

## SIO 15 (FQ 2024) – Homework #9 Due December 3, 2024 5 pm

Maximum score: 20 points + 0.5 bonus

### **NO LATE SUBMISSION BEYOND TUESDAY MIDNIGHT POSSIBLE**

-2 point penalty for late submission (more than 30 min past due date), regardless of the reason.

Divide by 4 for contribution to total cumulative

### **ANSWERSHEET**

#### **Topics 23 - 25**

- 1) a) Provide the three most threatened types of live forms and the fraction of species affected, as of 2022.  
If a range is given, consider the higher number. (0.5 pt)  
b) For each of the three, discuss whether there was an increase in threatened species since 2000.  
(0.5 pt)  
c) Provide three ways how diseases can spread across the globe. (0.5 pt)  
d) Provide the two main sources of pollution that contributed to the Sahel drought in the 1970s-1980s. (0.5 pt)  
(2 points total)  
**a) plants (35-69%); invertebrates (1-57%); fishes (5-46%);**  
**b) plants: increase; invertebrates: increase; fishes: increase**  
**c) by dust storms; air travel; ship**  
**d) local slash-and-burn farming; coal burning in North America**
  
- 2) a) Provide four examples that emphasize the value of forests. (0.5 pt)  
b) For how long have humans removed pristine forests? (0.5 pt)  
c) How much of the original temperate rainforest remains today? (0.25 pt)  
d) How much of the original tropical rainforest remains today? (0.25 pt)  
(1.5 points total)  
**a) any 4 of the following: hold soil to the ground; regulated water supply to surrounding region; are part of the climate system; home to a rich variety of wildlife; major producer of oxygen**  
**-0.25 pt for “logging is especially damaging ...”**  
**b) for the last 8000 years**  
**c) 50%**  
**d) 43%**  
**-0.25 pt for any other number**
  
- 3) Work with the CO<sub>2</sub> emissions table on the class website:  
a) Not including the EU27 (consisting of 27 countries), but considering individual countries, which five countries are currently – as of 2022 – the top fossil CO<sub>2</sub> emitters. Numbers are not required but put them in the right order. (0.5 pt)  
b) Not including the EU27, but considering individual countries, which five countries were the top emitters in 1990? Numbers are not required but put them in the right order. (0.5 pt)  
c) Now including EU27, which five countries/areas are the top per capita emitters as of 2022? (0.5 pt)

d) World emissions: have they increased or decreased between 1970 and 2022? By how much in percent? (0.5 pt)

e) For 1990-2022, which five countries had a larger fractional increase than the world? (0.5 pt)  
(2.5 points total)

**a) China, U.S., India, Russia, Japan**

**-0.25 pt if one country is missing or countries are not in the correct order**

**b) U.S., China, Russia, Japan, Germany**

**-0.25 pt if one country is missing or countries are not in the correct order**

**c) Canada, Australia, U.S., Russia, China**

**-0.25 pt if one country is missing or countries are not in the correct order**

**d) increased; increased by 143%; also accepted: 243% as this is how the table presents the increase**

*NB: strictly speaking, the use of the word increase in the last column of the table is not correct. The numbers listed there do not represent the increase but the fraction of the current emissions compared to the 1990 value, i.e. if something increased by 100%, the value in the right column would be 200%.*

**e) China, India, Indonesia, Iran, Brazil**

**-0.25 pt if one country is missing or countries are not in the correct order**

4) a) What are the top three primary pollutants from fossil fuel burning? Include numbers with units.

Careful! Listing more than three will result in subtraction of points. (0.5 pt)

b) Which process causes acid rain in the eastern U.S.? Which process causes acid rain in southern California? (listing the gas alone is not enough here!) (0.5 pt)

c) Why are PM<sub>2.5</sub> particulates a greater health hazard than PM<sub>10</sub> particulates? (0.5 pt)

d) What range in the air quality index is considered 'good'? (0.25 pt)

e) Wildfires (not lastly from slash-and-burn farming) can cause AQI values in excess of 320. What is the corresponding air quality health concern? (0.25 pt)

(2 points total)

**a) Carbon Monoxide 49.1%; Sulfur Oxides 16.4%; Nitrogen Oxides 14.8%**

**-0.25 pt if more than 3 are listed**

**b) coal-burning power plants in northeast; traffic/combustion engines in SoCal**

**-0.25 pt if only SO<sub>2</sub> and NO<sub>2</sub> are listed; these are gases, not processes**

**c) because they can penetrate deeper into the lungs**

**d) 0 – 50 ppm (ok not to list the unit)**

**e) hazardous**

5) a) What are the two reasons why water is becoming increasingly scarce? (0.5 pt)

b) How did global water use change between 1900 and 1995? Between 1950 and 1995? How does this compare to the rate of population growth? (0.5 pt)

c) During recent beach cleanups, which fraction of collected debris came from recreational items? List the four items mentioned in the text. (0.5 pt)

d) Which fraction came from cigarette butts and filters? (0.25 pt)

e) What happens during coral bleaching? (0.5 pt)

f) What kind of temperature change (incl. trend, numbers and unit) triggers corals to bleach? (0.25 pt)

(2.5 points total)

a) population increase; climate change

-0.25 pt if one is missing

b) increased 6-fold; more than tripled; rate of increase is 2x as large as population growth

-0.25 pt if one is missing

c) 60%; fishing lines, nets, beach toys, food wrappers

-0.25 pt if one is missing

d) 29%

e) coral expel algae that live on them in symbiosis

-0.25 pt if answer too short, e.g. "they expel algae"

f) increase of 1-2°C

-0.25 pt if "increase" or "warming" is missing

6) Earthwatch 4 November 2024

a) A new UN report warns that global warming will exceed which temperature increase by the end of the century? (0.25 pt)

b) By how much did global emission increase between 2022 and 2023? Global emissions equivalent of what substance? (0.25 pt)

c) Follow the link: And open the UNEP State of the Climate 2024 Update. By how much was the January – September 2024 global mean surface temperature above the pre-industrial average? Which natural phenomenon contributed to the increased warming? So where does the long-term warming currently place? (0.75 pt)

d) How does the heat absorbed by the oceans compare to the world's total energy consumption? (0.25 pt)

e) How has the rate in sea level rise changed from the time period 1993-2002 to 2014-2023? In addition to the factor, also provide both rise rates. Include units. (0.5 pt)

(2 points total)

a) 3 deg C (also accepted: 5.4 deg F)

-0.25 pt if unit is missing

b) 1.3% CO<sub>2</sub>

-0.25 pt for incomplete answer

c) 1.54 deg C; El Niño; below 1.5 deg C

-0.25 pt if one answer missing;

-0.5 pt if two answers missing

d) 18 times greater

-0.25 pt of number or "greater" missing

e) doubled; 1993-2002: 2.13 mm/yr; 2014 – 2024: 4.77 mm/yr

-0.25 pt if any of the three infos is missing/incomplete

7) Earthwatch 4 November 2024

a) Since the 1980s, how has climate change affected the areas that suffer from extreme drought? (0.25 pt)

b) What is the fraction of the world that experiences extreme drought for at least three months? What was that fraction four decades ago? (0.5 pt)

c) In which areas was the increase most severe? Compared to the 1990s, how many more people faced food shortage last year? (0.5 pt)

d) Follow the link (you may have to VPN to UCSD to access the article). By how much did the heat-related mortality of people older than 65 years change, compared with the 1990s? What would the increase be without the temperature rise? (0.5 pt)

e) Heat exposure is also increasingly affecting which two human habits? (0.25 pt)

(2 points total)

**a) area has tripled**

**b) almost 1/3; 5%**

**c) South America, Middle East, Horn of Africa; 151 million**

**-0.25 pt if any one of the above is missing**

**d) 167%; 65%**

**-0.25 pt if one is missing**

**e) physical activity; sleep quality**

**-0.25 pt if one is missing**

8) Earthwatch 4 November 2024

a) What is so special about Mount Fuji's snow-free timing this year? When did records begin? (0.5 pt)

b) Between June and August, how far above normal were temperatures? (0.25 pt)

c) How far from Tokyo is the volcano? When did it last erupt? (0.5 pt)

d) Follow the link to Wikipedia: What type of climate does the summit have? What is the lowest recorded temperature there? (0.25 pt)

(1.5 points total)

**a) latest time in the year that mountain has been snow-free; 1894**

**-0.25 pt for partial answer**

**b) 3.1 deg F**

**-0.25 pt for missing unit**

**c) 60 mi; just over 300 years ago**

**-0.25 pt for partial answer**

**d) tundra climate; -38°C (also accepted: -36.4°F)**

**-0.25 pt missing unit/partial answer**

9) Newsclip 9 November 2024

a) In which country has smog sickened how many people? (0.5 pt)

b) Closures apply to which four public places? (0.5 pt)

c) The smog shrouded the capital of Punjab province. What is its name of this city, how many people live there? (0.25 pt)

Newsclip 16 November 2024 (relates to same topic)

d) How many people were sickened by this time? (0.25 pt)

e) Which two major cities were shut down? (0.25 pt)

f) This article cites a different number of residents in the capital: 11 million people. Go to Wikipedia and find this city (log the coordinates which you will need for #10). What is the number of residents there? (0.25 pt)

Newsclip 16 November 2024 (one down from the previous)

g) Cities in which two regions of the world emit the most heat-trapping gas? Which city is top? (0.25 pt)

h) This city alone emits more greenhouse gases than which two countries? (0.25 pt)  
(2.5 points total)

**a) Pakistan; tens of thousands of people**

**-0.25 pt for partial answer**

**b) public parks, zoos and museums, historical places, playgrounds**

**-0.25 pt if any one is missing**

**c) Lahore; 14 million**

**-0.25 pt for partial answer**

**d) nearly 2 million**

**e) Multan and Lahore**

**-0.25 pt if any one is missing**

**f) 13 million (also accepted: 13,004,135)**

**g) Asia and United States; Shanghai**

**-0.25 pt if any one is missing**

**h) Colombia; Norway**

**-0.25 pt if any one is missing**

10) Go to <https://earth.nullschool.net>; choose the date 11/9/24 12:00 UTC; find the location of 9c,f)

a) Choose the following: mode - particulates; overlay - PM2.5; find the location of 9c,f). What is the PM2.5 concentration? What is the PM10 concentration? (include units). (0.5 pt)

b) Given the table below: into which category would each of the two measurements fall? (0.5 pt)

c) In a new browser tab (you will still need the current one!) Go to Wikipedia and find the coordinates for Shanghai. In earth.nullschool, choose the following (keep date and time from above): mode – chem; overlay – CO2 (you will notice that the time switches to 13:30 UTC) What are the CO2 concentration? What are the CO, SO2 and NO2 concentrations? (include units) (0.5 pt)

d) Go back to CO2 and turn to the U.S.. Near which major city are concentrations the highest. What is the highest value? (it may be offshore). Also log CO, SO2 and NO2 (for each, try to find the highest value in the area even though the location may slightly change). (0.5 pt)

(2 points total)

**a) PM2.5 159  $\mu\text{g}/\text{m}^3$  (allowed range: 149 – 163); PM10 259  $\mu\text{g}/\text{m}^3$  (allowed range: 243 – 262)**

**-0.25 pt for missing units/one answer missing**

**b) PM2.5 – extremely poor; PM10 – extremely poor**

**-0.25 pt for missing units/one answer missing**

**c) CO2 429 ppmv (allowed range: 428 – 431); CO 273 ppbv (allowed range: 245 – 400); SO2 78.23  $\mu\text{g}/\text{m}^3$  (allowed range: 20-220); NO2 53.81 ppbw (allowed range: 37 – 68)**

**-0.25 pt for missing units/one answer missing**

**d) Los Angeles; CO2 477 ppmv (allowed range: 465 – 480); CO 1620 ppbv (allowed range: 1550-1650); SO2 11.97  $\mu\text{g}/\text{m}^3$  (allowed range: 11 – 12); NO2 40.67 ppbw (allowed range: 38-43)**

**-0.25 pt for missing units/one answer missing**

### European Air Quality Index for PM2.5 and PM10 (numbers in $\mu\text{g}/\text{m}^3$ )

(source: Wikipedia)

EU AQI	good	fair	moderate	poor	Very poor	Extremely poor
PM2.5	0-10	10-20	20-25	25-50	50-75	75-800
PM10	0-20	20-40	40-50	50-100	100-150	150-1200