

31 Jan 2003
ham

PROBLEM SET 1 Atmo 445/545 Due Feb 5

You will have to study the links
on the class web page

1- ANSWER THE FOLLOWING QUESTIONS FOR
THE NATIONAL WEATHER SERVICE WSR-88D
WEATHER RADAR

a) WHAT IS THE POWER OUTPUT
AT THE KLYSTRON _____ KW

b) WHAT IS THE POWER LOSS FROM THE
KLYSTRON TO THE ANTENNA FEED _____ KW
_____ dB

c) IF THE FIRST SIDE LOBE, RELATIVE TO
THE ANTENNA POWER TRANSMITTED, IS
-29 dB THEN THE POWER IN SIDE LOBE IS _____

d) CALCULATE THE SHORTEST AND LONGEST
UNAMBIGUOUS RANGES IF THE RADAR IS
OPERATING IN SHORT PULSE MODE
_____ Km to _____ Km

NOTE: YOU'LL HAVE TO LOOK AHEAD TO
PP 105 & 106 IN THE TEXT

e) If the pulse duration is $2 \mu\text{s}$ then the pulse length is _____ m

f) If the pulse duration is $2 \mu\text{s}$ AND the PRF is 500 Hz , calculate the following -
 ASSUME THE ANTENNA ROTATION RATE IS 1 RPM (REVOLUTION PER MINUTE) -

The amount of time THE ANTENNA IS TRANSMITTING POWER during 1 revolution _____ S

The amount of time THE ANTENNA IS RECEIVING POWER DURING 1 REVOLUTION _____ S

2 - CONSIDER A POLICE TRAFFIC RADAR GUN, AS TYPIFIED BY THE ASTROPRODUKTS "PHANTOM" RADAR

a) POWER TRANSMITTED RANGE IS _____ to _____ $\frac{\text{m}^2}{\text{MW}}$

b) BEAM WIDTH IS _____ degrees

c) Pulse LENGTH is _____ m

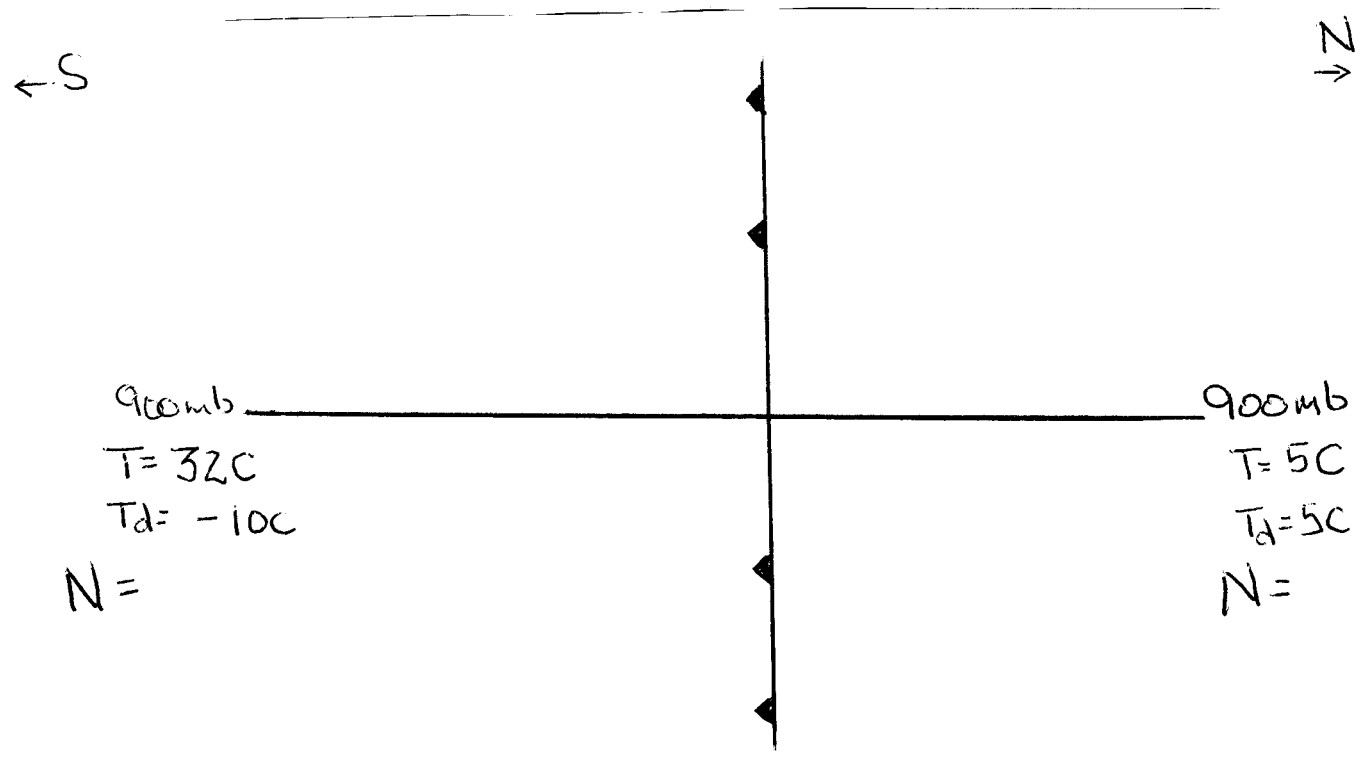
d) MAXIMUM RANGE AT WHICH THE BEAM DIAMETER IS \leq THE WIDTH OF AN INTERSTATE TRAFFIC LANE (CONSIDER A TRAFFIC LANE TO BE 5m wide)

_____ m

e) A HIGHWAY PATROL OFFICER "CLOCKS" you speeding at 90mph along I-10 NW of TUCSON. SHE STATES THAT THE READING IS COMPLETELY ACCURATE. DESCRIBE ALL THE CONDITIONS THAT MUST BE MET FOR HER TO MAKE THIS STATEMENT.

3- BEAM PROPAGATION AND ATMOSPHERIC REFRACTION

a) A VERY STRONG COLD FRONT IS APPROACHING (MOVING AWAY FROM) A WSR88-D RADAR AT 20 m/s. THE RADAR IS OPERATING IN VCP-11. THE CENTER OF ONE OF THE TRANSMITTED BEAMS INTERSECTS THE FRONT AT 900 MB AT ANGLE OF 14 DEGREES RELATIVE TO HORIZONTAL. WHAT IS THE ANGLE OF REFRACTION FOR THE FRONT APPROACHING _____ DEGREES AND FOR THE FRONT MOVING AWAY _____ DEGREES?



SKETCH, IN RED, ONE OF YOUR ANSWERS ON THE ABOVE DIAGRAM. CONSIDER THE FRONT TO BE A SINGULAR, VERTICAL DISCONTINUITY WITH THERMODYNAMIC CONDITIONS ON EITHER SIDE AS INDICATED ON DIAGRAM.

b) CONSIDER JOE FLETCHER'S ACCOUNT OF FLYING OVER THE OCEAN "LOOKING" FOR A RESEARCH RADAR'S BEAM IN HIS PAPER ON THE HISTORY OF RADAR. IF THAT RADAR BEAM WERE COMPLETELY TRAPPED (OR "DUCTED") AT AND BELOW 100m MSL, THE TEMPERATURE AT 100m MUST HAVE BEEN AT LEAST _____ C.

OTHER CONDITIONS OF IMPORTANCE WERE:

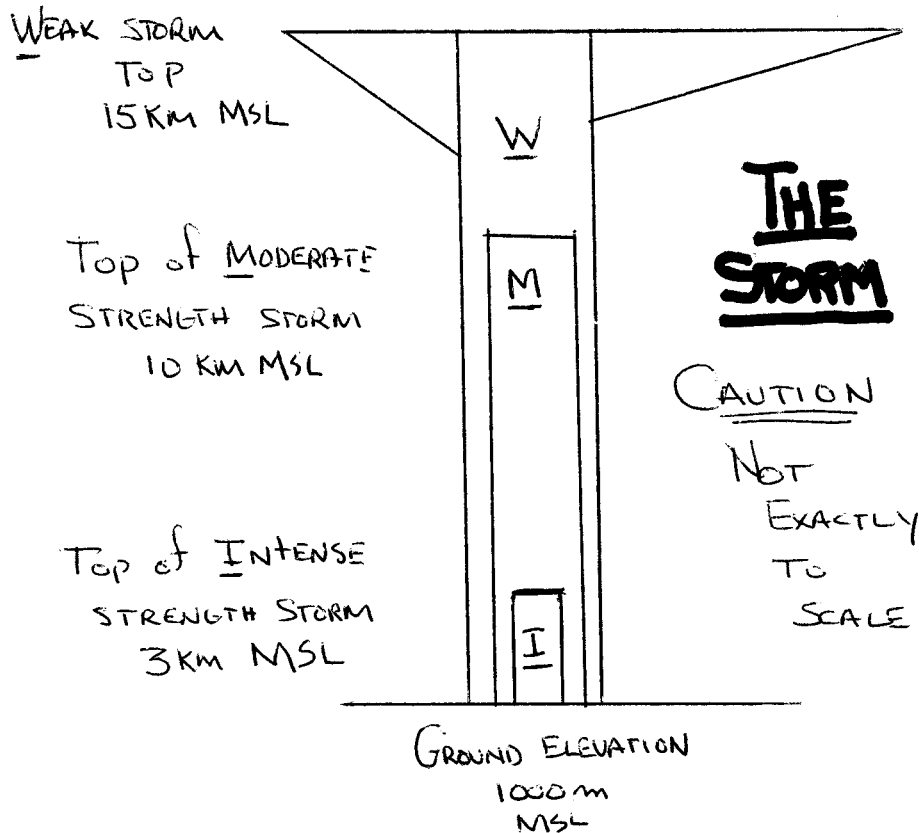
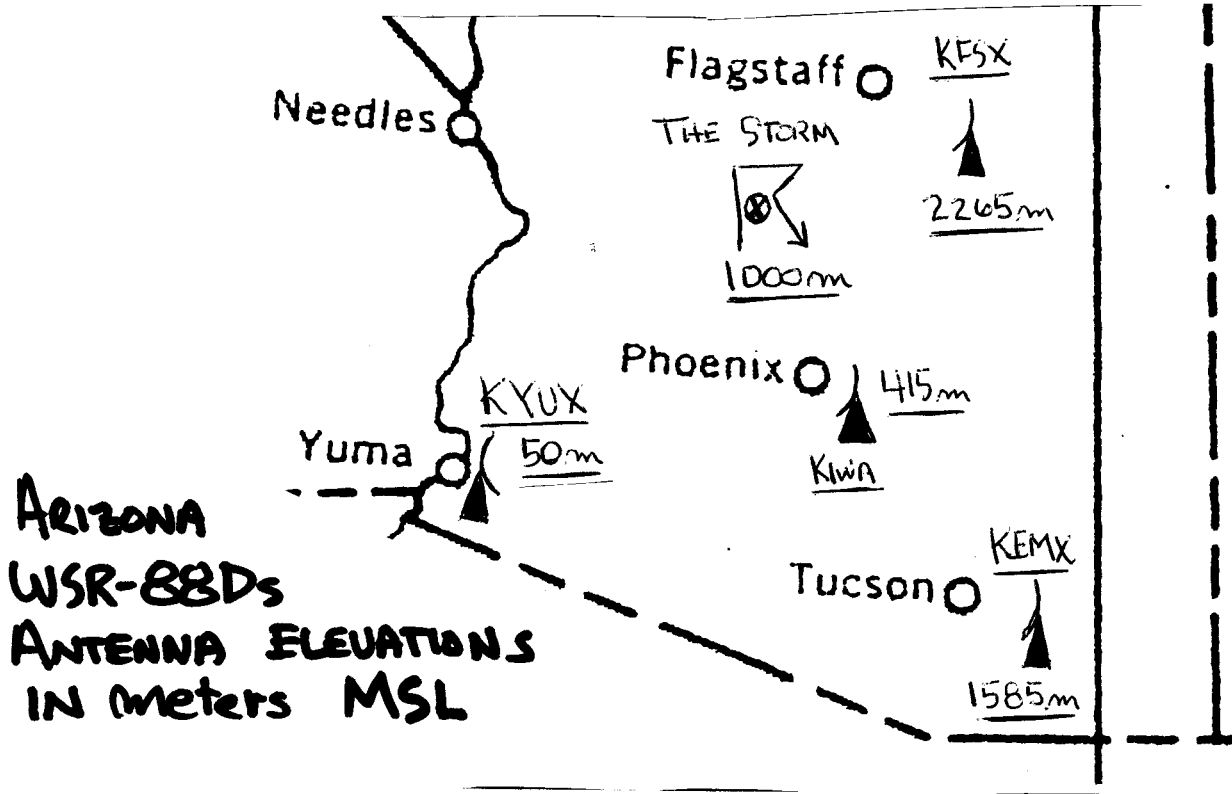
WARM, DRY AIR WAS BLOWING FROM THE LAND OVER THE OCEAN, WHICH HAD AN SST OF 10C.

THE AIR AT THE SEA SURFACE HAD $T = 10C$ AND $RH = 100\%$.

THE AIR AT 100m HAD A MIXING RATIO OF 6g/kg.

SEA LEVEL PRESSURE WAS 1000mb AND PRESSURE DECREASED 1mb/10m WITH HEIGHT.

4 Use this map AND THE STORM DRAWING TO DETERMINE ANSWERS FOR THIS QUESTION.



OTHER DETAILS

THE STORM IS LOCATED FROM EACH RADAR AT RANGE OF: KFSX 90km KIWA 90 km KYUX 255 km

KEMX 310 km KFSX IS OPERATING IN VCP11

KIWA IS OPERATING IN VCP21

RADARS CAN "DETECT" STORM ECHO IF AT LEAST HALF THE BEAM IS FILLED BY STORM. RADARS DETECT INTENSITY LEVELS ONLY IF ENTIRE BEAM FILLED BY THAT INTENSITY OF STORM. "HEIGHTS" OF ALL STORM FEATURES DETERMINED BY HEIGHTS OF RADAR BEAM CENTERS. ASSUME "STANDARD" REFRACTION. ARL = HEIGHT ABOVE RADAR ANTENNA ELEVATION
AGL = HEIGHT ABOVE GROUND SURFACE AT STORM LOCATION.

DETERMINE THE FOLLOWING
KIWA KFSX

STORM BASE	_____ mARL	_____ mAGL	_____ mARL	_____ mAGL
STORM TOP	_____ mARL	_____ mAGL	_____ mARL	_____ mAGL
MAX STORM STRENGTH	_____		_____	

Note: STORM "BASE" is lowest height of radar detected
STORM ECHO
STORM "TOP" is highest height of radar detected
STORM ECHO

BOUNDARY CONDITIONS

INDIVIDUAL WORK EFFORTS

ALL CALCULATION AND WORK PAGES MUST,
AS IN MUST, BE ATTACHED TO

YOUR ANSWER SHEETS

PROBLEMS DUE AT START OF CLASS ON FEB 5

GRADING POINTS

GRADUATE STUDENTS - 100 POINTS, 25 PER QUESTION

UNDERGRADUATES - 100 POINTS, 30 FOR QUESTIONS

1 and 2, 40 FOR EITHER

QUESTION 3 OR 4, TAKE YOUR
PICK