PART 1 (10 marks): MULTIPLE CHOICE QUESTIONS

INSTRUCTIONS: Choose the BEST answer to each of the following questions. Indentify your answers on this exam booklet and ALSO on the accompanying bubble sheet.

1. While you are writing this exam, government leaders from around the world are meeting in New York to sign the Paris Agreement, which was forged at the UN Climate Change Conference held in December 2015. In its most recent report, the Intergovernmental Panel on Climate Change reported on actions that have a strong possibility of reducing the average global temperature. The report claims that, to limit the average global temperature rise to 2°C by the end of this century, greenhouse gas emissions need to be substantially reduced in every sector of the economy. To do this, each country signing the agreement need to present NDCs. What are NDCs?
    a. National Dioxide Concentrations
    b. National Defense Commitments
    c. NOx and Dioxide Concentrations
    d. National Determined Contributions
    e. No-increase Degrees Celsius

2. One way of thinking about human influence on the environment is the IPAT equation. One of the variables in this equation is:
    a. Agriculture
    b. Temperature
    c. Affluence
    d. Pollution
    e. Industry

3. There are several key factors leading to the successful facilitation of a stakeholder engagement activity. Which of the following is NOT a key factor?
    Facilitators:
    a. Are focused, yet flexible, and express clearly stated expectations of participants
    b. Listen respectfully, investing the necessary time in learning the perspectives of the attending stakeholders
    c. Accept that it is not necessary to agree on everything and that some perceptions will neither align with the facilitator's, nor will they ever be changed.
    d. Encourage all participating stakeholders to identify and explain their personal biases so that everyone understands their perspective
    e. Operate in a transparent and accountable manner

4. The general stakeholder engagement framework has 6 steps. The 2nd step is entitled "Stakeholder identification and analysis". What is analyzed in this step?
    a. Stakeholder influence
    b. Ease of communication with stakeholder
    c. Degree to which a stakeholder is impacted
    d. Number of stakeholders in a given category
    e. Stakeholder net worth

5. Consider the relationships between a city's transportation system and human health. Which of the following has NOT been shown to be a feedback loop between these two systems?
    a. Improving health increases the likelihood of a person choosing to walk and choosing to walk further increases the likelihood of good health
    b. A walkable transportation system increases the likelihood that a person will choose to walk, and the habit of walking may increase the advocacy for a walkable transportation system.
    c. The perception that the local area is walkable may lead to increased walking, and increased walking may increase awareness of the walkability of an area
    d. A walkable transportation system improves community mental health and an improved level of mental health within a community increases advocacy for a walkable transportation system
    e. Personal health is associated with a person's improved perception of the built environment, and an improved perception of the built environment can lead to a more active lifestyle which improves a person's health

6. Which of the following is NOT an indicator of the livability of an urban environment?
    a. Air quality
    b. Walkability
    c. Average personal income
    d. Volunteerism
    e. Housing affordability

7. Which of the following is NOT a way in which a factory and a biological organism are similar? They both:
    a. Reproduce and mutually interact
    b. Are capable of independent activities
    c. Use energy and material resources and release waste heat and material residues
    d. Respond to external stimuli
    e. Move through stages of growth and decay

8. Which of the following is one of three key sub-systems within an urban ecology?
    a. Governance systems
    b. Bio-physical systems
    c. Economic systems
    d. Water systems
    e. Energy systems

9. Megacities are particularly vulnerable to disruptions because they are:
    a. often located near river deltas or coastlines
    b. often located near farming areas
    c. old and have aging infrastructure
    d. full of people from an older demographic
    e. centres of trade

10. What is "Integrated Water Resource Management"?
    a. a process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems
    b. a non-market based approach which considers water as a human right and social good and not as an economic good, ensuring water for all, helping set priorities for water policy and resolving water conflict
    c. a cross-sectoral policy approach, designed to promote the traditional approach to water resources and management such as hydrological and hydraulic engineering and traditional resource use and management
    d. a one-size-fits-all prescription to help protect the world's environment, foster economic growth and sustainable agricultural development, promote democratic participation in governance, and improve human health
    e. an approach involving the design of urban infrastructure that integrates water design goals with energy system design goals, transportation design goals, and health system design goals.

11. Which of the following is a "green" certification process applied to buildings?
    a. The Bullitt Foundation Certification Program
    b. The Living Building Challenge
    c. Civil Engineering Quality Infrastructure Program
    d. Leadership in Adaptive and Environmental Design
    e. Certification of Sustainable Structural Design

12. Sustainable supply chains are relevant to civil engineering because part of civil engineering involves:
    a. managing and treating urban waste
    b. maintaining product delivery systems
    c. maintaining industrial systems
    d. designing water treatment facilities
    e. managing the structural components of municipal assets

13. Freya has just landed a job with an engineering consulting firm. In her second week, the boss drops by her desk and asks her if she knows anything about LCAs. Thankfully, she took CIVL 200 and so is able to say, "Yes, I know a little bit about them." To which her boss replies: "Great. I haven't got a clue about LCAs but just got a contract to complete the first step. "Where to we start?"
    Which of the following is the best response that Freya can give?
    a. "Who is the client and who are the stakeholders?"
    b. "What materials are being used and wasted?"
    c. "What decisions will be made based on the results of the LCA?
    d. "We should figure out the impacts"
    e. "What is being compared by the LCA process?"

14. An example of biomimicry in engineering is the shape of …
    a. an ipod
    b. bumpers on the modern electric car
    c. the front (i.e. "nose) of a fast train
    d. the handles of modern grocery bags
    e. the shape of downhill mountain bike pedals

15. Sustainability extends the reach of supply chain management. From the list below, identify a way in which this reach is NOT extended.
    a. Product design
    b. Product user behaviour
    c. Manufacturing of by-products
    d. Product life extension
    e. Product end-of-life

16. As part of the sustainability assessment of a proposed project (e.g. a mine, or even a large piece of infrastructure), one of the Seven Questions for Sustainability asks:
    a. Has an environmental assessment taken place?
    b. Has an LCA been performed?
    c. Has a Social-LCA been performed?
    d. Will people's well-being be maintained and improved over the long term?

e. Are all levels of government being consulted by the project proponents?

17. The NGO entitled "Engineering for Change" has developed guiding principles for the design of appropriate technology. Which of the following is NOT one of the guiding principles of appropriate technology?
    a. Consider the "do nothing" option
    b. Consider the context
    c. Create transparent and accessible technology
    d. Embrace the market
    e. Design for Do-It-Yourself

18. An example of low resiliency in a city is:
    a. The American response to the attack of New York's Twin Towers on Sept. 11, 2001
    b. The response of New Orleans to hurricane Katrina in 2005
    c. London's response to the volcanic eruption in Iceland in 2010
    d. The 2015 failed transportation referendum in metro Vancouver
    e. The Japanese response to recent earthquakes in it's southern island of Kyushu

19. One of the 4 dimensions of the Cities Resilience Framework is entitled "Infrastructure and Environment". This dimension describes the presence in resilient cities of human-made and natural systems that provide critical services, protect, and connect urban assets enabling the flow of goods, services, and knowledge. Which of the following things in Metro Vancouver LEAST reflects the "Infrastructure and Environment" dimension of the Cities Resilience Framework?
    a. The Stanley Park Seawall
    b. Burns Bog
    c. The Capilano and Seymour water reservoirs
    d. Beaches at Spanish Banks
    e. The Vancouver Harbour Seabus (which transports people between downtown and North Vancouver) and Lionsgate Bridge

20. What are the three foundational attributes of leadership?
    a. Direction, protection, order
    b. Integrity, authenticity, committing to something bigger than oneself
    c. Honesty, capacity, fierce resolve
    d. Catalyzing, compelling, works effectively with others
    e. Charismatic, inspirational, authoritative

PART 2 (20 marks): SHORT ANSWER QUESTIONS

21. What fundamental concepts should be included in a working definition of sustainability? (2 mark)

The 3 imperatives – society, environment, economy (1 mark for all three, 0 if less than three are mentioned – i.e. no part marks)
Systems thinking – or something related to systems (1 mark)

22. Why is Kalundborg Denmark an industrial ecology? (1 mark)

An industrial ecology is a set of factories or other human activities that, together, act similarly to an ecosystem. That is, the waste from one activity is used as a feedstock (or other input) to different activity.
Kalundborg is one of the first examples of an industrial ecology. Within it, public and private companies buy and sell waste from each other in a closed cycle of industrial production.

0.5 mark for defining industrial ecology and 0.5 mark for explaining a little bit about Kalundborg.

23. What is "future scenario planning"? (1 mark)

Future scenario planning:

Long-term planning is challenging because of the increased likelihood of step changes and unforeseen events such as natural disasters, political unrests, economic upheavals, technological innovations. Future Scenario Planning is a long-term planning technique. (0.5 marks) It involves imagining multiple possible futures. Planners prepare to respond to any one of the several possible future scenarios. (0.5 marks)

24 How is future scenario planning different from traditional planning? (1 mark)

Traditional planning is performed over the short-term (i.e. about a 5year period) and generally involves traditional forecasting techniques such as time-series analysis and regression analysis can be used. Its aim is to accurately predict what will happen in the short term. In contrast, future scenario planning (as described in the pervious question) is more useful for long-term planning than are traditional planning techniques.

The student answer should indicate that traditional planning is useful for short-term planning, while future scenario planning is useful for long-term planning. (0.75 marks) 0.25 marks for extra info

25. For each of the following infrastructure project in the City of Rotterdam, describe two sustainability-focused characteristics. (3 marks)

Benthemplein Square:

The square provides a vibrant social space (events, play sports, etc) AND it can act as a water catchment in the event of heavy rainfall events (i.e. contributes to stormwater management).

To earn 1 mark, students much identify BOTH issues – contributing to social systems and water systems

Museum Park Garage:

The parking garage provides space for automobiles AND is can be used as an underground stormwater reservoir.

To earn 1 mark, students much identify BOTH issues – contributing to the transportation system and water systems

The Dakakkers Green Rooftops:

This infrastructure feature contributes to the stormwater drainage system AND provides vegetables and honey for urban residents.

To earn 1 mark, students much identify BOTH issues – contributing to food systems and water systems

26. What functional unit would you use when conducting an LCA comparison between a paper and a ceramic coffee cup? (1 mark) Why? (1 mark)

Functional Unit: *The answer should account for the expected life time of the product. So something like "per volume of coffee held over the life time of the cup" (1 mark)*
Reason for choosing this unit: *The student should explain why the functional unit they have chosen is a fair comparison. Something like: "Most LCAs do not simply list the environmental impacts of a product; instead, they list impacts per unit of service. If you compare the environmental impact of a disposable paper coffee cup to a ceramic mug, the paper cup has a lower impact to manufacture. This is misleading, however, because the ceramic mug lasts much longer. This makes its environmental impact per liter of coffee consumed much lower than that of the disposable cup." (1 mark)*

27. For engineers, one of the biggest challenges raised by sustainability is the need to translate broad sustainability goals into detailed engineering actions. Concept mapping is a tool that can help the practicing engineer tackle this challenge with logic and rigor.

- List the steps followed to create a concept map (2 mark).

Steps:

0.5 marks for each step in the following list:

STEP 1: List candidate concepts
STEP 2: Rank relevant concepts
STEP 3: CREATE PRELIMINARY CONCEPT MAP THAT DEMONS
BOTH DEPTH & BREADTH.
STEP 4: ADD CROSS LINKS

28. Starting with the focus question on the following page, **construct a preliminary concept map that also has cross-links.** (8 marks)

- Make sure you provide a concept map containing at least **20** of the most significant concepts. You should include as many concepts as you can, which may be much more than 20 concepts. Make sure to include all components of a concept map.

- Marks will be given for an illustration of both the depth of your knowledge (i.e. details – i.e. levels within the concept map), breadth of what you know (i.e. identification of broad issues – i.e. number of sub-groups within the concept map), and your understanding of cross-links between different issues.

Focus Question**:** **What are green buildings?**

Concept Map:

Number of Concepts (Max of 5 marks)
0.25 mark for each concept in the map that is related to green buildings. Subtract 0.25 mark for each error in the concept map (e.g. missing connecting word, missing arrow, not circling (or otherwise distinguishing) concepts, etc.)

Breadth and Depth (Max of 5 marks)
0.25 for each hierarchy mark for each hierarchy (i.e. each main branch) in the concept map.

0.25 marks for each level within each hierarchy.

0.25 marks for each cross-link (i.e. link between hierarchies)

Use this space if necessary:

PART 3 (10 marks): ARGUMENTATION QUESTION

29. At the end of this question is a short Opinion Editorial written by the president of the Greater Vancouver Board of Trade, Iain Black. Read this Op Ed then respond to items a, b, c, and d.

a. Paraphrase the primary claim of this media article (1 mark):

Any paraphrase of the following: Now is the ideal time to construct the Site C Dam

b. List the reasons that support the primary claim (4 marks):

R1: Construction costs are relatively low. (1.33 marks)

R2: There is currently an abundance of labour (1.33 marks)

R3: Dam construction now will boost that BC economy during a time of need (particularly in northern BC) (1.33 marks)

c. Provide all supporting evidence found in the media article for ONE of the reasons you list above. (4 marks)

For example
R1E1: The cost of borrowing money for construction is relatively low due to low interest rates (1.33 marks)
R1E2: Commodity prices (e.g. energy and material) is currently low due to the low cost of oil (1.33 marks)
R1E3: Labour costs are currently low (1.33 marks)

d. Name one underlying assumption made by the author that is not explicitly stated in the article (i.e. identify a warrant in the argument that is presented). (1 mark)

For example
The construction costs will not rise (above nominal levels) during the construction period.