Physics 140– Exam II
April 4, 2007
Prof. Karin M. Rabe

Your name sticker

with exam code ⇒

1. The exam will last until 4:00 p.m. All cell phones must be turned off. Use a #2 pencil to make entries on the answer sheet. Enter the following ID information now, before the exam starts.
2. In the section labelled NAME (Last, First, M.I.) enter your last name, then fill in the empty circle for a blank, then enter your first name, another blank, and finally your middle initial.
3. Under STUDENT # enter your 9-digit Identification Number.
4. Enter 140 under COURSE, and leave SEC blank.
5. Under CODE enter the exam code given above.
6. During the exam, you may use pencils, a calculator (not a cell phone) and your one-sided 8.5 inch x 11.0 inch information sheet. Detach the last page with the FIGURE and table of conversions for convenient reference during the exam.
7. There are 2 written (W1 and W2) and 18 multiple-choice questions (1-18) on the exam. For each multiple-choice question, mark only one answer on the answer sheet. There is no deduction of points for an incorrect answer, so even if you cannot work out the answer to a question, you should make an educated guess. At the end of the exam, hand in the multiple-choice answer sheet and the cover page of the exam with the answers to the two written questions. Retain the rest of the exam for future reference and study.
8. Before starting the exam, make sure that your copy contains all 20 questions (W1,W2, and 1-18). Raise your hand if this is not the case, and a proctor will help you. Also raise your hand during the exam if you have a question.
9. A proctor will check your name sticker and your student ID sometime during the exam. Please have them ready.

Useful Information

Be sure to quickly scan through all the questions in the exam before beginning in earnest. You may want to do the easy ones first. Some of the questions may be related to each other, so you may want to do them together. Don't assume that a longwinded question is necessarily a difficult one.

To convert a fraction into %, multiply by 100. For example, 1/5 = (1/5)100% = 20%

If a quantity x changes to y, then the percentage change is $100(y-x)/x$ %. For example, if the price of a gizmo was 20 and became 25, the change is (100(25-20)/20)% = 25%

1. Which of the following do NOT give information about past climate before the year 1500?

   a) tree rings b) ice cores c) records of thermometer readings
   d) fossils e) corals

2. REFER TO THE FIGURE! Judging from the graph, the approximate average time between from the end of one ice age to the end of the next is

   a) 110,000 years b) 10,000 years c) 18,000 years
   d) impossible to judge e) 1,100 years

3. Which of the following statements is FALSE?

   a) Emission of CO_2 from burning fossil fuels is the only human activity that influences global average temperature.
   b) Absorption of CO_2 by the ocean has measurably changed its acidity.
   c) The measured sea level rise in the 20th century was about 8 inches.
   d) The measured change in global average temperature in the 20th century was about 1.4°F.
   e) The effects of carbon dioxide emissions are global, extending beyond the country or region that produced them.

4. The rate of thermal radiation energy loss from a particular black spherical object at room temperature is 0.1 W. The rate of thermal radiation energy loss from a second, otherwise identical, black spherical object with twice the surface area of the first object is

   a) 0.1 W b) 0.05 W c) 0.2 W d) 0.4 W
   e) 2 W

5. Which of the following statements is FALSE?

   a) Adding methane to the atmosphere adds to the greenhouse effect about 20 times more than an equal number of molecules of CO_2
   b) Dust and soot from industrial air pollution generally have a cooling effect on the atmosphere.
   c) The atmosphere is transparent to visible light.
   d) The rate of energy loss from the earth due to thermal radiation increases as its temperature increases.
   e) Greenhouse gases cause global warming by absorbing and reradiating heat from ultraviolet radiation.

6. REFER TO THE FIGURE! The highest temperature recorded in the Vostok ice core was for

   a) 325,000 years ago
   b) 275,000 years ago
   c) 325 million years ago
   d) the present
   e) 350,000 years ago

7. REFER TO THE FIGURE! The largest rapid upward temperature swing recorded in the Vostok ice core was an increase in temperature by

   a) 110 °F b) 10,000 years c) 82 °F d) 11 °F
   e) 22 °F

8. If sea level measured at a particular location increased by 7.5 cm in 50 years, what would be the average annual rate of increase over that period?

   a) 7.5 cm b) 7.5 mm c) 0.75 mm d) 15 mm
   e) 1.5 mm

9. REFER TO THE FIGURE! The lowest CO_2 concentration recorded in the Vostok ice core was

   a) 282 ppm b) -84°F c) 382 ppm d) 182 ppm
   e) 84 ppm

10. Which of the following factors did NOT contribute to 20th century change in sea level as measured at New Orleans?

a) warming of the surface layer of the ocean
b) melting of Arctic sea ice
c) melting of the Greenland ice sheet
d) subsidence of the underlying land
e) melting of the glaciers in the mountains of Europe

11. Which of the following statements is FALSE?

a) Natural ecosystems stressed by other factors, such as air and water pollution, are more vulnerable to climate change.
b) The rapid rate of anticipated global warming tends to increase the severity of its negative impacts.
c) Poorer developing nations are more vulnerable to damage from increases in sea level than wealthier industrialized nations.
d) Global warming could have positive impacts in some areas.
e) A global temperature increase or decrease of one degree C is too small to have significant impacts.

12. A research team is drilling an ice core in Greenland. If the average layer thickness is 6.25 cm, how deep do they need to drill the core in order to reach ice that is 40,000 years old?

a) 2500 cm b) 6400 m c) 6400 cm d) 2500 m
e) 3000 m

13. REFER TO THE FIGURE! The average annual increase in CO_2 concentration from 18,000 years ago to the present is

a) 0.01 ppm/year
b) 0.001 ppm/year
c) 0.021 ppm/year
d) 200 ppm/year
e) 100 ppm/year

14. Which of the following statements is FALSE?

a) The climate could change abruptly if ocean circulation patterns were disrupted.
b) Even if human emission of greenhouse gases completely ceased today, the global average temperature would continue to increase for a while.
c) Positive climate feedbacks can amplify the effects of human activity on the climate.
d) Natural climate change is always gradual.
e) It is impossible to make projections of future climate without making assumptions about future human behavior.

15. In 2005, it was estimated that the volume of ice added to the Greenland ice sheet by snow accumulation was 96 cubic kilometers, while the loss due to ice melt and runoff was 154 cubic kilometers and the loss due to glacier ice breaking off into the ocean was 162 cubic kilometers. What was the net change in the volume of ice in the Greenland ice sheet that year?

a) increased by 96 cubic kilometers
b) decreased by 220 cubic kilometers
c) increased by 220 cubic kilometers
d) decreased by 316 cubic kilometers
e) stayed the same

16. You are asked to design a tank for which the water level will rise by 5 inches when 200 gallons of water are added to the tank at constant temperature. What should the base area of the tank be? (Recall 1 gallon = 231 in^3)

a) 64.2 ft b) 770 ft^2 c) 64.2 ft^2 d) 770 ft
e) 770 in^2

17. The atmospheric concentration of CO_2 is projected to reach 760 ppm before 2050. This means that of all molecules in the atmosphere, the percentage that are CO_2 molecules will be

a) 0.000760% b) 76% c) 7.6% d) 0.0760%
e) 0.00760%

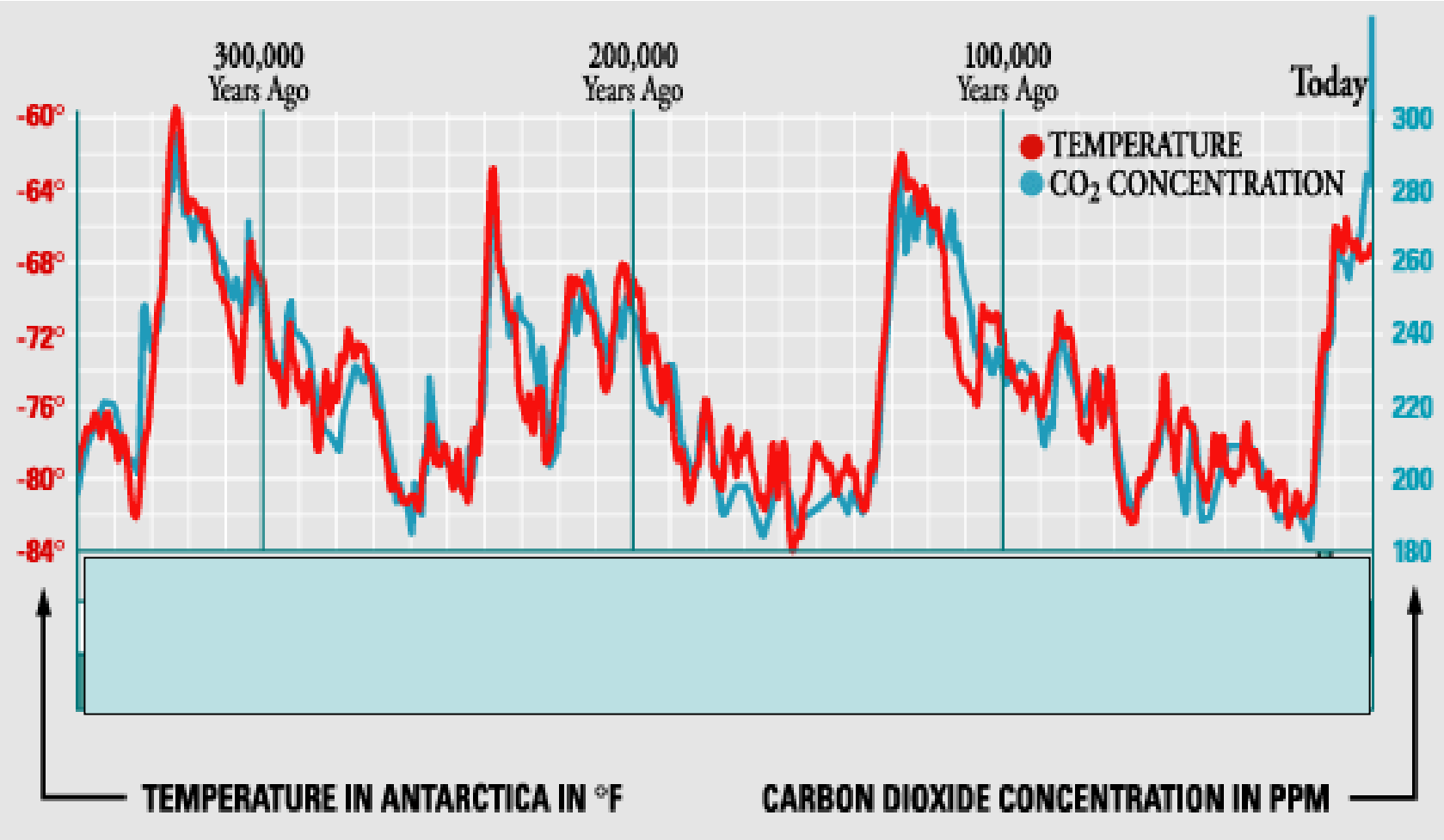
18. REFER TO THE FIGURE! From the data in the figure, one can conclude that in the period recorded by the ice core

a) natural variability in the climate is small
b) CO_2 concentration and temperature are unrelated
c) it has never been warmer in Antarctica than it is at present
d) the CO_2 concentration has never been higher than at present

e) the changes in temperature were caused by the changes in CO_2

W1: (5 pts) Describe briefly two current impacts of climate change in the Arctic.

W2: (5 pts) Describe briefly a piece of evidence that a significant part of the warming observed since the early twentieth century is anthropogenic.



This graph shows average annual temperature and atmospheric CO_2 concentration measured in ice cores drilled in Vostok, Antarctica, near the South Pole. The temperature scale is on the left and CO_2 concentration scale is on the right. The present-day concentration of CO_2, 380 ppm, is off the top of the graph.