



# PHYSICS

## Principles and Problems

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| <p><b>STANDARD 5.1 (SCIENTIFIC PROCESSES) ALL STUDENTS WILL DEVELOP PROBLEM-SOLVING, DECISION-MAKING AND INQUIRY SKILLS, REFLECTED BY FORMULATING USABLE QUESTIONS AND HYPOTHESES, PLANNING EXPERIMENTS, CONDUCTING SYSTEMATIC OBSERVATIONS, INTERPRETING AND ANALYZING DATA, DRAWING CONCLUSIONS, AND COMMUNICATING RESULTS.</b></p> |  |
| <p><b>Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:</b></p>  |  |
| <p><b>5.1.12 A. Habits of Mind</b></p>  |  |
| <p>1. When making decisions, evaluate conclusions, weigh evidence, and recognize that arguments may not have equal merit.</p>   | <p><b>Student Edition:</b><br/>                     8-10, 11-14, 747-757, 760-761<br/> <i>Extreme Physics</i> 188, 506<br/> <i>Internet Physics Lab</i> 20-21<br/> <i>Launch Lab</i> 3<br/> <i>Physics Lab</i> 218-219, 790-791<br/> <i>Technology and Society</i> 220, 608</p> <p><b>Teacher Wraparound Edition:</b><br/>                     A 9; CB 757; PP 16, 762</p> |

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| <p>2. Assess the risks and benefits associated with alternative solutions.</p>                      | <p><b>Student Edition:</b><br/> 176, 179-180, 184-185, 328-331, 726-734,<br/> 735-737, 822-823<br/> <i>Extreme Physics</i> 792<br/> <i>Technology and Society</i> 220, 394<br/> <b>Teacher Wraparound Edition:</b><br/> CD 176; CT 184; R 47</p>  |
| <p>3. Engage in collaboration, peer review, and accurate reporting of findings.</p>                 | <p><b>Student Edition:</b><br/> 12-14, 726-734, 737, 748-756<br/> <i>Extreme Physics</i> 366, 792<br/> <i>Future Technology</i> 22<br/> <i>Internet Physics Lab</i> 20-21, 246-247<br/> <i>Physics Lab</i> 274-275, 766-767<br/> <b>Teacher Wraparound Edition:</b><br/> BA 11; CB 12, 749</p>  |
| <p>4. Explore cases that demonstrate the interdisciplinary nature of the scientific enterprise.</p> | <p><b>Student Edition:</b><br/> 3-10, 411-419, 440-442<br/> <i>Astronomy Connection</i> 530<br/> <i>Biology Connection</i> 273, 410, 500<br/> <i>Chemistry Connection</i> 442<br/> <i>Extreme Physics</i> 792<br/> <i>Future Technology</i> 22<br/> <i>Geology Connection</i> 355<br/> <i>Meteorology Connection</i> 317<br/> <b>Teacher Wraparound Edition:</b><br/> CH 46; RLC 522; RLP 570</p> |

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| <b>5.1.12 B. Inquiry and Problem Solving</b>   |  |
| <p>1. Select and use appropriate instrumentation to design and conduct investigations.</p>         | <p><b>Student Edition:</b><br/> 11-14, 177, 183-184<br/> <i>Design Your Own Physics Lab</i> 532-533<br/> <i>Extreme Physics</i> 50<br/> <i>Future Technology</i> 476<br/> <i>How It Works</i> 110, 534, 740<br/> <i>Physics Lab</i> 136-137, 580-581, 686-687, 790-791</p> <p><b>Teacher Wraparound Edition:</b><br/> AP 13; CB 9, 177; CH 183; E 19; RLP 36</p> |
| <p>2. Show that experimental results can lead to new questions and further investigations.</p>     | <p><b>Student Edition:</b><br/> 8-10<br/> <i>Design Your Own Physics Lab</i> 392-393, 532-533<br/> <i>Extreme Physics</i> 188, 366, 506, 792<br/> <i>Future Technology</i> 768, 826<br/> <i>Physics Lab</i> 364-365, 580-581<br/> <i>Technology and Society</i> 220, 394, 608</p> <p><b>Teacher Wraparound Edition:</b><br/> A 233; CT 244; E 10; QD 128</p>     |
| <b>5.1.12 C. Safety</b>  |  |
| <p>1. Understand, evaluate and practice safe procedures for conducting science investigations.</p> | <p><b>Student Edition:</b><br/> Appendix D 918<br/> <i>Design Your Own Physics Lab</i> 160-161, 392-393, 660-661<br/> <i>Future Technology</i> 556<br/> <i>How It Works</i> 582<br/> <i>Physics Lab</i> 332-333, 580-581, 790-791<br/> <i>Technology and Society</i> 220, 394</p> <p><b>Teacher Wraparound Edition:</b><br/> CB 578, IM 238, RLP 154</p>         |

**STANDARDS****PAGE REFERENCES**

**STANDARD 5.2 (SCIENCE AND SOCIETY) ALL STUDENTS WILL DEVELOP AN UNDERSTANDING OF HOW PEOPLE OF VARIOUS CULTURES HAVE CONTRIBUTED TO THE ADVANCEMENT OF SCIENCE AND TECHNOLOGY, AND HOW MAJOR DISCOVERIES AND EVENTS HAVE ADVANCED SCIENCE AND TECHNOLOGY.**

**Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:**

**5.2.12 A. Cultural Contributions**

1. Recognize the role of the scientific community in responding to changing social and political conditions and how scientific and technological achievement effect historical events.

**Student Edition:**

179-180, 812-814

*Applying Physics* 180, 467, 764, 811

*Biology Connection* 500

*Extreme Physics* 662, 792

*Future Technology* 22, 826

*How It Works* 582, 688, 740

*Technology and Society* 220, 394, 608, 716

**Teacher Wraparound Edition:**

CB 9; PP 6, 213, 232; RLP 5, 816

**5.2.12 B. Historical Perspectives**

1. Examine the lives and contributions of important scientists who effected major breakthroughs in our understanding of the natural and designed world.

**Student Edition:**

8-10, 171-176, 179-180, 184-185, 352-358, 726-734, 735-737, 747-759, 760-761

*Extreme Physics* 366

**Teacher Wraparound Edition:**

CB 7, 9, 321, 354, 757; CD 789; RLC 751; RLP 383

2. Discuss significant technological achievements in which science has played an important part as well as technological advances that have contributed directly to the advancement of scientific knowledge.

**Student Edition:**

8-10, 14, 19, 172-176, 184-185, 352-358, 592-593, 655, 709-713, 781-789

*Extreme Physics* 50, 366

*Future Technology* 22, 476

*Geology Connection* 180

*How It Works* 534

*Technology and Society* 138, 394, 450, 716

**Teacher Wraparound Edition:**

CB 9, 321; E 10; RLP 5, 175, 295

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| <p>3. Describe the historical origin of important scientific developments such as atomic theory, genetics, plate tectonics, etc., showing how scientific theories develop, are tested, and can be replaced or modified in light of new information and improved investigative techniques.</p> | <p><b>Student Edition:</b><br/> 10, 72, 94-95, 171-176, 179-185, 726-737, 747-761, 776-783, 799-810, 815-823<br/> <i>Extreme Physics</i> 792<br/> <i>Future Technology</i> 22<br/> <i>Physics Lab</i> 186-187</p> <p><b>Teacher Wraparound Edition:</b><br/> CB 7, 9, 182, 778, 819; R 781; RLP 822</p>  |
| <p><b>STANDARD 5.3 (MATHEMATICAL APPLICATIONS) ALL STUDENTS WILL INTEGRATE MATHEMATICS AS A TOOL FOR PROBLEM-SOLVING IN SCIENCE, AND AS A MEANS OF EXPRESSING AND/OR MODELING SCIENTIFIC THEORIES.</b></p>  |  |
| <p><b>Building upon knowledge and skills gained in the preceding grades, by the end of Grade 8, students:</b></p>   |  |
| <p><b>5.3.8 A. Numerical Operations</b></p>   |  |
| <p>1. Express quantities using appropriate number formats.</p> <ul style="list-style-type: none"> <li>▶ decimals</li> <li>▶ percents</li> <li>▶ scientific notation</li> </ul>  | <p><b>Student Edition:</b><br/> 4-7, 11-13, 43, 175-178, 467-468, 564, 618-620, 677-678, 701-702, 708, 726-731<br/> <i>Design Your Own Physics Lab</i> 392-393<br/> <i>Math Handbook</i> 837-838, 841-843</p> <p><b>Teacher Wraparound Edition:</b><br/> A 9; CB 12; CD 179; ICE 377, 469, 566; R 14</p> |
| <p><b>Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:</b></p>  |  |
| <p><b>5.1.12 A. Numerical Operations</b></p>  |  |
| <p>1. Reinforce indicators from previous grade level.</p>   | <p><b>Student Edition:</b><br/> 4-7, 11-13<br/> <i>Example Problem</i> 45 #3, 181 #2, 377 #1, 385 #3, 472 #3, 566 #2, 621 #1, 622 #2, 703 #2, 730 #1, 778 #1, 782 #3<br/> <i>Math Handbook</i> 837-838, 841-843</p> <p><b>Teacher Wraparound Edition:</b><br/> A 9; CB 12; ICE 472, 621; R 14</p>        |

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| <b>5.1.12 B. Geometry and Measurement</b>  |   |
| <p>1. When performing mathematical operations with measured quantities, express answers to reflect the degree of precision and accuracy of the input data.</p> | <p><b>Student Edition:</b><br/> 12-13, 62-64, 323-324, 343<br/> <i>Design Your Own Physics Lab</i> 532-533<br/> <i>Example Problem 70</i> #5, 134 #6, 343 #1<br/> <i>Extreme Physics</i> 50<br/> <i>Internet Physics Lab</i> 20-21, 76-77<br/> <i>Physics Lab</i> 136-137, 332-333</p> <p><b>Teacher Wraparound Edition:</b><br/> CB 12; CT 14; ICE 325</p>   |
| <b>5.1.12 C. Patterns and Algebra</b>  |   |
| <p>1. Apply mathematical models that describe physical phenomena to predict real world events.</p>   | <p><b>Student Edition:</b><br/> 4-5, 19, 172-176, 184-185, 412-415, 747-758, 760-761<br/> <i>Example Problem 436</i> #1, 602 #3, 684 #2<br/> <i>Internet Physics Lab</i> 108-109<br/> <i>Physics Lab</i> 738-739<br/> <i>Problem-Solving Strategies</i> 123, 728</p> <p><b>Teacher Wraparound Edition:</b><br/> CD 172; CH 122; CT 123; HSS 754; ICE 602, 684; UM 4, 753</p>  |
| <b>5.1.12 D. Data Analysis and Probability</b>   |   |
| <p>1. Construct and interpret graphs of data to represent inverse and non-linear relationships, and statistical distributions.</p>                             | <p><b>Student Edition:</b><br/> 15-19, 38-42, 148-150, 457-463, 617-626<br/> <i>Extreme Physics</i> 78<br/> <i>Future Technology</i> 476<br/> <i>Internet Physics Lab</i> 20-21<br/> <i>Math Handbook</i> 848-853<br/> <i>Physics Lab</i> 136-137, 186-187, 332-333, 606-607, 790-791<br/> <i>Problem-Solving Strategies</i> 466</p> <p><b>Teacher Wraparound Edition:</b><br/> BA 15; CB 39; CT 18; PP 16; QD 17; TPK 38</p> |

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**STANDARD 5.4 (NATURE AND PROCESS OF TECHNOLOGY) ALL STUDENTS WILL UNDERSTAND THE INTERRELATIONSHIPS BETWEEN SCIENCE AND TECHNOLOGY AND DEVELOP A CONCEPTUAL UNDERSTANDING OF THE NATURE AND PROCESS OF TECHNOLOGY.**

**Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:**

**5.4.12 A. Science and Technology**

1. Know that scientific inquiry is driven by the desire to understand the natural world and seeks to answer questions that may or may not directly influence humans, while technology is driven by the need to meet human needs and solve human problems.

**Student Edition:**

8-10, 14, 179-180, 323-331, 659, 709-712, 723-731, 735-737, 747-761, 784-789

*Extreme Physics* 366, 792

*Future Technology* 22, 768

*Technology and Society* 394, 450, 608, 716

**Teacher Wraparound Edition:**

E 10; PP 232; RLP 5, 173, 175, 329

**5.4.12 B. Nature of Technology**

1. Assess the impacts of introducing a new technology in terms of alternative solutions, costs, tradeoffs, risks, benefits and environmental impact.

**Student Edition:**

601-605, 659, 761-765, 784-789, 812-814

*Extreme Physics* 792

*Future Technology* 22

*How It Works* 334, 582, 740

*Technology and Society* 220, 608

**Teacher Wraparound Edition:**

CB 649, 809; CH 183; PP 232; RLP 779

**5.4.12 C. Technological Design**

1. Plan, develop, and implement a proposal to solve an authentic, technological problem.

**Student Edition:**

8-9

*Design Your Own Physics Lab* 160-161, 660-661

*Extreme Physics* 792

*Future Technology* 162, 476, 826

*Physics Lab* 218-219, 580-581, 790-791

*Technology and Society* 220, 394, 450, 716

**Teacher Wraparound Edition:**

A 9

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| <b>STANDARD 5.6 (CHEMISTRY) ALL STUDENTS WILL GAIN AN UNDERSTANDING OF THE STRUCTURE AND BEHAVIOR OF MATTER.</b>  |  |
| <b>Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:</b>   |  |
| <b>5.6.12 A. Structure and Properties of Matter</b>   |  |
| <p>1. Know that atoms are made of a positive nucleus surrounded by negative electrons and that the nucleus, a tiny fraction of the volume of an atom, is composed of protons and neutrons, each almost 2,000 times more massive than an electron.</p> | <p><b>Student Edition:</b><br/>698-700, 748-756, 760-761, 800, 811-812, 818-820<br/><i>Physics Lab</i> 766-767</p> <p><b>Teacher Wraparound Edition:</b><br/>CB 757, 801; D 819; HSS 754; IM 752, 818; UM 753</p>                      |
| <p>2. Know that the number of protons in the nucleus defines the element.</p>   | <p><b>Student Edition:</b><br/>800-801</p> <p><b>Teacher Wraparound Edition:</b><br/>R 801</p> <p>Also see Glencoe's <i>Chemistry: Matter and Change</i> © 2005 pages 98-99.</p>   |
| <p>3. Know that an atom's electron arrangement, particularly the outermost electrons, determines how the atom can interact with other atoms.</p>  | <p>See Glencoe's <i>Chemistry: Matter and Change</i> © 2005 pages 140, 159, 179-180, 211-214.</p>  |
| <p>4. Explain that atoms form bonds (ionic and covalent) with other atoms by transferring or sharing electrons.</p>   | <p>See Glencoe's <i>Chemistry: Matter and Change</i> © 2005 pages 215-220, 241-247.</p>  |
| <p>5. Explain how the Periodic Table of Elements reflects the relationship between the properties of elements and their atomic structure.</p>   | <p><b>Student Edition:</b><br/><i>Appendix D</i> 916</p> <p><b>Teacher Wraparound Edition:</b><br/>A 781</p> <p>Also see Glencoe's <i>Chemistry: Matter and Change</i> © 2005 pages 154-158, 163-169, 263-266.</p>                     |
| <p>6. Know that many biological, chemical and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules.</p>  | <p><b>Student Edition:</b><br/>323-324, 342-345, 347-348, 350-351, 359-363, 404-405, 411-419, 779-781</p> <p><i>Extreme Physics</i> 366, 422, 662</p> <p><b>Teacher Wraparound Edition:</b><br/>AML 330; CT 326, 354; TPK 314, 359</p> |

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| 7. Recognize that the properties of matter are related to the structure and arrangement of their molecules and atoms, such as in metallic and nonmetallic crystals and carbon compounds.  | <p><b>Student Edition:</b><br/>313-315, 323-324, 342-345, 350-351, 359-363, 404-405, 411-419, 779-781<br/><i>Extreme Physics</i> 366, 422</p> <p><b>Teacher Wraparound Edition:</b><br/>AML 362; PP 361, TPK 314, 349, 359; UM 324</p> |
| 8. Know that different levels of energy of an atom are associated with different configurations of its electrons.   | <p><b>Student Edition:</b><br/>753-756, 759, 762-763<br/><i>Example Problem</i> 757 #1, 758 #2</p> <p><b>Teacher Wraparound Edition:</b><br/>CT 756; D 753; E 759; ICE 757, 758; UM 753</p>  |
| <b>5.6.12 B. Chemical Reactions</b>   |  |
| 1. Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another and that the rate is affected by nature of reactants, concentration, pressure, temperature, and the presence of a catalyst. | See Glencoe's <i>Chemistry: Matter and Change</i> © 2005 pages 532-534, 536-541.   |
| 2. Show that some changes in chemical bonds require a net input or net release of energy.   | <p><b>Student Edition:</b><br/>326-328</p> <p><b>Teacher Wraparound Edition:</b><br/>IM 326</p> <p>Also see Glencoe's <i>Chemistry: Matter and Change</i> © 2005 pages 219, 246-247, 498-500, 673-679.</p>                             |

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| <p><b>STANDARD 5.7 (PHYSICS) ALL STUDENTS WILL GAIN AN UNDERSTANDING OF NATURAL LAWS AS THEY APPLY TO MOTION, FORCES, AND ENERGY TRANSFORMATIONS.</b></p>   |   |
| <p><b>Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:</b></p>  |   |
| <p><b>5.7.12 A. Motion and Forces</b></p>   |   |
| <p>1. Apply the mathematical relationship between the mass of an object, the net force exerted on it, and the resulting acceleration.</p>   | <p><b>Student Edition:</b><br/> 90-95, 96-101, 131, 179-184<br/> <i>Example Problem</i> 129 #4, 133 #5, 134 #6<br/> <i>How It Works</i> 110<br/> <i>Internet Physics Lab</i> 108-109<br/> <i>Physics Lab</i> 136-137<br/> <b>Teacher Wraparound Edition:</b><br/> CB 92; CD 176; QD 100; RLP 93</p> |
| <p>2. Explain that whenever one object exerts a force on another, an equal and opposite force is exerted on the first object.</p>   | <p><b>Student Edition:</b><br/> 102-103, 105-107<br/> <i>Example Problem</i> 104 #3<br/> <i>Internet Physics Lab</i> 108-109<br/> <b>Teacher Wraparound Edition:</b><br/> CD 105; CU 107; D 106; HSS 104</p>  |
| <p>3. Recognize gravity as a universal force of attraction between masses and that the force is proportional to the masses and inversely proportional to the square of the distance between them.</p>   | <p><b>Student Edition:</b><br/> 72-75, 175-178, 179-180, 182-185<br/> <i>Example Problem</i> 181 #2<br/> <i>Extreme Physics</i> 188<br/> <i>Internet Physics Lab</i> 76-77<br/> <b>Teacher Wraparound Edition:</b><br/> AML 73; CB 74, 177, 182; CD 176, 542; CT 175, 184; CU 185; ICE 181</p>      |
| <p>4. Recognize that electrically charged bodies can attract or repel each other with a force that depends upon the size and nature of the charges and the distance between them and know that electric forces play an important role in explaining the structure and properties of matter.</p> | <p><b>Student Edition:</b><br/> 549-552, 564-568, 569-571, 573, 575<br/> <i>Design Your Own Physics Lab</i> 554-555<br/> <i>Example Problem</i> 574 #4<br/> <b>Teacher Wraparound Edition:</b><br/> CH 574; EX 553; IM 552; R 550; RLP 570; TPK 546</p>   |

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| <p>5. Know that there are strong forces that hold the nucleus of an atom together and that significant amounts of energy can be released in nuclear reactions (fission, fusion, and nuclear decay) when these binding forces are disrupted.</p>     | <p><b>Student Edition:</b><br/>802-805, 812-814<br/><i>Example Problem</i> 804 #1</p> <p><b>Teacher Wraparound Edition:</b><br/>A 802; CD 803; CU 805; ICE 804; TPK 806</p>   |
| <p>6. Explain how electromagnetic, gravitational, and nuclear forces can be used to produce energy by causing chemical, physical, or nuclear changes and relate the amount of energy produced to the nature and relative strength of the force.</p> | <p><b>Student Edition:</b><br/>258-260, 288-292, 313-315, 326-328, 811-812, 820<br/><i>Future Technology</i> 826</p> <p><b>Teacher Wraparound Edition:</b><br/>CD 807; CH 804; CU 805, 814; ICE 318; R 820</p>  |
| <p>7. Demonstrate that moving electric charges can produce magnetic forces and moving magnets can produce electric forces.</p>  | <p><b>Student Edition:</b><br/>648-649, 652-656, 672-673, 675-678, 679-685<br/><i>Design Your Own Physics Lab</i> 660-661<br/><i>Example Problem</i> 674 #1<br/><i>Extreme Physics</i> 662<br/><i>Launch Lab</i> 671<br/><i>Physics Lab</i> 686-687</p> <p><b>Teacher Wraparound Edition:</b><br/>BA 671; CB 675; CH 680; D 648, 672; IM 674; TPK 652</p> |
| <p>8. Recognize that magnetic and electrical forces are different aspects of a single electromagnetic force.</p>  | <p><b>Student Edition:</b><br/>546-553, 569-571, 648-649, 652-657, 672, 705-713, 802<br/><i>Design Your Own Physics Lab</i> 660-661</p> <p><b>Teacher Wraparound Edition:</b><br/>BA 563; CB 675; PP 802; RLP 648; TPK 546, 652</p>   |
| <p><b>5.7.12 B. Energy Transformations</b></p>  |   |
| <p>1. Explain how the various forms of energy (heat, electricity, sound, light) move through materials and identify the factors that affect that movement.</p>  | <p><b>Student Edition:</b><br/>317-318, 319-320, 404-405, 432-433, 437-438, 445-447, 544-545, 707-708, 776-780<br/><i>Physics Lab</i> 420-421, 714-715</p> <p><b>Teacher Wraparound Edition:</b><br/>A 544; CB 318, 321; CD 706; CT 316; E 322, 545; R 433</p>  |

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| <p>2. Explain that while energy can be transformed from one form to another, the total energy of a closed system is constant.</p>                    | <p><b>Student Edition:</b><br/>           293-295, 297-301, 319-320<br/> <i>Physics Lab</i> 302-303</p> <p><b>Teacher Wraparound Edition:</b><br/>           AIL 303; CB 298; CD 294; HSS 296; QD 295;<br/>           R 731, 734</p>   |
| <p>3. Recognize that whenever mechanical energy is transformed, some heat is dissipated and is therefore unavailable for use.</p>                    | <p><b>Student Edition:</b><br/>           126-127, 293-295, 326-331<br/> <i>Technology and Society</i> 304</p> <p><b>Teacher Wraparound Edition:</b><br/>           CD 327; CU 331; IM 326</p>   |
| <p>4. Explain the nature of electromagnetic radiation and compare the components of the electromagnetic spectrum from radio waves to gamma rays.</p> | <p><b>Student Edition:</b><br/>           440-442, 708-713, 764-765, 783<br/> <i>Future Technology</i> 476<br/> <i>How It Works</i> 534, 688, 740<br/> <i>Launch Lab</i> 697<br/> <i>Technology and Society</i> 450, 716</p> <p><b>Teacher Wraparound Edition:</b><br/>           CH 785; IM 710; PP 711, 764; RLC 702, UM 706</p> |