1. a) John Suffers from an obstructive lung disease like emphysema
It is obstructive disease Since the ratio of FEV_1 to FVC is 33%
and it Should be 80%. The reason for this result would
be the reduced Surface area in the lungs with a
disease like emphysema.

b) • Bronchitis
• Bronchial Asthma

c) The Helium dilution test is not very effective
Since the disease is obstructive in nature, and with Helium
dilution a uniform distribution of helium is required to make
an effective measurement.

d) i) The whole body Plethysmography was far more effective
Since the volume behind the obstruction is taken into
account, and this would make Helium dilution ineffective

ii) $$FRC = \Delta V \left(\frac{P_{m2}}{P_{m1} - P_{m2}} \right)$$

$\Delta V =$ $\quad FRC = 2.5$, $P_{m_1} = 100\,kPa$, $P_{m_2} = 97\,kPa$

$$\Delta V = \frac{2.5}{\left(\frac{97}{100-97}\right)} = 0.077\,L \quad (2sf)$$

$$V_{b_1} = \frac{P_{b_2} \times (V_{b_1} - \Delta V)}{P_{b_1}}$$

$$100 V_{b1} = 100.009 \times (V_{b1} - 0.077\ldots)$$

$$100 V_{b1} - 100.009 V_{b1} = -7.732$$

$$V_{b1} = 859\,L \ (3\,sf)$$

$$V_{b2} = 859.1\ldots - 0.077\ldots = 859.1\,L$$

e) i) $F_{CO(t_1)} = 0.3\%$.

The extended breathing aspects the accuracy of the DLCO estimate due to $DLCO \propto \frac{1}{t_2 - t_1}$, and $t_2 - t_1$ should be 10s, it might be an underestimate.

ii) $$DLCO = \frac{FCO(t_1)}{FCO(t_2)}$$

$$DLCO = \frac{60\ V_{al}}{(t_2 - t_1) P_b} \times \ln\left(\frac{F_{CO}(t_1)}{F_{CO}(t_2)}\right)$$

$$t_2 - t_1 = \frac{(60)(5000)}{25 \times 760} \ln\left(\frac{0.3}{0.13}\right) = 18.2\,s$$

2. a) Everywhere below the injury to the Spinal cord is affected, the person will be paralysed from this point on. Another effect would be uncontrolled reflex movements or twitching.

FES cycling increases the muscle conditioning which enables the patient to potentially activate those muscles.

b) The contraindications to be considered would be whether the patient is pregnant, has active implants or has cancer (due to the risk metastasis.

Pregnancy: might be affected but the effects of ES on foetus is unknown.

Active Implants: The ES should not be close to the ES as it would interfere with their function.

The precautions to be considered are obesity as this is an insulator the area of ES. Another would be that the patient might have absent or diminished sensation so they may not give indications when electrical Stimulation is applied too strongly. Diabetics also have fragile thin skin that could be affected by ES.

C) The test that can be conducted is the Stretch reflex test. A hammer can be used to temporarily stretch the tendon, which causes a motor response to be induced in the afferent nerve. This would mean that this pulse travels to the spinal cord and back to the muscles by the efferent nerves. This response can be measured using surface electrodes to test for the issue with the patient.

D) FES cycling is a form of Transcutaneous Stimulation. The typical values for this are:

Pulse width μs: 200 - 500 μs

Since the motor neuron has a chronaxie of around 200μs

Frequency: 20 - 50 Hz

This is the range since this range represents a transcutaneous Stimulation

Waveform: Rectangular Biphasic as it's similar to the natural waveform

e) when using a constant current Stimulator, out of compliance means that the current can't be delivered. This is because the voltage has limit to from the power supply. Thus, after a specific current this error will appear to represent that the current can't be increased

f) Extension is given by max voltage.
Flexion is given by min voltage.

Max voltage = 2.35V
Min Voltage = 1.1V

$\theta = 198 - 82$ (volts output)

peak knee extension:

$198 - 82(2.35) = 5.3°$

Peak knee flexion:

$198 - 82(1.1) = 107.8°$

g) The Shoft encoder angle is ~100°
↳ left quadricep

This corresponds to quadricep due to trough on electro-output curve.

The flexion occurs at ~300°, since the peak
↳ left hamstring

for the electro-output curve corresponds to 300°

3. a) The Storage phase is regulated by the Sympathetic nerves - these contract the Sphincter to ensure no leakage. During the Storage phase urine from the Kidneys accumulates in the bladder and expands with a rise in pressure. Also, the pelvic floor remains in contraction due to efferent Signals in the Pudenal nerve, and this enables continence to be maintained. Also, the hypogastric nerve is Sympathetic during this phase. to enable the bladder to be filled up.

After a certain amount of liquid has accumulated (400 ml), the Stretch Sensors in the bladder initiate an afferent Signal in the Pelvic nerve (para Sympathetic) to the Sacral Micturition Centre.
In the emptying phase, the efferent Signals in the pelvic nerve are not inhibited, so the bladder contracts and the efferent Signals in the pudenc nerve are inhibited to relax the pelvic floor, so the bladder is emptied. The hypogastric nerve is not involved in the emptying phase.

b) The paraplegic at T4 affects the storage and emptying process of the bladder.

Since this is an upper motor neuron disease, they would feel no sensation during the storage phase of micturition. They will have reduced capacity also. The muscles that normally enable the emptying of the bladder fail to work in tandem, the relaxation in the bladder and contraction in the sphincter don't happen together. Thus, they have reduced capacity and incontinence:

emptying they have incontinence due to high pressure in the bladder, and the sphincter is not relaxing. This means that this patient cannot control their bladder function.

c) The findings from the trace yield that the quality of the data is good since the cough test show that the traces can be subtracted to give a flat green line, which is a sign of good data.

An increase in the intravesical and detrusor pressure demonstrates non-compliance of the bladder. Therefore the catheter might have moved in the bladder

The bladder pressure increases which means that it's not compliant.

Also, the clinical importance of the contractions shows that bladder is trying to void, as the pressure's increasing.

d) The current Strategy is not Suitable Since the patient is not showing signs of voiding