

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) Over a million years.
 - b) To about 10,000 BC.
 - c) To the fifth century BC.
 - d) To the early 13th century AD.
2. A heat pump is a device that:
 - a) Uses the difference in temperature between two objects to move a fluid
 - b) Uses mechanical power to move heat from a cold object to a hot object
 - c) Uses mechanical power to move heat from a hot object to a cold object
 - d) Extracts work from hot fluids
3. Henry Hollerith adapted the punched card to store information about:
 - a) Complex weaving patterns
 - b) the 1890 US population
 - c) the control of lathes for making gun barrels
 - d) military codes used by Germany during World War II
4. One cause suggested in lectures for the re-awakening of technology in Europe in the fourteenth century was:
 - a) the influence of the Church
 - b) the need to defend against invaders from Eastern Europe
 - c) the discovery of the New World
 - d) the Black Death
5. In what profession were the Luddites employed?
 - a) Priests
 - b) Weavers
 - c) Rocket scientists
 - d) Lathe operators

6. Which of the following 20-th century inventions was *not* developed during the Second World War?
 - a) the computer
 - b) the transistor
 - c) atomic power
 - d) the jet aircraft
7. The traveller Lemuel Gulliver encountered a community of absurdly impractical scientists during his voyage to:
 - a) Lilliput
 - b) Brobdingnag
 - c) Laputa
 - d) Houyhnhnmland
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,
 - a) the unit cost of each item tends to zero
 - b) the unit cost of each item tends to the cost of the raw materials used in its manufacture
 - c) the number of flaws in each item tends to increase
 - d) the ratio of materials costs to engineering design costs remains fixed
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)?
 - a) A bucket of lukewarm water is placed in the box. When the box is opened, a cloud of steam escapes, and there is some ice left in the bottom of the bucket.
 - 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.
 - 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.
 - d) A bucket of boiling water and a discharged battery are placed in the box. When the box is opened, the water is cold and the battery is fully charged.
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?
 - a) A bucket of lukewarm water is placed in the box. When the box is opened, a cloud of steam escapes, and there is some ice left in the bottom of the bucket.
 - 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.
 - 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.
 - d) A bucket of boiling water and a discharged battery are placed in the box. When the box is opened, the water is cold and the battery is fully charged.

11. What is the information content of a picture on a megapixel computer screen, if each pixel can have any one of 256 colours?
 - a) 10^6 bits
 - b) $256 * 10^6$ bits
 - c) $8 * 10^6$ bits
 - d) 2^{8*10^6} bits
12. Which of the following passages (which are of equal length) has the highest information content?
 - a) Passage 1
 - b) Passage 2
 - c) Passage 3
 - d) They all have the same information content

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:
 - a) No machine can pass the Turing test
 - b) The ability to speak Chinese is necessary for true intelligence
 - c) Passing the Turing test is not evidence of intelligence
 - d) No machine can ever be taught to converse in Chinese
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?
 - a) Parallel processing
 - b) Neural Net processing
 - c) Object-oriented programming
 - d) Functional programming

15. Dr John Bird's views on artificial intelligence can be summarised as:
- Computers are certainly not intelligent, whereas human beings are.
 - We can never really tell whether any agent is intelligent or not.
 - Computers are certainly not intelligent, whereas human beings may or may not be.
 - No computer will ever pass the Turing test.
16. The literal meaning of 'Technocracy' is:
- Rule by engineers
 - Rule by a governing body known as the 'Technate'
 - Rule by experts
 - Rule by those best fitted to govern
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:
- The First World War
 - The Great Crash
 - The Second World War
 - The Black Death
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:
- A steel foundry
 - A factory for weaving cloth on steam-powered looms
 - A Ford assembly line
 - 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:
- Adam Smith himself.
 - Frederick Taylor, in *The Principles of Scientific Management*.
 - Karl Marx, in *The Communist Manifesto*.
 - Charles Chaplin, in *Modern Times*
20. The total number of landmines in the world is approximately:
- 600,000
 - 6,000,000
 - 60,000,000
 - 600,000,000

21. According to Dr Jones's lecture on the environment, the ecosystem that best prevents global warming is:
 - a) the rainforest
 - b) the peat bog
 - c) equatorial deserts
 - d) high-rise city centres
22. The web text on 'Engineering and the Environment' mentions a phenomenon known as *hormesis*. Hormesis may be defined as:
 - a) the preservation of canned pork by use of sodium nitrite.
 - b) the strengthening of the metabolism as a result of exposure to low levels of toxins
 - c) the release of carbon dioxide by the decay of vegetable matter
 - d) the tendency of the species in an ecosystem to work together to preserve the health of the ecosystem.
23. The Therac 25 X-ray machine was manufactured by:
 - a) Atomic Energy of Canada, Ltd.
 - b) Health Canada
 - c) General Electric
 - d) The FDA
24. According to Sir Karl Popper, the 'historicists' mistakenly believe that:
 - a) scientific progress makes it impossible to predict the future
 - b) there are laws of historical development which will take human civilization through a fixed series of stages
 - c) there can be no certain knowledge about human history, only different opinions
 - d) human civilization has gradually deteriorated from a past Golden Age to its present pitiful state
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
 - b) every great revolution in science has been accomplished by unusually intelligent people
 - c) every great revolution in science has eventually led to new engineering developments
 - d) every great revolution in science has built upon what came before it
26. What five nations account for more than 75% of the international arms trade?
 - a) The USA, Russia, France, United Kingdom and Germany
 - b) North Korea, Iran, Iraq, China and Libya
 - c) Brazil, Sweden, France, China and Israel
 - d) Cuba, China, North Korea, Syria and Japan
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?
 - a) 0.01 m/s
 - b) 0.1 m/s
 - c) 1 m/s
 - d) 100 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:
- 'English' physics involved separate, *ad hoc* explanations for each phenomenon, whereas 'French' physics deduced explanations rigorously from a set of deep axioms.
 - 'English' physics was concerned with impractical, abstract ideas, whereas 'French' physics was better suited to engineering applications.
 - 'English' physics concerned itself with mathematical manipulations, whereas 'French' physics tended to provide common-sense verbal explanations.
 - 'English' physics was suited to deep, but narrow, minds, whereas 'French' physics was more suitable for broad, ample minds.
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?
- Engaging in destructive tribal warfare
 - Living an idyllic existence characterised by pride in craftsmanship
 - Developing earlier urban civilizations, which have vanished without trace.
 - Developing culture, and, most importantly, language.
31. In lectures, the expression 'tailfin engineering' was used to refer to:
- The tremendous progress that took place in the automotive industry in the 1950's, when lessons from aerodynamic design were applied to reduce wind resistance and improve fuel economy in cars.
 - The application of ideas from the biological world to suggest new engineering designs.
 - Working backwards from a competitor's product to figure out what purpose is served by each feature of the product's design.
 - The addition of product features which are supposed to perform an engineering function, but which are actually purely decorative.
32. A triode is:
- The Russian name for a spacecraft carrying three people
 - A vacuum tube with three electrodes, used to amplify signals
 - A neural net consisting of three layers: an input layer, an output layer, and a 'hidden' layer
 - The three-pronged spear carried by the Roman god Neptune
33. A perceptron is:
- An early form of neural net
 - A set of goggles, headphones and datagloves used to immerse a subject in virtual reality
 - Any robot that has the ability to sense its environment directly
 - A machine developed by Brion Gysin to induce hallucinations by exposure to stroboscopic light.
34. The expression 'ecological footprint' refers to:
- The traces left behind by earlier civilizations in the form of midden heaps, etc.
 - The amount of land needed to produce the resources and assimilate the waste of a group of people.
 - The benign, shallow footprints left by Dr Scholl's Eco-Boots (tm), with their thick crepe-rubber soles.
 - the history of the technological development of a culture, as reconstructed from the species that the culture domesticated, eradicated, and co-existed with.

35. In a study of the effort required to produce bug-free software, IBM found that:
- a) Five simple principles could eliminate 95% of software errors
 - b) The cost of removing bugs increases with each bug removed, so that no large piece of software can ever be guaranteed bug-free.
 - c) Object-oriented programming makes it straightforward to produce large, bug-free codes.
 - d) Removing the first bugs takes considerable effort, but it becomes increasingly easy to find the remaining ones.
36. The current human population of the world is about:
- a) Three billion
 - b) Six billion
 - c) Nine billion
 - d) Twelve billion
37. In nanotechnology, one device that can be used to position individual atoms is the:
- a) Field ion emission microscope
 - b) Scanning tunneling microscope
 - c) Travelling electron microscope
 - d) Nuclear magnetic resonance 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:
- a) Nucleoli
 - b) Chromosomes
 - c) Ribosomes
 - d) Chloroblasts
39. Nanotechnology has its origins in a talk given in 1959 by:
- a) Eric Drexler
 - b) Richard Feynman
 - c) Edward Teller
 - d) Howard Scott

40. This drawing by Leonardo da Vinci illustrates the design principle that:
- Engineering progresses by incremental advances on existing designs
 - Many successful engineering designs come from imitating nature
 - The costliest mistakes are those made in the conceptual stages of design
 - Engineering consists in the application of scientific knowledge to practical ends
41. Which of the following is *not* one of Taylor's four principles of scientific management?
- A spirit of cooperation and trust must be developed between workers and management.
 - 'Know-how' can be replaced by scientific knowledge
 - Management must share a role in organising the work
 - Automation of the production process is the most effective means of improving product quality
42. According to the 'Trickledown Theory of Engineering', when did scientists rise above engineers in the esteem of the general population?
- Between 1750 and 1850
 - Between 1850 and 1900
 - Between 1900 and 1950
 - Between 1950 and 2000

43. The view of science expressed in lectures was that
- it was one possible viewpoint among many equally valid alternatives
 - it was essentially irrelevant to engineering
 - it would eventually replace engineering ‘know-how’
 - it consisted of procedures for obtaining agreement between different points of view
44. If a blast furnace is scaled up to produce 1000 times the mass of steel, the total fuel costs will increase by a factor of approximately:
- 10
 - 100
 - 1000
 - 10,000
45. Carl Houston, a welding supervisor on the construction of a nuclear reactor in Virginia, saved the public from a potential nuclear disaster by his persistence in drawing attention to inadequacies in the welding of the pressure vessel. As a result, he was:
- Awarded the ASME’s Gold Medal for Safety
 - Promoted to management
 - Fired and blacklisted
 - Personally thanked by the Governor of Virginia

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:

- Varies chaotically
 - Eventually settles down to a stable equilibrium
 - Oscillates between a high and a low value in alternate years
 - 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:
- 26 bits
 - 2^{26} bits
 - About 4.7 bits
 - 10^{26} 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:
- 1 bit
 - 2 bits
 - 4 bits
 - 2^4 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
 - b) A sufficient condition is that f be non-linear
 - c) A sufficient and necessary condition is that f be non-linear
 - d) x_1 must be in the range $[0,1]$
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:
- a) Extending human lifespan
 - b) Recycling copper from landfills
 - c) Turning lead into gold
 - d) Building single-stage-to-orbit spacecraft