

# Questions and Answers

## Levels I, II and III **Mass Spectrometer Testing Method**

Supplement to  
*Recommended Practice*  
No. *SNT-TC-1A*  
Book HM



The American Society  
for Nondestructive Testing, Inc.



**Documents**

Document Sharing Hub

# Questions and Answers

Levels I, II and III

## **Mass Spectrometer Testing Method**

Supplement to  
*Recommended Practice*  
No. SNT-TC-1A  
Book HM



The American Society  
for Nondestructive Testing, Inc.  
**Documents**  
AVA Document Sharing Hub

This publication contains suggested questions and answers in the Mass Spectrometer Testing Method for use in conjunction with *Recommended Practice No. SNT-TC-1A for Personnel Qualification and Certification in Nondestructive Testing. Recommended Practice No. SNT-TC-1A* is available from ASNT.

Published by  
The American Society for Nondestructive Testing Inc.  
1711 Arlingate Lane  
PO Box 28518  
Columbus, OH 43228-0518

No part of this book may be reproduced or transmitted in any form, by means electronic or mechanical including photocopying, recording, or otherwise, without the expressed prior written permission of the publisher.

Copyright © 1996 by The American Society for Nondestructive Testing Inc. ASNT is not responsible for the authenticity or accuracy of information herein. Published opinions and statements do not necessarily reflect the opinion of ASNT. Products or services that are advertised or mentioned do not carry the endorsement or recommendation of ASNT.

IRRSP, *NDT Handbook*, *The NDT Technician*, and [asnt.org](http://asnt.org) are trademarks of The American Society for Nondestructive Testing Inc. ACCP, ASNT, *Level III Study Guide*, *Materials Evaluation*, *Nondestructive Testing Handbook*, *Research in Nondestructive Evaluation*, and *RNDE* are registered trademarks of The American Society for Nondestructive Testing Inc.

ASNT Mission Statement:

ASNT exists to create a safer world by advancing scientific, engineering, and technical knowledge in the field of nondestructive testing.

ISBN-13: 978-0-931403-40-8

Printed in the United States of America.

first printing 03/96  
second printing 02/97  
third printing 11/01  
fourth printing 12/05  
fifth printing 01/08  
sixth printing 05/09  
seventh printing 02/12  
eighth printing 11/16  
ninth printing 02/19

# Table of Contents

|                                        |           |
|----------------------------------------|-----------|
| <b>References</b>                      | <b>5</b>  |
| <b>Reference Usage List</b>            | <b>6</b>  |
| <b>Level I</b>                         | <b>7</b>  |
| <b>Questions</b>                       | <b>7</b>  |
| <b>Answers</b>                         | <b>15</b> |
| <b>Level II</b>                        | <b>17</b> |
| <b>Questions</b>                       | <b>17</b> |
| <b>Answers</b>                         | <b>25</b> |
| <b>Level III</b>                       | <b>27</b> |
| <b>Questions</b>                       | <b>27</b> |
| <b>Answers</b>                         | <b>39</b> |
| <b>Sample Specification</b>            | <b>41</b> |
| <b>Sample Specification Attachment</b> | <b>47</b> |
| <b>Sample Specification Questions</b>  | <b>49</b> |
| <b>Sample Specification Answers</b>    | <b>51</b> |



# Recommended Training References

## Mass Spectrometer Testing Method

- A. *Leak Detection Manual* 992249-0017. DuPont.
- B. *Operation and Maintenance Manual Type 24-120B, Leak Detector* 992231-0017. DuPont.
- C. *Vapor Emission Detection Course No. C690*. Martin-Marietta.
- D. *Nondestructive Testing - A Survey*, NASA SP-5113. National Aeronautics and Space Administration.
- E.\* *Metals Handbook*, eighth edition, *Nondestructive Inspection and Quality Control*, Volume 11. Metals Park, OH: American Society for Metals. 1976.
- F.\* *Annual Book of ASTM Standards*, Volume 03.03, *Nondestructive Testing*. "Standard Terminology for Nondestructive Examinations," Standard ASTM E 1316. Philadelphia, PA: American Society for Testing and Materials. Latest edition.
- G.\* *Annual Book of ASTM Standards*, Volume 03.03, *Nondestructive Testing*. "Standard Guide for Selection of a Leak Testing Method," Standard ASTM E 432. Philadelphia, PA: American Society for Testing and Materials. Latest edition.
- H. *Handbook of Chemistry and Physics*. 46th Ed. The Chemical Rubber Co. 1966.
- I. *Leakage Testing Handbook*, revised edition. Prepared by General Electric and NASA under contracts CR-952, NAS 7-396, and NASA CR 06139. NASA Report #N69-38843 is available from NTIS, Springfield, VA, as report #IST-295. U.S. Department of Commerce, National Technical Information Service (NTIS). 1969.
- J. *Introduction to Helium Mass Spectrometer Leak Detection*. Varian Associates, Inc. 1980.
- K. *Introduction to Vacuum and Leak Detection*. Veeco Instruments, Inc. 1980.
- L.\* McMaster, R. C., ed. *Nondestructive Testing Handbook*, second edition: Volume 1, *Leak Testing*, Sections 1, 2, 3, 5, 6, 8, and 9. Columbus, OH: The American Society for Nondestructive Testing. 1982.
- M. *Mass Spectrometer Leak Test Station Operation and Maintenance Manual for Models MS-17A, AB, ABC and AM*. Veeco Instruments, Inc.
- N. Guthrie, Andrew. *Vacuum Technology*. Second Printing, April 1965. New York: John Wiley and Sons, Inc.
- O. *Instruction Manual for Model 936-40 Porta-Test Leak Detector*. Varian-Lexington Vacuum Division.
- P. Arons, A. B. *Development of Concepts of Physics*. Addison-Wesley Publishing Co., Inc. 1965.  
\*Available from The American Society for Nondestructive Testing, Inc.

Each question found in this book contains letter(s) and page number(s) in bold type immediately following the answers. For example,

35. The evacuation of the test object to the point at which its volume can be exposed to a mass spectrometer leak detector system is called the:

- a. diffusion cycle
- b. vacuum cycle
- c. roughing cycle
- d. pressurizing cycle

**J.29**

In this example, the letter "J" refers to Reference J in the list provided above and "29" is the specific page in Reference J where the answer to the question can be found.

# Reference Usage List

## Mass Spectrometer Testing Method

### Reference A: Total = 56

Level I (19)  
Level II (15)  
Level III (22)

### Reference B: Total = 16

Level I (6)  
Level II (6)  
Level III (4)

### Reference C: Total = 31

Level I (11)  
Level II (10)  
Level III (10)

### Reference D: Total = 6

Level I (1)  
Level II (4)  
Level III (1)

### Reference E: Total = 7

Level I (2)  
Level II (5)  
Level III (0)

### Reference F: Total = 36

Level I (8)  
Level II (13)  
Level III (15)

### Reference G: Total = 11

Level I (3)  
Level II (2)  
Level III (6)

### Reference H: Total = 12

Level I (3)  
Level II (9)  
Level III (0)

### Reference I: Total = 31

Level I (1)  
Level II (9)  
Level III (21)

### Reference J: Total = 61

Level I (18)  
Level II (23)  
Level III (20)

### Reference K: Total = 70

Level I (8)  
Level II (27)  
Level III (35)

### Reference L: Total = 192

Level I (59)  
Level II (64)  
Level III (69)

### Reference M: Total = 47

Level I (25)  
Level II (13)  
Level III (9)

### Reference N: Total = 63

Level I (18)  
Level II (20)  
Level III (25)

### Reference O: Total = 8

Level I (3)  
Level II (2)  
Level III (3)

### Reference P: Total = 7

Level I (0)  
Level II (0)  
Level III (7)

# Level I Questions

## Mass Spectrometer Testing Method

1. A vapor is best defined as:
  - a. water in a test system
  - b. a substance which, though present in the gaseous phase, exists as a liquid at room temperature
  - c. a substance in the gaseous state whose temperature is above its critical temperature
  - d. a substance in the liquid state whose temperature is below its critical temperature

**H; J.102; K.14; L.34, 62; M.14**
2. Gage pressure is:
  - a. the harmonic pressure within a gage
  - b. atmospheric pressure plus absolute pressure
  - c. the difference between absolute and atmospheric pressure
  - d. a sum of the partial pressures of air at standard temperature and pressure

**J.103; L.192; N.85**
3. All leak testing methods are dependent upon:
  - a. barometric pressure
  - b. gas or liquid flow
  - c. mass spectrometer analysis
  - d. mean free paths of helium flow

**L.5-6**
4. A type of virtual leak caused by the slow release of absorbed or entrapped tracer gas in a helium mass spectrometer vacuum system is a:
  - a. hang-up
  - b. condenser
  - c. getter
  - d. molecular leak

**A.1-2; F**
5. The sensitivity of a mass spectrometer leak detector system is the mass flow rate of tracer gas:
  - a. that gives a maximum measurable signal
  - b. that gives a minimum measurable signal
  - c. at standard temperature and pressure
  - d. in a leak

**A.1-4; F; L.445**
6. As the required sensitivity of a leak test increases, the cost of the test:
  - a. decreases
  - b. remains constant
  - c. increases
  - d. decreases exponentially

**G.4; L.12**
7. Which of the following can be considered a major class of mass spectrometer leak testing?
  - a. static test
  - b. dynamic test
  - c. both a and b
  - d. none of the above

**G; L.14, 44-50**
8. Outgassing is defined as:
  - a. the removing of the free gas from a system
  - b. the spontaneous evolution of gas from a material in a vacuum
  - c. the spontaneous conversion of a gas to a liquid
  - d. removing the vacuum

**A.1-3; F; J.108; N.68**
9. Vacuum bake-out is defined as the:
  - a. heating of a system to remove water vapor
  - b. degassing of a vacuum system by heating
  - c. use of a halide torch to boil off liquids in the system
  - d. heating of liquid nitrogen in the cold trap by condensable vapors

**F; L.333; N.441**
10. A material that is included in a vacuum system for removing gas by absorption is called:
  - a. a getter
  - b. a collector
  - c. an orifice
  - d. a molecularizer

**N.117-118**

## Mass Spectrometer Testing Method, Level I

11. The diffusion pump and mechanical forepump in a mass spectrometer leak detector system:
- use the same type of oil
  - use different types of oil
  - operate using the same motor
  - use the same principal of operation
- B.1-3; L.327-329, 539; M.14, 64**
12. The warm-up period for diffusion pumps:
- is instantaneous
  - takes 20-30 minutes
  - is after the system is below 133 Pa (1 mm Hg)
  - is not required
- C.9; L.539; M.30, 35; O.3-4**
13. When calibrating a helium mass spectrometer instrument to determine the instrument sensitivity, which one of the following statements is *not* true?
- the filament must be "ON"
  - the instrument must be connected to the system being tested
  - the standard leak valve must be connected to the test port of the instrument
  - the standard leak valve must be open
- B.4-11; M.35-36; N.476-477**
14. The condition of the oil in the forepump of a vacuum system is important because:
- the pump will not be lubricated properly
  - the limiting forepressure of the diffusion pump may be exceeded
  - the water introduced will rust the pump internals
  - all of the above
- B.6-11**
15. The helium mass spectrometer detector probe pressure test technique is:
- a quantitative test
  - a qualitative test
  - a semiautomatic test
  - none of the above
- J.10; L.385, 484**
16. When performing a tracer probe mass spectrometer vacuum test, it is desirable to:
- pressure test the system first
  - have a slight draft blowing across the surface of the test object to distribute the tracer gas evenly
  - perform the test in a still air environment
  - rotate the vessel constantly during the test
- C.28; L.452; N.487, item 6**
17. In vacuum systems, a mechanical pump is used in a series with the diffusion pump because the:
- mechanical pump achieves a lower pressure
  - diffusion pump uses fractionating oil
  - diffusion pump will not discharge against atmospheric pressure
  - mechanical pump handles condensable vapors
- I.7-4; L.538; M.14; N.100**
18. When the high vacuum section of a helium mass spectrometer is diffusion pumped, the leak detector's forepump belt breaks while the instrument is in operation and unattended. Which of the following is true?
- no damage will occur since the automatic protection system will be activated
  - the vacuum system will stay at low vacuum as long as the cold trap remains filled
  - backstreaming of the diffusion pump oil vapors will occur, contaminating the system
  - the system will continue to function properly as long as the diffusion pump is operating
- C.9**
19. 300 psig is approximately equal to:
- 101 kPa (1 atmosphere of pressure)
  - 40 kPa (300 mm Hg)
  - 2.1 MPa (21 atmospheres of pressure)
  - none of the above
- C.97; L.191-193; N.8**
20. In the normal sequence of starting up a mass spectrometer leak detector unit with a mechanical forepump and diffusion pump, what is the start-up sequence?
- the diffusion pump is started first
  - the mechanical pump is started first
  - both pumps are started simultaneously
  - the starting sequence is not important
- B.4-5; J.26; L.539; M.34-35**
21. Increasing the length of a tube connecting the mass spectrometer leak detector to an evacuated test object may:
- cause a decrease in the system's response time
  - cause an increase in the system's response time
  - have no effect on the system's response time
  - none of the above
- A.2-12; J; K.137; L.80, 453, 502**

22. When vacuum testing large volumes with a mass spectrometer leak detector, the response and cleanup times depend on:
- the volume of the system under test
  - the conductance of the connecting tubes
  - the pumping speed of the mass spectrometer leak detector unit
  - all of the above
- A.2-12; L.452-453, 461; N.479, 482**
23. Operating the mass spectrometer tube at a pressure greater than that recommended by the manufacturer is undesirable because:
- too many electrons will be produced
  - the spectrometer filament may burn out prematurely
  - the diffusion pump cannot handle it without wear
  - the pressure relay switches will arc
- A.2-10; L.523; M.18**
24. When connecting an auxiliary vacuum pump system to a test vessel, the plumbing lines should be kept as short as possible because the:
- outgassing effect will be reduced
  - conductance of the system is inversely proportional to the length of the tubing
  - leak detector should be as close to the test system as possible
  - pumps will run smoother
- A.2-12; C.12; L.324**
25. The minimum leakage detectable in a helium mass spectrometer leak testing system changes when a continuous parallel vacuum auxiliary pump is used according to the:
- position of the pump in the system
  - ratio of the throughput of the auxiliary pump to that of the leak detector
  - design of the cold trap
  - type of throttle valve used
- C.28; L.450, 464**
26. The accumulation technique of helium mass spectrometer leak testing is:
- a semiquantitative test
  - a static quantitative test
  - a qualitative test
  - both b and c
- A.3-1; L.442, 481-483; N.484**
27. It is desirable for a system being helium mass spectrometer leak tested to have:
- a long response time
  - a short response time
  - a fluctuating time constant
  - none of the above
- A.3-12; E.269; L.48-49; N.478**
28. When performing a helium mass spectrometer detector probe test, the scanning should be conducted in a sequence from the:
- highest to the lowest areas in the system
  - farthest to the nearest areas from the instrument
  - most difficult to the easiest areas to test
  - lowest to the highest areas in the system
- L.488**
29. When using the mass spectrometer leak detector probe test technique, it is:
- difficult to detect small leaks that are close to large leaks
  - impossible to segregate leaks
  - desirable to have a draft blowing across the test surface
  - simple to accurately size detected leaks
- A.3-10; L.479, 488**
30. A vessel designed to hold liquid nitrogen when inserted into a vacuum system is called a:
- bell jar
  - cold cathode tube
  - cold trap
  - condenser
- A.3-10; J.29; K.56; L.330, 447, 529, 540; N.134-136; O.133-135**
31. A vacuum pump using a vapor jet as the pumping means is called a:
- mechanical vacuum pump
  - cold trap
  - diffusion pump
  - fission pump
- A.1-1; J.101; K.52; L.328-329, 538-539**
32. The percentage of helium in air is approximately:
- the same as nitrogen
  - 0.0004%
  - 1%
  - 21%
- A.1-1; K.115; L.67, 448, 509**

## Mass Spectrometer Testing Method, Level I

33. The area to be leak tested must be free of:
- oil
  - grease
  - paint
  - all of the above
- C.34; L.455, 458, 462, 466, 487**
34. Tracer gas ions in a helium mass spectrometer leak detector are separated from the remainder of the ion beam by the:
- ion collector
  - magnetic field
  - hot tungsten filament
  - cold trap
- E.264; L.509-511, 513, 517; M.13**
35. The evacuation of the test object to the point at which its volume can be exposed to a mass spectrometer leak detector system is called the:
- diffusion cycle
  - vacuum cycle
  - roughing cycle
  - pressurizing cycle
- J.29**
36. The gage that is used to monitor the pressure in the high vacuum section of a mass spectrometer leak detector is called a:
- cold-cathode discharge gage
  - Bourdon pressure-vacuum gage
  - Pirani gage
  - bulk pressure gage
- A.1-4; J.27; L.531, 541; M.18**
37. The mass spectrometer vacuum gage that is used to monitor the pressure during the roughing cycle is called a:
- cold-cathode discharge gage
  - thermal conductivity gage
  - Bourdon pressure meter
  - bulk pressure gage
- C.10; L.531; M.20**
38. Which of the following factors would affect the sensitivity of a mass spectrometer leak detector?
- use of a remote control system
  - the pumping speed of the mass spectrometer leak detector vacuum system
  - design of the roughing pump
  - type of throttle valve used
- L.533-534; N.480**
39. Background signal in mass spectrometer leak detector testing refers to:
- an output signal of the mass spectrometer leak detector caused by any reason other than leakage
  - noise level above 70 dB through the detector
  - signal created by the mechanical forepump
  - noise created by stressing the part in pressure testing
- B.4-14; L.512, 534**
40. Which of the following is the best definition of the term "torr"?
- 133 Pa (1 mm Hg)
  - 1 atmosphere
  - 760 mm Hg
  - 101 kPa (14.7 psig)
- F; L.8,192; N.8**
41. When dynamic mass spectrometer vacuum testing:
- the system analyzes collected samples
  - the system is in motion
  - the system is being continually pumped
  - none of the above
- A.1-13; F; L.443, 446; N.26**
42. The cold cathode pressure gage can be damaged by:
- an extended time at pressure below 0.01  $\mu\text{m}$
  - an extended time at pressure below 0.02  $\mu\text{m}$
  - a high output meter reading
  - a low ionization current
- L.540-541; M.18**
43. Increasing probing speed over the area being tested will result in:
- an increase in response time
  - an increase in test sensitivity
  - a decrease in test sensitivity
  - a decrease in instrument sensitivity
- A.3-8; L.48, 470**
44. The scale of a mass spectrometer leak detector output meter reads in:
- SCFM
  - micrometers ( $\mu\text{m}$ )
  - torr ( $\mu\text{m Hg}$ )
  - none of the above
- A.4-11; L.533**
45. The purpose of a mass spectrometer tube is to:
- measure tracer gas content in the test sample
  - analyze total gas content in the test sample
  - pump tracer gas ions
  - measure the internal pressure in the system
- C.10; J.27; K.118; L.513; M.9**

46. For a mass spectrometer leak detector, what is the function of the roughing pump?
- a. to evacuate the system external to the mass spectrometer leak detector
  - b. to pressurize the system external to the mass spectrometer leak detector
  - c. to evaluate the internal mass spectrometer leak detector high vacuum section
  - d. none of the above
- A.3-10; J.29; K.128; L.537; M.14**
47. The gas having the lowest molecular weight is:
- a. helium
  - b. hydrogen
  - c. nitrogen
  - d. oxygen
- B.4-12; H; J.21; L.75**
48. Helium has an atomic mass of:
- a. 2
  - b. 3
  - c. 4
  - d. 8
- D.208; H; J.21; L.75**
49. 760 torr are approximately equal to:
- a. 10 kPa (76 mm Hg)
  - b. 101 kPa (760 mm Hg)
  - c. 2 kPa (14.7 mm Hg)
  - d. none of the above
- C.30; F; L.8, 192**
50. When performing a detector probe helium mass spectrometer test, the test object is:
- a. blanketed in helium
  - b. evacuated
  - c. pressurized
  - d. immersed in water
- C.34; G.3; L.446, 478**
51. When completely shutting down a helium mass spectrometer, the cold trap should:
- a. always be removed, warmed-up, cleaned, and replaced if cryogenic liquid was used
  - b. never be removed because of the possibility of atmospheric contamination
  - c. be left in place to clean up as the diffusion pump cools down
  - d. be inspected but not cleaned unless discoloration is noticed on the cold trap
- L.539; M.39**
52. When the operating diffusion pump in a helium mass spectrometer is suddenly exposed to high pressure for an extended period of time, the result can be:
- a. cracking of the diffusion pump oil
  - b. backstreaming oil vapor contamination of the cold trap
  - c. backstreaming oil vapor contamination of the entire high vacuum system, including the analyzer tube
  - d. any of the above
- L.329, 544; M.14**
53. The valve in a helium mass spectrometer that makes it possible to manually connect the instrument to a higher pressure vacuum system for the purpose of leak testing that system is usually called the:
- a. block valve
  - b. throttle and/or test valve
  - c. accumulator valve
  - d. pump valve
- J.30-31; L.384, 542-543; M.2**
54. When leakage is indicated during a helium mass spectrometer test, the operator should:
- a. mark the approximate area where the signal was received and continue testing
  - b. immediately vent the system, repair the leak, retest the repair, and continue with the test
  - c. retest the same area to verify that the signal was really caused by leakage, pinpoint and mark the source of that leakage for repairs, temporarily seal it if necessary, and continue testing
  - d. peen it shut to eliminate the need for later repairs and continue testing
- J.121,126; L.470, 478-480**
55. When starting up a helium mass spectrometer, the circuit breaker repeatedly shuts off the test manifold roughing pump. Which of the following could be the cause?
- a. the pump was improperly shut down
  - b. the pump oil is too cool
  - c. the roughing pump belt is too tight
  - d. any of the above
- L.538; M.58**
56. When performing a helium mass spectrometer tracer probe test, the probing should be conducted in a sequence from the:
- a. highest to the lowest areas in the system
  - b. farthest to the nearest areas from the instrument
  - c. most difficult to the easiest areas to test
  - d. lowest to the highest areas in the system
- J.121; K.131; L.452, 470, 472**

## Mass Spectrometer Testing Method, Level I

57. In a helium mass spectrometer, exposure of the filament to high pressure for extended periods of time will:
- increase the life of the filament
  - do little or no harm to the filament
  - cause the filament to burn out
  - increase the sensitivity of the filament
- M.18; O.6-21**
58. The section of a helium mass spectrometer that “detects” extremely small quantities of helium gas, indicating leakage, is known in general terms as the:
- spectrometer tube
  - amplifier element
  - ionizer element
  - diffusion element
- J.26; L.509, 512; M.9**
59. The safest effective and economical cryogenic fluid commonly used in cold traps is liquid:
- oxygen
  - argon
  - nitrogen
  - hydrogen
- J.100; L.330, 540; M.18; N.134**
60. For a complete shutdown or if a power failure occurs while operating a cold trapped helium mass spectrometer with a high vacuum system diffusion pump, one of the first things the operator should do is to:
- look for some other source of electrical power
  - disconnect the power cord to the machine so that when the power comes back on, the electronics will not come on before the roughing pump
  - close the diffusion pump isolation (accumulator) valve
  - vent the system to atmosphere, remove the cold trap, and clean it
- L.541; M.33, 39**
61. When starting up a helium mass spectrometer from total shut down, the high vacuum system diffusion pump takes about \_\_\_\_\_ to begin pumping after it is turned on.
- 2 minutes
  - 20 minutes
  - 60 minutes
  - 1.5 hours
- L.539; M.30, 35**
62. When adding cryogenic liquid to a cold trap, one should:
- use a funnel and pour the liquid in rapidly so less will be lost by evaporation
  - just pour the liquid into the opening without using a funnel
  - use the funnel and pour in a small amount, wait a few minutes, and slowly pour in the rest
  - not worry about getting freeze burns from the liquid since it evaporates very rapidly
- L; M.30-31**
63. A micrometer of mercury pressure is equal to which of the following?
- 101 kPa (760 mm Hg)
  - 13 kPa ( $10^{-4}$  torr)
  - 0.01 Pa ( $10^{-3}$  torr)
  - 133 kPa (1 000 mm Hg)
- F; L.192; N.8, 10**
64. An absolute pressure of 50  $\mu$ m Hg is the same as:
- $5 \times 10^{-1}$  torr
  - $5 \times 10^{-4}$  mm Hg
  - $5 \times 10^{-2}$  torr
  - 50 torr
- A-A2; L.192**
65. A pressure of 0.000025 mm Hg can also be written as:
- $25 \times 10^6$  mm Hg
  - $2.5 \times 10^5$  mm Hg
  - $2.5 \times 10^{-5}$  mm Hg
  - $2.5 \times 10^{-2}$   $\mu$ m Hg
- L.192; M.91**
66. The product of  $\frac{(5 \times 10^{-2})}{(1 \times 10^2)} \frac{(5 \times 10^3)}{(2.5 \times 10^{-4})}$  equals:
- $1 \times 10^4$
  - $5 \times 10^3$
  - $1 \times 10^{-3}$
  - $2.5 \times 10^4$
- M.92-93**
67. A pressure of 1 mm Hg is the same as:
- 13 mPa (100  $\mu$ m Hg)
  - 133 mPa (1 000  $\mu$ m Hg)
  - 0.13  $\mu$ Pa ( $10^{-3}$   $\mu$ m Hg)
  - 13 Pa (1  $\mu$ m Hg)
- F; L.192; N.8, 10**

68. A bellows stem-sealed vacuum valve should always be turned to the open position before removing the stem assembly from the valve in order to:
- a. be certain that pressure on either side of the valve seat has been equalized
  - b. prevent cracking the bellows
  - c. ensure that the gasket is not stuck to the seat
  - d. determine whether the bellows is leaking

**L.331**



# Level I Answers

## Mass Spectrometer Testing Method

- |              |              |              |
|--------------|--------------|--------------|
| 1. <b>b</b>  | 24. <b>b</b> | 47. <b>b</b> |
| 2. <b>c</b>  | 25. <b>b</b> | 48. <b>c</b> |
| 3. <b>b</b>  | 26. <b>b</b> | 49. <b>b</b> |
| 4. <b>a</b>  | 27. <b>b</b> | 50. <b>c</b> |
| 5. <b>b</b>  | 28. <b>d</b> | 51. <b>a</b> |
| 6. <b>c</b>  | 29. <b>a</b> | 52. <b>d</b> |
| 7. <b>c</b>  | 30. <b>c</b> | 53. <b>b</b> |
| 8. <b>b</b>  | 31. <b>c</b> | 54. <b>c</b> |
| 9. <b>b</b>  | 32. <b>b</b> | 55. <b>d</b> |
| 10. <b>a</b> | 33. <b>d</b> | 56. <b>a</b> |
| 11. <b>b</b> | 34. <b>b</b> | 57. <b>c</b> |
| 12. <b>b</b> | 35. <b>c</b> | 58. <b>a</b> |
| 13. <b>b</b> | 36. <b>a</b> | 59. <b>c</b> |
| 14. <b>b</b> | 37. <b>b</b> | 60. <b>c</b> |
| 15. <b>b</b> | 38. <b>b</b> | 61. <b>b</b> |
| 16. <b>c</b> | 39. <b>a</b> | 62. <b>c</b> |
| 17. <b>c</b> | 40. <b>a</b> | 63. <b>c</b> |
| 18. <b>c</b> | 41. <b>c</b> | 64. <b>c</b> |
| 19. <b>c</b> | 42. <b>c</b> | 65. <b>c</b> |
| 20. <b>b</b> | 43. <b>c</b> | 66. <b>a</b> |
| 21. <b>b</b> | 44. <b>d</b> | 67. <b>b</b> |
| 22. <b>d</b> | 45. <b>a</b> | 68. <b>b</b> |
| 23. <b>b</b> | 46. <b>a</b> |              |