Geo Factsheet

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DEPRESSIONS

Introduction

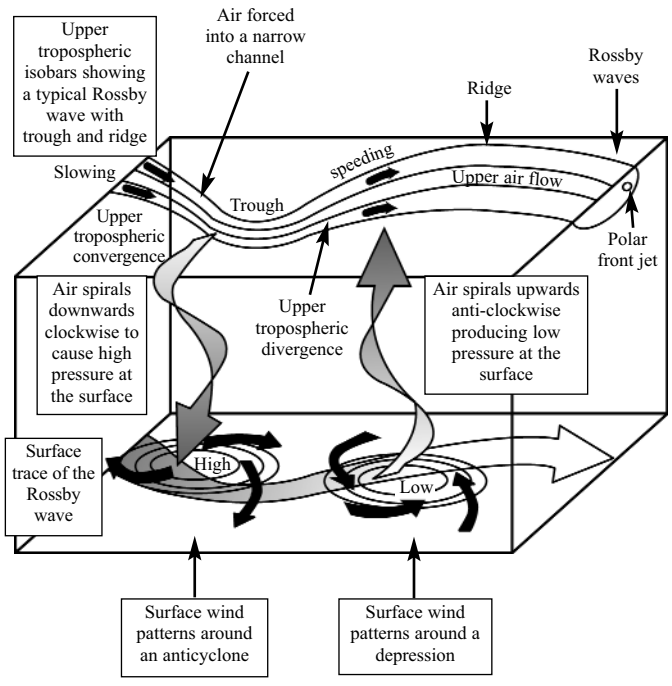
Depressions are low pressure systems. In mid latitudes such as the UK they occur when pronounced Rossby waves lead to a strong jet stream in the troposphere. The strong jet generates marked activity along the **polar front**. Depressions begin to form when a tropical air mass meets a polar air mass, to form a vortex of anticlockwise swirling air.

Fact Box

- *Every year on average, mid latitude areas such as the UK experience about 50-60 depressions.*
- *For 15-20% of the year the cyclonic weather type prevails (one of Lamb's seven weather types).*
- *On average each depression lasts from 3-5 days from formation to occlusion and decay (life cycle).*
- *The combination of changes over time combined with rapid movement leads to a pattern of rapidly changing weather, which nevertheless follows a discernible sequence.*

Both the development and movement of low pressure systems are controlled by the polar front jet stream. The rate the air is sucked upwards *(Fig. 1)* determines how low the surface pressure is (a very marked low produces a very deep depression with tightly packed isobars and very strong winds). The speed of the jet stream within the upper air westerlies determines the rate of movement (passage) of the depression.

Fig. 1 The development and movement of low pressure systems.

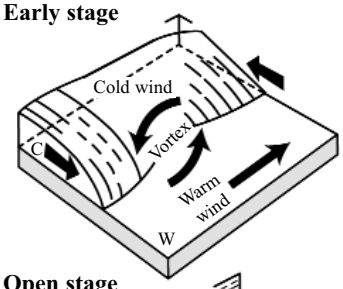


Development

Fig. 2 shows the pattern of development, maturation and decay of the system (the depression and its associated front) known as a life cycle. The stage the depression is at when it passes will clearly influence the nature of its impact. Further variation is provided by the nature, type and temperature differences between the converging air masses which form the system.

Fig. 2 The pattern of development of a depression.

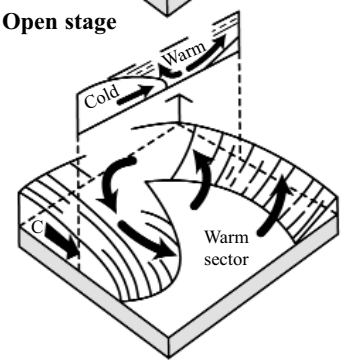
Early stage



Polar front boundary between cold and warm air.

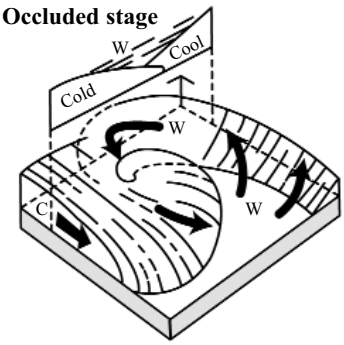
1 Instability occurs on the polar front.

Open stage



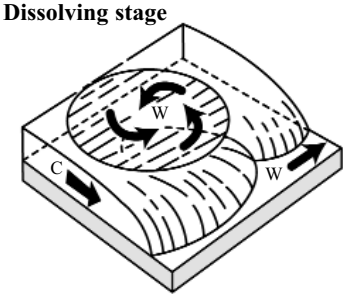
2 Cold air pushes warm air north in the northern hemisphere. The less dense warm air rises over cold air. The boundary between the two forms the warm front. The colder advancing air to the west is denser and undercuts the warmer air. The boundary forms the cold front.

Occluded stage



3 The cold front moves faster than the warm front and eventually catches it up and lifts it away from the ground, forming an occluded front.

Dissolving stage



4 After occlusion the depression dissolves. Warm air is now trapped on poleward side of polar front.

Fig. 3 shows an annotated synoptic chart to identify the main features of a depression.

Fig. 3 Annotated synoptic chart.

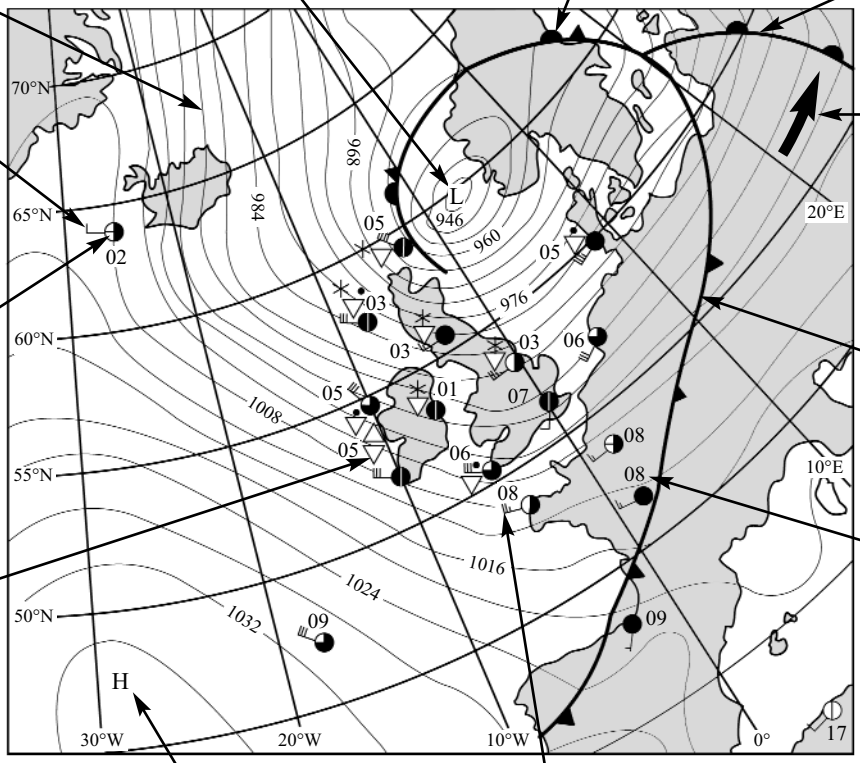
*A **synoptic chart** is a general survey of weather over an area at a particular time. Coded symbols are printed on a chart using data from a number of observation points. The charts show **temperature, wind direction and speed, total amount of cloud,** and **precipitation**. In an A-level question you may be asked to use them in the following ways: to describe air pressure; to detail weather conditions at a specific place; to show weather conditions at a certain time of day; to forecast future weather.*

Isobars / pressure: Measured in mb. Tightly packed isobars show strong winds

Low pressure system: Closed isobars numbers decrease towards centre

Occluded front

Warm front: Warm air mass rises over a colder one



Wind direction: Remember it is named for the direction it blows from (West here)

Draw an arrow parallel to isobars in warm sector to show which way depression is moving, i.e. towards NE

Cloud cover: Measured in oktas

Cold front: Occurs where a warm air mass is under cut by a cold air mass

Present weather: e.g. rain, hail, showers, atmospheric moisture, snow (here - hail showers)

Temperature: Measured in degrees centigrade (°C)

High pressure system: Closed isobars. Numbers increase towards centre

Wind strength is shown by the 'feathers' – each half feather is worth 5 knots

Symbols used on synoptic charts

WIND

Symbol	Wind speed (knots)
	Calm
	1 – 2
	3 – 7
	8 – 12
	13 – 17
For each additional half feather add 5 knots	
	48 – 52

CLOUD

Symbol	Cloud amount (oktas)
○	0
◍	1
◔	2
◔	3
◑	4
◑	5
◕	6
●	7
●	8

WEATHER

Symbol	Weather
=	Mist
≡	Fog
,	Drizzle
•	Rain
▽	Shower
△	Hail
*	Snow
⚡	Thunderstorm

PRESSURE

	Isobars (with pressure in millibars)
H	High pressure
L	Low pressure

TEMPERATURE

This is shown by two digits and is in degrees Celsius (e.g. 05 = 5°C)

	Warm front
	Cold front
	Occluded front

Exam hints:

- *The diagram provides you with a checklist as to what to look out for on a synoptic chart. Work round the annotations to make sure you understand:*
  1. *the big picture (systems)*
  2. *precise interpretation of symbols*
- *Always look at the date and time on the map in this case **January** at midday (it helps interpretation of °C)*
- *Exam boards give you a copy of the symbols, but make sure you know them so you can get straight into the question.*
- *Always annotate the key features shown so you can prepare a logical structure. Rarely are you asked to **describe** at A2. Usually you will need to explain the significance or assess likely changes.*

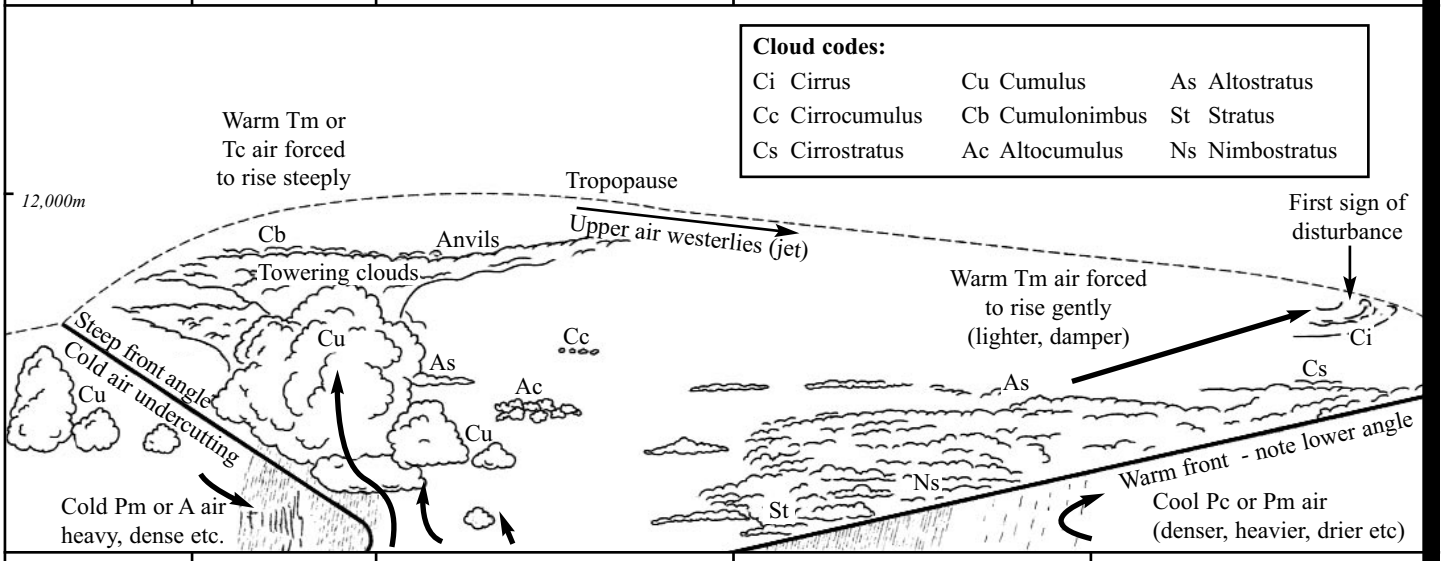
The Weather Sequence associated with depressions

Fig. 4 summarises the impact the passage of a depression can make on the sequence of weather.

Exam Hint: *Fig. 4 is a very useful one to learn. You can explain the sequence beginning with the approach.*

Fig. 4 The impact of the passage of a depression.

Cold sector	Cold front 50 - 100km	Warm sector Variable width	Warm front 200 - 400km



Cold Sector	Cold front	Warm sector	Warm front	The Approach
Rise in pressure continues but steadies out	Sudden rise in pressure	Steady low pressure	Fall of pressure slows down and ceases in time	Steady fall of pressure
NW winds	Wind veers again SSW-NW	SW/S	Wind veers from SSE-SW	Likely to be SSE/SE winds
Squally, speed of wind slowly decreases (force 3-6).	Very strong gusting winds, strong to gale force (force 6-8).	Decreases (e.g. force 2-4)	Strong (e.g. force 4-5)	Slowly increasing in strength (force 1-3 common)
Cold 3-4°C (W) Cool 12-13°C (S)	Sudden decrease of 4-5°C	Warm mild 10-11°C (W) Warm/hot 19-20°C (S)	Sudden rise in °C 10-11°C winter 19-20°C summer	Relatively cool in winter 6°C around 15-16°C summer
Rapid fall in humidity	High humidity until precipitation	Still high relative humidity – drizzle	High during precipitation	Slowly rising relative humidity
Decreasing cloud, fair weather cumulus	Often towering cumulo-nimbus	Low stratus clouds may clear a little	Low thick nimbostratus cloud	Clouds initially high and thin. Hooked cirrus in upper air show first sign of disturbance
Heavy showers but sunny intervals	Short period of heavy rain, then showers of hail, sleet, snow in W	Drizzle. May clear a little	Continuous rainfall for several hours, steady and quite heavy	No precipitation
Very good visibility except in showers	Poor visibility but improving	Poor visibility	Rapid decrease in visibility	Visibility good initially, but decreasing as cloud base lowers

Wind begins to decrease ← Increasing wind strength ←

Increasing surface wind strength ←

Increasing cloud cover, and humidity

Rising pressure ←

Decreasing pressure ←

The impact of depressions

Whilst in general the rapidly changing weather associated with depressions can be seen as a bonus – the equable climate with abundant well distributed rainfall, and the rapidly moving air leads to an absence of severe fogs occasionally depressions can lead to very severe weather events.

- The most common hazardous impact is extremely high **winds** and **gales**, for instance in the 1987 great storm or hurricane or the deep depression which led to the Burns' day storm in January 1990. The strong winds are caused by the very steep pressure gradient which is brought about by extreme contrasts in temperature between the converging polar and tropical air masses. Gales have a huge impact on infrastructure such as power/transport. October 2002 was the latest example.

- Coastal floods (East Anglia 1953 and Towyn, February 1990) result from on-shore gale force winds drawn towards a deep depression, which itself leads to a storm surge developing as water is 'sucked up'. When this is combined with high spring tides, huge breakers are driven downwards, breaking sea defences and causing serious localised flooding.

- Violent **thunderstorms** can be associated with violent uplift at the cold front which leads to the development of towering cumulo-nimbus clouds. Cold N Westerly or Northerly air (pM or A) wedges underneath very warm air. Occasionally violent **hailstorms** occur as in London in 1968 when hail the size of tennis balls fell, formed by the strong power of the updraughts and downdraughts in the storm clouds.

- Depressions which remain static (usually controlled by Rossby wave patterns) can cause extremely **heavy rainfal**l, as the warm air within them (mT air mass) can hold very large quantities of moisture. As in 1952 Lynton/Lynmouth where between 50 and 100mm fell in a 24 hour period, this can lead to localised flooding. Alternatively, a succession of depressions can lead to very high levels of antecedent moisture in the ground, so even modest rainfall leads to flooding (Midlands April 1998, November 2000) January 2003.

- **Snow,** especially in areas of high altitude, can result from a number of circumstances when the land surface has become very cold after a blocking winter anticyclone. When warm Atlantic air finally comes via a depression, as it is forced to rise precipitation is initially in the form of snow (e.g. the South West Blizzard in February 1978 which led to between 100 and 200mm of snow) or sometimes a deep depression draws in very cold Arctic and polar air as it tracks northwards, which can lead to very heavy snow falls (for example in March 1993 the American Storm of the century occurred in this way with huge falls of snow).

Further research

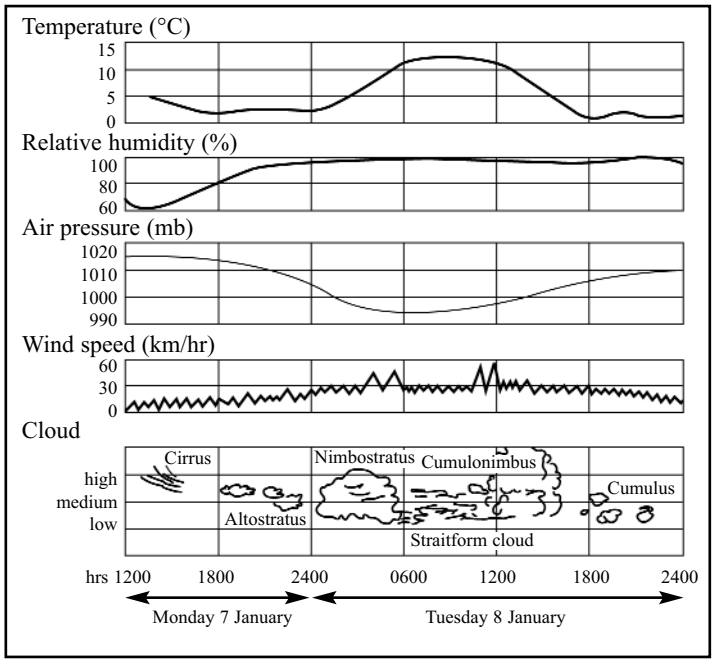
Nagle, G. Climate & Society. Hodder. Access Series
McNaught, A. Weather & Climate. Hodder. On line resources on Weather & Climate

Useful websites

www.bbc.co.uk/weather BBC Weather Centre provides a wide range of live weather satellite images
www.royal-met-soc.org UK/met international
www.atschool.eduweb.co.uk met link or www.witu.rdg.ac.uk/rms/rms are ways of Reaching Royal Met Society who publish weather
www.nelsonthornes.com monthly update of weather news and hazards
www.meto.gov.uk Meteorological Office Education Services, Bracknell
www.metoffice.gov.uk/index-html - a dial up weather info service with data on 300 weather stations
www.met-office.gov.uk/education/historic - provides historic records for example of extreme weather
www.nottingham.ac.uk/meteosat an excellent source of Meteosat data
www.sat.dundee.ac.uk register free - excellent source of images from NOAA satellites

Exam Question

Fig. 5 shows the sequence of weather experienced with the passage of a depression.



(a) Make a copy of the diagram and mark on the position of the warm front, warm sector and cold front. *(3 marks)*
(b) Justify your choice using evidence from the date shown. *(9 marks)*
(c) Choose two further measurements you might make and explain how they would confirm your choice. *(8 marks)*

Exam Hint: *Remember although the depression will be moving W-E, the graphs show a time sequence of weather recordings at a particular weather station.*

Suggested answer framework

(a) Warm front – somewhere between midnight and 6.00am
Warm sector – 6.00am – 12.00pm
Cold front – probably around 1.00pm – 4.00pm

(b) Evidence **Temperatures**, **cloud pattern:** cirrus, mackerel sky etc for approach of warm front (disturbed air) stratus cloud for warm sector, clearing clouds cumulus for cold front, towering an actual front.
Wind speed always gustiest at fronts. The **barometer** pressure reading shows the centre of the low passed over just after 6am.
Note: This type of question will usually be marked in 3 levels for highest (level 3) you need detailed evidence and explanation to show your own knowledge of a depression.

(c) Further measurements include **wind direction** - winds veer round from SE → S → SW → NW as the depression passes. Now weather is also very useful for instance continuous rainfall is associated with warm front, drizzle with warm sector and heavy shows with passage of cold front.

Acknowledgements
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