METEOROLOGY

The actual examination paper consists of twenty questions with a multiple choice of four answers A, B, C or D. The candidate should indicate the chosen answer by placing a cross in the appropriate box on the answer paper provided.

Time allowed 1 hour.

The pass mark is 75%, so the minimum number of questions that must be answered correctly to obtain a pass is fifteen. Marks are not deducted for incorrect answers.

The explanation section follows the question section and each explanation is prefixed EM (Explanation Meteorology).

METEOROLOGY - QUESTIONS

Q1 Which of the following correctly decodes a TAF that reads: EGNX 130410 130615 21005kt 0550E DZ BCFG VV002?

A - For East Midlands Airport issued on the 13th day of the month at at 0400UTC to 1000 UTC with a trend from 0615 UTC surface wind 210°T at 5kt visibility 5500 metres to the east in moderate drizzle becoming fog with a vertical visibility of 200 metres.

B - For East Midlands Airport issued on the 13th day of the month for the period 0400 UTC to 1000 UTC with a trend from 0600 UTC to 1500 UTC: surface wind 210°T at 5kt visibility 550 metres to the east in drizzle becoming fog with a vertical visibility of 200 ft.

C - For East Midlands Airport issued on the 13th day of the month at at 0410UTC and valid for the forecast period on the 13th day from 0600 - 1500 UTC: surface wind from 210°T at 5kt with a surface visibility of 550 metres to the east in moderate drizzle and patches of fog with a vertical visibility of 200 ft.

D - For East Midlands Airport observed at 0615 UTC on the 13th day of the month; the surface wind was from 210°T at 5kt with a surface visibility of 550 metres to the east in moderate drizzle with a vertical visibility of 200 ft.

Q2 A TAF Time Group 0220 means that the TAF:

A - is a long range TAF valid from 0200 to 2000 local time.

B - was observed at 0220 UTC.

C - was issued at 0220 UTC.

D - is a long range forecast for the 18-hour period 0200 - 2000 UTC.

Q3 An AIRMET service is:

A - a telephone service intended for use by aircrew not having access to meteorological forecast charts or area forecasts, disseminated in textual form in plain language by the Aeronautical Fixed Telecommunication Network (AFTN).

B - a telephone, telex, or fax service for use by general aviation pilots who do not have access to the centralised forecast offices provided by the major aerodromes.

C - a discrete telephone service for the sole use of private pilots operating from smaller aerodromes or private strips, outside controlled airspace, who do not have access to forecast charts.

D - a discrete telephone/ fax service in plain language for private pilots unable to interpret regional forecasts.

Q4 An aerodrome VOLMET report for 0450 UTC during the autumn in the UK is:

Surface wind	15005kt
Visibility	2000 metres
Weather	Nil
Temperature	9°C
Dewpoint temperature	8°C
QNH	1029hPa
Trend	NOSIG

Given that sunrise is at 0600 UTC, during the two hours following the report, the most probable meteorological condition to develop would be:

A - CAVOK.

B - advection fog.

C - a very low cloud base.

D - radiation fog.

Q5 Lenticular clouds observed above the top of a range of hills seen from an A/C that is approaching from the downwind or leeward side of the range, indicate the possibility of:

A - strong katabatic up currents above the tops of the hills.

B - strong katabatic downdraughts and turbulence after the ridge is passed.

C - strong downdraughts immediately before the ridge of the range is reached, with the possibility of severe turbulence in or below roll cloud with turbulence and strong updraughts after passing the ridge to the windward side.

D - strong anabatic up currents above the tops of the hills.

Q6 In a mountain wave situation, the severest turbulence is most likely to be encountered when flying:

A - at about mid height between lenticular and roll cloud.

B - just above roll cloud.

C - at or just below the mountain summit up to 10nm downwind.

D - in or below roll cloud.

Q7 An aircraft flying at low level in the vicinity of a range of hills across which a strong wind is blowing may experience:

1 - severe turbulence below any rotor zone.

2 - downdraughts which may completely overcome the rate of climb of some low powered light aircraft.

3 - a greater than normal risk of icing in cloud over the crest of the hills.

A - only 1 and 3 are correct.

B - 1, 2 and 3 are correct.

C - only 1 and 2 are correct.

D - only 2 and 3 are correct.

Q8 Which of the following is true of the lowest level windshear?

A - It is rare where there is an inversion level close to the surface.

B - It is only found under the core of the anvil of a cumulonimbus cloud.

C - It is very common within a mountain wave.

D - It may be experienced 15 to 20 miles ahead of a moving thunderstorm.

Q9 The extent of rain ahead of a typical warm front affecting the UK may be up to:

A - 50 miles behind the surface position of the front.

B - 200 miles ahead of the surface position of the front.

C - 500 miles ahead of the surface position of the front.

D - 200 miles behind the surface position of the front.

Q10 Seen from the surface, the passage of a warm front in the UK is characterised by which of the following cloud types?

A - Cirrus, Cirrocumulus, Altocumulus, Altostratus Cumulus, Cumulus Fractus.

B - Cirrostratus, Cirrocumulus, Cumulus, Nimbostratus, Fractostratus.

C - Cirrus, Cirrostratus, Altostratus, Nimbostratus, Stratus.

D - Cirrostratus, Cirrocumulus, Altostratus, Nimbocumulus, Stratus.

Q11 Which of the following frontal systems is more likely to produce thunderstorm activity?

A - A cold front.

B - A warm front.

C - A ridge of high pressure.

D - An occluded front.

Q12 A low level inversion causing a mist layer severely reduces your forward visibility of the surface when operating at about 2000ft. To improve your view of the ground ahead you should:

A - fly higher.

B - fly as close as possible to the upper surface of the haze layer.

C - fly lower.

D - fly slower.

Q13 Frontal fog may exist:

A - behind a cold front.

B - ahead of a warm or occluded front.

C - ahead of a cold front.

D - at the surface interface of a cold front.

Q14 Select the following list that describes cloud types in the ascending order of Low, Medium and High?

A - Stratus, Cumulonimbus, Cirrocumulus.

B - Cumulonimbus, Stratocumulus.

C - Nimbostratus, Altocumulus, Cirrus.

D - Altocumulus, Cumulus.

Q15 One or more coloured rings around the sun or moon, known as a Corona, suggests the presence of which level of cloud?

A - High.

B - Low.

C - High or medium.

D - Medium.

Q16 Unstable air is characterised by:

A - cumulus cloud with poor visibility and intermittent drizzle.

B - layered cloud with continuous light rain and moderate visibility.

C - cumulus cloud with showers and generally good visibility.

D - layered cloud with continuous moderate to heavy rain and moderate to poor visibility.

Q17 Hazards to aviation due to the presence of cumulonimbus or thunderstorm cloud at their mature stage may be experienced:

A - only when the aircraft is within the cloud.

B - only when the aircraft is within or underneath the cloud.

C - when the aircraft is within 10nm of the cloud.

D - within 10nm of the cloud around its mid level prior to maturity.

Q18 Hazards associated with cumulonimbus clouds include turbulence, windshear, icing, lightning and heavy precipitation. Which of the following statements is true?

A - All of the hazards may be encountered within or in the vicinity of the cloud.

B - All of the hazards can be avoided by not flying in or in the vicinity of the cloud.

C - Heavy precipitation and windshear may be encountered outside the cloud, but turbulence, icing and lightning are confined to inside the cloud.

D - All of the hazards except severe icing may be encountered within or in the vicinity of the cloud. Severe icing can only be encountered from SCWDs falling from the anvil.

Q19 Hail is most likely to be produced by:

A - AC

B - NS

C - SC

D - CB

Q20 The use of 'Nimbo' or 'Nimbus' in the designation of a cloud indicates that it is:

A - wispy, consisting of ice crystals.

B - rain bearing.

C - medium cloud.

D - cloud of extensive vertical development.

Q21 Which of the following is normally associated with drizzle?

A - Cumulonimbus and nimbostratus.

B - Cirrostratus and stratocumulus.

C - Nimbostratus.

D - Stratus.

Q22 What meteorological conditions most favour the formation of radiation fog?

A - High relative humidity, moderate wind and cloudy sky.

B - Low relative humidity, no wind and clear sky.

C - Low relative humidity, cold air and a warm surface under clear sky.

D - High relative humidity, light wind and clear sky.

Q23 In the UK, the surface wind following the passage of a warm front will normally:

A - veer.

B - back.

C - remain the same.

D - reverse direction to correspond with the isobaric pattern and pressure gradient.

Q24 The wind at 1000ft during the day at an inland aerodrome in the UK was 33015kt. Using a rule of thumb, what would you expect the surface wind to have been?

A - 35008kt.

B - 32010kt.

C - 31012kt.

D - 30005kt

Q25 Below the tropopause, the International Standard Atmosphere (ISA) assumed values are:

A - a surface density of 1013.25hPa, a mean sea level temperature of 15°C decreasing at the rate of 1.98°C/1000ft until it reaches –56.5°C at 36090ft above which it remains constant.

B - a surface pressure of 1013.25hPa together with a sea level temperature of 15°C decreasing at the rate of 1.98°C per 1000ft until it reaches absolute zero (–273°C) at 44200 metres above which it remains constant.

C - a mean sea level pressure of 1013.25hPa together with a mean sea level temperature of +15°C decreasing at the rate of 1.98°C/1000ft until it reaches –56.5°C at 36090ft above which it remains constant.

D - a surface pressure of 15 lb/in^2 together with a sea level temperature of 15°C decreasing at the rate of 2°C per 1000ft until it reaches a minimum at 36090ft above which it remains constant.

Q26 At about 1400Z under clear skies at an inland aerodrome in Kent, the surface wind was observed to be 22025kt. The most likely wind velocity at 2000ft agl would be:

A - 26040kt.

B - 24035kt.

C - 22020kt.

D - 23030kt.

Q27 The temperature at 2000ft amsl is forecast to be +5°C: compared to the International Standard Atmosphere (ISA) this is:

A - ISA –6.

B - IAS +6.

C - ISA +5.

D - ISA –4.

Q28 A low level temperature inversion, for example between the surface and 2000ft agl, may produce:

A - an on-shore breeze at night.

B - good visibility by day due to a steep temperature gradient.

C - light to moderate icing if the inversion prevails after sunset due to warmer air aloft and associated high moisture content.

D - turbulence between the surface and 2000ft.

Q29 The atmospheric layer within which the greatest majority of weather occurs and within which light aircraft operate is the:

A - troposphere.

B - tropopause.

C - stratosphere.

D - atmosphere.

Q30 The atmosphere is heated mainly by:

A - direct solar energy not filtered by the ozone layer absorbed by the lower atmosphere.

B - heat re-radiated at a modified wavelength from the Earth's surface.

C - exchanges of latent heat during the process of moisture in the atmosphere changing state.

D - warm air from high equatorial regions spreading out and descending into more northerly and southerly latitudes.

Q31 A pressure gradient stimulates the motion of air from:

A - a region of low pressure to a cyclonic region.

B - a region of high pressure to a low pressure region.

C - region of low pressure to a region of high pressure.

D - a cyclonic region to an anticyclonic region.

Q32 When flying in the vicinity of a range of hills lying north/ south across which the wind is blowing west to east, exposure to hazardous downdraughts is most likely to occur:

A - when flying west towards the hills from the east.

B - when flying north to south parallel to the range.

C - when flying east towards the range from the west.

D - when flying south to north parallel to the range..

Q33 For cumulonimbus cloud to develop, there needs to exist:

A - from the surface upwards, a shallow layer of very unstable moist air.

B - a deep layer of very stable moist air with a shallow lapse rate.

C - from the surface up, a deep layer of very unstable moist air with a shallow lapse rate.

D - from the surface upwards, a deep layer of very unstable moist air.

Q34 When comparatively warm dry air flows over a water surface, the air in close proximity to the surface will absorb water vapour and become:

A - more dense and stable

B - less dense, colder and remain at the surface.

C - less dense and rise.

D - saturated.

Q35 When an unsaturated parcel of air is forced to rise, its temperature will.....(**a**).....its density will.....(**b**).....and its relative humidity will.....(**c**)..... Select the answer that correctly completes this statement.

	a	**b**	**c**
A -	remain unchanged	increase	decrease
B -	decrease	increase	decrease
C -	decrease	decrease	increase
D -	increase	decrease	increase

Q36 You arrive at a south coast aerodrome three hours after sunrise during a summer morning and the weather report indicates CAVOK. As the coast line is predominantly east/ west and a sea breeze is beginning to establish, which of the following would you expect to be an into wind runway?

A - 36.

B - 21.

C - 27.

D - 18.

Q37 Which air mass arriving over the UK would be characterised by cold, moist, unstable air producing convective cloud, showers and thunderstorms?

A - Tropical maritime.

B - Polar maritime.

C - Arctic maritime.

D - Returning Arctic maritime.

Q38 When two air masses converge within a depression and warmer air replaces cold air at the surface, the front thus formed would be a:

A - cold front with a sloping interface of approximately 1:150.

B - warm front with a sloping interface of approximately 1:150.

C - cold front with a sloping interface of approximately 1:50.

D - warm front with a sloping interface of approximately 1:50.

Q39 Given a surface temperature of +21°C and a dewpoint temperature of +7°C, at approximately what height will the base of cumulus cloud be found.

A - 4000ft.

B - 7000ft.

C - 8500ft

D - 5500ft.

Q40 Amongst others, which of the following conditions are most likely to produce thunderstorm activity:

A - A high moisture content together with a steep environmental lapse rate.

B - A shallow environmental lapse rate together with a low relative humidity.

C - A shallow environmental lapse rate together with a high moisture content.

D - a front formed by an advancing tropical continental air mass.

Q41 During the winter months in the UK, which of the following weather conditions would most likely be produced by an anticyclone:

A - Subsidence due to surface cooling will produce extensive low level stratiform cloud as the dewpoint temperature is exceeded.

B - During the day, surface warming will produce convective activity with the extensive development of cumulus cloud in the lower levels and stratus cloud in the middle level as adiabatic cooling causes the air to stabilise.

C - General subsidence and adiabatic warming could lead to a temperature inversion, trapping smoke and dust particles within the inversion layer, which will give poor in-flight visibility.

D - generally appearing from the south west, stability with high relative humidity will produce longer than normal periods of stable weather with poor visibility in the middle levels as the only cloud development occurs over rising ground.

Q42 Precipitation produced by stratus cloud is normally:

A - None.

B - Heavy rain.

C - Showers of rain.

D - Drizzle.

Q43 When air in the northern hemisphere under the influence of a pressure gradient is forced to move towards an area of lower pressure, the Coriolis effect will cause the moving air at approximately 2000ft to be deflected to:

A - the left and flow approximately parallel to the surface isobars.

B - the right and flow across the surface isobars.

C - the left and flow across to the surface isobars.

D - the right and flow approximately parallel to the surface isobars.

Q44 A balanced wind that follows curved isobars from about 2000ft above the surface is known as a:

A - isothermic wind.

B - gradient wind.

C - fohn wind.

D - geostrophic wind.

Q45 You are flying in a cold sector above the freezing level in rain which is falling from overlying warmer air due to an approaching warm front. What type of icing are you most likely to encounter?

A - Carburettor ice.

B - Rain or clear ice.

C - Rime ice.

D - Hoar frost.

Q46 Tropical maritime air originating from the Azores that affects UK weather is characterised by:

A - moist unstable conditions leading to well developed CBs thunderstorms.

B - moist but stable conditions due to a general subsidence giving low stratus and poor visibility.

C - dry stable conditions leading to good visibility at low level, with poor visibility in the middle layers.

D - moist unstable conditions due to increased moisture content as the air tracks north east over the Atlantic Ocean.

Q47 The type of fog that develops rapidly both by day and by night is:

A - advection.

B - radiation.

C - haar.

D - sea smoke.

Q48 You experience a constant drift to the right when flying over the UK at a constant indicated altitude. If the altimeter sub-scale is not updated this will result in:

A - flying at a progressively higher altitude than that indicated.

B - flying at the actual altitude indicated by the altimeter.

C - the possibility of using the wrong Regional Pressure Setting.

D - flying at a progressively lower altitude than that indicated.

Q49 An unstable air mass when forced to rise due to orographic lifting will produce:

A - cloud of extensive vertical development.

B - thick stratiform cloud, probably nimbostratus.

C - none, as the air will subside and warm adiabatically after the summit is passed.

D - lenticular cloud.

Q50 The cloud species that forms over mountains in stable air that is forced to rise due to orographic lift is:

A - altocumulus

B - cirrostratus

C - altostratus

D - lenticularis

Q51 The passage of a cold [illegible]ic surface is characterised by:

A - a dewpoint rise, [illegible]rature fall and the wind backing.

B - dewpoint rise, a [illegible]erature fall and the wind veering.

C - a dewpoint fall, a [illegible]emperature fall and the wind backing.

D - a dewpoint fall, a temperature fall and the wind veering.

Q52 The formation of advection fog is often caused by:

A - water vapour becoming mixed with dust particles that have become trapped below a low level temperature inversion in moderately windy conditions.

B - a warm moist air mass under the influence of light to moderate winds being cooled to below its dewpoint by flowing across a much colder surface.

C - moist air in contact with the ground being cooled to below its dew point in light wind conditions on a cloudless night.

D - a moist air mass under the influence of light to moderate winds becoming saturated by flowing across a water surface.

Q53 If flying at 2000ft just below cloud in rain with an OAT of between +4°C and +6°C there would be a:

A - risk of carburettor icing

B - risk of rain ice

C - risk of rime ice.

D - risk of impact icing

Q54 A piston engined aircraft flying in clear air may be subjected to the accretion of:

A - precipitation icing.

B - clear ice.

C - rime ice.

D - carburettor ice.

Q55 Just before dawn at an inland aerodrome, the prevailing conditions result in the formation of radiation fog. The probable consequence of the surface wind velocity increasing to 10kt would be:

A - any low cloud and fog to disperse.

B - increased mixing of the surface layer and thickening of the fog layer.

C - an initial thickening of the fog as surface dust particles act as condensation nuclii to produce more water droplets. The fog will thin and disperse as the dust particles are exhausted or lift if the wind velocity increases much above 10kt.

D - the fog to lift and form low stratus cloud.

Q56 An aircraft with a constant altimeter setting of 1009hPa flies at a constant indicated altitude from (**A**), QNH 1009hPa to (**B**), QNH 1019hPa. When overhead (**B**) the indicated altitude will be:

A - higher or lower depending on the airfield elevation.

B - lower than the actual altitude.

C - higher than the actual altitude.

D - the same as the actual altitude.

Q57 If an airfield is 240ft above mean sea level (amsl) and the airfield QNH is 1024hPa calculate the airfield QFE given that 1 hPa = 30ft.

A - 1016hPa

B - 1021hPa

C - 1011hPa

D - 1032hPa

Q58 You observe the passage of the following cloud sequence: Cirrus, cirrostratus, altostratus, nimbostratus, which would suggest the passage of:

A - a cold front.

B - an occluded front.

C - a quasi stationary front

D - a warm front.

Q59 Ice accretion in a piston engine induction system is produced by:

A - high power settings, moderate humidity and cold air.

B - low power settings, low humidity and very cold air.

C - low power settings, high humidity and warm weather.

D - High power settings, high relative humidity and lean fuel mixture.

Q60 The change of atmospheric pressure, cloud and visibility following the passage of a typical warm front when observed at the surface would be:

	PRESSURE	CLOUD	VISIBILITY
A	increases steadily with medium level base.	not more than 4/8	good.
B	falls then rises	8/8 slowly reducing with base rising	poor with the possibility of fog close to the front.
C	stops falling-steady	4/8 or less with very low base	rapidly improving to 10km or more after cessation of rain.
D	rises then falls	4/8 slowly increasing with base lowering	poor with the possibility of fog close to the front.

Q61 Your planned route lies within a warm sector of a depression which would suggest:

A - Good visibility below scattered cumuloform cloud.

B - Good visibility above and below extensive stratiform cloud.

C - Poor visibility above stratus cloud but moderate to good visibility below.

D - Poor visibility both above and below extensive stratus cloud.

Q62 Providing the minimum sector altitude is not a determining factor, CAVOK in a TAF or METAR:

A - means visibility 10km or more and no cloud below 5000ft.

B - means visibility 10km or more with only few cloud below 5000ft.

C - means visibility 10nm or more and no cloud below 5000ft.

D - means visibility 10nm or more.

Q63 NOSIG appearing at the end of the METAR below means:

EGAC SA1720 161720Z 22009KT CAVOK 16/11 Q1010 NOSIG=

A - no expected significant variation to the observed weather during the two hour forecast period following the time of observation.

B - no significant changes to the forecast conditions during the period of validity of the forecast.

C - no significant weather at the time of observation.

D - nothing significant in general for that day.

Q64 Study the following METAR in which the cloud base has been omitted.

28005KT 9999 SCT/// 12/05 Q1024 NOSIG:

Select one of the following that would most accurately complete the cloud group and trend for the prevailing conditions.

A - SCT015 - not changed during the past 3 hours.

B - SCT025 - no significant change for the next 2 hours.

C - SCT035 - no significant changes for the next hour.

D - SCT045 - no other signals received.

Q65 A VOLMET is defined as:

A - a radio broadcast of selected aerodrome forecasts.

B - a continuous telephone message of selected aerodrome METARs.

C - a continuous radio broadcast of selected aerodrome actual weather observations and forecasts.

D - a radio transmission of a requested aerodrome actual weather observation and forecast.

Q66 The weather group +SHSNRA contained in Terminal Aerodrome Forecast (TAF) means:

A - slight showers of snow and rain.

B - slight showers of snow becoming rain.

C - heavy showers of snow and rain.

D - heavy showers of snow becoming rain.

Q67 If you plan a flight of less than 500nm, the minimum time required before your ETD for a special route forecast to be issued is:.

A - 4 hours.

B - 1 hour.

C - 3 hours.

D - 2 hours

Q68 With the existence of similar pressure gradients, the approximate speed of travel of a warm front will be:

A - 1/4 of that of a cold front.

B - 1/3 of that of a cold front.

C - 2/3 of that of a cold front.

D - 3/4 of that of a cold front.

Q69 A METAR – EGZZ 130350Z 32005kt 0400N DZ 10/10 BCFG VV002 – in plain language means:

A - Observed on the 13th day of the month at 0350Z, surface wind 320°T/05kt, minimum visibility 400 metres to the north, moderate drizzle, temperature +10°C, dewpoint + 10 °C with fog patches, vertical visibility 200ft.

B - Reported on the 13th day of the month at 0350Z, surface wind 320°M/05kt, minimum visibility 400metres to the north, drizzle, temperature +10°C, dewpoint above 10 °C with fog patches, vertical visibility 200metres.

C - Observed on the 13th day of the month and valid between 0300 and 0500Z, surface wind 320°T/05kt, minimum visibility 4000 metres to the north, drizzle temperature +10°C, dewpoint + 10 °C, becoming fog patches, vertical visibility 200ft.

D - Reported on the 13th day of the month and valid between 0300 and 0500Z, surface wind 320°M/05kt, minimum visibility 400 metres to the north, drizzle temperature +10°C, becoming fog patches, vertical visibility 200ft.

Q70 An aircraft with 1020hPa set on the altimeter sub-scale departs aerodrome '**A**' which is 800ft above mean sea level (amsl). The flight is made to the planned destination aerodrome '**B**' which is in an area of low pressure, but the altimeter sub-scale is not updated en route. If the QNH at aerodrome '**B**' is 999hPa, and the highest point on the landing area is 500ft amsl, what should the altimeter read?

Assume 1hPa = 30ft.

A - 830ft

B - –130ft

C - 1130ft

D - –180ft

Q71 Which of the following report the wind direction referenced to true north?

A - TAF, ATIS, AIRMET.

B - METAR, ATIS, SIGMET.

C - TAF, ATIS, SIGMET.

D - TAF, METAR, VOLMET.

Q72 The symbol below appearing on a forecast weather chart means:

A - severe turbulence.

B - severe icing.

C - thunderstorms.

D - severe lightning.

Q73 A meteorological chart symbol illustrated below means:

A - mist.

B - stratus cloud

C - strong low level winds

D - fog

Q74 METAR may be defined as:

A - a routine weather report concerning a specific aerodrome.

B - a routine weather report for a large area.

C - an aerodrome forecast containing a TREND for the next two hours.

D - meteorological, terminal area report.

Q75 The conditions most likely encountered following an east west track that crosses an occluded front lying north/south would be:

A - calm conditions before the occlusion with a considerable backing of the wind across the occlusion.

B - thick stratus and drizzle ahead of the occlusion with light wind gently backing across the occlusion.

C - severe weather approaching the front with a large change of W/V crossing the occlusion.

D - Severe weather with the possibility of thunderstorm activity with little or no change in W/V within the occlusion.

Q76 The symbol below appearing on a forecast weather chart means:

A - severe turbulence.

B - thunderstorms.

C - rain ice decreasing then increasing.

D - severe icing.

Q77 When receiving circuit joining information prior to an approach to its destination, the pilot of a light aircraft is warned of the presence of low level windshear. The pilot should first consider:

A - delaying the approach or avoid it by diverting.

B - using a higher than normal approach speed to counteract the loss of head wind component.

C - the possibility of a missed approach.

D - the landing distance available and a flapless approach.

Q78 During the evening at an inland airfield in the UK, the surface wind velocity is most likely to have .....**?**..... from the surface wind velocity during the day. Which of the following responses correctly completes the above statement?

A - backed and increased.

B - backed and decreased.

C - veered and decreased.

D - veered and increased.

Q79 Low level winds in the northern hemisphere that blow around a depression are drawn on surface weather charts:

A - in an anticlockwise direction.

B - in a clockwise direction.

C - across the isobars.

D - parallel to the isobars.

Q80 Winds that blow around an anticyclone (high pressure system) at lower levels in the northern hemisphere are represented on a low level weather chart as blowing:

A - parallel to the isobars.

B - in an anticlockwise direction.

C - across the isobars.

D - in a clockwise direction.

Q81 Select the statement that is most representative of land and sea breezes in the UK.

A - The surface wind is likely to be on shore during the night.

B - The surface wind is likely to be on shore during the day.

C - By day the 1000ft wind is likely to flow parallel to the coast line.

D - By night the 1000ft wind is likely to flow parallel to the coast line

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Q82 Which of the following correctly defines the datums for forecasting or reporting cloud bases?

A -	METAR - agl	TAF - amsl	Area Forecast amsl.
B -	METAR - agl	TAF - amsl	Area Forecast agl.
C -	METAR - amsl	TAF - amsl	Area Forecast amsl.
D -	METAR - agl	TAF - agl	Area Forecast amsl.

Q83 The usual method of flight crew briefing in the UK is:

A - individual briefing by a forecaster face to face or by phone, available every 15 minutes.

B - individual briefing by a forecaster to assistant staff at weather centres and aerodromes for dissemination to individual flight crew, and available every 30 minutes.

C - self briefing using facilities, information and documentation routinely available in aerodrome briefing areas.

D - self briefing via information and documentation updated every 15 minutes

Q84 The visibility group R20/0050 in a METAR means:

A - as measured by runway measuring equipment for runway 20, a current visibility of 50 metres.

B - for runway 20, a current visibility of 500 metres measured by runway visual range equipment.

C - the visibility reported is 50 metres as measured by runway visual range equipment within the last 20 minutes.

D - for runway 20, a current visibility of 500 feet measured by runway visual range measuring equipment.

Q85 A meteorological chart symbol illustrated below means:

A - hail.

B - light rime icing.

C - moderate turbulence.

D - snow, not reaching the surface.

Q86 A meteorological chart symbol illustrated below means:

A - ice-laden freezing wind.

B - low level turbulence.

C - freezing fog.

D - hard hail

Q87 Tropical maritime air that affects UK weather originates from:

A - the Indian Ocean.

B - the Mediterranean.

C - the north Atlantic.

D - the Azores.

Q88 When a TEND is included at the end of an aviation METAR or 'Station Actual', the trend is a forecast valid for:

A - 2 hours after the time of observation.

B - 2 hours after it is issued.

C - 2 hours commencing 1 hour before the end of the forecast period.

D - 1 hour after the time of observation.

Q89 The code: BECMG FM 1100 – RASH when used in a METAR means:

A - from 1100 UTC the cessation of rain showers.

B - becoming from 1100 UTC slight rain showers.

C - becoming fairly moderate weather from 1100 UTC.

D - from 1100 UTC the prevailing rain showers becoming slight.

Q90 BECMG 1820 BKN030 in a TAF means:

A - gradually the wind changing to 18020kt, cloud cover changing to 5 - 7 oktas base 3000ft above ground level.

B - becoming between 1800 and 2000 local time, 5 - 7 oktas, base 3000ft above aerodrome elevation.

C - becoming between 1800 and 2000 UTC 5 - 7 oktas, base 3000ft above aerodrome elevation.

D - at 1820 UTC, cloud cover changing to 5 - 7 oktas base 3000ft above ground level.

Q91 TEMPO in an Aerodrome Forecast or TAF means:

A - a temporary variation to the main forecast that will last for less than an hour or, if recurring, for less than half of the period indicated.

B - a temporary variation to the main forecast lasting less than an hour.

C - the development of unpredictable temporary conditions that may be a hazard to aviation.

D - a temporary variation to the main forecast lasting for less than half of the forecast period.

Q92 The correct decode for a TAF 0615 14025G40 1200 BR would be:

A - The forecast is for a nine hour period from 0615 UTC with a surface wind of 140°M at 25kt gusting 40kt, visibility 1200 metres in mist.

B - for the nine-hour period 0600-1500 UTC, for runway 14 a wind of 025°T at 40kt, runway visibility 1200 metres improving to 10 kilometres or more.

C - for the nine-hour period 0600-1500 local time, a surface wind from 140°M at 25kt, gusting 40kt, runway visibility 1200 metres in blowing rain.

D - for the nine-hour period 0600-1500 UTC and forecasts a surface wind of 140°T at 25kt gusting to 40kt, visibility 1200 metres in mist.

Q93 An aerodrome VOLMET report for 0450 UTC during the autumn in the UK is:

Surface wind	150/05kt
Visibility	2000 metres
Weather	Nil
Temperature	9°C
Dewpoint temperature	8°C
QNH	1029hPa
Trend	NOSIG

Given that sunrise is at 0600 UTC, during the two hours following the report, the most probable meteorological condition to develop would be:

A - CAVOK.

B - radiation fog.

C - advection fog.

D - 9999

Q94 An AIRMET is issued **(i)** and is valid for **(ii)** with an outlook period of **(iii)**.

	(i)	**(ii)**	**(iii)**
A	6 times a day	8 hours	4 hours.
B	4 times a day	6 hours	4 hours.
C	4 times a day	8 hours	6 hours.
D	6 times a day	6 hours	6 hours.

Q95 The frequency of issue and period of validity of Metforms 214 and 215 are.

A - every 4 hours for an 6 hour period

B - every 3 hours for a 8 hour period

C - every 6 hours for a 6 hour period

D - every 8 hours for a 3 hour period

Q96 A 'temperature group' of 28/24 in a METAR means that:

A - the temperature is 28°C at the time of reporting, but is expected to become 24°C by the end of the TREND period.

B - the temperature is 28°C and the dewpoint is 24°C.

C - the dewpoint is 28°C and the temperature is 24°C.

D - the maximum forecast temperature is 28°C and the minimum forecast temperature is 24°C.

Q97 Refer to Appendix 'A' FORM 214.

What is the forecast wind velocity at 5000ft at position 50°N 0°E/W?

A - 18020kt.

B - 07015kt.

C - 22020kt.

D - 25015kt.

Q98 Refer to Appendix 'B' MET FORM 215.

Note: weather zones are delineated by scalloped lines on the chart.

What is the height above mean sea level of the 0°C level at Bristol EGGD?

A - 600ft.

B - 3000ft.

C - 4500ft

D - 6000ft.

Q99 Refer to Appendix 'B' Zone 4 (extract below).

ZONE 4 GEN 10KM NIL/RA 3-5/8CUSC 2000\8000 7/8 AC 8000\22000

What is the cloud amount indicated by 3-5/8?

A - scattered/ broken

B - few/ broken

C - scattered/ overcast

D - broken/ few

Q100 Refer to Appendix 'B' MET FORM 215.

Note: Weather zones are delineated by scalloped lines on the chart.

For a sea level aerodrome, the following TAF would be typical of which weather zones?

1322 35020kt 9999 SCT030 SCT090 TEMPO 1322 8000 SHRA BKN015 PROB30 TEMPO 1522 5000 +RASH SCT008 BKN 009CB=

A - Zones 2 and 1.

B - Zones 4 and 2.

C - Zones 2

D - Zone 3.

Q101 Refer to Appendix 'B' MET FORM 215.

The feature OY at 55N over the North Sea at 1500Z is:

A - a quasi-stationary front at the surface.

B - an occluded front above the surface moving slowly northwest.

C - an occluded front at the surface moving at less than 5kt towards the northwest.

D - a quasi-stationary front above the surface moving at less than 5kt towards the northwest.

Q102 Refer to Appendix 'B' MET FORM 215.

The forecast for 1500 UTC gives X L 988 at position 50°N 1°E. This denotes a:

A - low pressure centre of 988hPa.

B - chart QFE of 988hPa at 0900Z and surface wind velocity of 20kt.

C - high pressure centre of 998.8hPa.

D - the centre of a 998.8hPa pressure gradient.

Q103 Refer to Appendix 'B' MET FORM 215. Note: Weather zones are delineated by scalloped lines on the chart.

A route for a precision visual navigation exercise (in which the pilot is required to follow the route without deviation) is pre-planned for an area of South West England lying mainly within Zone 3.

The exercise area is Class G Airspace (open FIR) and the pilot will carry one passenger to assist with the lookout and navigation. The maximum indicated airspeed will be 100kt and the minimum altitude is 2000ft.

The VMC minima for a PPL without either an IMC or Instrument Rating are an in flight visibility of not less than 3km, clear of cloud and in sight of the surface.

The aircraft is not certificated for flight in known icing conditions.

Examine the MET FORM 215 Appendix 'B' and decide which of the following is the correct course of action.

A - The cloud base is forecast to be above the required operating altitude. Occasional precipitation with a lower cloud base would prove to be a bar to the exercise even if the general cloud base improved. The conditions are unlikely to improve during the rest of the day. Cancel the flight.

B - The front will move clear of the area by the late afternoon. Postpone until mid afternoon.

C - Conditions are suitable for the exercise during the early afternoon. Proceed.

D - The cloud base is forecast to be above the required operating altitude. Occasional precipitation with a thinning cloud base and general visibility improvement during the rest of the day. Proceed with caution.

.Q104 Refer to Appendix 'C' MET FORM 214.

Calculate the 2000ft wind velocity and temperature at position 50N 0E/W.

A - 18020kt +10°C.

B - 21513kt +11°.

C - 22013kt +12°C.

D - 24515kt +13°C.

Q105 Refer to Appendix 'D' MET FORM 215.

At position 55N 0°E/W the height of the forecast freezing level is:

A - 5000ft.

B - 6000ft.

C - 7000ft.

D - 4000ft.

Q106 Refer to Appendix 'D' MET FORM 215.

The feature identified by the letter J at position 60N 12W is:

A - a warm frontal system.

B - a quasi-stationary frontal system.

C - an occluded frontal system.

D - a cold frontal system.

Q107 Refer to Appendix 'D' MET FORM 215.

Study the TAF below and select the zone which would most likely give rise to a TAF relating to a sea level aerodrome at 1500Z.

EG** FT0800 030903 11005KT 9999 FEW010 BKN025 TEMPO 0912 SCT012 TEMPO 1421 6000 –SHRA SCT025 BECMG 2023 BKN006=

A - Zone 2.

B - Zone 1.

C - Zones 1 or 2.

D - Zone 3.

Q108 Refer to Refer to Appendix 'D' MET FORM 215.

A route is planned as indicated on the chart by a dashed line from 'A' Swansea in Zone 1 to 'B' Manston in Zone 3 with the Alternate 'C' Goodwood. The flight is to be undertaken during the forecast period at low level not below 1500ft AGL. The pilot is a PPL holder with neither an IMC nor Instrument rating and plans to fly the route under VFR.

Assume the route is entirely within the open FIR (Class G Airspace) and that no restricted airspace or hazardous areas exist along the route. The aircraft is not certificated for flight in known icing conditions.

Note: VFR requires that the aircraft remain clear of cloud, in sight of the surface with a minimum in flight visibility forward of the cockpit of 3km.

ETD 1430Z Flight plan time to destination 2hr 50min.

The 1400Z METAR for Swansea reads: 23015KT 9999 –SHRA SCT020 Q1005=

The TAF for MANSTON reads: 1019 2210KT 9999 SCT020=

Consider the above information together with the MET FORM 215 and select the safest course of action.

A - Both the departure METAR and destination TAF are above the pilot's minima, but a change of course en route to avoid isolated showers may prove necessary. Proceed with caution.

B - Both the departure METAR and destination TAF are above the pilot's minima, but the outlook suggests a deteriorating cloud base later in the forecast period to below the required minima so delay the flight until the next day.

C - The flight should be delayed until later in the day because isolated heavy thunderstorms are forecast for Manston around the planned ETA.

D - Both the departure TAF and destination METAR are above the pilot's minima, but the outlook suggests a deteriorating cloud base later in the forecast period to below the required minima so proceed with caution.

Q109 Refer to Appendix 'E' MET FORM 214.

Calculate the wind velocity and temperature at 2000ft over position 50°N 0°E/W.

A - 17515kt +5°C.

B - 35518kt +6°C.

C - 34512kt +7°C.

D - 31511kt +8°C.

Q110 Refer to Appendix 'F' MET FORM 215.

What is the height of the freezing level above mean sea level at position 50°N 2°E?

A - 3000ft.

B - 5000ft.

C - 6000ft

D - 7000ft.

Q111 Refer to Appendix 'F' MET FORM 215.

What is the meaning of the symbol X as shown at 0900Z on the right hand side of the chart at 55°30'N?

A - A cold front at the surface moving south south east.

B - A quasi-stationary front at the surface.

C - An occluded front moving slowly south east.

D - A warm front moving slowly south east.

Q112 Refer to Appendix 'F' MET FORM 215.

Study the METAR below and select the zone which would most likely give rise to METAR relating to a sea level aerodrome at 0900.

EG** 30012 9999 SHRA BKN012 OVC070 07/05 Q1020=

A - Zone 3.

B - Zone 2.

C - Zone 4.

D - Zone 1.

Q113 Refer to Appendix 'F' MET FORM 215.

The outlook for 1800Z indicated by the right hand outlook chart is:

A - a quasi-stationary front lying SW/NE forming across the North Sea and SE England.

B - a semi-occluded front across SE England lying NE/SW.

C - a quasi-stationary front forming at the surface across SE England lying SW/NE.

D - combined cold and warm fronts moving across SE England lying NE/SW.

Q114 Refer to Appendix 'F' Metform 215.

A route is planned along the English east coast as indicated on the chart by a dashed line from 'A' Shipdham in Zone 2 to 'B' Newcastle-upon-Tyne in Zone 3 with the Alternate 'C' RAF Lynton-on-Ouse in Zone 3. The flight is to be undertaken during the forecast period at low level but not below 1000ft agl avoiding high ground which is generally 500ft amsl. The pilot is a PPL holder with neither an IMC nor Instrument rating and plans to fly the route under VFR.

Assume the route is entirely within the open FIR (Class G Airspace) and that no restricted airspace or hazardous areas exist along the route. The aircraft is not certificated for flight in known icing conditions.

Note: VFR requires that the aircraft remain clear of cloud, in sight of the surface, with a minimum in flight visibility forward of the cockpit of 3km.

ETD 1030Z Flight plan time to destination 1hr 50min.

The 1000Z METAR for Shipdham reads: 07010KT 9999 -RA SCT020 01/03 Q1017 =

The TAF for Newcastle: 1019 08010KT 7000 -RASN SCT010 BKN020 BECMG 1013 9999 SCT025 BKN045=

Consider flight in Zones 2 and 3 at about 1100 UTC, study the available weather forecasts and select the safest course of action.

A - Plan for an immediate departure because the lowest cloud base en route is a 1000ft agl and the destination TAF is above the minima required for a visual approach.

B - Delay departure for 3 hours to allow the weather at Newcastle behind the frontal passage to clear.

C - The en route cloud base of 2000ft and occasionally broken at 2000ft would preclude flight under VFR. With the slow passage of the front to the south east there is a possibility of an immediate improvement. Proceed with caution.

D - The initial en route cloud base of 1000ft in Zone 2 and occasionally broken at 200ft together with in Zone 2 a general cloud base of 2000ft and occasionally broken cumulus base 1500ft with rain showers would preclude flight under VFR. With the slow passage of the front to the south east there is no possibility of an immediate improvement. Delay the flight for 24 hours.

Q115 Refer to Appendix 'G' MET FORM 214.

Calculate the wind velocity and temperature at 5000ft over position 55°N 005°W:

A - 14015 +5°C.

B - 15018 +2°C.

C - 21528 +5°C.

D - 18028 +2°C.

Q116 Refer to Appendix 'H' MET FORM 215.

At position 50N 002E, what height is the 0° isotherm:

A - 70ft.

B - 700ft.

C - 7000ft.

D - 1700ft

Q117 Refer to Appendix 'H' MET FORM 215.

Identify the feature over Ireland at position 53N 007W together with its direction and speed of movement.

A - An occluded front moving north-north-east over the surface at 10kt.

B - An quasi-stationary front moving north-east at 6000ft at 10kt.

C - A cold front moving east-north-east at 600ft at 10kt.

D - A warm front moving east-north-east at 600ft at 5kt.

Q118 Refer to Appendix 'H' MET FORM 215.

At 1500Z of which forecast zone would the following METAR be most typical of a sea level aerodrome:

EG** 1450 05006KT 9999 SCT035 BKN055 10/07

A - Zone 3.

B - Zone 4.

C - Zone 1.

D - Zone 2.

Q119 Refer to Appendix 'H' MET FORM 215.

Using both chart elements: the outlook for 2400Z forecasts:

A - little change with a low epicentre over the St. George's Channel.

B - conditions improving slowly over the next 24 hours.

C - the occlusion over the St. George's Channel will dominate conditions with little change over the next few days.

D - a warm front and high pressure system moving in from the SW will result in a slow improvement.

Q120 Refer to Appendix 'H' MET FORM 215.

A solo short route is planned for the purpose of undertaking a precision navigation exercise within Zone 3 indicated by the dashed line. The flight is to be undertaken during the forecast period not below 1500ft amsl at an indicated airspeed of 90kt. The pilot is a PPL holder without either an IMC or Instrument rating and plans to fly the route under VFR.

Note: VFR requires that the aircraft remain clear of cloud, in sight of the surface with a minimum in flight visibility forward of the cockpit of 3km.

Assume the route is entirely within the open FIR (Class G Airspace) and that no restricted airspace or hazardous areas exist along the route. The aircraft is not certificated for flight in known icing conditions.

ETD 1500Z Flight plan time to destination 45minutes.

In respect of the above, select the safest course of action.

A - The cloud base and visibility are above the minima at the planned ETD but forecast to deteriorate. Make an immediate departure.

B - The cloud base and visibility are both at or below minima but forecast to improve later with frontal movement. Delay the flight until late afternoon.

C - The cloud base is forecast to be below the designated altitude. With precipitation, lowering cloud base and occasional deteriorating visibility in rain and drizzle near the front, the flight should be postponed until at least the next day.

D - The cloud base is forecast to be at the designated altitude. With precipitation and occasional deteriorating visibility in rain and drizzle behind the front, the flight should be postponed until at the evening.

Q121 When water evaporates to form water vapour:

A - latent heat is absorbed.

B - latent heat is released.

C - specific heat is released

D - specific heat changes to latent heat.

Q122 An observer at the surface during the passage of an cold front associated with an Atlantic depression would experience.

	(i) pressure	(ii) cloud	(iii) visibility.
A -	increases steadily	not more than 4/8 medium level base	good
B -	rises then falls	5/8 with low base	poor with little change
C -	stops falling - steady	4/8 or less with very low base	poor with possibility of fog close to the front
D -	falls then rises	8/8 reducing in amount after precipitation with base rising	poor in precipitation followed by rapid improvement

Q123 The conditions experienced during flight within a cold air sector will most probably be:

A - good visibility below scattered to broken cumuloform cloud.

B - poor visibility below stratiform cloud.

C - good visibility below a high overcast.

D - poor visibility due a low level inversion.

METEOROLOGY
PRACTICE ANSWER SHEET

	A	B	C	D
1				
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	A	B	C	D
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	A	B	C	D
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60				

METEOROLOGY
PRACTICE ANSWER SHEET

	A	B	C	D
61				
62				
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81				

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101				
102				

	A	B	C	D
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121				
122				
123				

METEOROLOGY
ANSWERS

	A	B	C	D
1			X	
2				X
3	X			
4				X
5			X	
6				X
7		X		
8				X
9		X		
10			X	
11	X			
12	X			
13		X		
14			X	
15				X
16			X	
17			X	
18		X		
19				X
20		X		

	A	B	C	D
21				X
22				X
23	X			
24			X	
25			X	
26		X		
27	X			
28				X
29	X			
30		X		
31		X		
32	X			
33				X
34			X	
35			X	
36				X
37		X		
38		X		
39				X
40	X			

	A	B	C	D
41			X	
42				X
43				X
44		X		
45		X		
46		X		
47	X			
48				X
49	X			
50				X
51				X
52		X		
53	X			
54				X
55				X
56		X		
57	X			
58				X
59			X	
60		X		

METEOROLOGY
ANSWERS

	A	B	C	D
61				X
62	X			
63	X			
64		X		
65			X	
66			X	
67				X
68			X	
69	X			
70			X	
71				X
72			X	
73				X
74	X			
75			X	
76				X
77	X			
78		X		
79	X			
80				X
81		X		

	A	B	C	D
82				X
83			X	
84	X			
85	X			
86			X	
87				X
88	X			
89		X		
90			X	
91	X			
92				X
93		X		
94			X	
95			X	
96		X		
97				X
98				X
99		X		
100				X
101			X	
102	X			

	A	B	C	D
103	X			
104		X		
105		X		
106			X	
107				X
108	X			
109		X		
110				X
111	X			
112		X		
113			X	
114				X
115		X		
116			X	
117	X			
118				X
119	X			
120			X	
121	X			
122				X
123	X			

METEOROLOGY EXPLANATIONS

EM1(C)

TAF Decode: See also EM66 fig M24.

Airfield Identifier	EGNX	
Time code	130410	Issued on 13th at 0410 UTC
Time code	0615	For the 9 hour period from 0600 UTC to 1500 UTC.
Wind velocity	21005	Direction from 210°T speed 5kt.
Visibility	0550E	550 metres to the east.
Weather	DZ BCFG	moderate drizzle and fog patches.
Cloud amount	not reported	
Vertical visibility	VV002	200 ft.

EM2(D)

This is a long range TAF for the 18-hour period from 0200 UTC to 2000 UTC.

EM3(A)

AIRMET is a telephone service where forecast information is given in plain language for specific areas. The service is intended for use by aircrew not having access to meteorological forecast charts or area forecasts. Telephone numbers assigned to each area are published in the UK. AIP GEN 3-5-25

EM4(D)

See EM22.

The time of the report is for just before dawn (0450) during the autumn and the sky is clear as no cloud is reported. The wind is light (5kt) and the air temperature (9°C) has almost cooled to its dewpoint (8°C). With prevailing high pressure, the conditions are ideal for the formation of radiation fog before sunrise at 0600.

Note: The visibility is already poor at 2000 metres.

It is quite possible that CAVOK may exist much later during the morning as solar heating causes the fog to disperse.

EM5(C)

See fig M1.

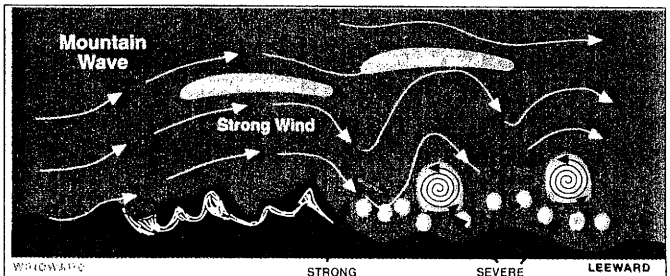


fig M1

Flying towards a mountain range from its leeward side (right to left in fig M1).

Lenticular clouds producing airframe icing form in the crest of a mountain wave and remain relatively stationary.

The airflow passing over the ridge from windward to leeward (left to right) follows the general undulation of the surface. This creates a strong downdraught just before the ridge is reached on the leeward side and strong updraughts would be experienced after passing the ridge to the windward side. The most dangerous point is approaching the range from the leeward side where the strong downdraughts may defeat the aircraft's rate of climb with disastrous consequences.

EM6(D)

See fig M1.

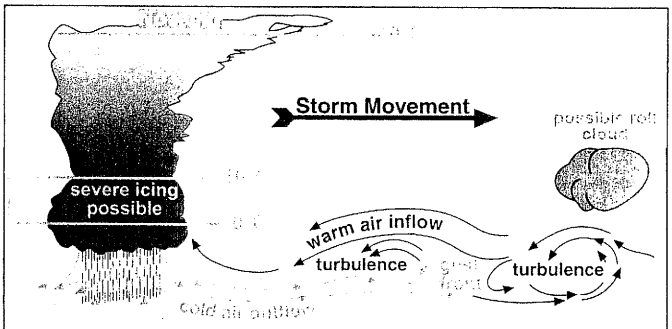
The severest turbulence is always downwind to the lee of the mountain below the level of the ridge, in or just below the roll cloud rotor, but generally within the layer between the surface and the top of the rotor. Observations have shown that turbulence here can be as severe as anything found in thunderstorms.

EM7(B)

See EM5, EM6 and fig M1.

EM8(D)

See fig M2.



A gust front due to the outflow of cold air and inflow of warmer air may extend as far as 15 to 20 miles ahead of a moving thunderstorm.

fig M2

A gust front due to the outflow of cold air and inflow of warmer air may extend as far as 15 to 20 miles ahead of a moving thunderstorm.

EM9(B)

See fig M3.

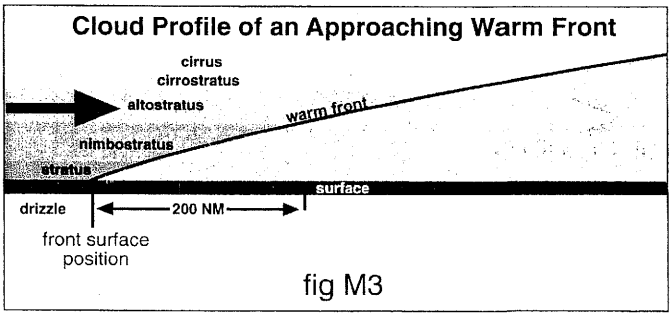


fig M3

A warm air mass overruns a colder air mass ahead creating a slope of about 1:150

In this example, stable warm moist air is lifted creating layers of stratus cloud up to high levels with a band of precipitation extending some 200 miles ahead of the surface position of the front. The high cloud (cirrus) may extend up to 600 miles ahead of the surface position of the front.

Note: Rain ceases at the front's surface position, but drizzle may follow.

The behaviour of frontal systems is very variable, but the accepted generalised yardstick in this instance is precipitation up to 200nm ahead of the front's surface position.

EM10(C)

See EM 09 and fig M3

A warm front produces cloud of horizontal development (stratus) at all levels due to the gradual slope of the front (1:150).

EM11(A)

See fig M4.

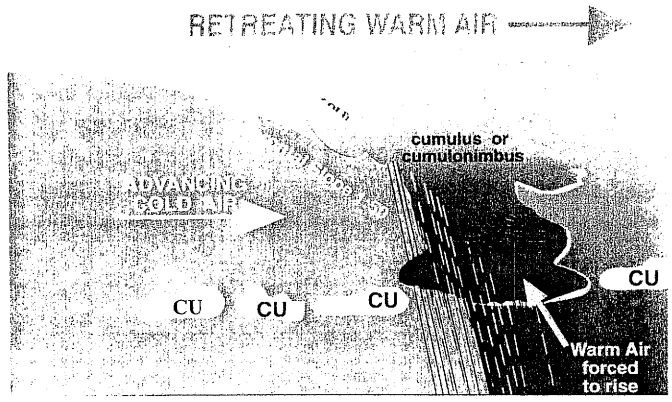


fig M4

A rapidly moving cold front, where a cold air mass is undercutting warmer moist unstable air ahead, is more likely to produce thunderstorm activity. A steep frontal slope is created (1:50) that rapidly lifts the warmer air ahead, producing cloud of extensive vertical development, (cumulonimbus) with the possibility of thunderstorm activity.

Note: Precipitation occurs both ahead and behind the surface position of the front.

EM12(A)

See fig M5.

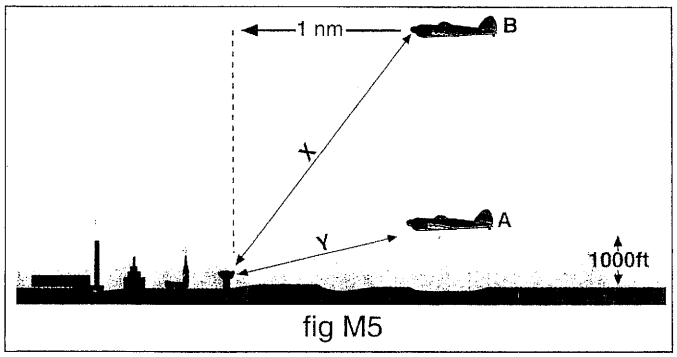


fig M5

Forward of the cockpit, vision of the surface may be improved by flying higher. Although the total distance of aircraft **B** to a point on the surface is greater than that for aircraft **A**, the distance **B** through the haze layer to the surface object is considerably less than distance **A**.

EM13(B)

Fog is cloud at the surface but classified as fog only when the visibility is less that 1000 metres. A front is the interface of two air masses of different temperatures and characteristic of an approaching warm front that is overriding colder air ahead is a lowering statiform cloud base, progressively reduced visibility and precipitation ahead of the front's surface position.
Frontal fog can form in two ways.

(a) Precipitation ahead of the front's surface position will evaporate at the surface and recondense in the colder air to form a shallow fog layer.

(b) The cloud itself in the warm air reaching the surface as the front passes which occurs mainly over rising ground which is also referred to as hill fog.

Occluded fronts are formed by the coalescence of cold and warm fronts. The warm air behind the warm front is progressively squeezed up and over the less warm air ahead and to a lesser extent over the advancing cold air behind resulting in a gradual reduction in the amount of warm air at the surface. When the warm air at the surface is depleted, the two fronts will have coalesced with the depression completely surounded by cold air. The occlusion actually lies along a trough of low pressure spreading out in a curved path that rotates around the centre of the low.

Being bounded by two colder air masses, weather aloft within an occlusion is often marked by low cloud, precipitation and poor visibility with light to moderate turbulence. The manifestation and degree of any weather encountered by the presence of an occlusion along a route is dependent upon the difference in physical characteristics of the two cold air masses and as such cannot be described by any one particular model.

EM14(C)

The three levels of cloud are LOW, MEDIUM and HIGH.

Low clouds do not have a prefix added to their name whereas medium- and high-level clouds are prefixed to further define their species. Hence, the level of any cloud may be identified as:

Low Level Cloud	no prefix
Medium Level Cloud	prefixed ALTO
High Level Cloud	prefixed CIRRO or simply Cirrus as a cloud species.

Correct answer

Low	**Medium**	**High**
Nimbostratus,	Altocumulus,	Cirrus

Note: 'Nimbo' prefixing 'stratus' or 'nimbus' suffixing 'cumulo' means rain bearing.

EM15(D)

A corona or halo results from light being refracted by moisture particles in medium level cloud such as thin altostratus.

EM16(C)

An unstable parcel of air is that which when forced to rise, will continue to rise when the initial lifting agent is removed. Air that continues to rise will continue to cool adiabatically. The initial lifting agent may be convection (caused by surface heating), orographic (caused by topography) or frontal lift. If the parcel of air continues to rise, once the condensation level is passed, water droplets will continue to condense out of the saturated air and cumuliform (heaped) cloud will progressively form.

When the air is initially very moist, showers may result from continued cloud development due to the rising air no longer able to support the growing water droplets. During precipitation, visibility may be severely restricted but the consequence of the strong updraughts and cloud formation is that solid particles in the air that restrict visibility are carried into the upper atmosphere resulting in generally good visibility at lower levels outside of precipitation.

EM17(C)

See fig M2 and fig M4 both of which illustrate mature CBs.

The life of a thunderstorm or cumulonimbus (CB) cell passes through three stages:

1 Developing or cumulus.

2 Mature

3 Dissipating.

During development, warm moist air is drawn into the cell causing updraughts which penetrate to great heights during the mature stage. At this time, an abundance of ice crystals and water droplets arepresent. This leads to precipitation which, at the surface, marks the transition from cumulus to mature stage. Cold precipitation causes a drag on the warmer updraughts and is one reason for the onset of cold downdraughts, initially, found only in the middle and lower levels of the cell but gradually

increasing in vertical and horizontal development eventually arriving at the surface and spreading out along the ground.

There now exists at and near the surface an inflow of warm air and an outflow of cold air (windshear) together with marked surface weather conditions. In addition, the friction between the downdraught and updraft near the surface at the front of the cell often causes a roll of cloud to form at the leading edge of the storm, producing severe and sudden changes in both wind strength and direction, both vertically and horizontally (windshear). This may exist for a considerable distance outside the cell.

If the cell is tilted, hail may fall from the overhang some distance outside the cell into clear air which can result in airframe damage. Severe turbulence or windshear encountered either inside or outside the cell may impose structural loads beyond the design capability of the airframe.

Within the cell, severe turbulence will be experienced due to the opposing up and downdraughts and descending supercooled water droplets striking an aircraft will cause rapid accretion of airframe ice when flying above the freezing level.

A single cell may grow from two miles up to five miles in diameter and a thunderstorm may consist of many cells along a front of several hundred miles. Mature CBs should be given a wide berth as hazards may be experienced within 10 miles of the cloud.

EM18(B)

See EM8, EM11 EM17, figs M2 and M4.

The correct answer concerns safety, which is not flying within the vicinity of CBs.

EM19(D)

Hail is produced by cumulonimbus during the mature stage. See EM17.

EM20(B)

'Nimbo' means rain bearing: see EM14.

EM21(D)

Stratus is a uniform layer cloud that develops horizontally. It does not have significant depth and often produces drizzle.

EM22(D)

Fog is cloud at the surface, therefore the air has to be cooled to its dewpoint for it to form.

Radiation fog only forms over land and often in the late evening, but more commonly around dawn after a cloudless night which has allowed surface heat to escape into the atmosphere.

If the temperature of warm moist air in contact with a cool surface is lowered sufficiently for it to reach its dewpoint, the condensation process will begin and radiation fog will form. Any wind must be light (2 - 8kt) as any wind much greater than this will cause the fog to be lifted into low cloud.

After sunrise, if solar heating can penetrate the fog, rising surface temperature will cause the fog to lift and disperse. However, after sunrise, it is the rising wind speed due to thermal mixing outside of the fog layer which is a dominant factor in fog dispersal.

EM23(A)

See fig M6.

The surface wind during a constant pressure gradient blows across the surface isobars, their direction differing either side of a warm front because it lies in a trough of low pressure.

The direction from which the wind is coming will alter in a clockwise direction (veer) as the front passes a surface position.

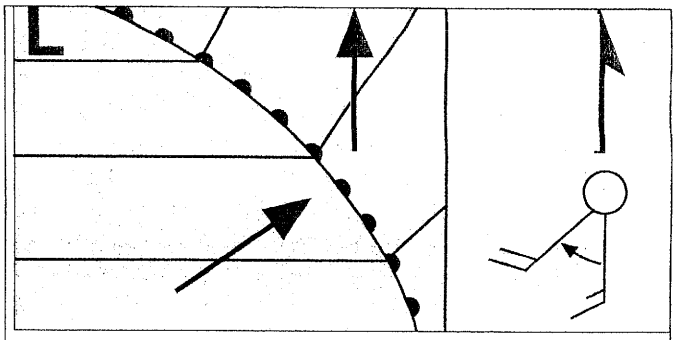


fig M6

EM24(C)

Surface friction will reduce the wind speed by approximately 20%. Because the surface wind speed is reduced, the Coriolis effect (that causes the wind above the surface to veer in the northern hemisphere) will be reduced so the surface wind will be backed from that at 1000ft by approximately 20°.

Therefore:	330°	– 20°	=	310°
	15kt	– 20%	=	12kt
	Surface wind		=	31012kt

EM25(C)

The INTERNATIONAL STANDARD ATMOSPHERE (ISA) specifies conditions of Temperature, Pressure, Density and Lapse Rate at all levels of the atmosphere up to an altitude of 36090ft (tropopause), above which the temperature remains constant at –56.5°C. See TEC2 fig T1 page 173.

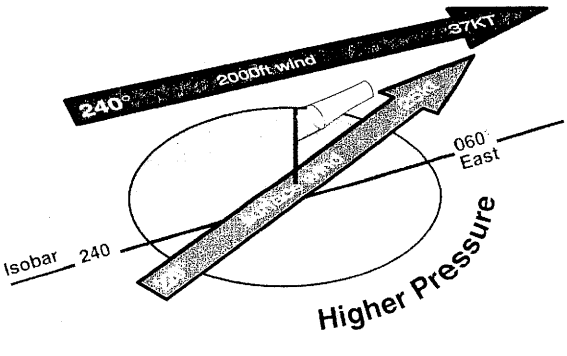
ISA – mean sea level values are:

Temperature +15°C
Lapse Rate –1.98°C/1000ft
Pressure 1013.25 hectopascals
Density 1225 grammes/cubic metre

Note: For the practical purpose of calculating the temperature at altitude when given the mean sea level temperature, use a lapse rate of –2°C/1000ft.

EM26(B)

See fig M7.



2000 wind veered to 24035kt

fig M7

Under clear skies, heating of the surface is strongest at 1400 local time, corresponding with the strongest surface winds.

From sunrise, warming of air at the surface causes it to expand, become less dense and rise. The cooler, denser, faster-moving air at 2000ft will subside to replace the rising surface air, setting up a significant mixing layer within which the wind will assume fairly uniform characteristics.

Blowing from about 2000ft above the surface, winds follow the general direction of curved and straight surface isobars formed by HIGH and LOW pressure systems.

Friction produced by air flowing over surface topography produces further modification by retarding the surface wind speed, further invigorating the mixing layer at the lower level. *Progressively below 2000ft, the wind speed due to surface friction* is reduced which in turn reduces the Coriolis effect causing the wind to back in direction.

Any frictional modification is dependent upon the surface nature, but compared to the free wind aloft, the general retardation of the surface wind both by day and by night means that the Coriolis effect is also reduced.

The surface wind therefore when compared to the wind aloft is backed in direction to flow approximately across the surface isobars in the general direction of the low pressure system.

Overland under clear skies, the velocity of the 2000ft wind will be about 50% faster than the surface wind.

Due to the increased Coriolis effect it will veer in direction from the surface wind by approximately 25°.

Therefore: 220° + 25° = 245°

25kt + 50% = 25 + 12.5 = 37.5kt

2000 wind = 24537kt

Nearest answer = 24035kt.

EM27(A)

The ISA Lapse Rate of 1.98°C/1000ft is an arbitrary standard rounded up to 2°C/1000ft for the practical purpose of calculating the temperature aloft, or determining how the actual temperature aloft differs from ISA.

ISA at 2000ft = +15°C – (2°C x 2)

ISA at 2000ft = +15°C – 4°C = +11°C

OAT at 2000ft = +5°C which is 6°C lower than ISA

OAT at 2000ft = ISA –6

EM28(D)

The accepted temperature model of the Earth's lower atmosphere is that it cools adiabatically with altitude increase by approximately 2°C/1000ft. After sunset, surface heat absorbed during the day radiates upwards and as the earth cools, air in contact with the surface will cool by conduction to a temperature which is lower than that at 2000ft. This is a temperature inversion where a shallow layer of the atmosphere increases in temperature for just a few hundred feet.

Besides fog at the surface, generally poor visibility together with slight turbulence may be encountered during flight through an inversion layer.

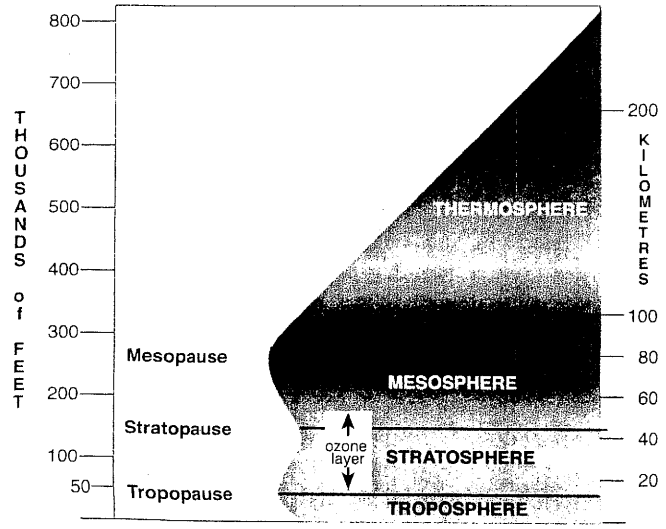


fig M8

EM29(A)

The troposphere. See fig M8.

EM30(B)

The wave length of the incoming solar radiation is too short to be absorbed by the lower atmosphere although some is absorbed by cloud and atmospheric impurities. Radiation reaching the Earth's surface is absorbed and then re-radiated at a modified wave length that heats the air in close proximity to the surface. Air in contact with the surface is also heated by conduction.

EM31(B)

See fig M9.

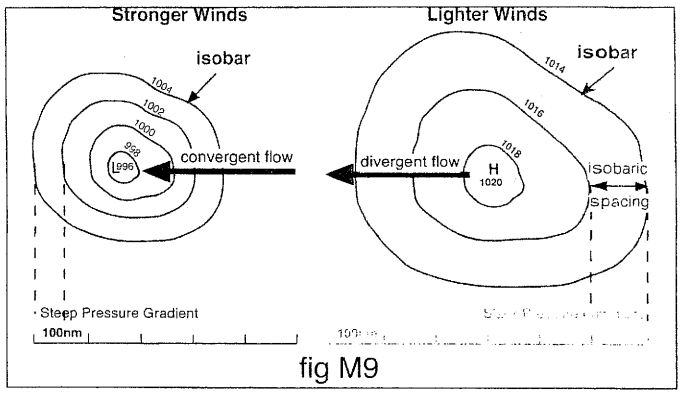


fig M9

A region of high pressure to a cyclonic region or lower pressure.

A pressure gradient may be described as the uniform change of pressure that exists between two adjacent air masses of different density temperature and pressure. Air will always diverge away from a region of high pressure (anticyclone) and converge to fill a region of low pressure (cyclone).

Note: The Coriolis effect will cause the air flow to deflect to the right in the northern hemisphere.

EM32(A)

See fig M10.

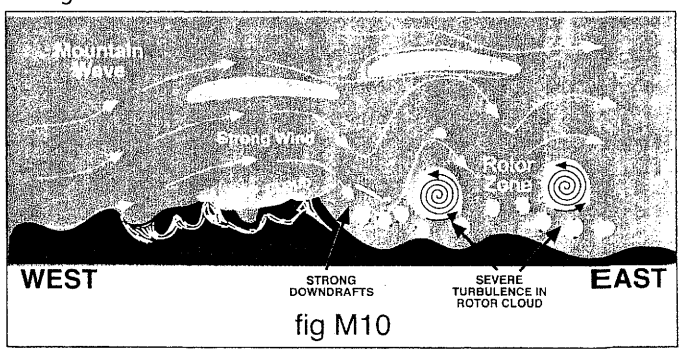


fig M10

Flying towards the range from east to west.

The airflow passing over the ridge from windward to the leeward ((WEST to EAST) follows the general undulation of the surface. This creates a strong downdraught just after the ridge on the leeward side. The most dangerous point is approaching the range from the leeward side or east in this instance, where strong downdraughts may defeat the aircraft's rate of climb with disastrous consequences.

EM33(D)

Cumulonimbus (CB)

See EM17.

For a CB to develop there must be a deep, unstable layer at least 10,000ft in height and three conditions must exist:

(i) Very moist unstable air at the lower levels.

(ii) A prevailing steep ELR remaining greater than the DALR even above the condensation level causing rapid cooling of the environment surrounding the unstable rising air.

(iii) An initial trigger action that causes the air to be lifted rapidly. This may be convective through a sudden rise of surface temperature, orographic or frontal action, the type of action identifying the storm type.

EM34(C)

Become less dense and rise.
Warm dry air in contact with a water surface will cause surface moisture to evaporate into water vapour which will be held in suspension by the warm dry air.

Water vapour is less dense than air, so when the water vapour content of a parcel of air is increased, it will become less dense and rise. As the air rises, it will expand and cool adiabatically and if the temperature falls below the dewpoint temperature, the water vapour will re-condense to form cloud.

EM35(C)

When a parcel of unsaturated air is forced aloft, for example by orographic lift, it will expand, reducing in density and subsequently cool adiabatically so its temperature will fall.

Warm air has th capacity to hold more water vapour than cooler air. Hence, if the temperature of a parcel of air falls, its capacity to hold water vapour will reduce.

Relative humidity is the amount of water vapour contained by a parcel of air at a given temperature compared with the maximum amount of water vapour that parcel of air could hold at the same temperature. Relative humidity is expressed as a percentage.

$$\frac{\text{Water vapour content at a given temperature}}{\text{maximum water vapour content at the same temperature}} \times \frac{100}{1} = \%$$

If temperature is reduced, relative humity will rise because the air's capacity to hold water vapour is reduced.

EM36(D)

See fig M11.

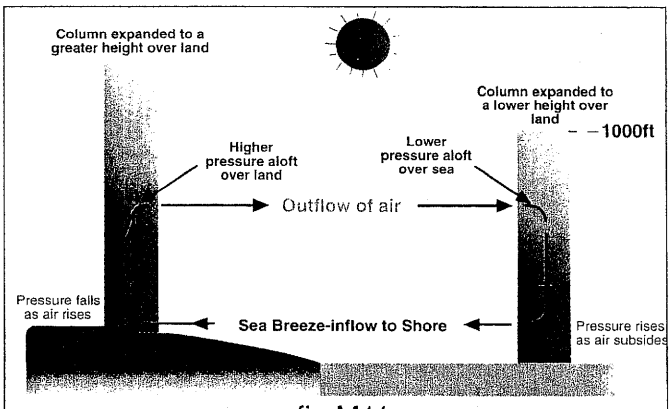


fig M11

Land and sea breezes are produced by a temperature difference between land and water surfaces.

The atmosphere is heated by solar radiation that is re-radiated from the Earth's surface at a wave length that heats the air from below. Under clear skies, surface heating over the land by day causes the air to rise, forming relatively high pressure aloft at about 1000ft agl. A sea surface reflects less heat back to the atmosphere than the land so the air at sea level, being cooler than the land, will expand less with lower pressure aloft at about 1000ft.

The higher pressure aloft over the land will flow out to sea to fill the area of lower pressure aloft, which then subsides to create higher pressure at the surface over the sea.

The outflow of air aloft from land to sea will create relatively low pressure over the land surface, producing an inflow of air at the surface from sea to shore. This is an onshore wind or sea breeze.

As the coast line runs east-west, and the sea breeze is just beginning to establish, the Coriolis effect would have had little time to modify the direction of the on-shore flow so an into wind runway would be 18,

EM37(B)

See fig M12.

Polar maritime air.

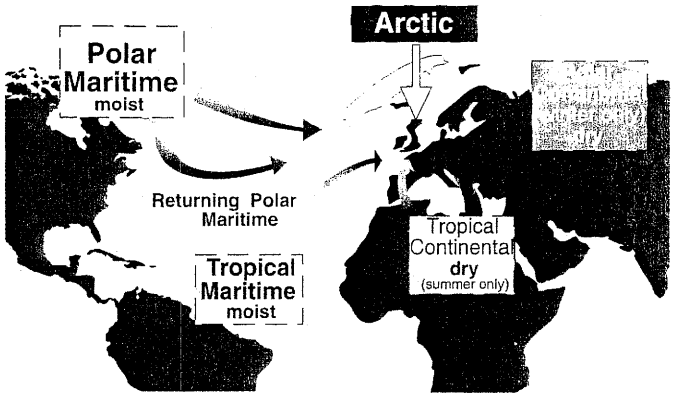


fig M12

Predominantly cold and stable at source, Polar Maritime Air becomes warmer and unstable due to surface heating as it tracks south east across the North Atlantic. The moisture content increases because of surface evaporation giving rise to convective cumuloform cloud with increasing instability which is intensified during summer daytime due to surface heating and orographic lift as it passes the western U.K. coastline. Cumuloform cloud and CBs may give rise to thunderstorms or showers during which visibility will be poor. The air will remain unstable, although losing moisture due to precipitation as it moves inland which results in improved visibility.

EM38(B)

This is a warm front. See EM9 fig M3.

EM39(D)

Because the surface dewpoint temperature is given, you are required to account for its affect when calculating the cloud base.

The dewpoint decreases by 0.5°C/1000ft, so the DALR of 3°C/1000ft is modified to 2.5°C/1000ft

$$\text{Cloud base} = \frac{\textit{surface temperature} - \textit{dewpoint temperature}}{\text{DALR}}$$

$$= \frac{(21°C - 7°C)}{-2.5°C/1000ft} = \frac{14°C \times 1000ft}{-2.5°C} = 5600ft$$

Cloud base = 5600ft agl

Note: The question asks 'at approximately what height' so take the nearest answer which, in this case, is 5500ft.

EM40(A)

See EM17 and EM33.

EM41(C)

An anticyclone or high pressure system affecting the UK during the winter will produce an outflow or divergent flow at the surface. This will stimulate subsidence to replace air that is depleted at the surface.

Subsiding air will warm adiabatically and as its pressure increases with a corresponding reduction in relative humidity, it will become very stable. If the air temperature rises above the dew-

point temperature, any cloud will disperse. Adiabatic warming above the surface may cause the temperature aloft to exceed that at the surface thus producing an inversion layer.

This will trap atmospheric impurities within the inversion layer producing very poor in flight visibility.

EM42(D)

Stratus (ST) is a uniform layer cloud generally existing from near the surface up to about 2000ft, above which the air is stable. Any precipitation produced will be light in the form of drizzle and either intermittent or continuous.

EM43(D)

To the right and at 2000ft, flow approximately parallel to the surface isobars.

Cyclones and anticyclones

When an anticyclone or HIGH is feeding a LOW, the pattern of and straight isobars created determine the general direction of airflow above the surface and are the subject of geostrophic and gradient winds.

Winds Above the Surface

Both straight and curved isobars depicted on weather charts are a map of surface pressures and are therefore surface isobars, but represent the general wind direction at about 2000ft. These straight and curved wind flow patterns produce respectively straight geostrophic winds and curved gradient winds and are now discussed in the context of the northern hemisphere.

Geostrophic winds (straight)

See fig M13.

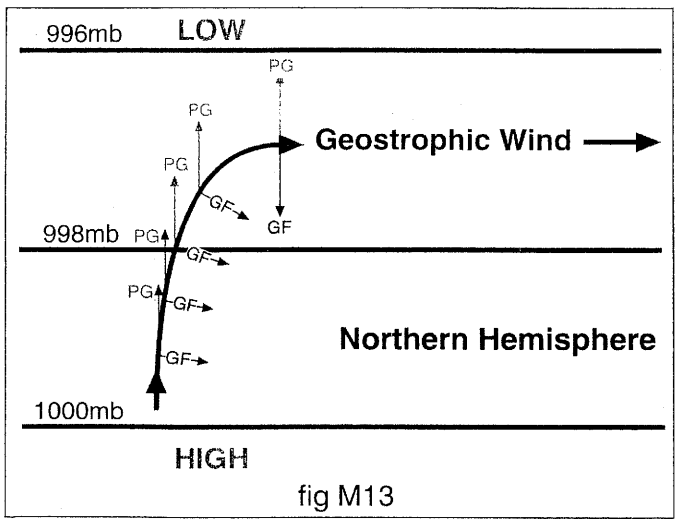


fig M13

Initially, the flow will be due to a pressure gradient (**PG**) flowing from HIGH to LOW but gradually influenced to turn right by the Coriolis effect hereon referred to as the *geostrophic force* (**GF**). **GF** acts at 90° to the flow to cause it to turn right. Therefore, a geostrophic wind is the product of two forces **PG** and **GF**.

Because it takes time to take effect, the value of **GF** will lag behind the value of **PG** and the maximum value of **GF** is dependent upon wind speed or **PG.** When **GF** attains its maximum value, **PG** and **GF** will be equal and opposite, establishing equilibrium, resulting in a straight wind that follows the straight isobaric pattern.

Gradient winds (curved)

Blowing from about 2000ft above the surface, gradient winds follow curved surface isobars formed by HIGH and LOW pressure systems. Gradient winds are the product of three forces in equilibrium: the two already mentioned, **PG** and **GF,** plus a centripetal force (**CF**) which is the product of rotation acting towards the centre of the system. In this instance, the effect of **CF** constrains the wind to follow a curved path by off setting the balance of **CF** = **PG** which produces a straight balanced Geostrophic Wind.

Around a high

See fig M14.

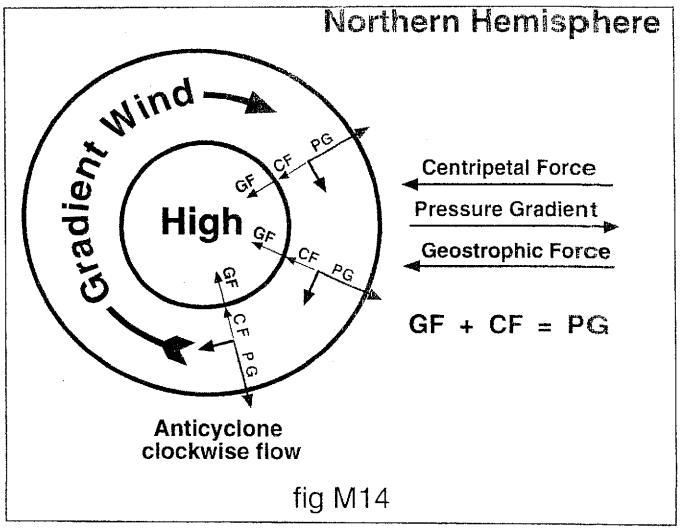


fig M14

Initially flowing directly from HIGH to LOW across the isobars, the wind is modified to turn right under the influence of **GF**. Centripetal Force **CF** acts in the same direction as **GF** towards the centre of the system.

Once the circular flow is established, the combined effect of **CF** and **GF** must be equal and opposite to **PG** which acts outwards from the centre of the HIGH.

Around a low

See fig M15.

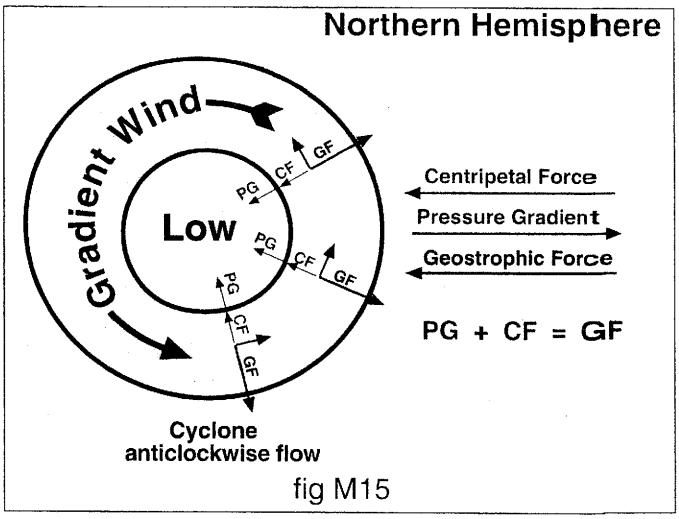


fig M15

The initial flow, again directly from HIGH to LOW, will be at 90° to the isobars following the direction of the pressure gradient **PG** but modified to turn right under the influence of **GF**.

Centripetal force **CF** in this instance now acts in the same direction as **PG**, and once the circular flow is established, their combined effect must be equal and opposite to **GF**. If **PG** across a High is compared with the value of **PG** across a Low, its effect is reduced by an amount equal to **CF**.

Because wind speed is proportional to the pressure gradient, the wind speed around a LOW will be less than that around a HIGH at the same latitude with the same air density and pressure gradient.

EM44(B)

See EM43

EM45(B)

See fig M16.

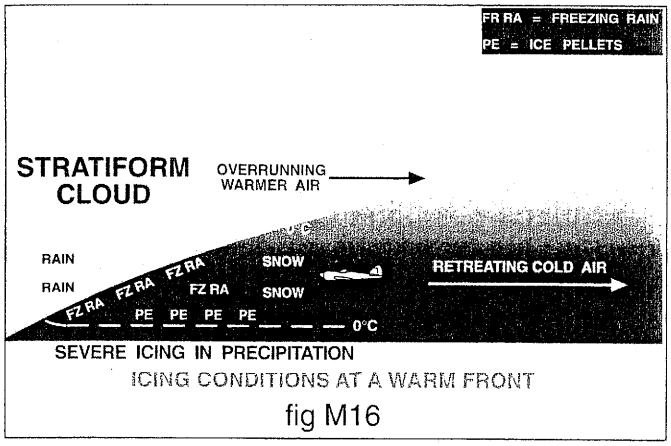


fig M16

If the front is active, the weather resulting from warm moist air over running a retreating cold polar air mass in winter would be widespread cloud and precipitation that could affect flight operations for a considerable period of time.

The skin temperature of an aircraft that has been flying for some time at low level in sub zero cold polar air will also be below 0°C.

Warmer air overrunning the cold polar air may produce rain precipitation which will fall into the sub zero air below. Precipitation striking a cold airframe will freeze, causing a rapid build up of clear ice (rain ice).

Note the vertical position of the freezing levels in the cold polar air and the warmer air aloft. The severest icing conditions exist between these two levels within the polar air mass close to the frontal interface.

EM46(B)

See EM37 fig M12.

Tropical maritime air is warm and moist at source. Whilst tracking north east from the Azores, it will pick up moisture, increasing its relative humidity as well as being cooled from below causing the air to subside intensifying its stability. During the winter, tropical maritime air because it is warmer than the prevailing polar maritime and polar continental air masses affecting the North Atlantic and Europe will give rise to milder temperatures with stratiform cloud and drizzle including the possibility of advection fog and poor visibility.

During the spring and early summer, frequent advection fog in the western approaches results from warm moist air flowing over a cooler oceanic surface, which may affect the coastal and inland areas of Cornwall and Devon.

During the summer, UK land temperatures, being higher than the North Atlantic, will heat the air mass from below causing any stratiform cloud to disperse, but poor visibility remains a dominant feature.

EM47(A)

Advection fog, as the name implies, is formed by advective action understood as the movement of air over the surface. Unlike radiation fog, advection fog will form over land or sea giving two types, the latter often drifting inland to become a particular hazard to operations at coastal aerodromes.

Warm moist air under the influence of light to moderate winds flowing over a colder land or sea surface is the catalyst for advection fog to form with wind strength not being critical, only necessary for advective action as fog may persist in wind speeds up to 15kt.

Over the sea, advection fog forms during late winter and early spring in and around the Western Approaches when the English Channel has been cooled to its lowest temperature. Very moist tropical maritime air arriving from the Azores will have been cooled from below as it tracked north east, causing it to subside and stabilise with a rising relative humidity due to surface evaporation and cooling.

Advective cooling may lower the surface air temperature to below its dewpoint temperature, resulting in condensation and fog formation by day or night irrespective of cloud cover. The fog may penetrate the Irish Sea or drift inland over Devon and Cornwall.

If land temperatures are low with light winds the fog will persist but stronger prevailing winds will lift the fog to form low stratus spreading further inland to give hill fog over rising ground. If the land surface is warm with light winds, the fog will soon evaporate and disperse as the air is heated from below.

Overland, advection fog may form under thaw conditions when a warm moist air mass replaces a cold air mass that has released snow precipitation or produced a heavy hoar frost.

Advection of the warm moist air over the colder surface will cause the air temperature to fall, increasing its relative humidity which is further increased as the air absorbs water vapour produced by melting and evaporation of snow or frost. Should the air be lowered to below its dewpoint temperature, fog will form by day or night irrespective of cloud cover.

EM48(D)

See fig M17.

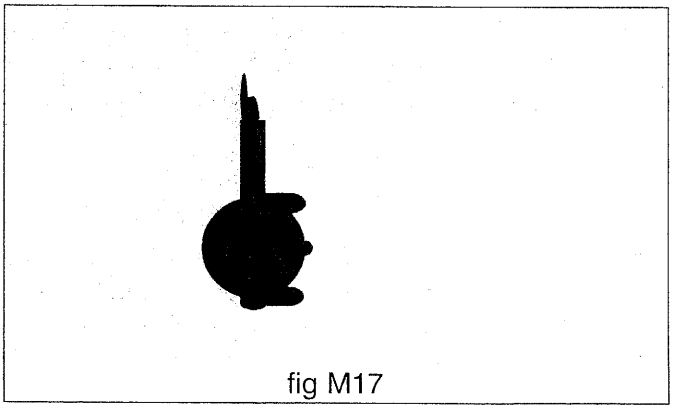


fig M17

Buys Ballot's Law states that, in the northern hemisphere, if you stand with your back to the wind, the area of low pressure will be to your left.

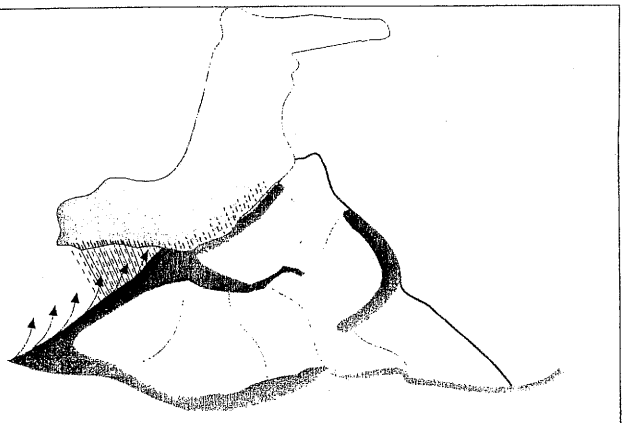
In this scenario, the aircraft is experiencing constant right (stbd) drift, so the wind is coming from the left. With your back to the wind, the area of low pressure will be to your left which is ahead of the aircraft. As the aircraft is flying into an area of lower pressure where the QNH will be lower, the altimeter sub-scale will be set too high and therefore **over-read** with the aircraft flying progressively lower.

EM49(A)

See fig M18.

When unstable air is forced aloft due to orographic lift, it will expand and cool adiabatically. If very moist, the cloud base (saturation level) will be only a few hundred feet above the point of ascent. Provided the ELR remains higher than the SALR, sustaining the inherent instability, the air will continue to rise with cloud developing vertically into the middle layers.

The danger to pilots is cloud development and precipitation falling on the windward side obscuring the high ground.



Moist Unstable Air

fig M18

EM50(D)

See fig M10

When a stable air mass is forced to rise and cool adiabatically, due to orographic lift for example, lenticular cloud will often form over the mountain crest and appear to be stationary. At this point, the air has become saturated with water vapour which will either condense to form cloud composed of water droplets or in the case of very cold air, sublimate to form cloud composed of ice crystals.

The apparant lack of movement of lenticular cloud above a mountain crest is generally due to the air reaching its saturation point at that level. After passing the crest, the wave form of the air flow and subsequent subsidence will cause the decsending air to warm adiabatically, lowering the relative humidity and arresting cloud development.

EM51(D)

When a cold front is approaching a surface position, the temperature will fall.

Moisture lost from the air in the form of heavy precipitation from cumulus cloud will cause both the relative humidity and dewpoint temperature to fall.

As a cold front passes a surface position, assuming a similar isobaric spacing both ahead and behind the front, the wind will veer and decrease in strength.

EM52(B)

See EM47.

EM53(A)

See fig M19.

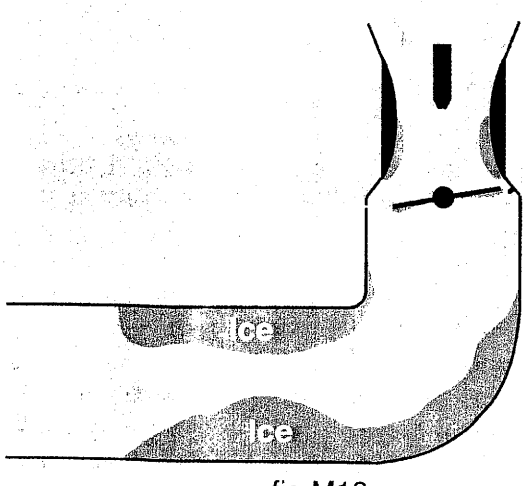


fig M19

A carburettor venturi causes the air passing through it to increase in velocity which results in a drop in pressure. A pressure reduction produces adiabatic cooling of the air that in turn lowers the temperature of the carburettor venturi. If the airflow is cooled, its relative humidity will increase.

Fuel entering the venturi is vapourised (changes state by evaporation). This will require the fuel in its liquid state to gain latent heat in order to evaporate.

The fuel takes latent heat from both the air passing through the venturi and the carburettor body, setting up a cooling process that may lower the temperature of the carburettor body and the airflow within it by as much as 30°C.

This cooling process may achieve two things:

1 The air temperature may be reduced to below its dewpoint temperature initiating condensation.

2 The carburettor body temperature may be reduced to below 0°C.

Should both 1 and 2 occur, water vapour in the air that is in contact with the sub-zero carburettor body will SUBLIMATE into ice which will form around and downstream of the throttle butterfly choking off the airflow to the engine.

Sublimation is the process of changing state directly from a gas to a solid, in this case, from water vapour directly to ice, missing out the water droplet (liquid) state.

Conditions most favourable to carburettor icing are:

1 Warm weather and high humidity, as this will provide an abundant supply of water vapour. The greater the relative humidity, the smaller the temperature drop required to reach the dewpoint.

2 Low power settings in the descent, when the throttle butterfly is only partially open, will produce a large velocity increase and corresponding large pressure reduction as the air accelerates to pass the restrictive space created by the partially open throttle butterfly and carburettor wall. This produces a significant cooling effect which may cause moisture present to form as ice on the down stream side of the throttle butterfly, further restricting the flow of fuel/air mixture to the engine. This is known as throttle ice.

Carburettor icing can occur in clear air with temperatures up to +25°C because the carburettor is capable of producing a temperature reduction of up to 30°C.

Note: Warm air has a greater capacity to hold water vapour than colder air, so warm air is capable of producing larger amounts of ice. Below –5°C carburettor icing is improbable, as air at low temperatures is relatively dry and incapable of producing ice in any significant quantity.

EM54(D)

See EM53 fig M19.

EM55(D)

Lift to form thin low stratus cloud.
Fog is cloud at the surface, therefore the air has to be cooled to its dewpoint temperature for it to form.

Radiation fog only forms over land and often in the late evening, but more commonly around dawn after a cloudless night which has allowed surface heat to escape into the atmosphere. If the temperature of warm moist air in contact with a cool surface is lowered sufficiently for it to reach its dewpoint temperature, the condensation process will begin and radiation fog will form. Any wind must be light (2 - 8kt), as any wind much greater than this will cause the fog to be lifted into low stratus cloud.

EM56(B)

See fig M20.

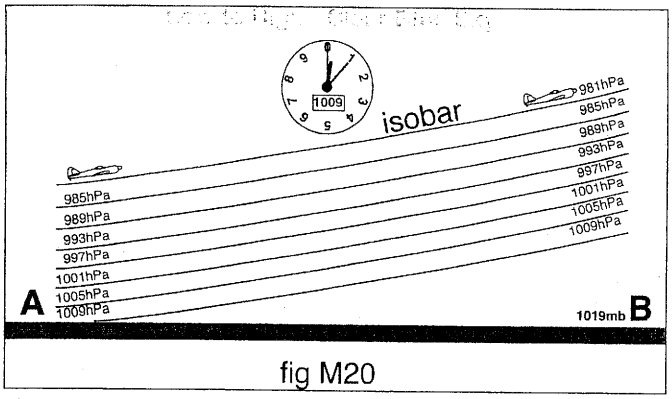


fig M20

The QNH at **B** is higher by 10hPa. The altimeter, if the sub-scale remains unchanged, will indicate a lower altitude equivalent to 10hPa. An aircraft, through its altimeter, follows a level of constant atmospheric pressure or isobaric level. If atmospheric pressure changes, the aircraft will climb or descend to maintain that same isobaric level.

Overhead '**A**' the aircraft is seen to be at the 981hPa isobaric level which it would follow to maintain a constant indicated altitude.

As the atmospheric pressure increases whilst en route to '**B**', the aircraft will climb to follow the 981hPa isobaric level and the correct indicated altitude.

EM57(A)

See fig M21

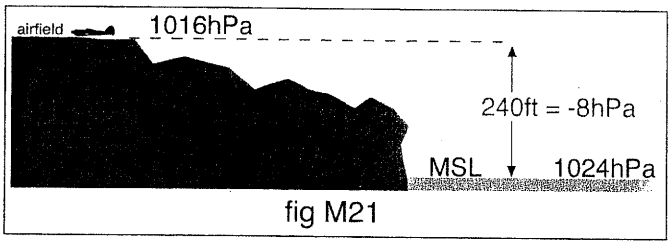


fig M21

The airfield is above mean sea level so the airfield pressure (QFE) will be less.

If 1 hPa = 30ft the airfield QFE = QNH - $\frac{240ft}{30ft/hPa}$

= 1024hPa - 8hPa = 1016hPa

EM58(D)

See fig M22.

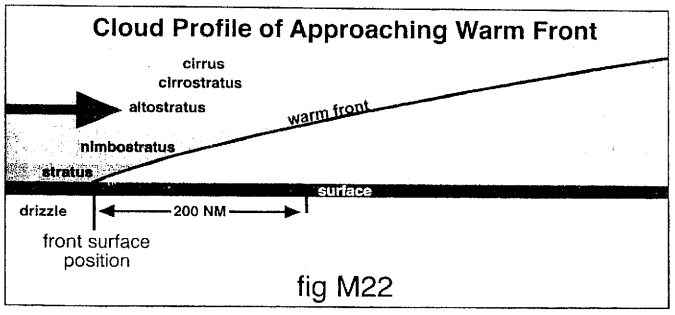


fig M22

A warm front produces cloud of horizontal development (stratus) at all levels due to the gradual slope of the front (1:150). These in ascending order are seen in fig M22.

EM59(C)

See EM53.

Low power settings, high humidity and warm weather.

EM60(B)

See fig M23.

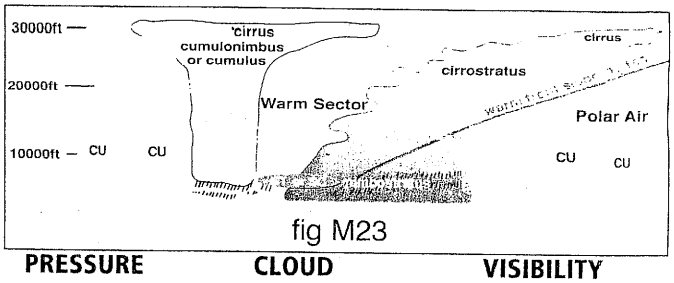


fig M23

PRESSURE	CLOUD	VISIBILITY
falls then rises	8/8 slowly reducing with base rising	poor to moderate with the possibility of fog close to the front.

Warm air is less dense than cold air so pressure will fall as the front approaches, but the fall is arrested as the front passes.

Cloud thickens as the front approaches with a very low base.

Very moist air and a low cloud base will produce poor visibility and possibly fog.

EM61(D)

See fig M23.

The warm sector, as the name implies, is an area of warm air behind a warm front and ahead of a normally faster moving cold front. The deterioration of visual conditions associated with a warm front tends to prevail in the warm sector with moderate to poor visibility below broken or scattered stratiform cloud.

EM62(A)

When CAVOK is included for any forecast period it means, amongst other things: Visibility 10km or more with no cloud below 5000ft or minimum sector altitude, whichever is greater, and no cumulonimbus.

For a two-hour Trend or Outlook (TEND) at the end of a METAR to be amended by the issue of a SPECI (Special METAR), during the two-hour period for which it was originally issued, the cloud base must fall to below 1500ft or CB develop.

EM63(A)

NOSIG may replace a trend if there are no expected significant variation to the observed weather during the two hour forecast period following the time of observation and again may only be included if a forecaster rather than a meteorological observer is on duty.

EM64(B)

Decode the METAR.

Airfield code	=	Not given.
Time group	=	Not given.
28005kt	=	Surface Wind from 280°T at 05kt.
9999	=	Visibility greater than 10km.
SCT///	=	Cloud amount 2-4oktas, Base omitted
12/05	=	Surface temp +12°C/dewpoint temp +5°C.
Q1024	=	QNH 1024hPa.
NOSIG	=	No significant change for next 2 hours.

The cloud base represents the level at which air has become saturated and the condensation process occurs. The temperature at which saturation is reached and cloud forms is known as the dewpoint temperature, occurring at the condensation level. The air below the cloud is unsaturated so any cooling will occur at the DALR 3°C/1000ft.

Because the surface dewpoint temperature is given, you are required to account for its effect when calculating the cloud base.

The dewpoint decreases by 0.5°C/1000ft, so the DALR of 3°C/1000ft is modified to 2.5°C/1000ft.

$$\text{Cloud base} = \frac{\text{surface temperature} - \text{dewpoint temperature}}{\text{DALR}}$$

$$= \frac{(12°C - 5°C)}{2.5°C/1000ft} = \frac{7°C \times 1000ft}{2.5°C} = 2800ft$$

nearest answer - Cloud base = **2500ft agl**.

EM65(C)

A continuous broadcast of selected aerodrome weather observations and forecasts on dedicated frequencies.

EM66(C)

See fig M24.

Significant Present and Forecast Weather Codes

Qualifier		Weather Phenomenon		
Intensity or Proximity	Descriptor	PRECIPITATION	OBSCURATION	OTHER
- Light	BC ... Patches	DZ ... Drizzle	BR ... Mist	DS ... Duststorm
Moderate (no qualifier)	BL ... Blowing	FZ ... Freezing	DU ... Widespread Dust	FC ... Funnel Cloud (tornado or water spout)
+ Heavy (Well developed in the case of FC and PO)	FZ ... Freezing	GR ... Hail	FG ... Fog	PO ... Dust/Sand Whirls (dust devils)
VC In the vicinity (not at the aerodrome but not further away than approx 8KM from the aerodrome perimeter)	MI ... Shallow	GS ... Small Hail (5mm dia and/ or snow pellets)	FU ... Smoke	SQ ... Squall
	PR ... Partial (covering part of the aerodrome)	IC ... Ice Crystals (Diamond dust)	HZ ... Ice Crystals	SS ... Sandstorm
	SH ... Showers	PL ... Ice Pellets	VA ... Volcanic Ash	VA ... Volcanic Ash
	TS ...Thunderstorm	RA ... Rain		RE ... Recent (recent weather)
		SN ... Snow		

fig M24

+SHSNRA = Heavy showers of snow and rain.

EM67(D)

2 hours.

UK. AIP MET 0-8

EM68(C)

The speed of travel of a warm front is generally two thirds of that of a cold front.

EM69(A)

See EM 66 fig M24.

Observed on the 13th day of the month at 0350Z.

Surface wind 320°T/05kt.

Minimum visibility 400metres to the north.

Moderate drizzle, with fog patches.

Vertical visibility 200ft.

EM70(C)

Presuming 1020hPa at '**A**' is the QNH, the altimeter at '**A**' on departure will read 800ft.

If the QNH was the same at '**B**' the altimeter would read 500ft on arrival.

The pressure is lower at '**B**' by (1020hPa - 999hPa) 21hPa so the altimeter at '**B**' thinks the aircraft is actually higher by the equivalent of 21hPa.

= 21hPa x 30ft/hPa = 630ft.

The altimeter will read 500ft + 630ft = 1130ft.

High to Low, **look out below** – OVER-READING

Note: When the altimeter sub-scale setting is moved to a lower setting, the indicated altitude will also be reduced and vice versa. In this case, if the altimeter sub-scale setting was reduced at '**B**' from 1020hPa to 999hPa, the indicated altitude would reduce by 630ft to 500ft.

EM71(D)

The only time the wind direction is reported with reference to magnetic north is when taking off or landing so the pilot can determine the cross wind component for the active runway. This is passed to the pilot by either the controller or the pre recorded Aerodrome Terminal Information Service (ATIS).

TAFs METARs and VOLMETs all give wind direction referenced to true north.

EM72(C)

Thunderstorms. See fig M25.

SIGNIFICANT WEATHER SYMBOLS

	Thunderstorm		Rain
	Tropical cyclone		Snow
	Severe squall line		Widespread blowing snow
	Hail		Shower
	Moderate turbulence		Severe sand or dust haze
	Severe turbulence		Widespread sand or duststorm
	Marked mountain waves		Widespread haze
	Light aircraft icing		Widespread mist
	Moderate aircraft icing		Widespread fog
	Severe aircraft icing		Freezing fog
	Freezing precipitation		Widespread smoke
	Drizzle		Volcanic eruption

fig M25

EM73(D)

Fog. See EM72 fig M25.

EM74(A)

METAR = Meteorological Aerodrome Report.

It is a routine weather report concerning a specific aerodrome.

EM75(C)

See fig M26.

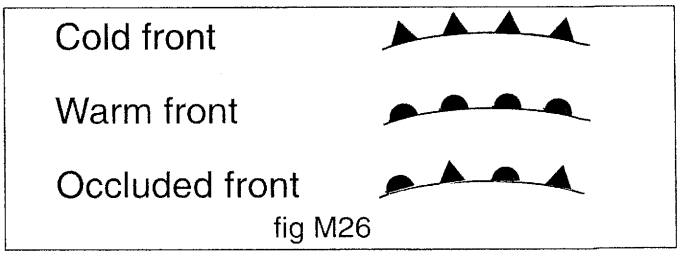


fig M26

An occluded front marks the final stages of a frontal depression and is formed when the faster moving front of a cold air mass overtakes a warm air mass front.

This causes the warm air to be squeezed upwards at a rate which is dependent upon the temperature difference between the two air masses. During the early stages of occlusion, statiform cloud associated with warmer air can conceal cumulonibus cloud and thunderstorm activity associated with an active the cold front.

Particularly if the rising air is unstable, flight through an occlusion will could encounter a marked difference in wind direction either side of the front and possibly severe weather.

EM76(D)

Severe icing. See EM72 fig M25..

EM77(A)

Low level windshear that results in a significant loss of headwind component may result in a serious accident when on final approach and should, wherever possible, be avoided.

If fuel endurance permits, the pilot should first consider diverting or, where this course of action is not practical, the approach should be delayed if conditions are forecast to improve.

EM78(B)

During the day, surface heating causes the surface air to rise and mix with the faster moving air aloft up to about 2000ft agl. The faster moving air aloft descends to replace the rising surface air which itself is heated and rises, setting up a convective mixing layer.

The longer this mixing process is sustained, the difference in direction and velocity between the surface and 2000ft winds becomes smaller. The surface wind will veer and increase in velocity while the 2000ft wind will back and decrease in velocity.

During the evening, as the surface cools, convective action and mixing decreases so the process is reversed. The 2000ft wind veers and increases and the surface wind backs and decreases.

EM79(A)

See fig M27.

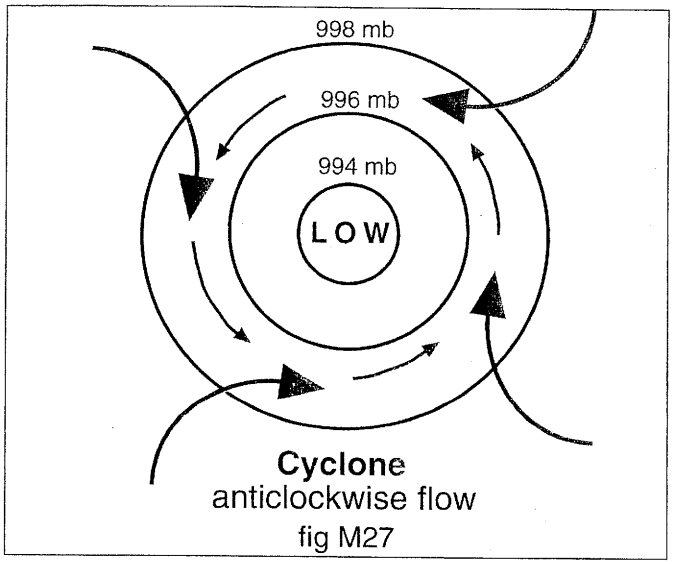


fig M27

Air flows into a depression (cyclone) from an area of high pressure (anticyclone). In the northern hemisphere the Coriolis effect deflects the wind to the right, to flow around the depression in an anticlockwise direction.

EM80(D)

See fig M28.

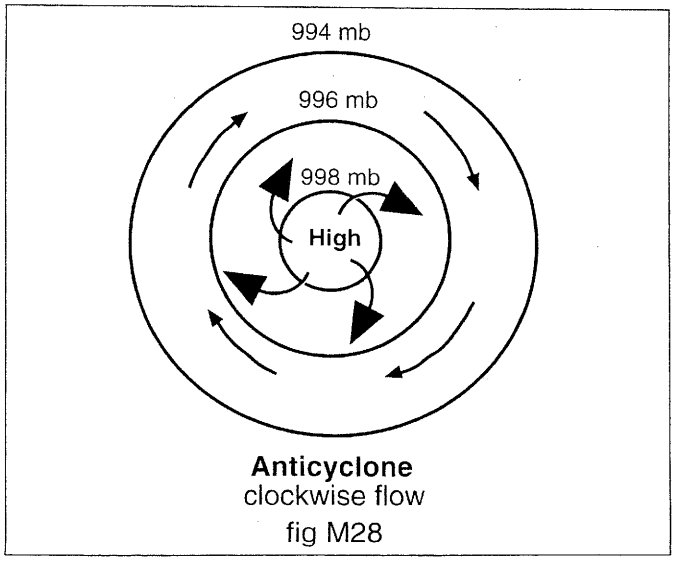


fig M28

Air flows out from an area of high pressure (anticyclone) to an area of low pressure (cyclone).

In the northern hemisphere the Coriolis effect deflects the wind to the right, therefore the wind will flow to the right around the high pressure area in a clockwise direction.

EM81(B)

See EM36 fig M11.

Land and sea breezes are produced by a temperature difference between land and water surfaces.

The atmosphere is heated by solar radiation being re-radiated from the Earth's surface at a wave length that heats the air from below. The wave length of the incoming solar radiation is too short to affect the atmosphere. Under clear skies, surface heating over the land by day causes the air in contact with the surface to rise, forming relatively high pressure aloft at about 1000ft agl. The sea surface reflects less heat back to the atmosphere than the land, so the air at sea level, being cooler than the land, will expand less with lower pressure aloft at about 1000ft.

The higher pressure aloft over the land will flow out to sea to fill the area of lower pressure aloft which subsides to create higher pressure at the surface over the sea.

The outflow of air aloft from land to sea will create relatively low pressure over the land surface, producing an inflow of air at the surface from sea to shore. This is an onshore wind or sea breeze.

EM82(D)

METAR - agl.
TAF - agl.
Area Forecast - amsl.

A METAR is an aerodrome meteorological report in which cloud base is reported as agl.78

A TAF is an aerodrome forecast in which cloud base is reported as agl.

An Area Forecast covers several hundred square miles for which cloud base is reported as amsl.

Note: When arriving at or departing from an aerodrome, a pilot wants to know the height of the cloud base above ground level. When operating over open country on the regional QNH, a pilot wants to know the height of the cloud base above mean sea level.

EM83(C)

Self briefing is the normal method of determining what meteorological conditions may be encountered during flight operations, hence the importance of being able to decode meteorological information from the various formats in which it is presented. Equally important is understanding what the various conditions imply with regard to safety and efficient management of the flight.

EM84(A)

The prefix letter 'R' means Runway Visual Range (RVR).

The following two-figure group 20 indicates the reported visibility is for Runway 20.

The four figure group gives the visibility in metres: eg /0050 = 50 metres.

EM85(A)

An unshaded triangle (apex up) as illustrated in this question means SOFT HAIL. See EM72 fig M25.

A closed or solid triangle (apex up) means HARD HAIL.

EM86(C)

Symbols comprising three horizontal lines as illustrated in this question relate to fog. A letter V superimposed on the three hori-

zontal lines means freezing fog.

See EM72 fig M25.

EM87(D)

A Tropical Maritime Air Mass originates as very warm moist stable air in the sub tropical Azores region of the Atlantic. Originating as a high pressure anticyclonic air mass it becomes more stable due to surface cooling as it tracks north east towards Europe. See EM37 fig M12.

EM88(A)

A METAR is a Meteorological Aerodrome Report, usually published 10 to 15 minutes after the observation was made.

It is not a forecast and therefore does not predict weather. However, if the weather observation was made by a qualified observer, an outlook may be appended to the end of the METAR which follows the word TEND. This will give a further series of codes that represents the meteorological outlook for a two-hour period valid from the time of the observation.

If no significant changes are expected during the following two hours, NOSIG may be used to end the METAR.

EM89(B)

BECMG	=	Becoming.
FM	=	From.
1100	=	1100 UTC.
-	=	Slight.
RA	=	Rain.
SH	=	Showers

Decode in plain language: becoming from 1100 UTC slight rain showers.

EM90(C)

BECMG 1820 BKN030 appearing in a TAF means:

BECMG	=	Becoming
1820	=	During the period 1800 - 2000 UTC.
BKN	=	5 - 7 oktas of cloud.
030	=	Cloud base 3000ft above aerodrome elevation.

Decode in plain language: becoming during the period 1800 UTC to 2000 UTC. 5 - 7 oktas of cloud, base 3000ft above aerodrome elevation.

EM91(A)

TEMPO appended at the end of a METAR or appearing in a TAF is used where temporary variations to the main forecast will occur during the period specified, lasting for less than 1 hour, or if recurring, lasting in total for less than half the forecast period.

EM92(D)

TAF Decode:

Airfield Identifier	Omitted
Time code	0615 For the 9 hour period from 0600 UTC to 1500UTC.
Wind velocity	14025G40 Direction from 140°T. Speed 25kt gusting 40kt.
Visibility	1200 = 1200 metres
Weather	BR = Mist, the cause of the poor visibility. See EM66 fig M24.
Cloud amount & base	Not forecast.

EM93(B)

See EM22.

The time of the report is for just before dawn (0450) during the autumn and the sky is clear as no cloud is reported. The wind is light (5kt) and the air temperature (9°C) has almost cooled to its dewpoint (8°C). These are ideal conditions for the formation of radiation fog before sunrise at 0600.

Note: The visibility is already poor at 2000 metres. It is quite possible that CAVOK may exist much later during the morning as freshening wind and solar heating causes the fog to disperse.

EM94(C)

AIRMETS are issued 4 times a day:

valid for	outlook period
8 hours	of 6 hours

0500 UTC until 1300 UTC with an outlook from 1300 UTC until 1900 UTC.

1100 UTC until 1900 UTC with an outlook from 1900 UTC until 0100 UTC.

1700 UTC until 0100 UTC with an outlook from 0100 UTC until 0700 UTC.

2300 UTC until 0700 UTC with an outlook from 0700 UTC until 1300 UTC.

EM95(C)

Metforms 214 and 215 are fixed time forecast charts containing forecast weather, winds and temperatures. They are issued together four times a day or every six hours and are valid for a fixed six hour period but suitable for use from three hours before to three hours after the fixed time. Current Metforms 214 and 215 are available by fax via 09060 700503. See GET MET page 5 available free from the Met Office.l

Like the METFORM 214, the 215 is a fixed time chart but with forecast and outlook elements relating to significant weather up to 15000ft. The times of issue and validity are the same as for the METFORM 214 with exception of the outlook period which only applies to the METFORM 215. Both were designed for the purpose of route planning, essentially to circumvent the necessity of requesting a specific route forecast.

EM96(B)

28/24 means:

the air temperature	=	+28°C
dewpoint temperature	=	+24°C

Either temperature prefixed **M** means that it is below 0°C.

EM97(D)

The boxes appearing on a Form 214 are located at intersections of parallels of latitude and meridians of longitude given at the top of each box. Information listed in each column is decoded as follows.

The left hand column indicates the altitude in thousands of feet.

The second column gives the direction the wind is coming from in degrees true.

The third column gives the wind speed in knots.

The fourth column gives the air temperature in degrees Celsius prefixed plus or minus.

50N 0°E/W lies between the two locations 50N 0230W and 50N 0230E so interpolate between these two locations to calculate the 5000ft wind velocity at 50N 0°E/W.

50N 0230W 5000ft wind direction = 320°T

50N 0230E 5000ft wind direction = 180°T

50N 0°E/W

wind direction $= \frac{320 + 180}{2} = \frac{500}{2} =$ 250°T

50N 0230W 5000ft wind speed = 10kt

50N 0230E 5000ft wind speed = 20kt

50N 0°E/W wind speed = $\frac{10 + 20}{2}$ = 15kt

Wind velocity at 5000ft over 50N 0°E/W = 25015.

EM98(D)

The areas of significant weather are delineated by scalloped lines identified by numbers enclosed in circles and referred to as Zones. Each Zone includes the freezing level given in thousands of feet AMSL denoted by a figure prefixed with 0°C. These are enclosed in a horizontal rectangular box. This decode information is given in the far left hand column on the upper half of the chart.

Bristol lies in Zone 3 and the freezing level is forecast to be at 6000ft amsl.

EM99(B)

See fig M29

ICAO Cloud Amounts

All cloud except cumulonimbus

SKC	Sky clear - no oktas of cloud
FEW	Few - 1 to 2 oktas
SCT	Scattered 3 to 4 oktas
BKN	Broken - 5 to 7 oktas
OVC	Overcast - 8 oktas

Cumulonimbus only

EMBD	Embedded - Thunderstorm clouds embedded in layers of other cloud
ISOL	Individual isolated cumulonimbus
OCNL	Occasional - Well separated cumulonimbus
FRQ	Frequent - Cumulonimbus with little or no separation

fig M29

The cloud amount and base height. abbreviations contained in fig M29 warrant further explanation particularly those that relate to amounts of cloud. For the purpose of reporting cloud amount, the entire sky visible from the surface is divided equally into eighths, each eighth referred to as an okta derived from okto which is the Greek word for eight. If three eighths of the sky is covered by cloud then the cloud amount is three oktas and five eighths is five oktas etc. For convenience, zero cloud to eight oktas is broken down into five groups listed in fig M29. In respect of a METARs and TAFs the cloud type is only reported if it is a cumulonimbus (CB).

When the cloud amount is variable such as that given in the question, 3 oktas to 5 oktas this can be expressed as scattered to broken ot SCT/ BKN.

EM100(D)

Decode the TAF

Time code	1300 UTC to 2200 UTC.
Surface wind	350°T at 25kt.
Visibility	10km or more.
Weather	Nil reported.
Cloud	3 - 4 oktas base 3000ft agl + 3 - 4 oktas base 9000ft agl.
Temporarily between 1300 UTC and 2200 UTC:	
Visibility	8000 metres.
Weather	showers & rain.
Cloud	5 - 7 oktas base 1500ft agl.
30% probability that temporarily between 1500 UTC and 2200 UTC:	
Visibility	5000 metres
Weather	heavy rain showers.
Cloud	3 - 4 oktas base 800ft agl + 5 - 7 oktas cumulonimbus base 900ft agl.

Zone 3	**I**	**TAF**
Visibility generally 20km occasionally 8km isolated 5000 metres		generally better than 10km temporarily 8000 metres temporarily 5000 metres
Weather generally nil occasionally rain showers isolated thunderstorms with heavy showers		generally nil temporarily showers and rain temporarily heavy rain showers.
Cloud generally 2 - 5 oktas base 3000ft amsl + 1 - 3 oktas base 9000ft amsl		generally 2 - 4 oktas base 3000ft agl + 2 - 4 oktas base 9000ft agl.
Occasionally 6 - 8 oktas base 1500 amsl		temporarily 5 - 7 oktas base 500ft agl
Isolated 7 - 8 oktas CB base 800ft tops 18000ft.		temporarily 2 - 4 oktas base 800ft agl + 5 - 7 oktas CB base 900ft agl.

EM101(C)

See EM75 fig M26 for surface front symbols.

The symbol represents the position of an occluded front at the surface which is moving NNW in the direction of the arrow. 'Slow' means at less than 5kt.

EM102(A)

A Low is identified by a thick letter **L** and its centre by an **X** which gives its exact location, in this instance, just inland of the coast of northern France. Next to the centre of the Low is the pressure in hectopascals, **988hPa** with the system seen to be moving east at 20kt as indicated by the arrow and the figure 20.

EM103(A)

Referring to the decodes given in EM100 it may be seen that both the TAF and UK Low Level Forecast Chart are for the afternoon period and both indicate occasional deteriorating conditions in respect of both cloud amount and cloud base in which VMC could not be maintained. The conditions are unlikely to improve during daylight hours for a precision navigation exercise to be undertaken at 2000ft.

EM104(B)

See EM97.

50N 0°E/W lies between the two locations 50N 0230W and 50N 0230E so interpolate between these two locations to calculate the 2000ft wind velocity at 50N 0°E/W.

50N 0230W 2000ft wind direction = 230°T.

50N 0230E 2000ft wind direction = 200°T.

50N 0°E/W wind direction = $\frac{230 + 200}{2}$ = $\frac{430}{2}$ = 215°T.

50N 0230W 2000ft wind speed = 15kt.

50N 0230E 2000ft wind speed = 10kt.

50N 0E/W wind speed = $\frac{15 + 10}{2}$ = 13kt rounded up.

Wind velocity at 2000ft over 50N 0°E/W = 21513kt.

50N 0230W 2000ft temperature = +08°C

50N 0230E 2000ft temperature = +13°C

Temperature = $\frac{8°C + 13°C}{2}$ = 11°C rounded up.

Temperature at 2000ft over 50N 0°E/W = +11°C.

EM105(B)

The areas of significant weather are delineated by scalloped lines identified by numbers enclosed in circles and referred to as Zones. Each zone includes the freezing level given in thousands of feet amsl denoted by a figure prefixed with 0°C. These are enclosed in a horizontal rectangular box. This decode information is given in the far left hand column on the upper half of the chart.

55N 0E/W is in Zone 3 and the freezing level is forecast to be at 6000ft amsl.

EM106(C)

An occluded front.

See fig M30.

EM107(D)

This is an 18-hour long range TAF identified by FT.

The TAF is for a UK aerodrome denoted by EG** so decoding of continental areas included in the METFORM 215 is not included.

Decode the TAF

Station identifier	British **
Time code	Forecast at 0800 UTC on: 3rd day of the month for the period 0900 UTC to 0300 UTC on the 4th day of the month.
Surface wind	110°T at 5kt
Visibility	Greater than 10km.
Weather	Nil reported.
Cloud	1 - 2 oktas base 1000ft agl + 5 - 7 oktas base 2500ft agl.
Temporarily between 0900 UTC and 1200 UTC:	
Visibility	unchanged.
Weather	unchanged.
Cloud	3 - 4 oktas base 1200ft agl.
Temporarily between 1400 UTC and 2100 UTC:	
Visibility	6000 metres.
Weather	slight rain showers.
Cloud	3 - 4 oktas base 2500ft agl.
Becoming from between 2000 UTC and 2300 UTC:	
Visibility	unchanged
Weather	unchanged.
Cloud	5 - 7 oktas base 600ft agl.

Zone 3	TAF
Visibility generally 20km occasionally 8km inland	generally better than 10km temporarily 6000 metres
Weather generally nil occasionally rain showers	generally nil temporarily slight rain showers
Cloud generally 3 - 6 oktas base 2500ft amsl + 2 - 4 oktas base 9000ft amsl.	generally 1 - 2 oktas base 1000ft agl + 3 - 4 oktas base 2500ft agl.

EM108(A)

The planned flight commences in Zone 2 for which the forecast visibility of 16km is well above the required minima, but a cloud base of 2500ft amsl is marginal taking into account high ground. The departure METAR for Swansea is also giving 2 - 4 oktas at 2000ft agl.

Most of the route lies in Zone 3 for which the forecast cloud base is 2500ft amsl and the visibility is forecast to remain above the required minima of 3km even though occasional rain showers may be expected. Icing need not be considered because of the freezing level. A change of course en route may prove necessary to avoid showers.

The TAF for Manston which covers the ETA is forecasting the visibility to remain above 10km with a cloud base of 2000ft agl. The occlusion to the north west is well clear of the intended route and the system is slow moving.

Proceed with caution.

EM109(B)

See EM97.

50N 0°E/W lies between the two locations 50N 0230W and 50N 0230E so interpolate between these two locations to calculate the 2000ft wind velocity at 50N 0°E/W.

50N 0230W 2000ft wind direction = 340°T.

50N 0230E 2000ft wind direction = 010°T.

50N 0°E/W

$$\text{wind direction} = \frac{340 + 010 + 360}{2} = \frac{710}{2} = 355°\text{T}.$$

50N 0230W 2000ft wind speed = 10kt.

50N 0230E 2000ft wind speed = 25kt.

50N 0E/W

$$\text{wind speed} = \frac{10 + 25}{2} = 18\text{kt rounded up.}$$

Wind velocity at 2000ft over 50N 0°E/W = 35518kt.

50N 0230W 2000ft temperature = +05°C

50N 0230E 2000ft temperature = +06°C

$$\frac{5°\text{C} + 06°\text{C}}{2} = +5.5°\text{C}$$

Temperature rounded up = +6°C

Temperature at 2000ft over 50N 0°E/W = +6°C.

EM110(D)

The areas of significant weather are delineated by scalloped lines identified by numbers enclosed in circles and referred to as Zones. Each Zone includes the freezing level given in thousands of feet amsl denoted by a figure prefixed with 0°C. These are enclosed in a horizontal rectangular box. This decode information is given in the far left hand column on the upper half of the chart.

50N 2E is in Zone 1 where the freezing level is forecast to be at 7000ft amsl.

EM111(A)

A cold front at the surface moving south south east.

See fig M30.

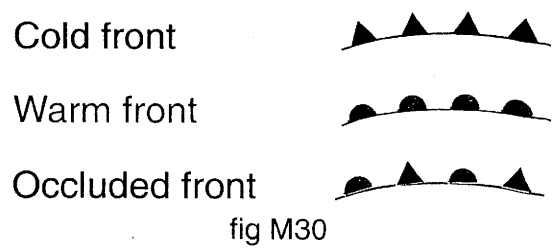


fig M30

EM112(B)

Decode the METAR

Time code	Omitted:
Station identifier	British **
Time code	Omitted:
Surface wind	300°T at 12kt
Visibility	Greater than 10km.
Weather	Rain showers
Cloud	5 - 7 oktas base 1200ft agl + overcast layer base 7000 agl.

Surface temperature	+7°C
Dewpoint temperature	+5°C
QNH	1020hPa.

Zone 2	METAR
Visibility generally 12km occasionally 20km inland. occasionally mainly over the sea and at the coast 2500m	better than 10km
Weather generally snow or nil weather occasionally inland nil weather or snow occasionally mainly over the sea and at the coast snow and rain.	rain showers no deviation
Cloud generally 4 - 7 oktas stratus and stratocumulus base 1000ft amsl + 7 - 8 oktas layer of cloud base 7000ft amsl occasionally inland 2 - 5 oktas cumulus and stratocumulus base 1500ft amsl + 5 - 7 oktas base 7000ft amsl. occasionally mainly over the sea and at the coast 7 oktas stratus and stratocumulus base 200ft amsl+ overcast layer base 7000ft amsl.	generally 5 - 7 oktas base 1200ft agl + overcast layer 7000ft agl.

EM113(C)

A quasi-stationary front at the surface forming across south east England lying SW/NE.

EM114(D)

The flight begins in Zone 2 for which the general forecast visibility and cloud base are above the required minima. The METAR for Shipdham gives both cloud and visibility above the required minima. However, occasional very low cloud base together with deteriorating visibility in rain may preclude returning to Shipdham once airborne should such action prove necessary.

The TAF for Newcastle which covers the destination ETA is only just above the required minima although forecast to improve as the front moves further south.

Most of the track lies in Zone 3 for which the general cloud base is only 2000ft amsl occasionally reducing to the 200ft near the coast which the flight is. Within Zone 3 the freezing level behind the front is at a 1000ft amsl so there exists a high risk of ice accretion.

Your planned alternate, Lynton-on-Ouse also lies in Zone 3.

The general conditions, particularly with a cold front giving low cloud, snow precipitation, poor visibility and icing which is moving at only 10kt down the planned track towards the Shipdham would preclude the flight for that day.

Delay the flight for at least 24 hours.

EM115(B)

See EM97.

55N 005W lies between two forecast locations: 55N 0730W and 55N 0230W so the wind is calculated by interpolating the 5000ft winds at these two locations.

55N 0730W	5000ft wind direction	=	130°T.
55N 0230W	5000ft wind direction	=	170°T.

55N 005W

wind direction $= \frac{130 + 170}{2} = \frac{300}{2} =$ 150°T.

55N 0730W	5000ft wind speed	=	20kt.
55N 0230W	5000ft wind speed	=	15kt.

55N 005W

wind speed $= \frac{20 + 15}{2} =$ 18kt rounded up.

Wind velocity at 5000ft over 55N 005°W = 15018kt.

55N 0730W	5000ft temperature	=	+01°C
55N 0230W	5000ft temperature	=	+03°C

Temperature $= \frac{1°C + 03°C}{2} =$ 2°C.

Temperature at 5000ft over 55N 005W = +2°C.

EM116(C)

The areas of significant weather are delineated by scalloped lines identified by numbers enclosed in circles and referred to as Zones. Each zone includes the freezing level given in thousands of feet amsl denoted by a figure prefixed with 0°C. These are enclosed in a horizontal rectangular box. This decode information is given in the far left-hand column on the upper half of the chart.

50N 2E is in Zone 3 where the freezing level is forecast to be at 7000ft amsl.

EM117(A)

An occluded front which is moving north north east at 10kt.

The direction of frontal movement is indicated by the arrow at 53N 007W adjacent to which is a figure 10 which is the speed of movement over the surface in knots, ie 10kt. See EM111 fig M30.

EM118(D)

Decode the METAR

Station identifier	British **
Time code	observed at 1450 UTC
Surface wind	050°T at 6kt
Visibility	Greater than 10km.
Weather	Nil
Cloud	3 - 4 oktas base 3500ft agl + 5 - 7 oktas base 5500agl.
Surface temperature	+10°C
Dewpoint temperature	+7°C
QNH	not reported.

Zone 2	METAR
Visibility generally 30km isolated over the sea and occasionally inland 7km.	better than 10km
Weather generally nil isolated heavy rain showers.	nil
Cloud generally 2 - 5 oktas cumulus base 2500ft amsl Isolated over the sea and inland 6 oktas cumulus base 1500ft amsl.	generally 3 - 4 oktas base 3500ft agl + 5 - 7 oktas base 5500ft amsl

EM119(A)

There is little change due to the dominant low pressure system centred over St. George's Channel.

EM120(C)

The cloud base for the route is below the required minima for the flight together with which, the flight takes place in an area of *high ground with an occluded front just to the west moving east* quite quickly at 20kt.

The visibility near the front is forecast to deteriorate to 5000 metres in rain and drizzle and the cloud base lowering to 800ft amsl.

The only safe course of action would be to delay the flight until the next day.

EM121(A)

Specific heat

When the temperature of any substance is raised or lowered by the absorption or release of heat, the heat transferred is known as specific heat and is relatively small. A standard unit of heat is the calorie and 1 calorie is gained or lost when the temperature of one gram of water is raised or lowered by 1°C.

Latent heat

Although any substance can exist in any one of three states, (gas, liquid or solid), the gas form contains the greatest amount of heat energy in the form of latent heat. Provided the atmospheric pressure remains constant, any change of state from water to water vapour (evaporation) occurs at a constant temperature as does a change of state from water vapour to water (condensation). During evaporation, latent heat is gained or absorbed at the rate of 540 calories for every gram of water vapour that evaporates out of water droplets. Conversely, the same amount of latent heat per gram is released during the condensation of water vapour to water. During a change of state from water to ice or ice to water (freezing and melting), 80 calories of latent heat are exchanged for every gram of water or ice undergoing a change of state.

EM122(D)

When a cold front is approaching a surface position, the temperature will fall along with pressure as the cloud base lowers.

Moisture lost from the air in the form of heavy precipitation from cumulus cloud will cause both the relative humidity and dewpoint temperature to fall.

As a cold front passes a surface position, assuming a similar isobaric spacing both ahead and behind the front, the wind will veer and decrease in strength but pressure may rise due to the loss of water vapour content during precipitation. Outside of precipitation, visibility will be improved due to an absence of water droplets and atmospheric impurities washed out during precipitation.

EM123(A)

Flight conditions within a cold sector will vary according to the aircraft's proximity to the front itself and temperature gradient between the two frontal air masses. Cloud will be cumuliform, generally scattered to broken within the cold sector. During precipitation, visibility will be poor with the possibility of airframe and engine induction system icing when close to frontal activity in colder weather, or above the freezing level when close to or within a CB.

Behind the front, cloud will become scattered giving good visibility in the absence of precipitation as precipitation due to frontal activity will have carried away most of the atmospheric impurities.