and the Environment' mentions a phenomenon known as *hormesis*. Hormesis may be defined as:
- b) the strengthening of the metabolism as a result of exposure to low levels of toxins
23. The Therac 25 X-ray machine was manufactured by:
- a) Atomic Energy of Canada, Ltd.
24. According to Sir Karl Popper, the 'historicists' mistakenly believe that:
- b) there are laws of historical development which will take human civilization through a fixed series of stages
25. Sigmund Freud listed the Copernican revolution, Darwin's theory of evolution, and his own theory of psychoanalysis as three examples of the fact that:
- a) every great revolution in science has involved a blow to human vanity
26. What five nations account for more than 75% of the international arms trade?
- a) The USA, Russia, France, United Kingdom and Germany
27. A scale model of a radio tower is to be tested in a wind tunnel. The model is 10 cm high, while the tower itself is to be 1000 m high. If the highest wind velocity for which the tower is to be rated is 100 m/s, what is the highest velocity the wind tunnel must be capable of creating?
- c) 1 m/s
28. In *The Aim and Structure of Physical Theory*, Pierre Duhem contrasted the English and French approaches to physics. The chief difference he saw between them was that:
- a) 'English' physics involved separate, *ad hoc* explanations for each phenomenon, whereas 'French' physics deduced explanations rigorously from a set of deep axioms.

30. According to the historian Lewis Mumford, what was humanity doing during the 25,000 years prior to the rise of the first known urban communities?
  - d) Developing culture, and, most importantly, language.
31. In lectures, the expression 'tailfin engineering' was used to refer to:
  - d) The addition of product features which are supposed to perform an engineering function, but which are actually purely decorative.
32. A triode is:
  - b) A vacuum tube with three electrodes, used to amplify signals
33. A perceptron is:
  - a) An early form of neural net
34. The expression 'ecological footprint' refers to:
  - b) The amount of land needed to produce the resources and assimilate the waste of a group of people.
35. In a study of the effort required to produce bug-free software, IBM found that:
  - b) The cost of removing bugs increases with each bug removed, so that no large piece of software can ever be guaranteed bug-free.
36. The current human population of the world is about:
  - b) Six billion
37. In nanotechnology, one device that can be used to position individual atoms is the:
  - b) Scanning tunneling microscope
38. Another possible route to the development of nanotechnology is to use enzymes to edit sequences of DNA. The DNA sequences would then be translated into strings of amino acids by cell structures known as:
  - c) Ribosomes
39. Nanotechnology has its origins in a talk given in 1959 by:
  - b) Richard Feynman



46. In the section of the course on Chaos, we encountered the Verhulst equation:

$$x(n+1) = (1+r)x(n) - rx(n)^2$$

which describes the number  $x(n+1)$  of rabbits in the year  $n+1$ , based on their population the previous year and the value of the parameter  $r$ , which controls both the rabbit breeding rate and the rate of predation by foxes. According to this equation, in the long term the rabbit population:

- d) Either (a), (b), or (c), depending on  $r$
47. If I ask you to guess a *mystery letter*, and the only thing you know is that it will be one of the 26 lower-case letters of the English alphabet, the amount of information you are missing is:
- c) About 4.7 bits
48. If you are trying to guess the answer to Question 48 in an engineering exam, and the only thing that you know is that it is one of the four possibilities (a), (b), (c), or (d), the amount of information you are missing is:
- b) 2 bits
49. Given an iterative equation of the form

$$x_{n+1} = f(x_n)$$

under what conditions will the sequence of values  $x_1, x_2, \dots, x_n$  be chaotic?

- a) A necessary condition is that  $f$  be non-linear
50. If a flourishing nanotechnology industry develops, many things may become possible which are currently impossible. One thing that nanomachines will *not* be able to accomplish is:
- c) Turning lead into gold