University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

SEMESTER I EXAMINATION 2010/2011

ACM 40500

Synoptic Meteorology I

External examiner: Professor Peter A Clark

Head of School: Professor Mícheál Ó Searcóid

Lecturer: Professor Peter Lynch*

Time Allowed: 2 hours

Instructions for Candidates

Answer **three (3)** questions.
All questions carry equal marks.
Total: 75 marks.

Instructions for Invigilators

Non-programmable calculators may be used during this examination.

Question 1 (25 marks)

In Figure 1, synoptic reports for seven Irish weather stations, valid at 1200Z, 6 November 2010 are given.

(a) (20 marks) From the synoptic reports, extract and supply the following:

(i) Temperature and dew point at Cork Airport
(ii) Mean sea level pressure at Valentia Observatory
(iii) Wind direction and speed at Shannon Airport
(iv) Visibility at Casement Aerodrome
(v) Pressure characteristic and tendency at Dublin Airport
(vi) Total cloud and height of cloud base at Dublin Airport
(vii) Rainfall over the previous 6 hours at Mullingar
(viii) Present weather at Connaught Airport

(b) (5 marks) Using the conventional Station Circle symbols, plot the weather conditions at Valentia Observatory and at Dublin Airport.

Time interval: from 11/06/2010 11:30 to 11/06/2010 12:30 UTC

SYNOPS from 03953, Valentia Observatory (Ireland) | 51-56N | 010-15W | 9 m

SM 06/11/2010 12:00-> AAXX 06121 03953 11582 33104 10105 20045 30184 40221 58010 69901 70181 83802 333 82825 83640 92438=

SYNOPS from 03955, Cork Airport (Ireland) | 51-51N | 008-29W | 153 m

SM 06/11/2010 12:00-> AAXX 06121 03955 11458 73108 10091 20068 30011 40209 57012 60011 78081 878/2 333 83713 87818 85075=

SYNOPS from 03962, Shannon Airport (Ireland) | 52-42N | 008-55W | 14 m

SM 06/11/2010 12:00-> AAXX 06121 03962 11358 62305 10098 20082 30171 40195 57020 69901 78082 8533/ 333 81708 83918 85643=

SYNOPS from 03967, Casement Aerodrome (Ireland) | 53-18N | 006-26W | 97 m

SM 06/11/2010 12:00-> AAXX 06121 03967 11465 62305 10069 20057 30069 40184 58017 69901 71011 8167/ 333 81710 86462=

SYNOPS from 03969, Dublin Airport (Ireland) | 53-26N | 006-15W | 68 m

SM 06/11/2010 12:00-> AAXX 06121 03969 11275 72405 10058 20056 30079 40184 58013 69901 70241 81632 333 81705 85362 86075=

SYNOPS from 03971, Mullingar (Ireland) | 53-32N | 007-22W | 101 m

SM 06/11/2010 12:00-> AAXX 06121 03971 17568 /2203 10060 20051 30058 40182 57018 69941 76163 87/// 333 81/27 85/38 87/47=

SYNOPS from 03973, Connaught Airport (Ireland) | 53-54N | 008-49W | 203 m

SM 06/11/2010 12:00-> AAXX 06121 03973 11378 72303 10058 20051 39924 40182 57020 60021 78081 8633/ 333 81706 83916=

Figure 1. Synoptic reports for 1200Z, 6 November 2010 for seven Irish stations

Question 2 (25 marks)

A tephigram with temperature and dew point is shown in Figure 2.

(a) (18 marks) Copy the table below into your answer book. Using the tephigram, complete the table. Specify units in every case.

(b) (4 marks) Give the value of pressure at the freezing level.

(c) (3 marks) Comment on the likely weather conditions, in particular on the probable state of the sky, based on the tephigram.

Parameter		1000 hPa	850 hPa	500 hPa
Temperature	T			
Dew point	T_d			
Wet bulb temperature	T_w			
Wet bulb potential temperature	θ_w			
Potential temperature	θ			
Equivalent potential temperature	θ_e			
Humidity Mixing Ratio	r			
Saturated Humidity Mixing Ratio	r_s			
Relative Humidity	RH			

Table: to be copied to answer book and completed.

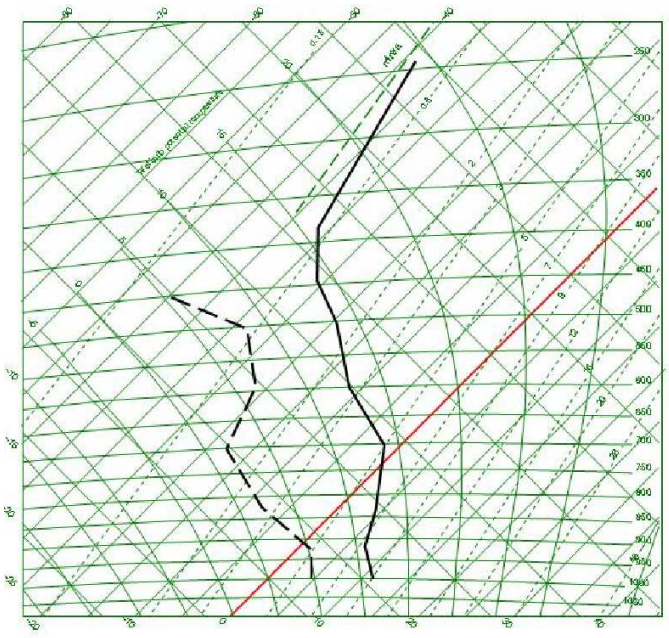

Figure 2 (A larger colour version of the tephigram will be provided).

Question 3 (25 marks)

In Figure 3 (a), (b) and (c) three synoptic charts are shown: an analysis and 12 hour and 24 hour forecasts based on it.

(a) (5 marks) Describe the general synoptic situation at the analysis time, on the basis of Fig. 3(a) (two or three sentences will suffice).

(b) (10 marks) Describe the probable evolution of the weather in Dublin over the 24 hour period, assuming the prognostic charts to be accurate.

(c) (10 marks) On the basis of the information in the charts, and estimating the wind force from the charts, write text suitable for the shipping forecast for the following sea areas:

(i) Dogger

(ii) Rockall

(iii) Faeroes

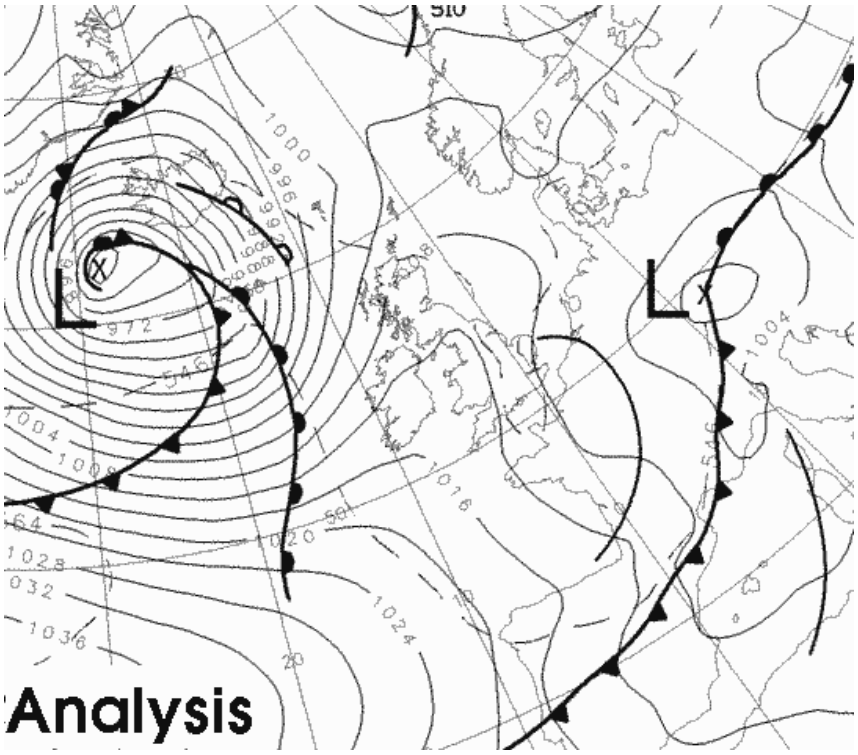

Figure 3(a). Analysis for midday today.

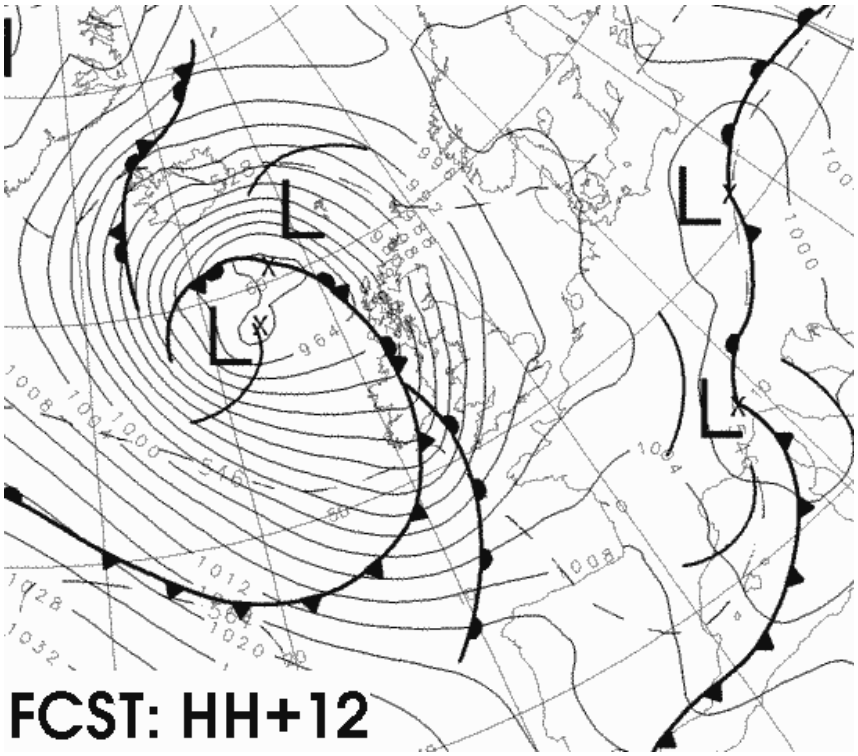

Figure 3(b). 12 hour forecast for midnight tonight.

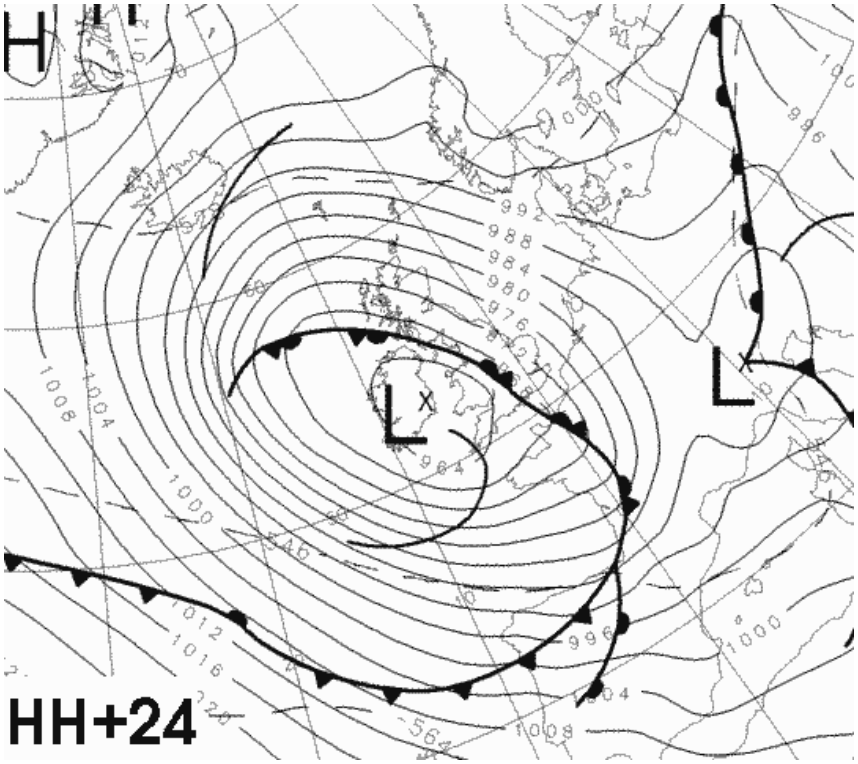

Figure 3(c). 24 hour forecast for midday tomorrow.

Question 4 (25 marks)

Two air masses, of uniform temperature T_1 and T_2, are moving with constant velocity V_1 and V_2 respectively, parallel to the (sloping) plane frontal surface separating them, with no along-front variations.

(a) (15 marks) Show, assuming geostrophic flow and making the Boussinesq approximation, that the angle of slope ε of the frontal surface is given by

$$\tan\varepsilon = \frac{f\bar{T}}{g}\frac{V_1 - V_2}{T_1 - T_2}$$

where $\bar{T} = (T_1 + T_2)/2$. State any further approximations or assumptions that you make.

(b) (10 marks) Calculate the frontal slope assuming that the mean temperature is $\bar{T} = 280\,\mathrm{K}$, the Coriolis parameter $f = 10^{-4}\,\mathrm{s}^{-1}$, $g = 10\,\mathrm{m\,s}^{-2}$, the difference in windspeed across the front is $\Delta V = 12\,\mathrm{m\,s}^{-1}$ and the difference in temperature is $\Delta T = 4\,\mathrm{K}$.

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