

Final Exam

YOUR NAME _____

200 points total. Be specific in your answers, don't just waffle! You may use the book and course content, as well as Google, Wikipedia, etc to find suitable answers. However, words should be your own, not just a simple "copy and paste" from these sources, although each answer may include a limited amount of quoted material (inside "", with a brief citation).

If you have a problem with typing quickly, you may elect to hand-write your answers, and submit a scan of these to me via email before the exam time is over.

1. (32 points) Briefly explain **any eight** of the following terms in a couple of sentences:

- (a) Reserves (for minerals)
- (b) Ecosystem
- (c) Waste Reduction at Source
- (d) Germany's "feed-in tariff"
- (e) ISO 9000
- (f) Intensification of agriculture
- (g) Lean manufacturing
- (h) Synthesis design (in green chemistry)
- (i) Fuel cell
- (j) Full-cost accounting

2. (26 points) (Around 200 words) Describe the history of sustainable development as a policy, from 1987 to the present day. Be sure to include specific landmark events, with dates if possible. Discuss the present-day policies and attitudes towards sustainable development of different governments around the world (be specific!). You should use the terms *natural capital*, *global warming* and *carrying capacity* (in appropriate places) to illustrate your points.

3. (12 points) If you are a manufacturer building a "green plan," you may find that there are some barriers causing mistrust between your company and certain outside groups. What are the two main outside groups, and how can you break down those barriers (give one way for each group)?

4. (38 points) (Around 300 words). What are the five major steps in the ISO 14001 cycle? You are the new environmental manager for a company manufacturing handmade furniture in Potsdam, New York. Given the company's environmental policy statement (see below), describe how you would take the company through these steps.

Potsdam Eco-furniture Environmental Policy

Our company is committed to the creation of a sustainable society, to ensure a good quality of life for future generations. To this end:

- We will meet or exceed all legal requirements on sustainability and the environment
- We will promote responsible stewardship of natural capital by our workers, customers and suppliers.
- We will use only biodegradable, sustainable materials, sourced locally where available.
- We will continually strive to improve our sustainability record, and track our progress using specific targets and benchmarks.
- We will ensure that our technology is continually updated to include more sustainable methods as these become available.

5. (20 points) (Around 150 words) Discuss the the benefits and the environmental damage that have resulted from the world's chemical industries. Why are so many highly polluting processes used, sometimes even when cheaper, cleaner processes may be available?

6. (12 points) In a couple of paragraphs, explain what has helped to make Sweden the leading "green nation" (according to Germanwatch)? (Give at least two factors.)

7. (12 points) Give a brief history of the Clean Water Act since its inception, in a couple of paragraphs.

8. (8 points) Calculate the atom economy for the following (very ancient) industrial process for making lime (formula CaO), used in making fertilizers. Molar masses are shown below each formula.



This means that 100 g (grams) calcium carbonate produces 56 g calcium oxide and 44 g carbon dioxide.

MULTIPLE CHOICE QUESTIONS (each worth 4 points)

9. What does Schumpeter regard as the engine of economic growth?

- Financial capital
- Natural capital
- Biodiversity
- Technical progress
- Consumption

10. Which of the following is **NOT** an ESSENTIAL part of the green engineering approach.

- Optimize design to avoid or reduce environmental impacts
- Design manufacturing processes that are feasible and economical
- Work to minimize risk to human health
- Aim to reduce waste at source
- Use only materials from biological sources, no chemicals

11. Which is the most apt description for concurrent manufacturing?

- A team of generalists performs the entire manufacturing process together, as a team
- A series of specialists each perform a single step in the manufacturing process
- The process is separated into a set of discrete steps
- The entire process is completed in a single day
- There is no time limit for the process to reach completion

12. Which one of the following is **NOT** traditionally one of Toyota's "seven deadly wastes" (muda)?

- Overproduction
- Hazardous materials
- Inventory
- Defects
- Excess motion

13. What is the world's annual consumption of chromium?

- 10,000 tonnes
- 100,000 tonnes
- 500,000 tonnes
- 2,000,000 tonnes
- 20,000,000 tonnes

14. Which of the following is a stock market index that tracks companies with a strong record on sustainability & human rights?

- S&P 3000
- DJIA
- FTSE4Good
- Dax-Eco2000
- Sustenda-400

15. A remanufacturing program is best defined as:

- Fixing products when they break
- Taking old products when used up, broken or no longer useful, and using these to make new products
- Making products from the pre-industrial era, since these are more sustainable
- Taking defective new products, and fixing them rather than throwing them away
- A public relations exercise by a company, to make it appear more "green"

16. Which of the following is **NOT** one of the standard stages of ISO14040 Life Cycle Analysis (LCA)?

- Goal and scope definition
- Inventory analysis
- Eco-labeling
- Impact assessment
- Interpretation of results

17. Which of the following is one of the “Melbourne Principles”?

- Provide communities with a wide range of affordable public transport options, as a means of reducing the carbon footprint.
- Recognise the intrinsic value of biodiversity and natural ecosystems, and protect and restore them.
- Promote equitable systems of employment among businesses and government
- Ensure that all chemical feedstocks are from renewable resources whenever possible
- The carbon intensity of a nation increases rapidly during its early development, then levels off or declines once the nation has become industrialized.

18. What does Jeremy Rifkin mean with his idea of the "hydrogen energy web?"

- Use of "distributed generation" of energy by consumers, then linking these together
- An Internet-based organization to advocate for the hydrogen economy
- A national system of pipes to allow economical transport of hydrogen, similar to the existing system used for natural gas
- The trap some environmentalists may fall into, being deluded by the false promise of hydrogen as a green "fuel"
- A means of transporting energy over the Internet