

Final Exam, ENSC 100, 1200-1500, Dec 12, 2004

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. You may circle as many answers as you like to each question.

Note that there is NO Question 29. You are automatically credited with 3 bonus marks to make up for this.

Mark your answers directly on the exam sheet.

1. According to the first few lectures in the course, which of the following is *not* a possible explanation for the slow pace of engineering progress over the period 35,000 BC to 10,000 BC?
 - a) Engineers at that period had small brains
2. Archimedes was employed in the city of
 - d) Syracuse
3. The word 'engineer' originates from:
 - b) A Latin word meaning 'siege engine'
4. When the operation of weaving was first mechanised, the weavers began to work in large buildings called 'mills' rather than in their own cottages. This was because:
 - c) it was impossible to make efficient cottage-scale steam engines
5. Between 1880 and 1930, the number of engineers in North America:
 - c) Increased tenfold
6. *Teledeltos paper* is an electrically-conducting form of paper. Engineers used to cut shapes from this paper, attach appropriate current and voltage sources to it, and, by measuring the electrical potential at various points on the paper, draw conclusions about the temperature that would be measured at the corresponding points in a thermal system. In doing this, they were using the paper as:
 - c) an analog computer

7. When applying the results of a wind-tunnel test in a scale model to predicting the performance of a real plane, we need to enforce *dynamic similarity* between the model and the plane. This means that:
 - d) the important forces experienced by the model must be in the same ratio to each other as the corresponding forces experienced by the plane
8. Imagine a collection of gas molecules inside a closed container. Each molecule has a different speed and direction of motion. Now imagine that we have a magical device that lines up the directions of motion of each molecule, so that each molecule retains its original speed, but is now moving due North. As a result of this change, the gas inside the container:
 - c) has the same energy but lower entropy
9. According to the ‘thermodynamics’ lecture, one important factor often omitted in comparing the efficiencies of electric and gas-powered vehicles for the Canadian market is:
 - c) gas-powered vehicles provide heat to keep the passengers warm
10. A sadistic engineering professor has set a multiple-choice exam with 50 multiple-choice questions, in which each question has 64 possible answers. What is the minimum number of bits of information you would need in order to be sure of scoring full marks in such an exam?
 - b) 300 bits
11. Engineering economics is based on the idea that we would rather have \$100 today than \$100 in a year’s time. Our preference is expressed as an ‘interest rate’; for example, if we can invest money at 10% annual interest, then we should be prepared to loan \$100 today if we expect to be paid back at least:
 - c) \$121 in 2 years time
12. Using the same reasoning as in the previous question, what is the most we should invest today in preventing a leak from a repository of radioactive waste 200 years from now, given that the leak will do a billion dollars worth of damage?
 - c) About 5 dollars
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:
 - a) Behaviour is not sufficient to prove intelligence
14. The purpose of the Turing test proposed by Alan Turing is:
 - a) To provide a practical test that will replace endless debates about the meaning of the word ‘intelligence’
15. Which of the following statements is consistent with Dr John Bird’s views on artificial intelligence, as presented in lectures:
 - b) Computers are ‘agents governed by necessity’, and humans may or may not be.

16. Which of the following further statements is consistent with Dr Bird's views on AI:
- d) The ability to make free choices is essential for true intelligence
17. Dow's chemists found that one benefit of adding polystyrene to napalm is that:
- c) It makes it sticky
18. In *The Ultimate Resource*, Harvard economist Julian Simon argues that:
- c) We can tell when we're running short of a resource because its price will rise
19. In rebutting Dr Jones's environmental lecture, Joshua McNab introduced Kuznet's Curve. This curve is intended to show that:
- b) Pollution increases with average income up to a certain level, but then starts to decline again
20. We have a well-insulated box, separated into two sections by an insulating partition. On one side of the partition is boiling water, on the other side is ice. We remove the partition and allow the contents of the box to come to equilibrium, at which point the box contains warm water. As a result of having removed the partition:
- b) the energy of the box contents stays the same, but the entropy increases
21. The 'solve' function on electronic calculators can find solutions for a range of non-linear equations. One algorithm that can be used for this purpose is:
- c) the secant method
22. We have two sequences of a million digits. One sequence was generated by a random process, such as measuring the seconds between successive decays of uranium nuclei. The other was generated by a chaotic process, such as the application of the iterative equation

$$x_n = (1 + r)x_{n-1} - rx_{n-1}^2$$

to an initial 'seed' value x_0 . If we compare the information content of the two sequences, we find that:

- c) the random sequence has a higher information content than the chaotic sequence
23. One characteristic of chaotic processes, such as the generation of successive values of x_n described in Question 22, is that:
- b) For a given n , x_n may change drastically for small changes in x_0 .
24. According to lectures, the earliest use of electricity as a method of torture was by:
- c) the French in Algeria
25. Referring to Question 24, the earliest instruments used for electrical torture were:
- b) hand-cranked field telephones

26. You are in a car travelling at 10 km/h. A balloon filled with hydrogen is floating in the middle of the car. All the car windows are closed. You suddenly step on the accelerator, causing the car to accelerate to 30 km/h in the space of 2 seconds. During this acceleration, the balloon:
- Moves towards the front of the car
27. Which of the following steps will *not* increase the sensitivity of the Leung accelerometer?
- Reducing its size
28. *Moore's Law* states that:
- The number of circuit elements that will fit into a square millimeter doubles every two years.
29. There is NO question 29.
30. Using the strength of the iron-iron chemical bond to predict the strength of structural steel:
- Gives us a figure which is at least 10 times too high
31. In 'Room at the Bottom', we considered an 'automated building site', in which a large number of brick-sized robots would hop out of a truck, scurry around assembling a house, then hop back in the truck and go to the next site. The purpose of this example was:
- To show that many of the goals of nanotechnology require solving problems of agent cooperation, which may be harder than just building small machines
32. In designing a bicycle wheel, the number of spokes, the spoke diameter and the spoke length are all examples of:
- Design parameters
33. The 'New Machine' was:
- An organization formed by Henry Gantt in 1916
34. Part of the technocratic solution to the economic problems revealed by the Great Crash was that goods should be valued according to:
- the Joules of energy needed to produce them
35. In the classical economics of Adam Smith, the long-term mass unemployment of the 1930's should be impossible because:
- In a free market, wages will adjust themselves downwards until it becomes profitable for an employer to start hiring
36. The official colour and symbol adopted by Howard Scott's Technocracy Inc. were:
- grey, monad
37. According to Sir Karl Popper, the historians and philosophers Spengler, Toynbee, Hegel and Marx all commit the fallacy of:
- historicism
38. Lord Acton's remark:

“You cannot give a man power over other men without tempting him to misuse it - a temptation which roughly increases with the amount of power wielded, and which very few are capable of resisting. ”

is quoted by Popper to illustrate:

c) How there are many timeless laws of human behaviour

39. *“Motion pictures will revolutionise our educational system, and in a few years will supplant largely, if not entirely, the use of textbooks.”*

This remark of Thomas Edison was quoted in ‘The Future’ to illustrate:

c) The importance of scepticism regarding the claims of salesmen for new technologies

40. The general conclusion of ‘The Future’ was that:

b) Study of the future is futile, since our predictions for the future usually turn out to be reflections of our own era

41. The prediction that humanity will eventually evolve into two or more sub-species (an effete class of aesthetes and a degraded class of workers) is to be found in:

d) All of the above

42. According to ‘The Future’, the prediction mentioned in Question 41 can be traced to the political theories of:

b) Karl Marx

43. In ‘The Future’, we encounter a quotation from two aviators, written in 1914:

“Airplanes, by linking the Earth, will bring about lasting peace between these close-knit nations.”

This statement was quoted to illustrate the general point that:

c) People have frequently and erroneously believed that the latest technology will bring about a change in the moral character of humanity

44. The flow of all fluids can be described by:

c) the Navier-Stokes equations

45. The basis of micromachining is the creation of small mechanical devices by means of:

b) The same technology used for the manufacture of silicon chips

46. According to the first lecture on the environment, the net result of photosynthesis is:

d) The conversion of carbon dioxide, water and energy to glucose and oxygen

47. What technological device appears on the flag of India?

b) A spinning wheel

48. Hollerith cards are:

c) Cards with holes punched in them, readable by a machine

49. Suppose it's 1 degree Celsius outside, and you want to keep the inside of your house at 20 Celsius. You have a generator which can supply a maximum of 1 kilowatt of power. Given a free choice of technologies (but no additional power), what is the greatest amount of heating power you can supply to the inside of the house?
- d) Considerably more than a kilowatt
50. The figure below shows two possible designs for nail clippers. The second design is intended to show:
- b) That the principle of decomposing design requirements into non-interacting hierarchies does *not* necessarily generate good designs