1. Part 1: Full-credit answer example

1.1. Five Things (10 points)

List the "5 things everyone should know about climate change" from class. For each of these 5 claims, give what you consider to be the strongest piece of evidence supporting the claim (use a specific example from class or the readings).

2. Part 2: Grading Rubric

N.B. (having clarified with Kim) The question was intended to be answered with Kim's "5 things everyone should know about climate change" ("Kim's 5"), i.e. from the climate change slides. If the question was answered with different "things everyone should know", that are not related to "Kim's 5" then they do not get a point. However, if the specific evidence supports the claim well, and is linked to climate change, then the evidence can get a point each.

For example if all of the "things everyone should know" is NOT linked to "Kim's 5" BUT they are related to climate change, and the evidence is good, then you can still get 5/10 points.

Overall question	1.1. (10 points)		
number			
Group members	Ellen, Danna, Elin, Katrine		
	Criteria for points		
Sub-question	Description of questions and total sub-question point value		
In no particular	Description of sub-question and total points value		
order			
Part 1	Points	Element	
1 thing everyone	1	The climate is warming, or a sentence indicating this	
should know about		(e.g. it's happening, it's real).	
Specific evidence	1	Evidence to support this claim (e.g. sentences that	
supporting claim		indicate the following: It is unequivocal that the	
		temperature has been rising since 1950.	
		Multiple observations (northern hemisphere snow	
		cover, Arctic summer sea Ice extend, Change in	
		global average upper ocean heat content, Global	
		average sea level change) indicates a change in	
		global climate (IPCC, 2013).	
		The total radiative forcing/Energy balance is	

		positive (IPCC, 2013).
		"Earth's climate during the last half of the
		twentieth century was warmer than during any 50-
		year interval in the last 500 years and probably the
		last 1,300 years or longer" (Chapin, 2011, p. 44).
		"The overwhelming scientific consensus is that the
		earth's atmosphere is warming rapidly, mostly
		because of human activities, and that this will lead
		to significant climate change during this century."
		(Miller & Spoolman, 2009, p. 482)).
Part 2	Description of sub	-question and total points value
1 thing everyone	1	It's us, or a sentence indicating this.
should know about		
Specific evidence	1	Evidence to support this claim (e.g. sentences that
supporting claim		indicate the following: The increase in temperature
		matches the increase in anthropogenic CO2
		level/emissions.
		Geographical patterns of surface warming (more
		heating over land surface than over oceans, more
		warming at higher latitudes, more warming in upper
		oceans than lower) indicates that the warming is
		caused by humans.
		CO ₂ concentration reflects sources and global
		circulation
		Vertical pattern of warming in the atmosphere
		shows more warming in the lower atmosphere than
		the upper, which indicates an increase in
		greenhouse effect.
		The share of carbon12 to carbon13 in the
		atmosphere has increased, which shows the effect
		of burning fossil fuels (Suess effect).
		Ocean CO ₂ is increasing -> pH decreasing
		Models cannot reproduce observations with natural
		forcing, but they can when including anthropogenic
		forcing.)
Part 3	Description of sub	-question and total points value
1 thing everyone	1	We're sure, or a sentence indicating this. Scientific
should know about		consensus on anthropogenic source of climate
		change.

Specific evidence supporting claim	1	Evidence to support this claim (e.g. sentences that indicate the following: <i>"It is extremely likely</i> (95- 100 %) that human influence has been the dominant cause of the observed warming since the mid-20th century." (IPCC, 2013, WG1 SPM). There is strong scientific consensus that humans are causing global warming (IPCC, 2013; Cook et al.
		2013; Oreskes, 2004; Powell 2012; Anderegg et al., 2010).
Part 4	Description of sub	-guestion and total points value
1 thing everyone should know about	1	It's bad, or a sentence indicating this.
Specific evidence supporting claim	1	Evidence to support this claim with clear examples of impact (e.g. sentences that indicate the following: The CO ₂ level and temperature have been as high as they are now before but the rate of change of which warming and CO ₂ level increase is happening are extremely unusual. The warming and CO ₂ level increase is happening on a global scale, which shows it is not local variability. The cause of global warming (anthropogenic) is unprecedented. Rockström et al. (2009) identified a boundary for climate change which should not be exceeded, the boundary is 350 ppm (atmospheric concentration of CO2), current state is 387 ppm, which means we have exceeded the boundary -> bad IPCC report shows a model where a high-emissions scenario (continuing business as usual) will lead to an increase of temperature by 4-7 degrees, which is the same change as between glacial and interglacial periods, hence big change in climate, ecosystems and the world as we know it today. Important physical, biological and human and managed systems are threatened by global warming and CO ₂ emissions on a global scale.)
Part 5	Description of sub	-question and total points value
1 thing everyone should know about	1	We can fix it, or a sentence indicating this.
Specific evidence	1	Evidence to support this claim (e.g. sentences that

1. Part 1: Full-credit answer example

Explain two problems with	1. The paraphrased text contains far too many of
the student text that make it	the same words used in the original text.
plagiarism of the original	
text.	2. The paraphrase also neglects to cite the second
	sentence, an idea that is clearly not the students
(1-2 sentences each;	own and requires proper attribution.
4 points total)	
, ,	
Write a 1-sentence summary	Americans have developed a symbiotic relationship
of this material that would be	with globalization that allows its population to
acceptable to use in an essay.	embrace it without fear (Thurow, 1993).
Be sure to include an APA-	
formatted in-text reference.	
(1 sentence: 3 noints)	
Explain why your summary	My summary avoids emulating the structure of
avoids the problems you	what I am paraphrasing by being clear and concise
identified above	what i am paraphrasing by being clear and concise.
dentined above.	Luca different from the source text while still
(2.2 contourses 2 cosiste)	Tuse different from the source text while still
(2-3 sentences, 3 points)	capturing the central ideas of the original passage.
	i use proper in-text citation at the end of my
	paraphrase.

Overall question	1.2 Academic Integrity		
Group members	Linn Luke Laura Christiane		
	Criteria for points		
Sub-question			
Part 1	2 problems with th	ne student version that make it plagiarism (4 pts)	
	Points	Element	
	1 point each, 2	Naming a problem such as:	
	needed	Same language	
		Same structure	
		Lack of independence in writing	
		Incorrect citation	
	1 point each, 2	Explain with correct reasoning why the above	
	needed	problem constitutes plagiarism	
		No points awarded for students claiming that the	
		reason for plagiarism was "misunderstanding" or	
		student misinterpretation of the original text	
	No points awarded to: answers that stated that		
		quotation marks are missing from the paraphrase.	
		For this text, the suggestion of using a "direct	
		quote" is not appropriate because direct quotes	
		should be avoided when the text can be	
		paraphrased (like the one on the exam)	
Part 2	Write a 1 sentence summary (3pts)		
	1	Write a summary that demonstrates independent	
		structure/language	
	1	Accuracy in capturing the meaning of the original	
		text	
	1	Use correct APA citation format (should contain	
		author name and year in correct format, e.g.,	
		sentence should end with "(Thurow, 1993)." Or	
		begin "Thurow (1993) states"	
Part 3	Explain why avoids problem (3 pts)		
	0.5 each (1 total)	Names two correct examples of how to avoid	
		plagiarism (Ex. Independent sentence structure,	
		different language, incorrect in-text citation)	
	1 each (2 total)	Explain the examples.	

1. Part 1: Full-credit answer example

Please **paste here** your question from the exam, and fill it out with an example of an outstanding answer.

Please explain the concept of "planetary boundaries", as proposed by Rockstrom et al. (2009).

The concept presents a **safe operating space** for human activities that affect the Earth systems. It defines the **threshold of nine subsystems or processes** and argues that if these thresholds are transgressed it will cause **environmental changes that will have catastrophic consequences for humankind.**

How were the proposed levels established, and what was the role of uncertainty in establishing the proposed boundary levels? Illustrate with a specific example.

The proposed boundary levels were established using **historical data**, **future projection models**, **and current observations**. (2 points)

The threshold is a zone of uncertainty (1) to allow for lack of scientific knowledge, intrinsic uncertainty in complex systems, feedback mechanisms, and allowable overshoot. (any of these is 1 point)

For example, the climate boundary is a proposed 350 ppm of CO2, based on the fact that the planet was largely ice-free until CO2 concentrations fell below 450 ppm, to allow for +/- 100 ppm CO2.

(1 point)

2. Part 2: Grading Rubric

Overall question number	1.3			
Group members	Cherry, Maja,	Cherry, Maja, Jonas, Markus		
	Criteria for points			
Sub-question	Description o	Description of questions and total sub-question point value		
Part 1	Description o	Description of sub-question and total points value		
1.3	Please expla al.	Please explain concept of planetary as proposed by Rockstrom et al.		
	Points	Element		
	1	safe operating space		
	1	9 subsystems		
	1	environmental changes with catastrophic consequences		
Part 2	Description of sub-question and total points value			
	How were the role of uncert Illustrate with	How were the proposed boundary levels established, and what was the role of uncertainty in establishing the proposed boundary level? Illustrate with a specific example.		
	2	historical data, future projection models, current observations (any 2)		
	2	threshold is a zone of uncertainty/or the threshold is a conservative boundary part of the zone of uncertainty (either is 1 point) that represents lack of scientific knowledge, intrinsic uncertainty in complex systems, feedback mechanisms, allowable overshoot (any of these is 1 point)		

	1	any example of a boundary that is uncertain
Part 3	Description of sub	-question and total points value
	Why are some bou	ndaries currently undefined?
	2	1. no standard way to define a control variable and measure the critical value for the boundary, 2. it may be a slow variable to take effect, 3. data on the process is lacking, 4. example illustrating any of these two. (any of these two points)

1. Part 1: Full-credit answer example

1.1. Arguing Albedo (10 points)

If albedo **decreases** in the system below, what will happen to surface temperature? Formulate your answer in terms of an academic argument by filling out the table below.



2. Part 2: Grading Rubric

Overall question	1.4			
number				
Group members	Noor, Stefan, Polina, Marius			
Criteria for points				
Sub-question	Description of que	Description of questions and total sub-question point value		
Part 1	General Definition	General Definition of a claim		
	Points	Points Element		
	0	Misunderstanding of the question/no		
		answer/wrong		
	0.5	Mentioning key words from one group		
	1	Clear understanding of the question and a		
		combination of keywords from group 1 and 2		
Group 1: Statement, idea, thought, argument, prediction (anything similar to these words) Group 2: True or false, arguable, proven, right or wrong (anything similar to these words)				
Part 2	General definition	n of evidence		
	0	Misunderstanding of the question/no		
		answer/wrong		
	0.5	Mentioning only one of the key words		
	1	Clear understanding of the question and a		
		combination of keywords from group 1 and 2		
Group 1: Proof, data, empirical material, facts, figures, information (or similar) Group 2: Supporting the claim or reason (or similar)				
Part 3	General definition	of Reasoning		
	0	Misunderstanding of the question/no		
		answer/wrong		
	1	Clear understanding of the question and concept		
Part 4	Definition of an a	Definition of an academic argument		
	0	Misunderstanding of the question/no		
		answer/wrong		
	0.5	Unclear understanding of the concept/ Mentioning		
		only one of the key words		
	1	Clear understanding of the question and a		
		combination of keywords from group 1 and 2		
Group 1: Clai	m, reason, idea (or s	similar)		
Group 2: Sup	The claim related	r sillilidij		
rdil J		No claim and no relationship (no answer		
	1	Having a claim OP a relationship not both (baving a		
	LT	naving a claim OK a relationship not both/ having a		

		wrong relationship
	2	Having a claim with the correct relationship
Part 6	The evidence related to the system above	
	0	Not including any of the data from the picture/ used
		reasoning as opposed to evidence/ no answer
	1	Mentioning only one of the facts for albedo with the
		numbers
	2	Mentioning one of the examples of high albedo and
		low albedos with the numbers
Part 7	The reasoning rela	ated to the system above
Part 7	The reasoning rela	ated to the system above Wrong relationship/ no answer
Part 7	The reasoning rela	ated to the system above Wrong relationship/ no answer Mentioning 1 of the 2 relationships (relationship 1:
Part 7	The reasoning rela	ated to the system above Wrong relationship/ no answer Mentioning 1 of the 2 relationships (relationship 1: high albedo means high reflection/low absorption.
Part 7	The reasoning rela	ated to the system above Wrong relationship/ no answer Mentioning 1 of the 2 relationships (relationship 1: high albedo means high reflection/low absorption. Relationship 2: relationship between reflection and
Part 7	The reasoning rela	Ated to the system above Wrong relationship/ no answer Mentioning 1 of the 2 relationships (relationship 1: high albedo means high reflection/low absorption. Relationship 2: relationship between reflection and temperature change)/ Directly relating albedo to
Part 7	The reasoning rela	Ated to the system above Wrong relationship/ no answer Mentioning 1 of the 2 relationships (relationship 1: high albedo means high reflection/low absorption. Relationship 2: relationship between reflection and temperature change)/ Directly relating albedo to temperature without mentioning
Part 7	The reasoning rela	Ated to the system above Wrong relationship/ no answer Mentioning 1 of the 2 relationships (relationship 1: high albedo means high reflection/low absorption. Relationship 2: relationship between reflection and temperature change)/ Directly relating albedo to temperature without mentioning absorption/reflection

1. Part 1: Full-credit answer example

1.5. Nutrients (10 points)

Based on the evidence above, describe a policy approach that could be effective to address excess global N application

Possible policy approaches:

1. Agroforestry : Promote the growth of nitrogen fixing trees and leguminous plants in farms.

2. Sharing of animal waste: Farms with livestock and poultry can share excess manure with neighbouring farmers in order to avoid over application on a single farm.

3. Impart knowledge to the farmers on good fertilizer management practices with respect to timing (season), rate and method of application.

Points: Policy 1 point Describing it properly 1 point

Describe 2 ways that humans have changed the global nitrogen cycle, compared with Preindustrial times.

Possible answers:

Fixation of atmospheric N2 has doubled due to...

• Haber process, the largest human alternator. (Chapin et al., 2011)

 Industrially removing nitrogen gas (N2) from the atmosphere, creating solid form of nitrogen that can be used as fertilizer.

- Legume crops and agricultural techniques (Miller and Spoolman, 2009)
- When harvesting crops and thereby removing the nitrogen from topsoil.

• Irrigation, adding abnormal amounts of water washing away the nitroge n.

- Waste (Miller and Spoolman, 2009; Chapin, et al. 2011)
- Domestic animals emit both nitrogen dioxide (NO2) and ammonia (NH3)
- Sewage emission, releasing nitrogen into ecosystems
- Over fertilization, releasing nitrogen into water bodies

• Fossil fuels (Miller and Spoolman, 2009; Chapin, et al. 2011)

 Adds nitrogen oxide (NO) which converts to nitrogen dioxide (NO2) and nitric acid (HNO3) in

the atmosphere, causing two major effects;

- 1. climate change (since NO2 is a greenhouse gas)
- 2. Acid rain (from the nitric acid)
- 3. Ozone depletion (when NO2 reacts with the Ozone (O3)

• Displacement of natural nitrogen cycle (*Miller and Spoolman, 2009; Chapin, et al. 2011*)

 Adding nitrogen to normally nitrogen poor environments, such as water bodies and seas.

• Destruction of natural ecosystems (Miller and Spoolman, 2009)

• When destroying wetlands, soils, forests and grasslands, nitrogen is emitted into the atmosphere.

Points (4 in total):

(2*) 1 point for each correct change

(2*) 1 point for proper comparison with preindustrial times

Explain how this excess nitrogen application relates to two other planetary boundaries. Be sure to specify the direction of impact.

1. Climate change (Miller and Spoolman, 2009, Chapin et al., 2011)

a. N2O which is 300 times more potent than carbon dioxide, contributes to global warming by increasing the greenhouse effect.

b. High concentrations of Nitrogen oxides (NOx) in reaction with carbon monoxide, methane and nonmethane hydrocarbons produce tropospheric ozone.

2. Biodiversity (Chapin et al., 2011; Lecture slides, 2014)

a. Nutrients displacement changing biodiversity in ecosystems, by changing the conditions for plants.

b. Nutrient poisoning, too much of too little of nutrients harm species and an overuse could cause plant poisoning.

3. Land use change

a. More effective use of land use.

b. Displacement can cause land degradation and push further change of land use

4. Global Freshwater use (Miller and Spoolman, 2009)

Eutrophication of lakes and rivers due to excessive nutrient loading by run off from agricultural farms. It causes algal blooms and severely degrades ecosystem services. Note: Blooming algae does not consume O_2 they produce it through photosynthesis! Oxygen loss occurs when the blooming algae die and sink to the bottom and decay. This is when oxygen is consumed by bacteria.

5. Ocean acidification (Miller and Spoolman, 2009; Chapin, et al. 2011)

a. Binds more carbon to solid form, when larger amounts of nitrogen reaches the sea causing

algae blooming and increasing the uptake of CO2 from the water.

b. NH3 reduces the acidification in air and potentially also oceans.

c. Acidify the oceans with increase of nitric acid.

6. Aerosol loading (Chapin et al., 2009)

a. Causes smog, global warming

7. Chemical pollution

a. Unknown factors

8. Ozone depletion (Chapin, et al. 2011)

N2O in the stratosphere reacts with excited oxygen in presence of ultraviolet radiation to produce NO, which catalyzes the destruction of stratospheric ozone.

9. Phosphor cycle Fertilizer is a mixer of P and N, application of N leads to an increase in P.

Points (4 in total):

(2*) 1 point for each correct impact on another planetary boundary

(2*) 1 point for proper describing of impact and how it impact

overall question	1.5		
Group members	Madhuri Pontus Ranhael Anna		
Group members	Criteria for points		
Sub-question	Description of questions and total sub-question point value		
Part 1	Description of questions and total points value		
	Points	Flement	
	1	Naming a policy as listed in the example	
	1	(Example 1: Sharing of animal waste: Farms with	
		livestock and poultry can share excess manure with	
		neighbouring farmers in order to avoid over	
		application on a single farm.)	
	1	Adequate description of policy	
	-0.5	No adequate and logical description of the policy	
Part 2	Description of sub-question and total points value		
	1	Correct specific change 1 as listed in the example	
	1	Correct specific change 2 as listed in the example	
	1	Indicating the impact and its direction 1	
	1	Indicating the impact and its direction 2	
	-0.5	If the change of the global nitrogen cycle is not	
		specifically addressed or explained	
	-0.5	If chemical equation or natural processes are not	
		correct	
Part 3	Description of sub-question and total points value		
	1	Correct impact on another planetary boundary 1	
	1	Correct impact on another planetary boundary 2	
	1	Proper describing of impact and direction of impact 1	
	1	Proper describing of impact and direction of impact 2	
	-0.5	Lack in proper description and direction of the impact	

Final Exam Rubric – Question 1.6 Experimental Design Earth Systems Science 2014 Group members: Shona Jenkins, Oskar Niemi, Yulia Kalashnikova, Sophie Baar

1. Part 1: Full-credit answer example

The following examples were taken from multiple exams

Construct a hypothesis using land	If a greater percentage of land is used for agricultural	
use change as the construct	purposes (independent, land use boundary), then the rate of	
behind your independent	biodiversity loss will increase (dependent).	
variable, and another of the		
planetary boundaries as the	(Note: the land use boundary is agricultural land, it does not	
construct behind your dependent	refer to other types of land use change specifically. It is OK to	
variable. Clearly identify your	have specific examples of the planetary boundaries, but the	
variables.	boundaries themselves must be used.)	
Explain your reasoning (i.e., why	A higher amount of agricultural land leads to more habitat	
would you expect the change in	loss, fragmentation, pollution. All the above leads to less	
land use you expect to produce	diverse ecosystems and thus results in biodiversity loss.	
the change in the dependent		
variable that you hypothesize?)		
How would you operationalize	1. Agricultural land	
each of these variables to make	Percent of crop land per hectare (compare decrease or	
them measures that you could	increase with historical data)	
observe?		
(2 sent, 2 pts)	2. Biodiversity loss	
	Measure species richness and evenness per hectare	
Describe and justify two criteria	1. The two sites would have to be areas that once had similar	
you would use to select a	land use, e.g. comparing a forest to agricultural land that was	
suitable study site to collect data	once forest.	
to test your hypothesis.		
(2 sent, 2 pts)	2. Two sites will be selected in the same area to control for	
	other influencing factors, like climate.	
Now construct a hypothesis	If climate change increases, then land use change will also	
where land use change is the	increase.	
dependent variable, and a (new)		
planetary boundaries is the	Climate change leads to sea level rise, increased floods and	
independent. Explain your	droughts, which forces people to relocate to other less	
reasoning. (1 hypothesis +	affected areas, which then leads to land use change in the	
explanatory sent, 2 points)	newly populated area.	

	Question 1.6 - Experimental Design					
Group members	Shona Jenkins, Oskar Niemi, Yulia Kalashnikova, Sophie Baar					
Criteria for points						
Sub-question	Description of qu	estions and total sub-question point value				
Part 1	Construct a hypothesis using land use change as the construct behind your independent variable, and another of the planetary boundaries as the construct behind your dependent variable. Clearly identify your variables. (2 points total)					
	Points	Element				
	0.5	If, then statement				
	0.5 Land use compared to another planetary boundary					
	0.5 Label independent variable					
	0.5 Label dependent variable					
Part 2	Explain your reas use you expect to you hypothesize?	oning (i.e., why would you expect the change in land produce the change in the dependent variable that ?). (2 points total)				
	2 Logical explanation why (mechanism) does the independent variable effect the dependent variable (strength and direction).					
	- 0.5 You do not explain strength and direction between the variables.					
Part 3	How would you o measures that yo	perationalize each of these variables to make them ou could observe? (2 points total)				

	0.5	Independent variable is measurable
	0.5	Independent variable has units
	0.5	Dependent variable is measurable
	0.5	Dependent variable has units
Part 4	Describe and site to collec (2 points tot	l justify two criteria you would use to select a suitable study t data to test your hypothesis. al)
	1.5	It has to explain that there is measurable difference in types of land use of the sites.
	0.5	Description of the site/sites.
Part 5	Now constru variable, and your reasoni	nct a hypothesis where land use change is the dependent d a (new) planetary boundaries is the independent. Explain ing. (2 points total)
	1	Comparing a new planetary boundary, to land use change.
	1	Logical explanation why (mechanism) does the independent variable effect the dependent variable (strength and direction).
	- 0.5.	The chosen independent variable is not directly a planetary boundary but is linked.

1. Part 1: Full-credit answer example

Please **paste here** your question from the exam, and fill it out with an example of an outstanding answer.

2. Your Brain on R: 20 points, mandatory

- Please draw clearly and label all relevant elements, axes, etc.
- You may want to start with a sketch on scratch paper before you make your final drawing below.



2.1. Please fill in the following table to explain what each numbered element of the line of R code above means. (4 points)

Element	What does this element mean in R? (1 bullet point each, 1 pt each)
1.	Name of the data set in R
2.	Command/Function to read .csv-file
3.	Directory/Path, where the .csv-file is saved on computer
4.	The .csv-file has headers (name of variables)

Given the data file: hpi.csv

code	country	region	lifesat	lifeexp	footprint	hly	hpi	hpirank	gdpcap	hdi	рор
CRI	Costa Rica	1a	8.5	78.5	2.3	66.7	76.12	1	10180	0.85	4327228
LAO	Laos	6c	6.2	63.2	1.1	39.4	57.34	19	2039	0.60	5663910
SWE	Sweden	2d	7.9	80.5	5.1	63.2	47.99	53	32525	0.96	9024040
TZA	Tanzania	4b	2.4	51.0	1.1	12.5	17.79	142	744	0.47	38477873
USA	United States of America	2b	7.9	77.9	9.4	61.2	30.73	114	41890	0.95	296507000

2.2. Please fill in the following table with the code required to produce the result described by the comment on the right. The first line is completed for you as an example. (6 points)

CODE (add code in R programming language; 2pts each)	COMMENT
hpidata=read.csv("/Users/Klara/Documents/work/R/hpi.csv",	#read in data to R
header=TRUE)	
	#inspect data
View(hpidata)	
or	
hpidata	
	# find out what each column in the
names(hpidata)	dataset is called.
	#plot a simple scatterplot with the 5 th
plot(hpidata\$lifeexp, hpidata\$lifesat)	column (lifeexp) on the X axis and 4 th
	column (lifesat) on the Y axis

Overall question	2.1					
number						
Group members	Giorgios, Jona	athan, Micaela and Siman				
		Criteria for points				
Sub-question	Description o	Description of questions and total sub-question point value				
Part 1	Description o	Description of sub-question and total points value				
	Points	Element				
	1	Name of data, dataset, variable or object (in R)				
	0,5	Vague description such as output				
	0	0 Understanding hpidata as the file (hpi.csv), blank or completely unreasonable				
Part 2	Description o	f sub-question and total points value				
	1 Command, Function, read data, import (.csv-file)					
	0,5 Vague description such as tell program what to do					
	0	Blank or completely unreasonable				
Part 3	Description o	of sub-question and total points value				
	1	Location, Path, Directory, origin, stored, saved				
	0,5	Mentions keywords but incomplete understanding				
	0	Blank or completely unreasonable				
Part 4	Description o	f sub-question and total points value				
	1	Variables, file includes headers, name of columns				
	0,5	Mentions keywords but incomplete understanding				
	0	Blank or completely unreasonable				
		· · ·				

Overall question	2.2					
Group members	Giorgios, Jon	athan, Micaela and Siman				
•		Criteria for points				
Sub-question	Description	Description of questions and total sub-question point value				
Part 1	Description	of sub-question and total points value				
	Points	Element				
	2	View(hpidata), hpidata, head(hpidata)				
	1,5	Correct structure, incorrect command or viceversa				
		(1 mistake)				
	1	Basic structure but otherwise incorrect (2 mistakes)				
	0	Blank or completely unreasonable				
Part 2	Description	of sub-question and total points value				
	2	names(hpidata), head(hpidata), hpidata				
	1,5	Correct structure, incorrect command or viceversa				
		(1 mistake)				
	1	Basic structure but otherwise incorrect (2 mistakes)				
	0	Blank or completely unreasonable				
Part 3	Description	of sub-question and total points value				
	2	Correct executable plot, e.g. plot(hpidata\$lifeexp,				
		hpidata\$lifesat)				
	1,5	Correct structure, incorrect command and viceversa				
		(1 mistake)				
	1	Correct structure, incorrect command and incorrect				
		arguments				
	0	Blank or completely unreasonable				



1. Part 1: Full-credit answer example

2.4

The graph shows a moderate to strong correlation between variables. Direction is positive – the longer the life expectancy, the higher the life satisfaction.

Overall question number	2.3 and 2.4			
Group members	Joep&Frans, Xiao&	Sara		
	Cri	teria for points		
2.3	Please sketch the output from your last line of code above. Please be sure to draw to scale, and label your axes as R would do. Please label the points you plotted with country labels from the first column so we can identify them (you don't have to specify the code for this). (8 points)			
	Points	Element		
	2 Label data points with correct country code/name			
	1	Logical scale used		
	2	X and Y axes are correctly oriented		
	1	Labels are written correctly (hpidata\$, not proper name)		
	2	Correct position of countries plotted on X, Y		
2.4	Describe the relat	ionship (strength and direction) that this figure		
	shows between th	e variables. (1-2 sentences, 2 points)		
	1	Direction: positive		
	1	Strength: moderate to strong		

1. Part 1: Full-credit answer example

3.1 Following Table 1 in Waggoner and Ausubel (2002), fill out the table below to describe what each term in ImPACT stands for, the responsible actors, and dimensions in this case. (7.5 points)

Grading = 0.5p/ right answer

Symbol	Category (what concept does the letter represent in ImPACT?)	What actors are responsible for this term in ImPACT?	Dimensions (units) in the case above?
1	Impact (on Environment)	All together or I=PxAxCxT	CO2 emission (in Gt) Or Emission from fossil fuel combustion
Р	Population	Parents	Capita or Population
A	Affluence	Workers	GDP / Capita income / Population
С	Consumption or intensity of use	Consumers	Energy / GDP Energy intensity / income
т	Technology or efficiency	Producers	CO2 / Energy Carbon intensity / Energy
			Emissions from fossil fuel combustion / Energy

3.2 Write out the ImPACT equation for the terms shown here. Be sure to include the correct units (dimensions), and label each term with its symbol from above. (5 points)

(it should be either	"normal"	' equation	or the	"change"	equation.	BUT i	t has	to be
consistent with the s	signs)							

I	=	Р	х	A	х	С	х	т
Emission of CO2 in GT	=	Capita	х	GDP Capita	х	Energy GDP	х	Carbon emissions Energy
Δi	=	Δр	+	Δa	+	Δc	+	Δt
Δ in emission of CO2 in GT	=	∆ in Capita	+	∆ in GDP Capita	+	Δ in <u>Energy</u> GDP	+	Δ in <u>Carbon emissions</u> <u>Energy</u>

Overall question number	3.1 & 3.2				
Group members	Mathilde, He	Mathilde, Hermine, Dennis, Saahil, Sandra & Nicole			
		Criteria for points			
Sub-question	Description of questions and total sub-question point value				
Part 1	Following Table 1 in Waggoner and Ausubel (2002), fill out the tabl				
	below to des	below to describe what each term in ImPACT stands for, the			
	responsible a	responsible actors, and dimensions in this case. (7.5 points)			
	Points	Element			
	0.5	Each correctly answered box of the table			
Part 2	Write out the ImPACT equation for the terms shown here. Be sure to				
	include the correct units (dimensions), and label each term with its symbol from above. (5 points)				
	1	Signs are correct (plus or multiplying)			
	1	Equation is written (I=PACT)			
		every term in the equation is present and correctly			
		stated with a clear connection to I = PACT			
		-1/2 points per item (no more than -1)			
	2	Terms cancel each other out (exception: capita and			
		population can be used as in the graph)			
		\rightarrow -½ points per item (no more than -2)			
	1	Label each term			
		\rightarrow each label missing – ½ point (no more than -1)			

1. Part 1: Full-credit answer example

Please **paste here** your question from the exam, and fill it out with an example of an outstanding answer.

	Decadal change in emissions				
	(gigatonnes CO ₂ /decade)				
	1971-1980	2001-	Change		
	(first	2010 (last	from first to		
	period)	period)	last period		
Driver					
Р	3	3	0		
А	3	6	3		
С	-2	-3	-1		
т	0	0.5	0.5		
Impact					
1	4	6.5	2.5		

We took the numbers of the graphic bars corresponding to each variable to calculate the absolute value for each period. Positive sign represents an increase and a negative sign represents a decrease. In our table we approximate to the nearest absolute 0,5 value in parenthesis. For calculating the ImPACT we compare our results with the total change number in the graph. In addition, we also calculate the total change by adding all the values between periods in column 4.

Overall question	3.3			
number				
Group members	Aurora Martin, Enrique Figallo, Tim Sievers, Clement Kopweh			
Criteria for points				
Sub-question	Description of questions and total sub-question point value			
Part 1	Description of sub-question and total points value (7.5)			
	Points	Element		
	+0.5	Population 1971-1980 will be around 3.0, (+/- 1.0)		
	+0.5	Population 2001-2010 will be around 3,0 (+/- 1.0)		
	+0.5	Change in population will be around 0 (+/- 1.0)		
	+0.5	Affluence 1971-1980 will be around 3.0 (+/- 1.0)		
	+0.5	Affluence 2001-2010 will be around 6.0 (+/- 1.0)		
	+0.5	Change in affluence will be around 3.0 (+/- 1.0)		
	+0.5	Consumption 1971-1980 will be around -2 (+/- 1.0)		
	+0.5	Consumption 2001-2010 will be around -3.0 (+/- 1.0)		
	+0.5	Change in affluence will be around -1 (+/- 1.0)		
	+0.5	Technology 1971-1980 will be around 0 (+/- 1.0)		
	+0.5	Technology 2001-2010 will be around 0.5 (+/- 1.0)		
	+0.5	Change in technology will be around 0,5 (+/- 1.0)		
	+0.5	Impact 1971-1980 will be around 4.0 (+/- 1.0)		
	+0.5	Impact 2001-2010 will be around 6.5 (+/- 1.0)		
	+0.5	Change in impact will be around 2.5 (+/- 1.0)		
	- 0.5	Missing explanation		

1. Part 1: Full-credit answer example

3.4.

Describe the change in each driver you calculated between the 2 time periods (direction and magnitude of change for the last column). What is one logical reason that could explain the trend observed in each case? (The reason should in principle be capable of being supported by observable evidence.) (6 points)

P = 1971-1980 (3.0GTco2) - 2001 - 2010 (3.0GTco2) = 0 Change

- P: Compared to the other driven factors, there has been a relatively small rise in carbon emissions based on population in the period.
- **Possible explanations:** This can be attributed to a global trend of population growth, in which a high rate of growth of developing countries is balanced with the decline of the rate of the developed ones.

A= 1971-1980 (3.0GTco2) - 2001 - 2010 (6GTco2) = +3.0GTCo2 Change

- A: In the two decades the great rise was in income (GDP/capita), with the period 2001-2011 showing considerable growth in the impact of A on carbon emissions.
- **Possible explanations:** Rate of development on global scale is driving this change in GDP/pop.

C = 1971-1980 (-1.5GTco2) – 2001 – 2010 (-3GTco2) = -1.5GTCo2 Change

- C: Widespread drive from dematerialization, decreased energy consumption per unit of GDP.
- Possible explanations: This could be because of the environmental awareness of individuals over the last decade that has increased the consumption of more emission-friendly products and thus reduced the amount of emissions per individual.

T = 1971-1980 (-0.5GTco2) – 2001 – 2010 (0.5GTco2) = +1GTCo2 Change

- T: Technological efficiency had a great change between the period, coming from a negative contribution to a positive one. This therefore has resulted in decreasing technology efficiency.
- **Possible explanations:** efficient technologies have not been developed over the past decade in comparison to 1971-1980; Producers have ignored the application of emission-friendly inputs to save costs in order to keep up with the pace of demand; Lack of incentive to producers; improved efficiency in developed countries but dramatically more Co2 is being produced due to the rapid industrialisation of developing countries

3.5 Across the entire time period studied, what has been the driving factor contributing the most to changes in CO₂ emissions (cite evidence from above)? What are the implications for reducing CO₂ emissions? (3-4 sentences; 4 points)

1 Point - (A= +3.0GTCo2 Change from 1971 – 2010)

1 Point - The driving factor that have most contributed to change emissions was the income (affluence) as show in SPM3 above. As Waggoner states, C x T are sustainability levers. The influence of A would be mitigated by declining T (increased efficiency), however this trend has followed a path to increased T (inefficiency). Therefore, emphasis could be placed on declining T in developing countries that are driving economic development through fossil fuel combustion.

1 Point - An increase in innovation in carbon efficient production of energy (or investment in other technologies or no carbon energy sources) would lead to -T, thus offsetting the impact of increasing affluence.

0.5 Points - Having said that, the impact of A is 10 x more than that of T.

0.5 Points- Therefore would mean that widespread efficiency in production on a global level is required under this scenario, increasing the impact of T by a factor of 10 Part 2: Grading Rubric

Overall question number	3.4, 3.5		
Group members	Gavin, Rosalind, Hitesh, Deborah		
		Criteria for points	
Sub-question	Description of	Description of questions and total sub-question point value	
3.4	Describe the change in each driver between time periods. Include observable evidence.		
	Points	Element	
	+0.5	Correct Direction	
	+0.5	Correct Magnitude	
	+0.5	Logical explanation using observable evidence that show trends	
3.5	What has been the driving factor been across time periods selected?		
	What are the implications for reducing Co2 emissions?		
	+1	A is the largest driver	
	+1	Magnitude of A in relation to others or over time	
	+1	A measure or change that would work	
	+0.5	Relative to A, or current trends	
	+0.5	Use of figures from table	
Bonus Question	What were th after the Runn	What were the ingredients in "Chemical Pollution" cocktail at the LUMES party after the Running Dinner?	
	+1	Gin and Tonic	