# Registered Pulmonary Function Technologist

## Test Prep RPFT

**Version Demo**

**Total Demo Questions: 18**

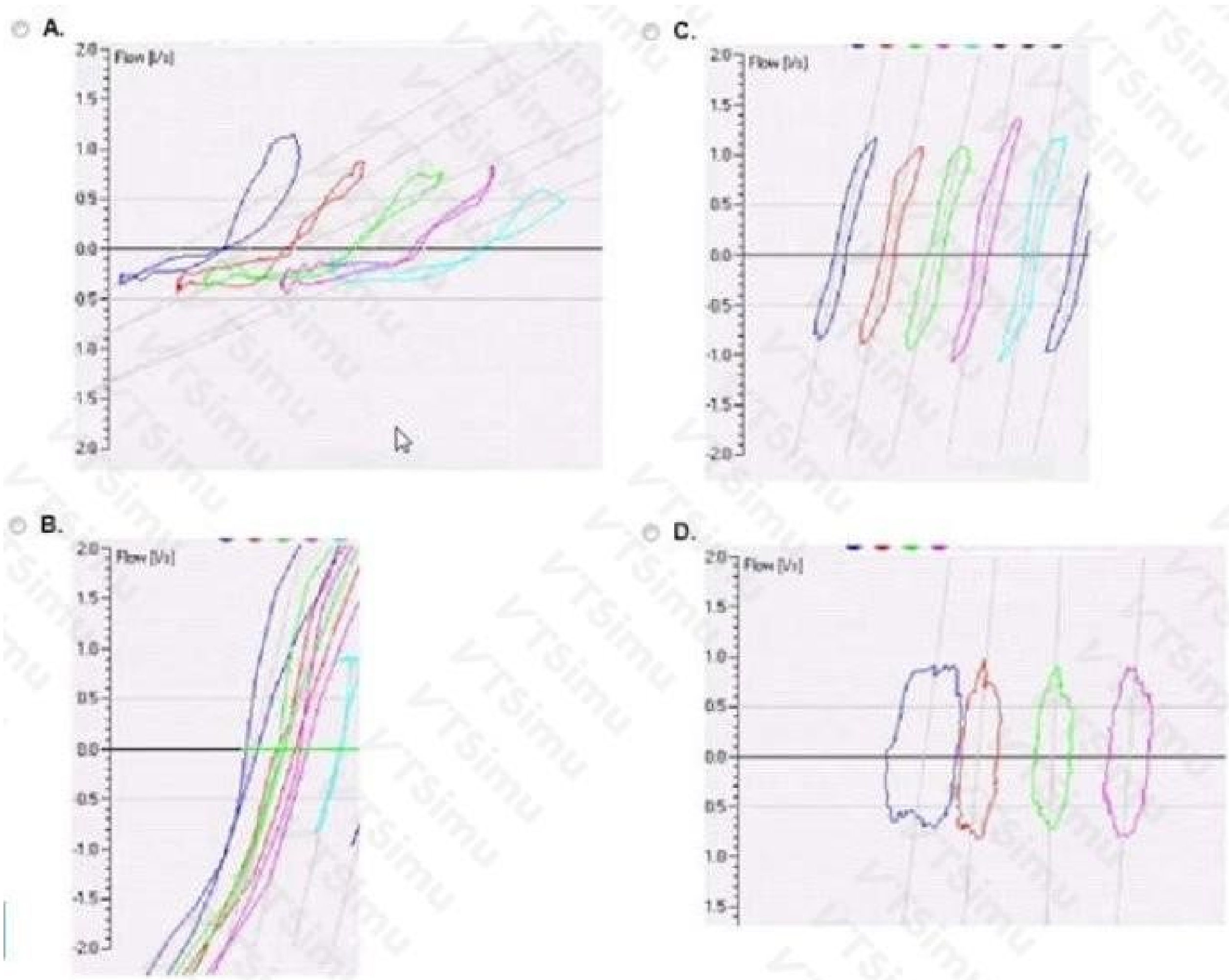
**Total Premium Questions: 181**

## Topic Break Down

| Topic | No. of Questions |
|---|---|
| Topic 1, Pre-test Procedures | 43 |
| Topic 2, Testing Procedures | 109 |
| Topic 3, Post-test Procedures | 28 |
| Topic 4, Mix Questions | 1 |
| Total | 181 |

QUESTION NO: 1

Which of the following tracings represents an airways resistance maneuver performed with a slow breathing frequency?




**A.** Option A

**B.** Option B

**C.** Option C

**D.** Option D

**ANSWER: D**

**Explanation:**

The tracing in *Option D* represents a slow-frequency airways-resistance maneuver because the displayed respiratory cycles are relatively long and widely spaced, indicating a low breathing rate. During measurement of airway resistance in a body plethysmograph, the patient performs gentle tidal panting while pressure and flow signals are recorded. A deliberately slow maneuver produces fewer oscillations over a given time interval and allows the relationship between alveolar pressure changes and airflow to be assessed over broad, smooth tidal excursions. This visual pattern is the key feature identifying the correct tracing: prolonged inspiratory and expiratory phases rather than closely packed rapid panting cycles. Slow, relaxed breathing also helps obtain stable signals with minimal artifact, provided the maneuver remains technically acceptable and the patient maintains an appropriate seal and consistent tidal effort. Standards for pulmonary-function testing describe airway-resistance assessment as a plethysmographic measurement based on simultaneous pressure and flow relationships; the respiratory rate directly changes the apparent density of cycles on the tracing. See the [ATS/ERS lung-volume measurement standard] and the [NCBI overview of body plethysmography].

**QUESTION NO: 2**

A patient has normal pulmonary and cardiac function. Which of the following is most likely when the patient reaches the anaerobic threshold during incremental stress testing?

**A.** Increased RER

**B.** Decreased $CO_2$ production

**C.** Increased VDA/VT ratio

**D.** Decreased VE

**ANSWER: A**

**Explanation:**

**Increased RER** is most likely at the anaerobic threshold during a progressively increasing exercise test. At lower work rates, energy demands are met predominantly through aerobic metabolism, and carbon dioxide output ($VCO_2$) generally rises in relative proportion to oxygen uptake ($VO_2$). As exercise intensity reaches the anaerobic threshold, lactate production increases beyond the rate at which it can be cleared. The associated hydrogen ions are buffered largely by bicarbonate. This buffering reaction generates additional $CO_2$, which is transported to the lungs and exhaled. Consequently, $VCO_2$ begins to increase disproportionately relative to $VO_2$. Because the respiratory exchange ratio is calculated as $VCO_2$ divided by $VO_2$, this disproportionate rise in $CO_2$ output produces an increased RER. This response is a key noninvasive marker used to identify the anaerobic threshold, often alongside the V-slope method and characteristic ventilatory responses during cardiopulmonary exercise testing. A normal patient should therefore demonstrate a rising RER as this physiologic transition is reached. See the ATS/ACCP Statement on Cardiopulmonary Exercise Testing and the ERS statement on standardisation of cardiopulmonary exercise testing.

## QUESTION NO: 3

Successive peak flow measurements made with a peak flowmeter on a subject previously diagnosed as having asthma yield the following results:

| | |
|---|---|
| Trial 1 | 6.27 L/sec |
| Trial 2 | 5.07 L/sec |
| Trial 3 | 4.38 L/sec |

Which of the following is the best explanation for these?

**A.** Condensation of moisture in the peak flowmeter

**B.** Normal response

**C.** Improper calibration of the peak flowmeter

**D.** Increasing airways resistance in the subject

**ANSWER: D**

**Explanation:**

**Increasing airways resistance in the subject** is the best explanation for a progressive reduction in successive peak-flow readings in a person with asthma. Peak flow reflects the maximum flow that can be generated during a forceful exhalation. During asthma worsening, bronchial smooth-muscle constriction, airway-wall inflammation, and mucus narrowing reduce airway calibre. This increases resistance to expiratory airflow and limits the maximum flow achieved, producing lower serial readings.

Serial peak-flow monitoring is specifically useful in asthma because variation or deterioration from the person's usual/best value can identify worsening airflow obstruction, sometimes before symptoms become severe. To make this interpretation meaningful, measurements should be performed with consistent technique, using a maximal forced expiration and recording the best of repeated attempts at each assessment. In the context provided—a previously diagnosed asthmatic patient with a sequential pattern indicating decline—the physiologic interpretation is increasing airflow obstruction and therefore increasing airway resistance. Clinical asthma guidance recognizes falling peak-flow values as a marker of deteriorating asthma control that may require prompt action according to the patient's asthma plan. See Asthma + Lung UK: Peak flow test and GINA Global Strategy for Asthma Management and Prevention.

## QUESTION NO: 4

A 6-year-old child has a history of repeated episodes of wheezing and shortness of breath. A pulmonary function technologist has difficulty obtaining repeatable spirometry results. Which of the following tests should be performed next?

**A.** MVV

**B.** DLco

**C.** SGaw

**D.** SpO2

## ANSWER: C

**Explanation:**

**SGaw** is the most appropriate next test because it measures specific airway conductance, an index of airway caliber that is particularly useful for identifying airway obstruction and assessing bronchodilator responsiveness in children with suspected asthma. Specific airway conductance is obtained during body plethysmography from airway resistance and thoracic gas volume measurements. It can provide clinically useful evidence of variable airway narrowing when conventional forced spirometry is not repeatable or cannot be performed to acceptable quality standards.

This is especially relevant in a 6-year-old with recurrent wheeze and dyspnea, since young children may have difficulty producing consistent maximal forced expiratory maneuvers. SGaw reflects the ease with which air moves through the airways after accounting for lung volume; a reduced value supports increased airway resistance. It can also demonstrate improvement after an inhaled bronchodilator, supporting the presence of reversible airway obstruction. Pediatric pulmonary-function guidance recognizes that alternative lung-function techniques may be valuable when reliable forced expiratory testing is limited, while body plethysmographic airway-resistance measures can characterize airway mechanics. See the American Thoracic Society/European Respiratory Society interpretive strategies and the NCBI overview of asthma evaluation.

## QUESTION NO: 5

A subject has the following values reported:

What is the SG AW ?

**A.** 0.20

**B.** 0.80

**C.** 1.25

**D.** 0.40

**E.** Cannot be determined from the information provided.

## ANSWER: E

**Explanation:**

"Cannot be determined from the information provided" is correct because the question states that values were reported but does not actually supply any numerical measurements. Specific airway conductance (sGaw, sometimes written SGaw) requires data from body plethysmography. It is calculated as the reciprocal of specific airway resistance: sGaw = 1/sRaw. When airway resistance and thoracic gas volume or functional residual capacity are supplied, specific airway resistance can be determined as Raw × FRC (or thoracic gas volume), after which its reciprocal gives sGaw. Alternatively, sGaw may be reported directly by the plethysmograph. Because neither sRaw nor the necessary resistance and lung-volume values are present, no numerical result—including 0.20, 0.80, 1.25, or 0.40—can be calculated or verified. Pulmonary-function interpretation should be based on recorded measured values, appropriate units, and the laboratory's reference equations. The ERS/ATS technical standard describes airway-resistance measurements and their relationship to lung volumes in body plethysmography: ERS/ATS technical standard on interpretive strategies for routine lung function tests. Additional clinical background on pulmonary-function testing is available from NCBI Bookshelf: Pulmonary Function Tests.

## QUESTION NO: 6

A pulmonary function technologist is performing an exercise study on a patient with sarcoidosis. Which of the following end-tidal $CO_2$ values should the technologist expect at rest, if the test is performed appropriately?

**A.** 7-10%

**B.** 0-1.5%

**C.** 4-5%

**D.** 2-3%

**ANSWER: C**

**Explanation:**

**4-5%** is the expected resting end-tidal carbon dioxide range in a properly performed exercise study. End-tidal carbon dioxide reflects the carbon dioxide concentration in gas exhaled at the end of expiration, which most closely approximates alveolar gas when sampling, mask or mouthpiece seal, and breathing pattern are adequate. A concentration of 4-5% corresponds approximately to an end-tidal carbon dioxide partial pressure of 30-38 mm Hg, a physiologically plausible resting range during cardiopulmonary exercise testing. Resting end-tidal carbon dioxide is commonly near 5% in healthy or clinically stable individuals, although its precise value can vary with alveolar ventilation, physiologic dead space, body position, and underlying cardiopulmonary disease. In sarcoidosis, pulmonary involvement may affect gas exchange or ventilatory efficiency in some patients, but the expected baseline value used for appropriate test performance remains in this range. Establishing this resting baseline is important because the subsequent pattern of end-tidal carbon dioxide during exercise helps characterize ventilatory and circulatory responses. The American Thoracic Society's cardiopulmonary exercise testing statement discusses measurement and interpretation of end-tidal gas variables during testing: ATS Clinical Practice Statement. Basic physiologic relationships between alveolar ventilation and carbon dioxide are reviewed by NCBI Bookshelf.

## QUESTION NO: 7

When performing quality control in a body plethysmograph using a 5-L isothermal bottle, the $V_{TG}$ at shutter closure are as follows:

| Trial | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| $V_{TG}$ (L) | 4.91 | 5.09 | 5.04 | 4.86 | 5.01 |

A pulmonary function technologist should

**A.** Service the mouth pressure transducer.

**B.** Recalibrate the box pressure transducer.

**C.** Check biological control before beginning testing.

**D.** Proceed with patient testing.

**ANSWER: A**

**Explanation:**

Service the mouth pressure transducer. A 5-L isothermal bottle provides a stable, known-volume simulator for body-plethysmograph quality-control testing. During the shuttered maneuver, the instrument derives thoracic gas volume from the relationship between pressure changes measured at the mouth and in the box. The displayed V TG values at shutter closure should therefore be repeatable and agree closely with the known 5-L reference volume. The pattern shown indicates that the mouth-pressure signal is not providing a reliable measurement at the moment of shutter closure. Because mouth pressure is integral to calculating V TG, a transducer with drift, inadequate frequency response, zero instability, contamination, or another service-related fault can cause inconsistent or inaccurate calculated volumes even when the reference bottle itself is stable. The appropriate next step is to remove the system from clinical use as needed and have the mouth pressure transducer inspected, serviced, and recalibrated according to the manufacturer's procedures, then repeat quality-control verification before patient testing. Current technical standards emphasize regular calibration and biologic/physical quality-control procedures to ensure valid lung-volume measurements. See the ERS/ATS technical standard for pulmonary function laboratory management and quality assurance and the ERS/ATS technical standard on body plethysmography.

## QUESTION NO: 8

Which of the following is a valid reason for using biologic controls for DLCo?

**A.** Establishing precision of the procedure

**B.** Identifying the source of gas analyzer error

**C.** Assessing accuracy of the volume measuring device

**D.** Determining the lower limit of normal values

## ANSWER: A

**Explanation:**

**Establishing precision of the procedure** is the valid reason for using biologic controls in DLCO quality control. A biologic control is generally a healthy, nonsmoking individual—often a staff member—who performs DLCO testing repeatedly under standardized conditions. Because the person's pulmonary status should remain relatively stable, serial results provide a practical measure of the repeatability and ongoing performance of the entire testing process. This includes the combined effects of patient maneuver coaching, test timing, inspired-gas delivery, gas sampling, analyzer performance, volume measurement, and calculation procedures.

The laboratory should establish that individual's baseline mean and expected variability from repeated acceptable tests, then compare subsequent control results against that baseline. A meaningful shift or excessive variability alerts staff that the procedure may no longer be performing consistently and should prompt investigation before patient reports are affected. Thus, biologic control testing is an end-to-end quality-control tool for monitoring procedural precision rather than a calibration check of one isolated component. The ATS/ERS DLCO technical standard identifies biologic controls as an important part of ongoing quality assurance: ATS/ERS 2017 DLCO standards. Additional pulmonary-function laboratory quality-assurance guidance is available from the American Thoracic Society.

## QUESTION NO: 9

The following biologic control data ranges were established:

| | $D_{LCO}$ | IVC |
|---|---|---|
| Mean | 34.30 | 4.2 |
| SD | 1.28 | 0.2 |

The following additional data were obtained when assessing the equipment:

| Date | $D_{LCO}$ | IVC |
|---|---|---|
| 7/2 | 38.50 | 5.30 |
| 7/2 | 39.50 | 5.44 |

Which of the following should a pulmonary function technologist do?

**A.** Change the CO2 and H2O absorbers.

**B.** Continue testing patients.

**C.** Change the DLco CO analyzer.

**D.** Check the flow sensor.

**ANSWER: D**

**Explanation:**

**Check the flow sensor.** Biologic quality-control testing is intended to detect a meaningful departure from the laboratory's established, stable baseline in a known healthy control subject. When the assessment data point toward an abnormality in measured volumes or flow-dependent results, the flow-measurement system is an appropriate first component to inspect. The sensor, its connections, tubing, and calibration can introduce systematic measurement error if there is contamination, moisture, damage, an improper connection, or an unsuccessful calibration verification.

The technologist should check the flow sensor and then repeat the applicable calibration and biologic-control procedures after the issue has been addressed. This supports documenting that the system has returned to its acceptable performance range before patient testing resumes. ATS/ERS spirometry standards emphasize routine verification of spirometer accuracy and quality assurance, while biologic controls provide an ongoing practical check of system performance under normal operating conditions. See the ATS/ERS 2019 spirometry technical standard and the American Thoracic Society pulmonary function statements.

## QUESTION NO: 10

A 35-year-old healthy male is performing a maximal stress test as part of an annual physical. The following data are observed:

| | Baseline | 5 Minutes |
|---|---|---|
| Work | rest | 100 watts |
| HR | 81 | 141 |
| BP (mm Hg) | 120/75 | 150/80 |
| $SpO_2$ | 96 | 81 |
| Borg Scale | 0 | 2 |

The patient denies any symptoms. Which of the following should a pulmonary function technologist do first?

**A.** Obtain an arterial blood gas while continuing exercise

**B.** Move the pulse oximeter sensor to another site

**C.** Administer oxygen at 3-4 L/min by nasal cannula

**D.** Terminate the test and stabilize the patient.

**ANSWER: D**

**Explanation:**

**Terminate the test and stabilize the patient.** is the appropriate first action because the displayed physiologic findings meet a safety-based reason to stop exercise testing, even though the patient does not report symptoms. During maximal exercise testing, the technologist must continuously assess objective data—such as ECG changes, blood pressure response, oxygen saturation, and rhythm—not solely the patient's subjective report. A patient can have clinically important ischemic, arrhythmic, hypertensive, or gas-exchange abnormalities without perceiving chest discomfort, dyspnea, dizziness, or other warning symptoms. Once a termination criterion is recognized, continued exertion can increase risk and can delay assessment of the abnormal finding. The immediate priority is to stop the workload, provide monitored recovery and appropriate supportive care, obtain repeat vital signs and rhythm assessment, and follow the laboratory's emergency procedures and medical-director protocol. Exercise-testing standards emphasize that abnormal objective findings may require prompt test termination and observation regardless of symptoms. See the American Heart Association's exercise-testing standards at https://doi.org/10.1161/CIR.0000000000000101 and the ATS/ACCP cardiopulmonary exercise testing statement at https://pubmed.ncbi.nlm.nih.gov/11555567/.

## QUESTION NO: 11

Which of the following spirometry results is most characteristic of a restrictive lung disease?

**A.** Decreased FEV1/FVC ratio and normal FVC

**B.** Normal FEV1/FVC ratio and decreased FVC

**C.** Increased residual volume and increased FEV1/FVC ratio

**D.** Increased FEV1 with normal total lung capacity

## ANSWER: B

**Explanation:**

**Normal FEV1/FVC ratio and decreased FVC** is the spirometric pattern most characteristic of restriction. In restrictive disorders, the lungs or chest wall cannot expand to normal volumes, so the forced vital capacity is reduced. Both FEV1 and FVC may decline, but they generally decline proportionally; consequently, the FEV1/FVC ratio is preserved or may be higher than predicted. Spirometry can identify this restrictive pattern, but it cannot independently establish restriction because a low FVC can also occur with other conditions or suboptimal exhalation. Confirmation requires measurement of static lung volumes, specifically a reduced total lung capacity below the lower limit of normal. This distinction is important in pulmonary function interpretation: a preserved ratio with reduced FVC should prompt lung-volume testing rather than be considered definitive proof of restrictive lung disease. The American Thoracic Society and European Respiratory Society technical standard describes restriction as requiring a reduced total lung capacity, while spirometry provides the screening pattern of reduced FVC with a normal ratio. See the ATS/ERS technical standard for interpretive strategies for routine lung function tests and the Merck Manual overview of pulmonary function testing.

## QUESTION NO: 12

When performing quality control in a body plethysmograph using a 5-L isothermal bottle, the VTG at shutter closure are as follows:

| Trial | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| $V_{TG}$ (L) | 4.91 | 5.09 | 5.04 | 4.86 | 5.01 |

A pulmonary function technologist should

**A.** Service the mouth pressure transducer.

**B.** Recalibrate the box pressure transducer.

**C.** Check biological control before beginning testing.

**D.** Proceed with patient testing.

**ANSWER: A**

**Explanation:**

**Service the mouth pressure transducer.** A 5-L isothermal bottle is used as a stable simulated volume for body-plethysmograph quality-control testing. Because the bottle volume is fixed and the system conditions are controlled, repeated measurements should produce consistent thoracic gas volume results and a stable relationship between mouth pressure and box pressure during shutter closure. The displayed shutter-closure results indicate a problem in the mouth-pressure signal rather than normal variation in the simulated volume. The mouth pressure transducer is essential because it measures the pressure changes used in the panting maneuver and contributes directly to calculation of thoracic gas volume. A malfunctioning, drifting, or poorly responding transducer can therefore produce abnormal or inconsistent VTG results even when the test bottle itself provides a constant reference volume. The appropriate action is to remove the instrument from routine use as needed and have the mouth pressure measurement pathway evaluated and serviced before relying on patient measurements. Lung-volume testing standards emphasize regular quality-control checks and prompt investigation of equipment performance that does not meet expected verification results. See the ATS/ERS technical standard for lung-volume measurement and the ATS/ERS spirometry technical standard.

**QUESTION NO: 13**

During a bronchial provocation study, a patient has the following spirometric values after a 0.25 mg/mL dose of methacholine:

| | Baseline | Observed |
|---|---|---|
| FVC (L) | 5.0 | 4.9 |
| $FEV_1$ (L) | 4.0 | 3.7 |
| $FEF_{max}$ (L/sec) | 9.0 | 5.0 |

Based on these results, a pulmonary function technologist should

**A.** Instruct the patient to blow out longer and repeat the effort.

**B.** Stop the test and immediately administer a bronchodilaior.

**C.** Instruct the patient to blow out harder and repeat the effort.

**D.** Reduce the concentration of methacholine on the next trial.

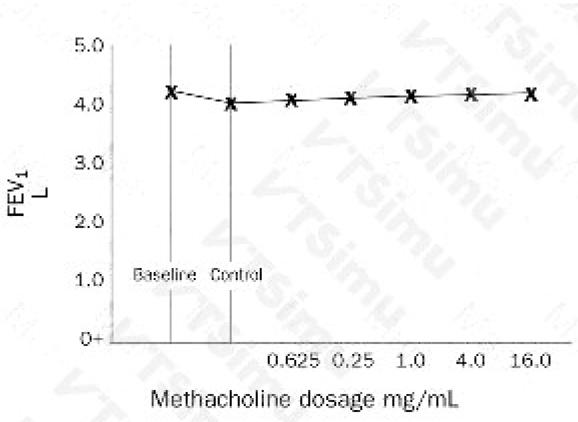
**ANSWER: A**

**Explanation:**

Instruct the patient to blow out longer and repeat the effort. In methacholine challenge testing, the decision to advance, stop, or administer bronchodilator therapy must be based on a valid post-dose $FEV_1$ measurement. The displayed maneuver indicates an inadequate expiratory duration, so the measured vital capacity has not been fully exhaled. Ending expiration prematurely can make the maneuver unacceptable and can yield an unreliable $FEV_1$ comparison with baseline. The technologist should coach the patient to continue exhaling until an adequate end-of-test criterion is reached, then obtain an acceptable, repeatable spirometric effort before interpreting the response to methacholine. Appropriate coaching is particularly important during bronchoprovocation because airway narrowing may make the patient feel finished before complete expiration has occurred. Once a technically acceptable post-dose $FEV_1$ is available, the percentage fall from the baseline $FEV_1$ can be calculated and used to determine the appropriate next step in the protocol. ATS/ERS spirometry standards emphasize achieving a satisfactory end of forced expiration and obtaining acceptable maneuvers for valid interpretation. Methacholine challenge standards likewise require reliable serial $FEV_1$ measurements to assess bronchial responsiveness. See the ATS/ERS Standardization of Spirometry 2019 Update and the ATS methacholine challenge testing guideline.

**QUESTION NO: 14**

The following data were obtained from a bronchial challenge test:




APC 20 of 2 mg/mL was obtained the next day in another laboratory. Which of the following is the most likely explanation for these data?

**A.** The two test results are within day-to-day variability.

**B.** Incorrect doses of methacholine were administered.

**C.** The spirometer accuracy drifted during the test.

**D.** The patient's effort was inconsistent.

**ANSWER: C**

**Explanation:**

**The spirometer accuracy drifted during the test.** A methacholine bronchial challenge depends on accurately measuring the serial change in forced expiratory volume in 1 second after each progressively stronger dose. The provocative concentration producing a 20% fall is calculated from those measured values. The data pattern is most consistent with a systematic measurement shift during the challenge rather than a stable representation of the patient's airway response. When spirometer accuracy drifts, later measurements can be biased relative to the baseline measurement, causing the apparent dose-response curve to be distorted and the calculated provocative concentration to differ substantially from a repeat test performed with accurate equipment. The next-day result of 2 mg/mL provides a clinically plausible reference for the patient's bronchial responsiveness and highlights that the original sequence was affected by a technical measurement problem. Quality assurance requires verification of spirometer calibration and volume accuracy so that serial measurements remain comparable throughout testing. Methacholine challenge methodology specifically relies on reproducible spirometry and valid serial forced expiratory volume measurements. See the American Thoracic Society methacholine challenge guidelines and the ATS/ERS spirometry standardization update.

## QUESTION NO: 15

During a cardiopulmonary stress test using breath-by-breath gas analysis, a pulmonary function technologist notices that the VO2 suddenly decreases. Which of the following may explain this change?

1. The patient has achieved anaerobic threshold.

2. The measurement of the expired gas volumes is inaccurate.

3. O2 analyzer "phase delay" has increased.

4. There is a leak in the tubing or mouthpiece.

**A.** 1, 3, and 4 only

**B.** 1, 2, and 3 only

**C.** 1, 2, and 4 only

**D.** 2, 3, and 4 only

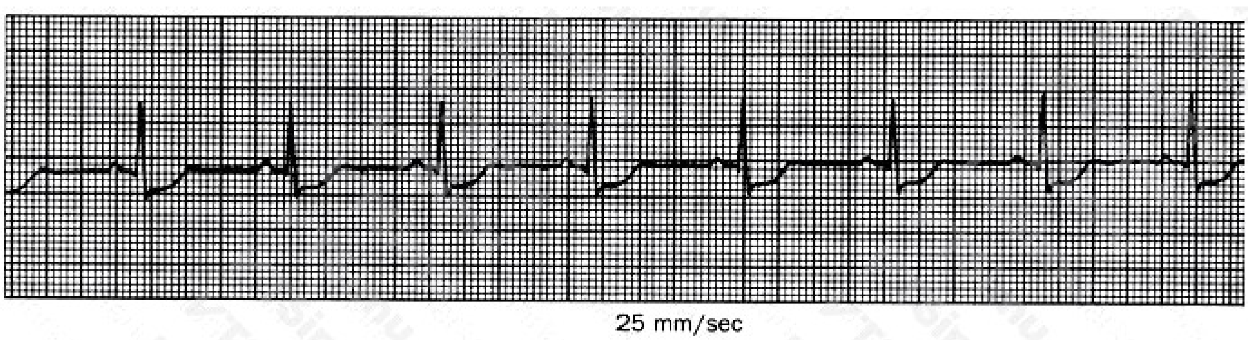
## ANSWER: D

**Explanation:**

**2, 3, and 4 only** is correct because each of these technical factors can create an artifactual abrupt fall in measured oxygen uptake during breath-by-breath cardiopulmonary exercise testing. $VO_2$ is calculated from measured ventilation and the difference between inspired and expired oxygen fractions; therefore, inaccurate measurement of expired gas volume directly distorts the calculated result. A leak at the mouthpiece, tubing, or other connections can cause expired gas or volume to bypass the measurement system, producing unreliable breath-by-breath ventilatory and gas-exchange values. Increased $O_2$-analyzer phase delay is also important because gas concentration data must be time-aligned with the corresponding flow/volume signal. If this synchronization degrades, the analyzer may pair gas fractions with the wrong portion of a breath, causing transient errors in calculated $VO_2$. These are recognized quality-control concerns in CPET, where appropriate calibration, leak checks, and verification of gas-flow signal alignment are essential before interpreting unexpected changes in metabolic data. The ATS/ACCP statement describes the central role of accurate gas concentrations, flow measurements, and calibration in CPET: ATS/ACCP Statement on Cardiopulmonary Exercise Testing. Additional CPET technical standards are available from the European Respiratory Society.

## QUESTION NO: 16

A 54-year-old male with a normal ECG at rest develops dyspnea during an exercise (stress) test, and the following ECG pattern is noted at 25 watts:




25 mm/sec A pulmonary function technologist should

**A.** Continue the test until the subject reaches target heart rate.

**B.** Stop the test immediately; there is evidence of heart block.

**C.** Continue the test and obtain an arterial blood sample.

**D.** Stop the test immediately; there is evidence of ischemia.

## ANSWER: B

**Explanation:**

**Stop the test immediately; there is evidence of heart block.** Exercise-induced conduction block is a clinically significant abnormal rhythm finding, particularly when it occurs early in a test at a low workload and is accompanied by dyspnea. The displayed tracing is consistent with impaired atrioventricular conduction, meaning that atrial impulses are not being conducted normally to the ventricles. During exercise, this may reduce the ability to increase ventricular rate and cardiac output appropriately, potentially causing symptoms and hemodynamic compromise. The appropriate immediate response is to terminate exercise, monitor the patient closely during recovery, obtain or preserve the ECG tracing, and promptly notify the supervising physician or follow the laboratory's emergency protocol. Exercise testing standards treat the development of significant arrhythmias or conduction disturbances as an indication for stopping testing because continued exertion can worsen instability and delays appropriate assessment. The patient requires medical evaluation of the conduction abnormality rather than continued efforts to reach a target heart rate. Guidance on exercise-test termination and monitoring is available in the American Heart Association's exercise testing standards at AHA Exercise Standards for Testing and Training and in the ATS/ACCP statement on cardiopulmonary exercise testing at ATS/ACCP Statement on Cardiopulmonary Exercise Testing.

## QUESTION NO: 17

Which of the following thresholds for a clinically significant change in lung function from the beginning to the end of a methacholine challenge test is significant?

**A.** An increase of more than 20% in airway resistance

**B.** A decline of more than 30% in FEF 25-75%

**C.** A decline of more than 20% in FEV 1

**D.** A decline of more than 20% in inspiratory capacity

**ANSWER: C**

**Explanation:**

A decline of more than 20% in FEV 1 is the clinically meaningful threshold used to identify a positive methacholine challenge response. Methacholine is administered in progressively higher concentrations or doses, with spirometry—particularly $FEV_1$—measured after each stage and compared with the prechallenge baseline. The test endpoint is conventionally a 20% fall in $FEV_1$; the methacholine concentration or dose producing that reduction is reported as the $PC_{20}$ or $PD_{20}$. $FEV_1$ is used because it is standardized, reproducible, and directly reflects induced airway narrowing during bronchoprovocation testing. In practical testing language, an observed fall greater than 20% clearly meets this response threshold, prompting termination of challenge dosing and administration of bronchodilator as appropriate. This threshold is central to interpreting airway hyperresponsiveness in the proper clinical context, alongside pretest probability and baseline spirometry. The American Thoracic Society methacholine challenge guidance describes the 20% $FEV_1$ reduction endpoint, and the European Respiratory Society technical standard likewise bases methacholine challenge interpretation on this measured $FEV_1$ response. See the ATS methacholine challenge guidelines and the ERS technical standard for bronchial challenge testing.

## QUESTION NO: 18

Which of the following is the most reliable indicator that a patient has achieved his maximum exercise capacity during a progressive exercise (stress) test?

**A.** Respiratory exchange ratio greater than 0.8

**B.** Heart rate of 210/min

**C.** VO2 remains stable with increasing workload

**D.** Minute ventilation greater than 170 L/min

**ANSWER: C**

**Explanation:**

**VO2 remains stable with increasing workload** is the most reliable indicator because it describes a physiologic oxygen-uptake plateau during progressively greater external work. During an incremental cardiopulmonary exercise test, oxygen consumption normally rises in proportion to workload as the cardiovascular, pulmonary, and skeletal-muscle systems deliver and use more oxygen. If the workload is increased but measured oxygen consumption no longer rises meaningfully, the patient has reached the highest oxygen uptake achievable under the test conditions. This finding is traditionally termed a VO2 plateau and is the classic direct criterion for maximal oxygen consumption.

In practice, laboratories interpret the plateau in the context of test quality, appropriate incremental protocol design, and continuously measured breath-by-breath gas-exchange data. A small increase in oxygen uptake despite an additional work-rate increment can support the conclusion that the patient has reached maximal exercise capacity. This is particularly valuable because it is based on the defining physiologic response being measured rather than on an age-based estimate or a single nonspecific observed value. Guidance on cardiopulmonary exercise testing and interpretation is available from the American Thoracic Society statement on cardiopulmonary exercise testing and the European Respiratory Society CPET interpretation resource.