Name: _____(circle family name) Last 3 digits of student number __ __ __

UNIVERSITY OF TORONTO

Faculty of Arts and Science, Department of Earth Science

AUGUST 2015 EXAMINATIONS

ESS205H1S Confronting Global Change

Lecturer – Lisa TUTTY, TAs – Quincy POON and April DALTON

Wed Aug 12th 2-5pm EX100. Duration - 3 hours.

Worth 35% of the course mark. 22 pages.

Examination Aids: One double sided (or two single sided) 'cheat sheet' printed from a computer and/or handwritten maximum 8.5 x 11 inch paper (A4/letter sized) can include text and/or figures. May NOT include any attachments or fold outs which increase the surface area of the page, all attachments must be firmly glued, stapled or taped on. NO magnifying lenses or similar are allowed.

Instructions: You must answer all multiple choice questions on the scantron card during the test, no extra time will be allotted for this after the test. You have CHOICE for the short and long answer questions, please select from the questions listed in each section only – no other substitutions are allowable. These questions too must be completed during the test. No extra marks for answering extra questions, only the first answer we come to in each section will be marked.

Item	**Out of ___ marks...**	**Your mark...**
Multiple choice	75	
Short answer	25	
Changing Earth: Terrestrial and Water ***76 or 77 or 78***	*5*	
Changing Earth: Atmosphere and Oceans ***79 or 80 or 81***	*5*	
Climate I ***82 or 83 or 84***	*5*	
Climate II ***85 or 86 or 87***	*5*	
Posters ***88 or 89 or 90***	*5*	
Long answer ***91 or 92 or 93***	20	
Total	Out of 120 marks	As %

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MULTIPLE CHOICE SECTION: Choose only the BEST answer for each question. You must answer on the scantron card during the test, no extra time will be allotted after the test is over.

Lecture 7: Changing Earth: Terrestrial and Water. Ch 4 (p125 to end), Ch8 (up to p231 and box 8-3 and p250-257).

1. Which of the following statements about domesticated ecosystems is FALSE?
   A) they include croplands and pastures and forest plantations
   B) they often require irrigation
   C) they often require fertilizers and pesticides
   D) they are particularly vulnerable to pests and disease
   E) none of the above (choosing this option means a-d are all true)

2. The big change (increased production) in the 1950s in farming was because of the ability to expand into marginal lands due to the technological advancements in tractor technology. A) True B) False

3. Dichlorodiphenyltrichloroethane (DDT) can affect bald eagle populations by making their egg shells too thin, reducing the viability of offspring.
   A) True B) False

4. Fill in the blank with the best option using the choices below. As discussed in class, flooding in ____ areas is more likely than in ____ areas due to the increased percentage of _____ surfaces.
   A) forested, grassland, hard soil B) grassland, urban, impermeable
   C) urban, rural, impermeable D) desert, forested, hard sand
   E) forested, desert, covered

5. As discussed in class, the likelihood of the "100 year flood" occurring in Toronto's Don Valley River in 2015 is ___?
   A) 50% b) 25% c) 10% d) 1% e) 0.1%

6. What uses the most water, worldwide?
   A) bottled water and other household uses B) cooling nuclear reactors
   C) irrigation D) pulp and paper and making cement
   E) smelting and other mining uses

7. After an aquifer is depleted by over-harvesting of water it can be repaired if left alone to replenish naturally over decades to centuries. A) True B) False

8. Instead of using traditional irrigation, farmers can help to conserve water by levelling their fields and by using micro-irrigation techniques. A) True B) False

9. How does saltwater intrusion occur?

A) salts accumulate in irrigated soils due to evaporation
B) road salts used in urbanized areas run off into nearby rivers and streams
C) naturally salty water is released from confined aquifers via artesian wells
D) ocean water moves into freshwater aquifers before they can recharge
E) salty leachate leaks into groundwater from sanitary landfills

10. What is the most likely source of sediment accumulation in a stream adjacent to a farm field?

A) acid mine drainage B) eutrophication C) salinization
D) soil erosion E) pesticides

Lecture 8: Changing Earth: Atmosphere and Oceans. Ch 11 (p390 to end, skip box 11-4), Ch 12(p436 to end, skip box 12-2).

11. Which element released by acid rain leaching of soils is contributing to tree mortality? A) Aluminium B) Carbon C) Mercury D) Sulfur

12. Which industrial process contributes the most to acid rain?

a) Making concrete b) Metal smelting
c) Drywall fabrication d) Plastic manufacturing

13. Which phenomenon inhibits vertical mixing and traps pollutants close to the ground?

a) Seismic inversion b) Temperature inversion
c) Monsoons d) Coriolis effect

14. Which component is required to create ground level (tropospheric) ozone from automobile exhaust?

a) Ozone in the stratosphere b) Cold, dark nights c) Sunlight d) Freon

15. Which material has been implicated in depleting stratospheric ozone?

a) NO_2 b) CO_2 c) Styrofoam d) plastic e) all of the above

16. How are nitrogen oxides, sulfur oxides, and carbon oxides related?
    a) All of them are air pollutants that contribute to global warming
    b) All of them are air pollutants that contribute to acid rain
    c) All of them are air pollutants formed by the combustion of fossil fuels
    d) All of them are air pollutants that result in human respiratory diseases
    e) All of the above

17. Which statement best describes the current situation with the ozone hole?
    a) The ozone hole has shown a major decline after the ozone-depleting chemicals were banned under the Montreal Protocol
    b) The ozone hole has grown about 50% larger
    c) The ozone hole remained more or less constant in size since 2000, despite a slight reduction in the amount of ozone depleting chemicals in the stratosphere
    d) Ozone holes of about equal size are now developing in both the Arctic and Antarctica.

18. Methane (CH_4) is about twenty times as powerful as carbon dioxide (CO_2) at destroying the ozone layer. A) True B) False

19. _____ near Chesapeake Bay has led to ____, causing hypoxia and a decline in _____. One of their main ecosystem functions is the _____.
    a) farming, eutrophication, shellfish, reduction of turbidity
    b) smelting, acidification, sport fish, predation of mussels
    c) automobile exhaust, mercury poisoning, the sport fishing industry, predation of mussels

20. Which type of geologic setting can rapidly lead to microbial contamination of beaches from septic tanks?
    a) Underlain by sandstone b) Granitic c) Gneissic d) Karst

21. Which event has been causing ocean acidification over the last century?
a) Volcanic activity b) Fossil fuel combustion c) Global warming d) Eutrophication

22. Which technology is used to map the seafloor, to aid in determining international ownership disputes over areas such as the Arctic sea?
a) marine magnetometer b) multibeam sonar c) sub-bottom seismic profiling

23. About ___ of excess CO_2 in the atmosphere is taken up by the ocean.
a) 66% b) 50% c) 33% d) 15% e) 5%

24. Ocean acidification leads to large areas (greater than the size of Texas) of plastic pellets that are ingested by marine creatures and which (pellets) are contaminated with chemicals at many times the concentration of the surrounding seawater. A) True B) False

25. Dead zones are either hypoxic or anoxic and are thus uninhabitable for many invertebrates and fish. A) True B) False

Lecture 9: Climate I. Ch 14, Ch 15 and box 5-1 and 8-1.

26. Rising levels of atmospheric carbon dioxide will cause which of the following changes in oceanic chemistry?
a) increased precipitation of calcium carbonate
b) increased salinity c) decreased salinity d) decreased pH
e) a and b

27. As sea ice and glaciers melt in the northern latitudes, this will cause the albedo of the Earth to ___?
a) increase b) decrease c) stay the same
d) first decrease but then the positive feedback will start and albedo will increase
e) first increase, but then the positive feedback will start and albedo will decrease

28. Which statement about thermohaline circulation is TRUE?
a) In general, less dense water is near the surface of the ocean than in the deep ocean, which creates a stable water column. Thus thermohaline circulation is slow as sinking can only happen at limited locations.
b) In general, more dense water is near the surface of the ocean than in the deep ocean, which creates an unstable water column. Thus thermohaline circulation is fast as sinking can happen at many locations.
c) In general, less dense water is near the surface of the ocean than in the deep ocean, which creates an unstable water column. Thus thermohaline circulation is fast as sinking can happen at many locations.
d) In general, more dense water is near the surface of the ocean than in the deep ocean, which creates an unstable water column. Thus surface water sinks in a lot of places, but thermohaline circulation is slow due to the large volume of the ocean.
e) In general, less dense water is near the surface of the ocean than in the deep ocean, which creates an unstable water column. Thus thermohaline circulation is slow as sinking can only happen at limited locations.

29. Which one of the following situations would result in the *widest* variation in seasonality on Earth?
a) low eccentricity b) minimum tilt c) northern hemisphere summer at aphelion
d) northern hemisphere summer at perihelion e) all of the above

30. Which one of the following statements is FALSE?
a) Greenhouse gases magnify the suns heat as it passes through toward Earth
b) Visible light from the sun heats up our planets atmosphere
c) The greenhouse effect is when greenhouse gases form a hole in the atmosphere so more energy can get in
d) All of the above (choosing this means a-c are all false)
e) None of the above (choosing this means a-c are all true)

31. After the transition interval about 0.9 Ma ice ages became shorter in duration and less frequent. A) True B) False

32. _____ contributed substantial greenhouse gases to the atmosphere on an anoxic early Earth but were killed off by ____.
a) cyanobacteria (blue green algae); breakup of Rodinia
b) cyanobacteria (blue green algae); breakup of Pangea
c) methanogens; oxygenation of the atmosphere
d) methanogens; stratospheric ozone depletion
e) c and d

33. Which change in Earth's average temperature would occur if all the continents congregated at the poles and only oceans were at the equator?
a) Decrease b) Increase
c) Stay the same, as more energy would be lost to counterbalance the effect
d) Stay the same, as melting glaciers would offset the gain

34. Which phenomenon could cause Earth to enter a glaciation phase?
a) Continents encircling the equator and only oceans at the poles
b) Seafloor spreading in places other than mid-oceanic ridges
c) High-magnitude earthquakes along the equator
d) Eccentricity in the lunar orbit

35. Which effect was created by rapid seafloor spreading during the Cretaceous?
a) Rapid advancement of glaciers b) Continental inundation
c) Drop in worldwide sea level d) Continental glaciation

36. Large boulders and gravel of terrestrial origin have been found in fine-grained ocean sediments far from land. Which feature or process created this phenomenon?
a) Rapidly spreading ocean ridges b) Volcanic eruptions
c) Icebergs d) The Gulf Stream

37. About ___ of sea level rise since 1961 is solely due to thermal expansion.
a) 2/3 b) 1/3 c) ¼ d) 15% e)5%

38. Which observation validates the premise that carbon dioxide in the atmosphere is due to burning of fossil fuel?
a) Reduction in atmospheric concentration of oxygen
b) Reduction in atmospheric concentration of nitrogen
c) Reduction in atmospheric concentration of argon
d) Increase in atmospheric concentration of methane

39. Which lesson is offered by the Paleocene-Eocene thermal maximum that occurred 55 million years ago?
a) Ocean acidification created mass extinctions of bottom-dwelling sea foraminifera.
b) Sea-surface temperatures plummeted, causing a mass extinction of sea mammals.
c) The ocean was flooded with carbonate sediments that buried and preserved whale fossils.
d) Deep-ocean salinity reversed and cod fisheries were disrupted.

40. Which geoengineering strategy has potential negative consequences?
a) Releasing sulfate aerosols into the stratosphere
b) Painting rooftops white to increase albedo
c) Planting trees to absorb CO_2
d) Carbon capture and storage

Lecture 10: Climate II. IPCC report: working group 1 summary report & FAQ.

41. Which of the following has a negative radiative forcing?
a) Carbon dioxide b) Ozone in stratosphere c) Ozone in troposphere d) Methane

42. Which event has the highest probability of occurring according to the IPCC?
a) Salinization of irrigation water b) Increased crop yields closer to poles
c) Crop damage d) Coral-reef damage

43. Which event has the least likelihood of occurring according to the IPCC report?

a) Loss of business at ski resorts b) Disruption due to flooding
c) Reduced hydropower generation potential
d) Relocation of coastal communities

44. Global circulation models have predicted that, by 2090–2099, the average world temperature will exceed conditions that have not occurred on this planet for tens of millions of years. A) True B) False

45. Warming over the past century is consistent with natural geologic processes.
A) True B) False

46. Melting permafrost in Arctic regions can lead to the increased release of greenhouse gases, it is part of a positive feedback cycle with warming.
A) True B) False

47. How might global warming lead to lower temperatures in Europe?

a) Melting of Greenland ice will cool European waters
b) The ocean conveyor belt might slow down
c) Global warming will lead to more El Niño events, and less upwelling
d) Changing winds will lead to increased clouds and rainfall in Europe
e) It is impossible for global warming to lead to lower temperatures anywhere in the world

48. The Younger Dryas was caused by a runaway greenhouse effect, most likely from rapid plate tectonics. A) True B) False

49. Some of the most convincing evidence against Snowball Earth includes the zipper rift theory. A) True B) False

50. Mitigation and adaptation are the same thing. A) True B) False

51. Of over 10000 scientists surveyed, 98.5% agreed that recent global warming is anomalous and is anthropogenically caused. A) True B) False

52. The Medieval Warm Period (950-1250) was as warm as the present day, but the warmth was not as coherent across regions as it is at present.
A) True B) False

53. Since 1971 most increased energy in the climate system has been stored by ___? a) atmosphere b) ocean above 700m depth c) ocean below 700m depth

54. Consider the last two decades: snow and ice worldwide is decreasing.
A) True B) False

55. Past and present emissions of greenhouse gases will determine the climate for centuries, even if we stop emitting carbon dioxide immediately. A) True B) False

"Lecture" 11: Posters.

56. Which effect will global warming have on human health?
a) Most people will be fine since cold-related diseases will decline.
b) Warmer weather is better for mental-health issues.
c) Increased snowfall will benefit people living in dry regions.
d) Tropical diseases like malaria will spread northward.
e) All of the above

57. Vector borne diseases will generally increase in range with global warming.
A) True B) False

58. The rate of parasite development often increases with temperature.
A) True B) False

59. Cases of gastroenteritis (stomach flu) and similar illnesses can increase drastically with increased water temperatures. A) True B) False

60. Possible mitigation for climate related disease increases can include insect repellent (natural or artificial) and simple rules such as not keeping standing water on your property. A) True B) False

61. Is climate change the only factor affecting transmission in any of the diseases that affect humans? A) Yes B) No

62. In his Papal letter, Pope Francis discussed climate change and biodiversity from both a scientific and a theological viewpoint. A) True B) False

63. Pope Francis had training as a botanist (plant scientist) in addition to studying theology. A) True B) False

64. Climate change moves at the same velocity worldwide. A) True B) False

65. Mountains may provide refuge areas as the velocity of climate change toward the polar regions outstrips the ability of most biomes to migrate and keep pace.
A) True B) False

66. Common ways to adapt to climate related coastal changes include building structures in the sea (ex. sea walls) and planting protective plants (ex. mangroves). A) True B) False

67. Coral bleaching is amongst the coastal effects related to climate change.
A) True B) False

68. Storm surges and erosion are amongst the coastal effects related to climate change. A) True B) False

69. Mitigating or adapting to climate related coastal effects (ex. beach erosion) in one area can have devastating effects on other areas. A) True B) False

70. Considering global climate change models, the one that covers both temperature and precipitation in a grid type pattern is __?
a) general circulation model b) radiative-convective model
c) zero-dimension model d) all of the above

71. Conservation efforts (ex. in National and Provincial Parks) must consider the velocity of climate change to be effective in the long term. A) True B) False

72. Conservation efforts must consider the connectivity of preserved areas in order to be effective in the long term, due at least in part to the velocity of climate change. A) True B) False

73. One of the effects of climate change on coastal areas is rising pH (more alkalinity). A) True B) False

74. Plastic debris such as balloons and pop can plastic holders can strangle and kill marine life. A) True B) False

75. Combined sewers sometimes dump untreated sewage directly into lakes, rivers and oceans, even in Canada. A) True B) False

SHORT ANSWER SECTION: Watch for choice. Please select from the questions listed in each section only – no other substitutions are allowable. These questions must be completed during the test. No extra marks for answering extra questions, only the first answer we come to in each section will be marked.

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Lecture 7: Changing Earth: Terrestrial and Water. Ch 4 (p125 to end), Ch8 (up to p231 and box 8-3 and p250-257). 76. or 77. or 78.

76. Describe in detail two (2) specific ways in which onland land use affects ocean/lake ecosystems. Include details about what is happening onland and what the end result is in the water system. Please write in pen. Please write in sentence format not point form. Please circle question 76 on page 1 of the test.

77. Describe in detail why the governments of Canada and the United States put out guidelines for how many Great Lakes fish should be consumed by various people. Include specific details, don't be general in your answer. Please write in pen. Please write in sentence format not point form. Please circle question 77 on page 1 of the test.

78. **Compare and contrast** bioaccumulation and biomagnification, give a specific *example* to explain each of these concepts *while* comparing and contrasting them. ALSO, explain *which* of these two concepts is responsible for the differences in the amount of pesticides found in these organisms (table 1), and *why* you believe this choice is correct. Please write in pen. Please write in sentence format not point form. Please circle question 78 on page 1 of the test.

Table 1.

ORGANISM	CONCENTRATION OF PESTICIDE (in parts per million)
Bird	26.4
Fish	2.07
Prawn (like shrimp)	0.23
Phytoplankton	0.04

Extra space found on pages 18 to 22 if needed. Please write CONTINUED if you have continued on into the extra space.

Name: _____(circle family name) Last 3 digits of student number __ __ __

Lecture 8: Changing Earth: Atmosphere and Oceans. Ch 11 (p390 to end, skip box 11-4), Ch 12(p436 to end, skip box 12-2). 79. or 80. or 81.

79. Discuss three (3) major pollution problems in the oceans. Use specific details in your answer. Please write in pen. Please write in sentence format not point form. Please circle question 79 on page 1 of the test.

80. Discuss smog OR ozone depletion, it causes (mostly) and effects (briefly). Please write in pen. Please write in sentence format not point form. Please circle question 80 on page 1 of the test.

81. Discuss acid rain, its causes (mostly) and effects (briefly). Please write in pen. Please write in sentence format not point form. Please circle question 81 on page 1 of the test.

Extra space found on pages 18 to 22 if needed. Please write CONTINUED if you have continued on into the extra space.

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Lecture 9: Climate I. Ch 14, Ch 15 and box 5-1 and 8-1. 82. or 83. or 84.

82. What causes NADW circulation to stop and/or slow down? What record is there of this? Give a specific example of when it has happened in the past. Please write in pen. Please write in sentence format not point form. Please circle question 82 on page 1 of the test.

83. Milankovitch variables – sketch and discuss each one and how they affect Earth. What is their overall importance? Please write in pen. Please write in sentence format not point form. Please circle question 83 on page 1 of the test.

84. How do we study paleoclimate? Detail at least three (3) separate methods. Please write in pen. Please write in sentence format not point form. Please circle question 84 on page 1 of the test.

Extra space found on pages 18 to 22 if needed. Please write CONTINUED if you have continued on into the extra space.

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Lecture 10: Climate II. IPCC report: working group 1 summary report & FAQ.
85. or 86. or 87.

85. Effects of global climate change – choose three *major* ones and discuss. Please write in pen. Please write in sentence format not point form. Please circle question 85 on page 1 of the test.

86. Discuss three (3) positive and two (2) negative radiative forcing chemicals/effects. Please write in pen. Please write in sentence format not point form. Please circle question 86 on page 1 of the test.

87. Younger Dryas – what is it and why did it happen? How is it recorded in the geologic record? Please write in pen. Please write in sentence format not point form. Please circle question 87 on page 1 of the test.

Extra space found on pages 18 to 22 if needed. Please write CONTINUED if you have continued on into the extra space.

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"Lecture" 11: Posters. 88. or 89. or 90.

88. NOTE: if this is YOUR poster topic then you can NOT choose this question. Summarize in ten (10) sentences or fewer your favourite of these "OTHER" topics (as covered on the student poster) that your co-students self-suggested: (The posters at the conference were: Arctic; Eutrophication; Fracking; Geomagnetic field; and Thermohaline circulation). Please write in pen. Please write in sentence format not point form. Please circle question 88 on page 1 of the test.

89. NOTE: if this is YOUR poster topic then you can NOT choose this question. The velocity of climate change - can biomes migrate quickly enough to keep pace with climate change? Does the answer depend upon physical factors such as topography? Use specific case studies for at least two (2) biomes. Please write in pen. Please write in sentence format not point form. Please circle question 89 on page 1 of the test.

90. NOTE: if this is YOUR poster topic then you can NOT choose this question. Will Pope Francis' papal letter (encyclical), "*Laudato si*" ("On Care for Our Common Home") change the world for the better? Why or why not? What are the major scientific points that Pope Francis brings forward in his work? What strengths and drawbacks are there to this work coming from a major religious figure? Is Pope Francis speaking "out of turn" to put forward a document about science? What was his training in, other than the obvious theology? Please write in pen. Please write in sentence format not point form. Please circle question 90 on page 1 of the test.

Extra space found on pages 18 to 22 if needed. Please write CONTINUED if you have continued on into the extra space.

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LONG ANSWER SECTION: Watch for choice. Please select from the questions listed in this section only – no other substitutions are allowable. These questions must be completed during the test. No extra marks for answering extra questions, only the first answer we come to in this section will be marked.

91. Discuss the many linkages between climate change and plate tectonics. Be quite specific about each linkage and how it works, **this question is worth 20 marks.** Please write an organized answer, part of the marks come from organization, spelling and grammar since this is an essay question. Please write in pen. Please write in sentence and paragraph format not point form. Please circle question 91 on page 1 of the test.

OR 92. ***Compare and contrast*** natural climate change with anthropogenic climate change. Discuss at least five (5) *causes* of natural climate change and at least five (5) *causes* of anthropogenic climate change. It is *important* that you compare and contrast because just *listing* everything you know about each of these things will result in a low mark. Note: I have NOT asked you to discuss the results of climate change, but only the CAUSES. **This question is out of 20 marks.** Please write an organized answer, part of the marks come from organization, spelling and grammar since this is an essay question. Please write in pen. Please write in sentence and paragraph format not point form. Please circle question 91 on page 1 of the test.

OR 93. Explain how understanding atmospheric and oceanic circulation is important in the context of global pollution (NOT climate change). In the course of doing this, give at least three (3) specific examples of pollution that are NOT related to climate change. Include information for each example about how the pollution problem is caused, whether the causes are natural, anthropogenic or both (explain each), and whether there is any mitigation strategies that can/have been used to reduce these three (3) pollution problems. Of course, for each pollution problem you must explain the relation to atmospheric and oceanic circulation. I suggest putting your answer in three sections, one for each pollution problem you are covering. **This question is out of 20 marks.**

END OF THE TEST

Extra space found on pages 18 to 22 if needed. Please write CONTINUED if you have continued on into the extra space.

Extra space for writing. Please clearly indicate which question you are answering.

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