

## ATMO 445/545 MID-TERM EXAM - GROUND RULES

THERE ARE THREE PAGES OF QUESTIONS.

PAGE 1 AND PAGE 2 WILL EACH BE WORTH 40pts.

PAGE 3 IS WORTH 20 pts.

### DISTRIBUTION:

PAGE 1 - GRADUATES CHOOSE 10 of 12 AT 4pts EACH.  
SENIORS CHOOSE 8 of 12 AT 5pts EACH.

PAGE 2 - GRADUATES CHOOSE 5 of 7 AT 8pts EACH.  
SENIORS CHOOSE 4 of 7 AT 10pts EACH.

PAGE 3 - ONE problem, which EVERYONE MUST DO FOR 20pts.

IGNORE PROBLEM #s - MY ORIGINAL EXAM HAD MANY MORE QUESTIONS.

You will need:

Scientific Calculator

PROBLEM SET #2

YOUR TEXTBOOK

DO ALL ANSWERS ON SEPARATE PAPER.

IF CALCULATIONS ARE INVOLVED, SHOW THEM.

ham 03-07-03

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1. RADAR IS AN ACRONYM FOR ?
2. Explain how a "BISTATIC" RADAR FUNCTIONS.
3. What is an "ISOTROPIC" ANTENNA ?
4. What is a PPI display ?
5. THE WIDTH OF THE MAIN BEAM, OR LOBE, OF A RADAR IS DEFINED AS ?
6. RESTATE # 5 IN DECIBELS.
7. THE VALUE OF THE GAIN USED IN Eq. 4.3 is in ?
8. Why do weather radars on aircraft tend to have short wavelengths ?
9. The refractive index of the atmosphere below 15-20 km MSL depends on ?
10. Standard linear refraction means
11. For conditions of subrefraction what is the speed of light at the top of the radar beam relative to that AT THE TOP OF THE EXACT SAME beam experiencing standard refraction ?
12. Explain what ducting means.

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- 13 - If a RADAR, beam width of 1 degree, is operating in a VCP mode that obtains 12 different elevation tilts of data in 6 minutes, AND its PRF is  $1200 \text{ s}^{-1}$ , HOW MANY PULSES ARE TRANSMITTED DURING EACH 1 degree radial?
- 14 - Explain why theoretical estimates of the power that should be returned from distributed Rayleigh scatterers were too high prior to the work of Probert-Jones. His correction to the radar equation reduces the calculated  $P_r$  by how many decibels?
- 20 - If you were going to design a "STEALTH" AIRCRAFT, I.E., ONE that could only be detected by RADAR AT VERY SHORT RANGES, what would your design need to achieve?
- 21 - Explain why RADAR REFLECTIVITY FACTOR,  $Z$ , is said to be AN ACTUAL PHYSICAL ATTRIBUTE OF A GIVEN WEATHER ECHO - CONTRAST WITH  $\eta$  radar reflectivity.
- 22 - Explain THE "Doppler dilemma" AND ILLUSTRATE IT QUANTITATIVELY.
- 23 - SHOW NUMERICALLY THAT, FOR UNAMBIGUOUS RADIAL VELOCITIES, AN OUTBOUND TARGET MUST PRODUCE A POSITIVE PHASE SHIFT.
- 29 - Explain AND ILLUSTRATE WHAT A "RANGE ALIASED" ECHO IS. HOW CAN IMPACTS OF RANGE ALIASING BE REDUCED?

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30 - REFER TO PROBLEM 4, PROBLEM SET 2, AND USE THE LOGARITHMIC FORM OF THE RADAR EQUATION, i.e., eq. 5.19

Using the value we calculated for  $C_3 = 58$  for the 3-cm  $\lambda$  variant of our radar, now calculate the power returned from a range of 100 km if:

- $\gamma$  for a unit volume in the beam is  $1 \times 10^1 \text{ mm}^6/\text{m}^3$
- $\gamma$  for a unit volume in the beam is  $1 \times 10^5 \text{ mm}^6/\text{m}^3$

IF ALL the TARGETS from a) and b) were present within the unit volume at 100 km range, what would be  $Z$ ?

Discuss the implications of your calculations.