EASA PPL(A) Meteorology: Atmosphere – Study Notes

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1. Atmosphere Overview

- **Definition**: The layer of gases surrounding Earth, essential for flight and life.
- **Composition**:
  - Nitrogen (N_2): ~78%
  - Oxygen (O_2): ~21%
  - Other Gases (CO_2, Argon, etc.): ~1%
  - Water Vapour: 0–4% (varies by location/time)

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2. Layers of the Atmosphere (by temperature profile)

Layer	Altitude (approx.)	Characteristics
Troposphere	Surface–11 km	All weather occurs here, temperature drops
Tropopause	~11 km	Boundary layer, stable, isothermal
Stratosphere	11–50 km	Temp rises with height, very stable
Mesosphere	50–85 km	Temp drops again
Thermosphere	85 km+	Temp rises, thin air

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3. International Standard Atmosphere (ISA)

- **MSL (Mean Sea Level) Conditions**:
  - Temperature: 15°C
  - Pressure: 1013.25 hPa (millibar)
  - Density: 1.225 kg/m³
  - Lapse Rate: -2°C per 1000 ft
- **Use**: Altimeter calibration, aircraft performance reference.

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4. Pressure

- **Definition**: Force per unit area from the weight of the air above.
- **Unit**: hPa (hectopascal)
- **Standard Pressure at Sea Level**: 1013.25 hPa
- **Pressure decreases with altitude**.

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5. Temperature

- Decreases with height in troposphere (~2°C/1000 ft)
- **Lapse Rates**:
  - Standard: -2°C/1000 ft
  - Dry Adiabatic: -3°C/1000 ft
  - Saturated Adiabatic: ~-1.5°C/1000 ft

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6. Density

- **Decreases** with altitude, temperature, and humidity.
- **Density Altitude**: Pressure altitude corrected for non-standard temperature.
- High density altitude = reduced aircraft performance.

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7. Global Circulation

- Driven by uneven heating of Earth.
- **Equator**: Rising warm air → low pressure.
- **Poles**: Sinking cold air → high pressure.
- **Creates circulation cells**: Hadley, Ferrel, Polar.
- **Jet Streams**: Fast upper-level winds near tropopause.

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8. Local Atmospheric Effects

- **Temperature Inversion**: Temp increases with height. Can trap fog/pollution.
- **Sea/Land Breeze**: Caused by different heating rates of land and sea.

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9. Humidity

- **Water Vapour Content** of the air.
- **Warm air holds more moisture**.
- **Relative Humidity**: Ratio of current water vapor to the maximum possible.
- High humidity = lower density = reduced performance.

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10. Key Values Recap

Concept	**Standard Value**
ISA Temperature @ MSL	15°C
ISA Pressure @ MSL	1013.25 hPa
Lapse Rate (Std)	-2°C per 1000 ft
Tropopause Height	~11 km (~36,000 ft)
Air Density @ MSL	1.225 kg/m³
Composition	78% N_2, 21% O_2, 1% Other