Define and describe LUNG compliance. Discuss the difference between static and dynamic compliance.

**Question interpretation**
Focus – LUNG compliance (not total respiratory system compliance)
Context – highlight difference between static and dynamic compliance

**Structure Plan**
*Introduction*
Define lung compliance
Describe lung compliance
  - Factors affecting
  - Regional differences
  - Hysteresis

*Body*
Static vs Dynamic compliance
  - Measurement
  - What distinguishes dynamic from static
  - Clinical relevance
Define and describe LUNG compliance. Discuss the difference between static and dynamic compliance.

- Lung compliance = change in lung volume per unit change in transmural pressure (alveolar – intrapleural P)
- Normal value in adult 200ml/cmH2O
- Because the calculated value will differ depending on the which two points are used in the calculation, by convention lung compliance is reported as the slope of the line joining the points at FRC and FRC + 1L on the compliance curve, during expiration

Factors Affecting Compliance
- Lung size (absolute)
  - Larger lungs, eg adult vs neonate → ↑ compliance
  - Specific compliance remains constant, 0.05cmH2O⁻¹
  - Specific compliance = compliance / FRC
- Lung volume (relative)
  - The compliance curve is steepest in the mid range (compliance is greatest around FRC, while at the extremes (high and low lung volumes), compliance is reduced
- Pulmonary blood volume
  - Blood vx contribute to stiffness of the lungs
  - Congestion → ↓ Compliance
- Age
  - Small ↑ compliance with ↑ age due to changes in elastin and collagen (elasticity mainly determined by surface tension)
- Bronchial smooth m tone
  - ↑ airway resistance → ↓ dynamic, but not static, compliance

Compliance Curve

- Compliance curve is sigmoid shaped
- At low volumes, compliance is less because of Laplace’s law - higher distending pressures are required to overcome surface tension at smaller volumes
- At high volumes, compliance is less because of increased stretch on elastic tissue
- The shape of the curve is different during inspiration and expiration (higher pressures during inspiration at the same volume during expiration), this is called 
\textbf{hysteresis}
Hysteresis

• The phenomenon whereby the transmural pressure required to distend an elastic body, such as the lungs, is greater during expansion compared to during contraction, for a given volume
• It is caused by time dependent behaviours of the lung

Time dependent behaviours of the lung

• Changes in surfactant activity
  o During expiration (contraction), the surfactant molecules are crowded together, thus having a greater effect in reducing surface tension
  o This is the most important cause of hysteresis in the lung
• Stress relaxation
  o An inherent property of elastic bodies
  o This is a viscoelastic property that is displayed by collagen in lung tissue
• Recruitment of alveoli
  o Recruitment of collapsed alveoli during inspiration results in greater volumes for lower pressure during expiration

Measurement of Compliance

Static Compliance

• At FRC, the subject relaxes against a closed airway and pressure readings are taken
• A known volume of air is inhaled then the subject relaxes against a closed airway and pressure readings are taken again - alveolar P and distal oesophageal P (as a surrogate for intrapleural P)

Dynamic Compliance

• Measurements of volume and pressure are taken during normal, rhythmic breathing without any pauses
• The two points used to calculate compliance are at end-expiration and end-inspiration - the two points of no gas flow during the respiratory cycle
• This is so that pressure measured at the mouth can be assumed to equal alveolar pressure

Static vs Dynamic Compliance

• Because of the time dependent behaviours of the lung, static compliance is always greater than dynamic compliance
• The difference will be accentuated if there is any pathology that increases the spread of fast and slow alveoli (eg bronchoconstriction, CAL) as this causes pendelluft
• Redistribution of gas (pendelluft)
  o During a short inflation, gas preferentially goes to fast alveoli (with lower compliance, hence greater transmural pressure)
  o Slow, sustained inflation, permits greater gas distribution to slow alveoli, in accordance to their compliance (hence lower transmural pressure)