



University College Dublin  
An Coláiste Ollscoile, Baile Átha Cliath

**SEMESTER I EXAMINATION 2012/2013**

**ACM 40500**

**Synoptic Meteorology I**

External examiner: Professor Peter A Clark

Head of School: Dr Patrick Murphy

Lecturer: Professor Peter Lynch\*

**Time Allowed: 2 hours**

**Instructions for Candidates**

Answer **all four (4)** questions.

All questions carry equal marks. Total: 80 marks.

**Instructions for Invigilators**

Non-programmable calculators may be used during this examination.

## Question 1 (20 marks)

(a) (10 marks) Describe the construction of a tephigram chart: state the variables used to define the principal axes, and list the secondary process lines plotted on the chart. What is the rationale for the orientation of the principal axes?

(b) (10 marks) In Figure 1, the tephigram for Valentia Observatory for 00 UTC on Tuesday 30 October 2012 is shown. Considering this chart, deduce the following information

1. Temperature at 500hPa.
2. Wind direction and speed at 300hPa.
3. Height of inversion in the lower troposphere.
4. Estimate of total cloud cover. Type of cloud.
5. Wet bulb potential temperature at the tropopause.

[A colour version of Fig. 1 will be provided.]

## Question 2 (20 marks)

(a) (10 marks) Write a description of the origin, development and evolution of a typical mid-latitude frontal depression. Assume that, at an initial time, there are two air masses separated by a broad zonally oriented transition region. Describe the stages of development of an initial disturbance, in synoptic terms but making reference to relevant concepts from dynamical meteorology.

(b) (10 marks) Table 1 (on page 4) shows a template for the pattern of changes in various atmospheric variables associated with the passage of a warm front. The following variables are given: wind speed and direction, dew point, pressure, temperature, cloud cover, visibility and weather.

Copy the table to your answer book and complete it, giving the generic behaviour of each variable as the front approaches, as it passes and after the frontal passage. For each box, only a brief summary, of no more than about six words, is required.

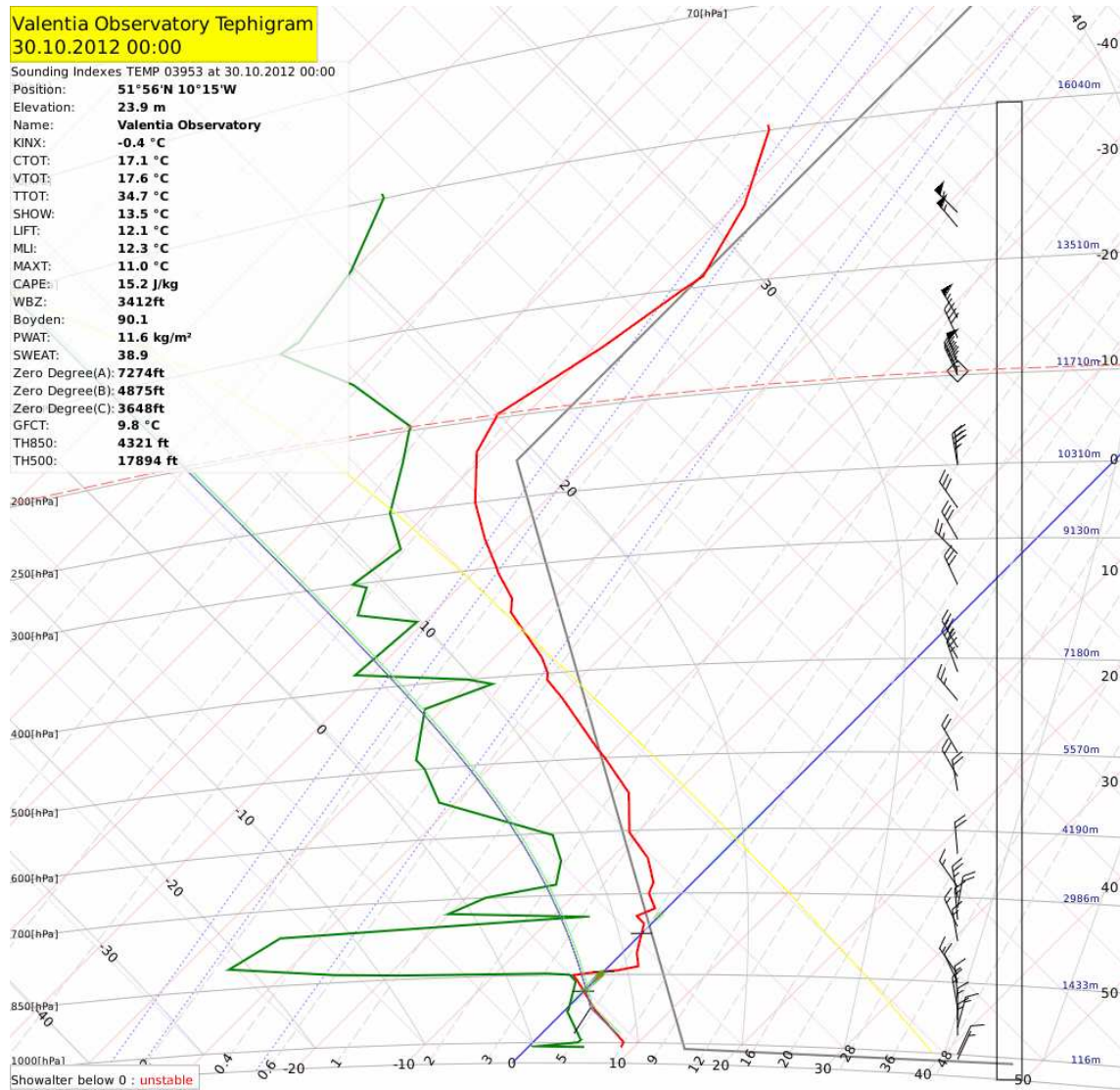


Figure 1: Tephigram for Valentia Observatory for 00 UTC, 30 October 2012.

Table 1: Passage of Warm Front

	<i>Before front</i>	<i>At front</i>	<i>After front</i>
<i>Wind Direction and Speed</i>			
<i>Dew Point</i>			
<i>Pressure</i>			
<i>Temperature</i>			
<i>Cloud</i>			
<i>Visibility</i>			
<i>Weather</i>			

### Question 3 (20 marks)

- (a) (5 marks) Explain how the centrifugal effect modifies the balance between the Coriolis and pressure gradient forces in an anticyclonic flow. How does the resulting 'gradient balance' compare to geostrophic balance?
- (b) (5 marks) Consider a geopotential field in northern mid-latitudes that decreases linearly with latitude and varies sinusoidally with longitude. Sketch the height contours and, assuming gradient balance, indicate regions where curvature effects result in maximum winds.
- (c) (5 marks) Considering anticyclonic flow, describe how frictional effects modify the geostrophic balance, and list some synoptic consequences of this.
- (d) (5 marks) Contrast the typical weather associated with anticyclonic conditions in Ireland in winter and summer.

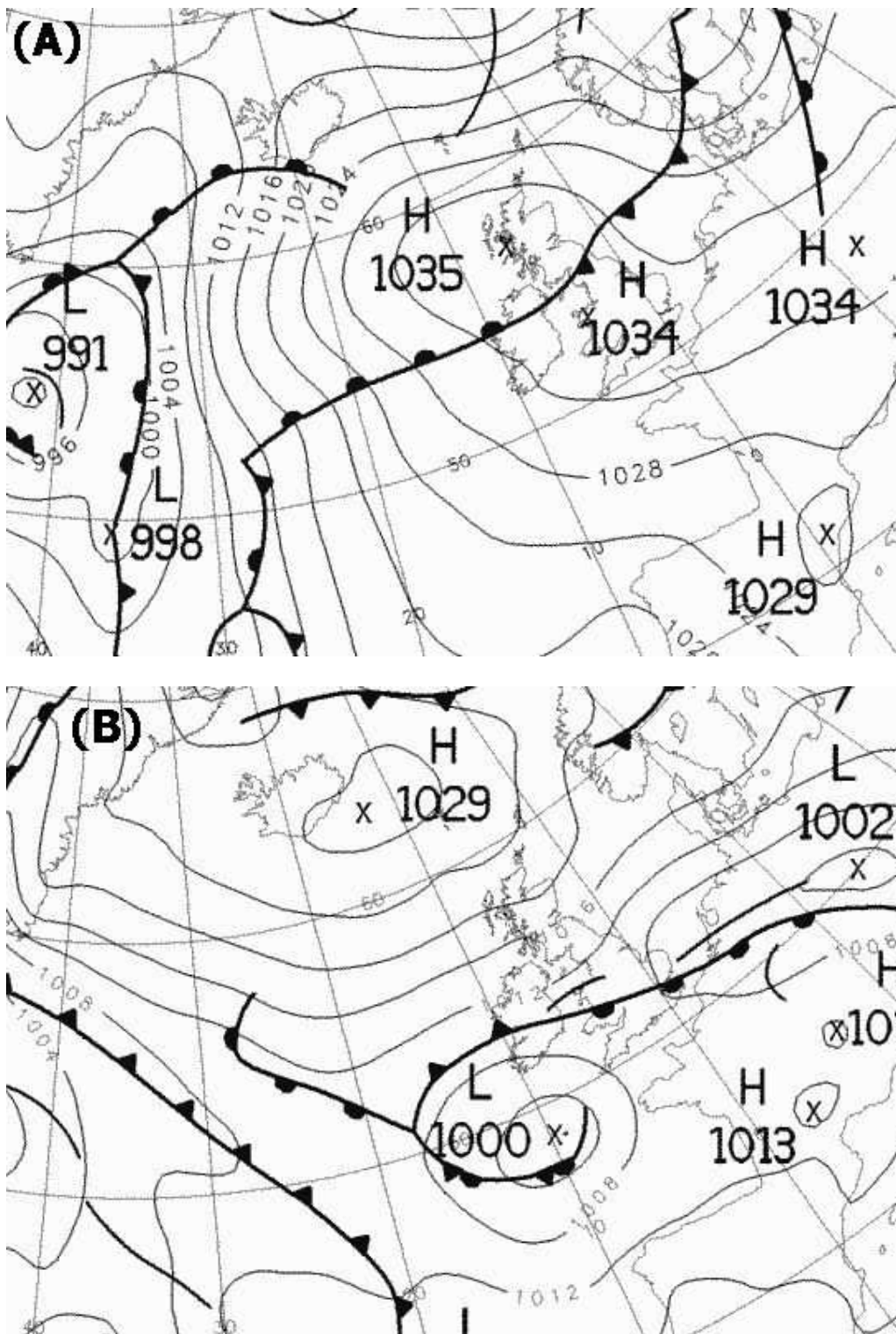


Figure 2: Synoptic charts (A) and (B).

## Question 4 (20 marks)

In Figure 2, two synoptic charts are shown, labelled (A) and (B). In each case, describe the synoptic situation in Ireland.

For each of the two charts, write a summary in a form suitable for a radio weather bulletin. Using only the information in the chart, include the following details:

- (a) General description of the pressure pattern
- (b) Expected wind direction or directions
- (c) Temperature, relative to the seasonal average (assume that Chart (A) is for summer and Chart (B) is for winter).
- (d) Likelihood of occurrence of precipitation
- (e) Any other expected weather phenomena (fog, thunder, etc.).

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