

## Challenge 2: Solution Guide

Section 2.8 provides almost all of the mathematical tools for the solution of this challenge. The question will make sense after students have had some experience with annuities. Students could start the solution after section 2.5.

- (a) The endowment must yield \$1200 interest every three months to pay for the scholarship, without depleting the endowment. This arrangement is to continue “forever.”

Let the endowment be  $x$ . The scholarship equals the interest on the endowment.

$$I = Prt$$

$$1200 = x(0.02)(1)$$

$$60\,000 = x$$

A deposit of \$60 000 will yield \$1200 interest in three months at 8%/a, compounded quarterly. This arrangement would continue forever, as long as the interest rate remains constant.

- (b) In this situation, the endowment must grow to \$60 000 in 21 months so that it will earn \$1200 interest in the three months before the scholarship is granted. The endowment must then earn interest for 21 months, or seven quarters, to accumulate to \$60 000.

$$P = A(1+i)^{-n}$$

$$P = 60\,000(1.02)^{-7}$$

$$P \approx 60\,000(0.870\,560\,178\,6)$$

$$P = 52\,233.61$$

\$52 233.61 deposited now will accumulate to \$60 000 in 21 months and, in 3 months from now, \$1200 can be awarded as a scholarship. This arrangement can continue forever.

## CHAPTER 2: RUBRIC FOR CHALLENGE 2

| Assessment Category                                                       | Scores and Criteria                                                                                                                    |                                                                                                                                       |                                                                                                                                                  |                                                                                                                                                |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                           | Passable level of achievement – below provincial standard<br>LEVEL 1                                                                   | Moderate level of achievement – below, but approaching provincial standard<br>LEVEL 2                                                 | High level of achievement – at provincial standard<br>LEVEL 3                                                                                    | Very high to outstanding level of achievement – above provincial standard<br>LEVEL 4                                                           |
| <b>Knowledge and Understanding</b>                                        |                                                                                                                                        |                                                                                                                                       |                                                                                                                                                  |                                                                                                                                                |
| <b>Performance of an algorithm by hand, mentally, or using technology</b> | <ul style="list-style-type: none"> <li>Some of algorithm performed but may contain inaccuracies.</li> </ul>                            | <ul style="list-style-type: none"> <li>Most of algorithm performed but may contain inaccuracies.</li> </ul>                           | <ul style="list-style-type: none"> <li>Algorithm performed completely; most computations generally correct.</li> </ul>                           | <ul style="list-style-type: none"> <li>Algorithm performed completely, accurately and verified or supported.</li> </ul>                        |
| <b>Demonstration of understanding of a concept</b>                        | <ul style="list-style-type: none"> <li>Attempted solution demonstrates limited understanding of interest and present value.</li> </ul> | <ul style="list-style-type: none"> <li>Solution demonstrates some evidence of understanding of interest and present value.</li> </ul> | <ul style="list-style-type: none"> <li>Solution demonstrates sufficient evidence to show understanding of interest and present value.</li> </ul> | <ul style="list-style-type: none"> <li>Detailed solution demonstrates thorough understanding of concept interest and present value.</li> </ul> |

## CHAPTER 2: RUBRIC FOR CHALLENGE 2 (continued)

| Assessment Category                                                                                      | Scores and Criteria                                                                                                               |                                                                                                                                                   |                                                                                                                                |                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                          | Passable level of achievement – below provincial standard<br>LEVEL 1                                                              | Moderate level of achievement – below, but approaching provincial standard<br>LEVEL 2                                                             | High level of achievement – at provincial standard<br>LEVEL 3                                                                  | Very high to outstanding level of achievement – above provincial standard<br>LEVEL 4                                                                                  |
| <b>Thinking, Inquiry, Problem Solving</b>                                                                |                                                                                                                                   |                                                                                                                                                   |                                                                                                                                |                                                                                                                                                                       |
| <b>Formulation and defense of hypothesis/conjecture</b>                                                  | <ul style="list-style-type: none"> <li>The student creates hypothesis but incorrectly identifies variables.</li> </ul>            | <ul style="list-style-type: none"> <li>The student creates hypothesis but the connection between the variables and hypothesis is weak.</li> </ul> | <ul style="list-style-type: none"> <li>The student correctly expresses hypothesis and identifies variables.</li> </ul>         | <ul style="list-style-type: none"> <li>The student's clearly expressed hypothesis directly relates to the stated variables and the context of the problem.</li> </ul> |
| <b>Creation of a model (algebraic, graphical, geometric, physical, technological) to solve a problem</b> | <ul style="list-style-type: none"> <li>The student uses a model or plan that addresses few aspects of the problem.</li> </ul>     | <ul style="list-style-type: none"> <li>The student uses a model or plan that addresses some aspects of the problem.</li> </ul>                    | <ul style="list-style-type: none"> <li>The student uses an appropriate plan.</li> </ul>                                        | <ul style="list-style-type: none"> <li>The student uses an appropriate plan that integrates all aspects of the problem.</li> </ul>                                    |
| <b>Justification of reasoning and/or conclusion</b>                                                      | <ul style="list-style-type: none"> <li>Reasoning is evident but lacks consistency.</li> </ul>                                     | <ul style="list-style-type: none"> <li>Reasoning is evident and logical in parts of the problem.</li> </ul>                                       | <ul style="list-style-type: none"> <li>Reasoning is logical and consistent within context.</li> </ul>                          | <ul style="list-style-type: none"> <li>Reasoning is logical and consistent and relates to broader context.</li> </ul>                                                 |
| <b>Communication</b>                                                                                     |                                                                                                                                   |                                                                                                                                                   |                                                                                                                                |                                                                                                                                                                       |
| <b>Correct use of mathematical symbols, labels, and conventions</b>                                      | <ul style="list-style-type: none"> <li>The student uses few mathematical conventions.</li> </ul>                                  | <ul style="list-style-type: none"> <li>The student uses some mathematical conventions correctly.</li> </ul>                                       | <ul style="list-style-type: none"> <li>The student uses most mathematical conventions correctly.</li> </ul>                    | <ul style="list-style-type: none"> <li>The student uses mathematical conventions correctly.</li> </ul>                                                                |
| <b>Integration of narrative and mathematical forms (graphs, charts, diagrams)</b>                        | <ul style="list-style-type: none"> <li>The student uses mathematical or narrative forms, but not both.</li> </ul>                 | <ul style="list-style-type: none"> <li>The student uses mathematical or narrative forms, but does not integrate them.</li> </ul>                  | <ul style="list-style-type: none"> <li>The student uses mathematical and narrative forms and integrates them.</li> </ul>       | <ul style="list-style-type: none"> <li>The student chooses a variety of mathematical and narrative forms and integrates them.</li> </ul>                              |
| <b>Appropriate use of mathematical vocabulary</b>                                                        | <ul style="list-style-type: none"> <li>The student uses few mathematical words correctly.</li> </ul>                              | <ul style="list-style-type: none"> <li>The student uses some mathematical words correctly.</li> </ul>                                             | <ul style="list-style-type: none"> <li>The student uses most mathematical words correctly.</li> </ul>                          | <ul style="list-style-type: none"> <li>The student uses mathematical words correctly.</li> </ul>                                                                      |
| <b>Application</b>                                                                                       |                                                                                                                                   |                                                                                                                                                   |                                                                                                                                |                                                                                                                                                                       |
| <b>Selection of a tool or strategy to solve a problem</b>                                                | <ul style="list-style-type: none"> <li>The selected tool is only partially appropriate to the context of the question.</li> </ul> | <ul style="list-style-type: none"> <li>The selected tool is generally appropriate to the context of the question.</li> </ul>                      | <ul style="list-style-type: none"> <li>The selected tool is appropriate and relates to the context of the question.</li> </ul> | <ul style="list-style-type: none"> <li>The selected tool is appropriate, efficient, and relates to the broadest context of the question.</li> </ul>                   |
| <b>Use of a selected tool or strategy</b>                                                                | <ul style="list-style-type: none"> <li>The student uses the selected tool or strategy somewhat inaccurately.</li> </ul>           | <ul style="list-style-type: none"> <li>The student uses the selected tool or strategy with minor errors.</li> </ul>                               | <ul style="list-style-type: none"> <li>The student uses the selected tool or strategy correctly.</li> </ul>                    | <ul style="list-style-type: none"> <li>The student uses the selected tool or strategy correctly and provided verification or support.</li> </ul>                      |