CANADIAN REGISTRATION BOARD
OF OCCUPATIONAL HYGIENISTS

ROH (Registered Occupational Hygienist)
Examination Information

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Examination Eligibility

Eligibility for the examination is based on having one of the following combinations of academic
qualifications and professional experience:

<table>
<thead>
<tr>
<th>Academic Qualification</th>
<th>Professional Experience</th>
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<tbody>
<tr>
<td>PhD (occupational hygiene or equivalent)</td>
<td>2 years</td>
</tr>
<tr>
<td>PhD (acceptable science or engineering)</td>
<td>3 years</td>
</tr>
<tr>
<td>Master (occupational hygiene or equivalent)</td>
<td>3 years</td>
</tr>
<tr>
<td>Master (acceptable science or engineering)</td>
<td>4 years</td>
</tr>
<tr>
<td>Bachelor (acceptable science or engineering)</td>
<td>5 years</td>
</tr>
</tbody>
</table>

Professional experience may only be claimed for periods in which the applicant was primarily (more than 50% of each year) engaged in the professional practice of occupational hygiene or closely related activities. Two references from ROHs must be provided.

**Examination Format**

The ROH examination process is predicated on the commonly-accepted education principle that there is no single examination format which can assess competence in factual and technical knowledge, as well as communication, technical and problem-solving skills, professional judgement and ethics (all of which are key to the functioning of a competent occupational hygienist).

The examination is divided into 2 parts.

**Part A** is a one-day written examination, one half of which is multiple choice, one half essay style questions. Equal weight is given to each of these components. The multiple choice section of the examination consists of approximately 130 questions, all of equal value. There is only one correct answer to each question and marks are given only for correct answers. [Note: Candidates who hold the CIH designation in Comprehensive Practice from the American Board of Industrial Hygiene (ABIH) will be exempted from the multiple choice component of the examination]. In the essay-style component of the examination, candidates are presented with 5 questions of equal value. All 5 questions must be answered. Candidates must achieve a passing grade in each of the written examination components in order to successfully complete Part A.

**Part B** is an oral examination for those who successfully complete Part A. The oral examination is an assessment of the candidate’s competence through evaluation of his or her verbal responses to questions or a scenario put forward by a group of examiners. Generally, three senior ROHs examine each candidate. The process, which lasts about an hour, is similar to an interview.

The multiple choice component of the examination is used primarily to test factual and technical knowledge. The essay-style component, in addition to testing the breadth and depth of factual and technical knowledge, enables assessment of the candidates’ problem-solving skills. The oral examination is used to evaluate the candidates’ problem-solving skills, breadth and depth of knowledge, professional judgement, communication skills and ability to respond to stressful or changing situations.

Examination - General Content

Occupational hygiene involves the identification of existing and potential health hazards in, or arising from the workplace, the evaluation or assessment of the extent of risk posed by the hazards and the development of effective strategies to eliminate or control the risks. For the ROH examination, it is expected that candidates will be familiar with a broad range of occupational hygiene topics identified by the CRBOH, including:

- air sampling, analysis and control measures for chemical hazards
- physics, measurement and control for physical agents such as noise, vibration, ionizing and non-ionizing radiation, temperature and pressure extremes, lighting
- industrial toxicology, the adverse health effects associated with the physical agents (as above)
- the rationale for occupational hygiene standard setting and Canadian legislation
- statistics, epidemiology, ergonomics, biohazards, hygiene program management, labour relations, safety and environmental issues, as they apply to the practice of occupational hygiene
- current topical issues in occupational hygiene

Examination Preparation

Candidates should consider their knowledge and experience within the areas of competency outlined below. This process may assist candidates in identifying their strengths and weaknesses, thereby enabling them to focus their efforts appropriately during examination preparation. Sample questions (multiple-choice and essay style), and a representative listing of references, are provided.

Sample Multiple Choice Questions

The following are examples of the type of questions that may be expected within the multiple choice component of the examination. These examples are not necessarily indicative of the degree of difficulty of all multiple choice questions.

1. Which of the following health effects is associated with chronic overexposure to ethylene oxide
   A) Colon tumors
   B) Increased frequency of spontaneous abortions
   C) Abdominal colic
   D) Kidney failure
   E) Aneurysm.

2. Two separate noise sources of 98 dBA and 96 dBA respectively are installed and operated together. What is the combined noise level?
   A) 99 dBA
   B) 100 dBA
   C) 101 dBA
   D) 123 dBA
   E) 194 dBA
3. Identify the most appropriate WHMIS classification for a product (pH of 11.5, flash point of 65°C) which causes skin sensitization according to scientifically accepted tests.

A) B2 (Flammable liquid)
   D2B (Toxic material causing other chronic effects)
   E (Corrosive material)

B) B3 (Combustible liquid)
   D1A (Very toxic material causing immediate and serious toxic effects)
   E (Corrosive material)

C) B2 (Flammable liquid)
   D2A (Very toxic material causing other toxic effects)
   C (Oxidizing material)

D) B3 (Combustible liquid)
   D1A (Very toxic material causing immediate and serious toxic effects)
   C (Oxidizing material)

E) B3 (Combustible liquid)
   D2B (Toxic material causing other chronic effects)
   E (Corrosive material)

Sample Essay Style Questions

Candidates are reminded that essay questions are typically broad in nature and cover several of the required areas of competency in an overlapping manner. Candidates should provide sufficient information within their answers to demonstrate the depth and breadth of their knowledge within these areas of competency.

1. One of the plants for which you are responsible as an occupational hygienist is a freezer manufacturing plant which employs 300 people. During a recent walkthrough survey, you pinpointed one area of the assembly line for further investigation - the foam insulation injection step. The foam is prepared by mixing a TDI and a polyol through a hand-held injection molding gun. Methylene chloride is used for cleaning the gun.

   (a) Briefly describe the major health effects associated with overexposure to:

   (i) methylene chloride
   (ii) toluene diisocyanate (TDI)

   (b) Outline the protocols you would use to assess worker exposures to these two chemicals. In your answer, include details regarding the sampling equipment and your strategy and, where appropriate, analytical methods.
(c) Describe what steps you would take to reduce personal exposures in this situation.

2. Many workplace hazards require special health and safety procedures and/or control programs to be developed. In this scenario, you are responsible for health and safety at the largest laboratory facility for occupational health and hygiene analytical services in North America. Services of the facility include the entire range of traditional hygiene air sampling analyses as well as analyses of blood and urine. There are 75 employees working in the laboratories.

(a) What process would you follow in designing and implementing an effective control program for chemical management and associated safety procedures in this environment? Please give details.

(b) What key elements would be included in your control program?

Point form answers are not acceptable.

**Examination Grading Process**

The CRBOH Administrative Office is responsible for ALL contact with examination candidates. This includes the receipt of application forms, review and decision-making regarding eligibility, exam location/date/time and selection of proctors. The Administrative Office handles all inquiries from candidates. The Administrative Office assigns each candidate a Candidate Identification Number. In order to ensure that marking is carried out “blind”, Examination Committee members do not have access to these identifiers.

Written examinations are marked by the ROH Examination Committee. Multiple choice questions are marked by the Chair of the Examination Committee. The essay style questions are marked independently by at least two members of the Committee. The results are collated by the Chair and any anomalies or inconsistencies are reviewed. The minimum grade necessary for successful completion is set prior to the exam. All candidates in any one year could successfully complete the exam (i.e. the percentage of candidates successfully completing the exam is not predetermined using statistical methods by the Examination Committee or the Board of Directors). The chair of the Committee forwards the results to the Board of Directors with the recommendation of the Committee as to whether the candidate should be granted a pass or fail. Only those candidates granted a pass on the written examination may take the oral examination.

The oral examination is made reliable by virtue of it being a “structured oral” where examiners plan the questions and expected answers prior to the examination. Candidates are first evaluated separately by each examiner through comparison of their responses and those expected. Responses of all examiners are then reviewed and discrepancies, should they occur, are resolved through discussion.

**Useful References in Occupational Hygiene**

The following list of texts, manuals, journals, regulations, standards and guidelines are provided to give candidates examples of the types of materials they should be reviewing in preparation for the examination. The list is not meant to be complete or exhaustive. Candidates are expected to use professional judgement in selection of other reading material for exam preparation. Candidates are expected to use the most recent edition available; as a guide, dates as of late 1998 are provided.
**Texts**

1. Casarette and Doull’s Toxicology: The Basic Science of Poisons (5th Edition); C.D. Klaassen, editor.

2. Ergonomic Design for People at Work, Volumes I and II; Eastman Kodak Company, New York, 1983 (Volume I), 1986 (Volume II)

3. Fundamentals of Industrial Hygiene (Latest Edition); B.A. Plog and T. Hogan, editors


5. In-Plant Practices for Job-related Health Hazards Control, Volumes I and II (Latest Edition); L.V. Cralley and L.J. Cralley, editors

6. Industrial Hygiene Management; J. T. Garrett, L.J. Cralley and L.V. Cralley, editors

7. Patty’s Industrial Hygiene and Toxicology, Volumes IA & IB, IIA to IIC, IIA & IIIB (Latest Edition); G.D. Clayton and F.E. Clayton, editors (Vols. I & II), L.J. Cralley and L.V. Cralley, editors (Vol. III)

8. Recognition of Health Hazards in Industry: A Review of Materials and Processes; W.A. Burgess

9. Industrial Toxicology: Safety and Health Applications in the Workplace; P.L. Williams and J.L. Burson, editors

10. Noise and Noise Control; M.J. Crocker and F.M. Kessler, editors

11. Air Monitoring for Toxic Substances, S. Ness, editor

12. Air Monitoring Instrumentation; C.J. Maslansky and S.P. Maslansky, editors

13. Applications and Occupational Elements of Industrial Hygiene; M.B. Stern and S.Z. Mansdorf, editors


17. AIHA Noise and Hearing Conservation Manual

**Manuals** (latest editions)

1. Handbook of Chemistry and Physics (latest edition)

2. ACGIH Industrial Ventilation: A Manual of Recommended Practice

3. NIOSH Guide to Industrial Respiratory Protection

4. NIOSH Manual of Analytical Methods
5. ACGIH Air Sampling Instruments Handbook

**Journals**

1. American Industrial Hygiene Association Journal
2. Applied Occupational and Environmental Hygiene
3. Annals of Occupational Hygiene
5. Journal of Toxicology and Environmental Health
6. Archives of Environmental Health
7. Health Physics
8. Journal of Occupational and Environmental Medicine
9. Acoustic Journal

**Regulations, Standards, Guidelines**

1. Occupational health and safety legislation (Acts and associated regulations) within at least one Canadian jurisdiction (provincial, territorial or federal)
2. Workplace Hazardous Materials Information System Regulation
3. Transportation of Dangerous Goods Act (federal)
4. Criteria for a Recommended Standard
5. The Documentation of TLVs and BEIs
6. TLVs: Threshold Limit Values and Biological Exposure Indices
7. Workplace Environmental Exposure Levels Guides.

**Areas of Competency**

**Basic Science**

General concepts within chemistry, biology, physiology, physics, biochemistry, anatomy and psychology which form the underlying basis for the science of occupational hygiene.

**Chemical Hazards**

Understanding of the toxicology and potential health effects of exposure to chemical substances (symptoms; modes of action; routes of entry, absorption, metabolism, distribution and excretion), methods of evaluation
of chemical exposure (air sampling and biological monitoring techniques), analytical methods, and controls (engineering controls such as ventilation, isolation, and process change; administrative controls; personal protective equipment selection, use and limitations).

**Physical Hazards - Noise**

Health effects arising from exposure to noise, the physics of noise, methods of measuring and evaluating noise exposure, engineering controls to reduce noise exposure, selection and use of hearing protection.

**Physical Hazards - Other**

Physical characteristics of, potential health effects of exposure to, evaluation and measurement of exposure to, and control methods for ionizing radiation, non-ionizing radiation, thermal and pressure stressors and vibration.

**Biological Hazards**

Potential and actual health effects of exposure to biological agents (bacteria, allergens, toxins, molds, fungi, viruses, bloodborne pathogens, etc). Evaluation, measurement and control of exposure to biological hazards.

**Legislation**

General understanding of the Canadian hygiene, health and safety regulatory environment and detailed understanding of occupational health, safety and hygiene legislation within at least one Canadian jurisdiction. Understanding of accepted industry health and safety standards including the American Conference of Governmental Industrial Hygienists threshold limit values, Canadian Standards Association’s health and safety standards, and ASHRAE guidelines respecting acceptable air quality.

**Ergonomics**

Understanding of biomechanical, anthropometric, physiological, anatomical, and engineering principles needed to design and organize the workplace for the purpose of preventing injuries and illnesses.

**Biostatistics and Epidemiology**

Techniques for study of occupationally-induced diseases and physiological conditions in workplaces. Basic statistical and non-statistical interpretation of epidemiological data in evaluating hazards.

**Safety**

Understanding of basic safety principles as they apply to the practice of occupational hygiene (eg. confined space).

**Environmental Issues**

Health and environmental effects of pollutants. Knowledge of current environmental issues and a general understanding of the requirements of environmental legislation. Knowledge of the potential impact of occupational hygiene controls (ventilation systems, air cleaning technologies) on public health.
**Process-related Hazards**

Hazards associated with processes within various occupational settings.

**Labour Relations**

Understanding of the roles and perspectives of the various occupational health, safety and hygiene perspectives of unions, workers and management.

**Ethics**

Standards of ethical professional conduct, conflict of interest, CRBOH Code of Ethics.

**Management**

Development, implementation and evaluation of occupational hygiene programs. Topics such as resource allocation, budgeting, delegation of authority, accountability, communication, policy-making, etc.

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**Useful Equations for CRBOH Examinations**

The following list of equations, adapted from that developed by the American Board of Industrial Hygiene, is intended to assist candidates in preparation for the CRBOH ROH examination. It will also be provided for use during completion of the examination. This list is not meant to be complete or exhaustive. Consequently, use of any or all of these equations will not necessarily result in successful completion of the ROH examination. In addition, this list may be revised from time to time without notice.

(i) **General Practice and Statistics**
\[
\begin{align*}
ppm &= \frac{Y_{\text{atom}} \times 10^6}{V_{\text{std}}} \\
ppm &= \frac{P_v}{P_{\text{std}}} \\
ppm &= \frac{mghn^3 \times 24.45}{\text{m.w.}} \\
\frac{P_1}{nRT_1} &= \frac{P_2}{nRT_2}
\end{align*}
\]

\[
\begin{align*}
Y_{\text{ex}} &= \frac{g d_y^2 (p_d - C_a)}{18 \eta} \\
R_y &= \frac{D_{\text{cv}}}{\eta} \\
C &= e^{-\frac{V}{T}} \\
\log \frac{I_o}{I} &= abc
\end{align*}
\]

\[
\begin{align*}
pH &= -\log_{10}[H^+] \\
I_{\text{total}} &= X_1P_1 + X_2P_2 + \ldots + X_nP_n
\end{align*}
\]

\[
\begin{align*}
TLV_{\text{mix}} &= \frac{C_1}{TLV_1} + \frac{C_2}{TLV_2} + \ldots + \frac{C_n}{TLV_n} \\
TLV_{\text{mix}} &= \frac{1}{\frac{F_1}{TLV_1} + \frac{F_2}{TLV_2} + \ldots + \frac{F_n}{TLV_n}}
\end{align*}
\]

\[
\begin{align*}
X &= \frac{X_1 + X_2 + \ldots + X_n}{n} \\
SD &= \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}} \\
GM &= 10^{\frac{\sum \log x_i}{n}} \\
GM &= \sqrt[n]{x_1 \cdot x_2 \cdot \ldots \cdot x_n}
\end{align*}
\]

\[
\begin{align*}
GSD &= 94.13 \% \text{tile value} \\
GSD &= 50 \% \text{tile value} \\
SAR &= 1.645 \times CV_{\text{total}} \\
t &= \frac{\bar{x}_1 - \bar{x}_2}{\text{SD}_{\text{pooled}} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \\
\text{SD}_{\text{pooled}} &= \sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}
\end{align*}
\]

\[
\begin{align*}
LCL &= \frac{C_A}{\text{STD}} - \frac{SAE}{PEL} \left( T_1^2 C_1^2 + T_2^2 C_2^2 + \ldots + T_n^2 C_n \right) \\
95\% \text{ Conf} &= \bar{X} \pm (1.645 \times CV \cdot \bar{X})
\end{align*}
\]

\[
\begin{align*}
95\% \text{ Conf} &= \bar{X} \pm (1.965 \times CV \cdot \bar{X}) \\
EC &= \sqrt{E_1^2 + E_2^2 + \ldots + E_n^2} \\
CV &= \frac{SD}{\bar{X}}
\end{align*}
\]

(ii) Noise

\[
\begin{align*}
L_p &= 10 \log \frac{P_v}{P_o} \\
L_{p2} &= L_{p1} + 20 \log \left( \frac{d_1}{d_2} \right) \\
L_{p2} &= 10 \log \left( \frac{L_{p1}}{10} \right) \\
L_{p3} &= 10 \log \left( \sum_{i=1}^{N} \frac{L_{p1}}{10} \right)
\end{align*}
\]
### iii) Ventilation

<table>
<thead>
<tr>
<th>Equation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q = VA$</td>
<td>$F = 4.04 \sqrt{VP}$</td>
</tr>
<tr>
<td>$</td>
<td>SP_h</td>
</tr>
<tr>
<td>$h_e = \frac{1 - C_e^2}{C_e^2} VP$</td>
<td>$C_e = \sqrt{\frac{VP}{</td>
</tr>
<tr>
<td>$VP_r = \left[\frac{Q_1}{Q_2}\right]VP_1 + \left[\frac{Q_2}{Q_3}\right]VP_2$</td>
<td>$Q_2 = Q_1 \left(\frac{Size_2}{Size_1}\right)^2 \left(\frac{RPM_2}{RPM_1}\right) \left(\frac{\rho_2}{\rho_1}\right)$</td>
</tr>
<tr>
<td>$PWR_r = PWR_1 \left(\frac{Size_2}{Size_1}\right)^2 \left(\frac{RPM_2}{RPM_1}\right)^2 \left(\frac{\rho_2}{\rho_1}\right)$</td>
<td>$AHP = \frac{Q(TP)}{6356}$</td>
</tr>
<tr>
<td>$FSP = SP_{net} - SP_{net} - VP_{net}$</td>
<td>$Q_{cor} = Q_{design} \sqrt{\frac{SP_{chosen}}{SP_{calc}}}$</td>
</tr>
</tbody>
</table>
(iv) **Radiation**

\[
\begin{align*}
\ln \left( \frac{G - Q'}{(G - Q/C)} \right) &= -\frac{Q'(t_2 - t_1)}{Y_{\text{room}}} \\
C &= \frac{G}{Q'} \times 10^6 + C_{\text{supply}} \\
C &= \frac{ER \times 24.45 \times 10^6}{MW \times Q'} \\
Q' &= \frac{(24.45)(c_e)(ER)(E)(10^6)}{(n.w.)(T/LP)} \\
C_i &= C_{\text{org}} e^{-t_{\text{room}}} \\
N_{\text{change}} &= \frac{60Q}{Y_{\text{room}}} \\
t_2 - t_1 &= -\frac{Y_r}{Q'} \ln \left( \frac{C_i}{C_1} \right) \\
Y_r &= 1086 \sqrt{\frac{V_F}{\rho}} \\
R_n &= \frac{h_s}{V_F \rho}
\end{align*}
\]

\[
I_2 = I_1 \left( \frac{d_1}{d_2} \right)^2 \\
R_{\text{en}} = (\text{RAD})(Q') \\
A = A_4 \left( \frac{t}{T_{1/2}} \right) \\
A' = \frac{0.633}{T_{1/2}} N_2
\]

\[
A = A_0 \left( \frac{e^{-t}}{T_{1/2}} \right) \\
\frac{1}{T_{1/2_{\text{eff}}}} = \frac{1}{T_{1/2_{\text{rel}}}} + \frac{1}{T_{1/2_{\text{bio}}}} \\
T_{1/2_{\text{eff}}} = \frac{T_{1/2_{\text{rel}}} \times T_{1/2_{\text{bio}}}}{T_{1/2_{\text{rel}}} + T_{1/2_{\text{bio}}}}
\]

\[
X = 3.32 \log \left( \frac{I_1}{I_2} \right) \left[ H_{\text{PV}} \right] \\
I_2 = \frac{I_1}{x} \left( \frac{2}{\text{H}_{\text{PV}}} \right) \\
\log \left( \frac{I_1}{I_2} \right) \left[ H_{\text{PV}} \right] \\
X = \frac{1}{\log 2} \left[ H_{\text{PV}} \right]
\]

\[
PD = \frac{E^2}{3770} \\
I = I_{\text{rel}} e^{-\text{ax}} \\
W = \frac{4P}{A} \\
PD = 37.7H^2
\]

\[
r = \left( \frac{PG}{4\pi EL} \right)^{1/2} \\
\text{spatial ave} = \left( \frac{\sum_{k=1}^{N} PG^2}{N} \right)^{1/2} \\
B_s = \sqrt{B_x^2 + B_y^2 + B_z^2} \\
t = \frac{0.003 J/cm^2}{E_{\text{eff}}}
\]
(v) Heat/Cold Stress

\[ t = \frac{rL}{M} \times 0.1h \]
\[ \Delta D = \log \left( \frac{I_e}{I} \right) \]
\[ D_L = \sqrt{a^2 + D^2 \tau^2} \]
\[ I_L = I_1 \times \text{magnifying factor} \]

\[ WBT = 0.7t_{\text{wet}} + 0.2t_e + 0.1t_s \]
\[ WBT = 0.7t_{\text{wet}} + 0.3t_e \]
\[ C = 0.65v^{0.6}(t_e - 95) \]

\[ \Delta S = (M-W) \pm C \pm R - E \]
\[ R = 15(t_e - 95) \]
\[ HSI = \frac{F_{\text{meq}}}{B_{\text{max}}} \times 100 \]
\[ E_{\text{max}} = 2.4v^{0.6}(42-vp_w) \]

\[ c_{\text{sf}} = \frac{\text{Total Sensible Heat (BTU/hr)}}{1.08(\Delta T)} \]

(vi) Constants

\[ \text{gas constant, } R = 8.314 \text{J/mol}\text{e}°K \]
\[ \text{Avogadro's number} = 6.024 \times 10^{23} \]

\[ \text{speed of sound in air at } 0°C = 331 \text{m/sec } (+0.6 \text{m/sec/°C}) \]

\[ \text{Planck's constant} = 6.626 \times 10^{-27} \text{erg/sec} \]
\[ \text{speed of light} = 3 \times 10^8 \text{m/sec} \]

\[ \text{molar vol at } 25°C, 1 \text{ atm} = 24.45 \text{l} \]
\[ \text{density of air} = 1.2 \text{kg/m}^3 \text{ @ } 760 \text{ mm Hg, 21°C} \]

(vii) Conversions

\[ °F = \frac{9}{5} (°C) + 32 \]
\[ °R = °F + 460 \]
\[ °K = °C + 273 \]
\[ 1 \text{ ft}^3 = 28.32 \text{l} \]

\[ 1 \text{ atm} = 14.7 \text{ psi} = 760 \text{ mm Hg} = 29.92 \text{ in Hg} = 33.86 \text{ ft water} = 1013.25 \text{ mbar} = 101,325 \text{ pascals} \]
<table>
<thead>
<tr>
<th>1 ft³ = 7.481 U.S. gal</th>
<th>1 l = 1.06 qt</th>
<th>1 inch = 2.54 cm</th>
<th>1 lb = 453.6 gm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 gram = 0.03527 oz</td>
<td>1 BTU = 1055.055 Btu = 0.293 wat thr</td>
<td>1 Gray = 100 Rad</td>
<td></td>
</tr>
<tr>
<td>1 Curie = 3.7 × 10¹² diso n/sec (Becquerel)</td>
<td>1 Sievert = 100 Rem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Tesla = 10,000 Gauss</td>
<td>[g = 981 cm/sec² = 32 ft/sec²]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>