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| Internal Assessment Resource |
| Mathematics and Statistics Level 3 |
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| This resource supports assessment against:Achievement Standard 91574Apply linear programming methods in solving problems |
| Resource title: Machine parts |
| 3 credits |

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| * This resource:
* Clarifies the requirements of the Standard
* Supports good assessment practice
* Should be subjected to the school’s usual assessment quality assurance process
* Should be modified to make the context relevant to students in their school environment and ensure that submitted evidence is authentic
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| Date version published by Ministry of Education | December 2012To support internal assessment from 2013 |
| Quality assurance status | These materials have been quality assured by NZQA. NZQA Approved number A-A-12-2012-91574-01-6196 |
| Authenticity of evidence | Teachers must manage authenticity for any assessment from a public source, because students may have access to the assessment schedule or student exemplar material.Using this assessment resource without modification may mean that students’ work is not authentic. The teacher may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

**Internal Assessment Resource**

Achievement Standard Mathematics and Statistics 91574: Apply linear programming methods in solving problems

Resource reference: Mathematics and Statistics 3.2B

Resource title: Machine parts

Credits: 3

Teacher guidelines

The following guidelines are supplied to enable teachers to carry out valid and consistent assessment using this internal assessment resource.

Teachers need to be very familiar with the outcome being assessed by Achievement Standard Mathematics and Statistics 91574. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing students against it.

Context/setting

This activity requires students to use linear programming to maximise profit for a company, given constraints around the production of two machine parts.

Teachers could modify this task by choosing another context in which to set a similar activity.

Conditions

This assessment activity may be conducted in one or more sessions. Confirm the timeframe with your students.

Students are to complete the task independently.

Students are expected to use appropriate technology.

An instructor observes each rider by walking along a particular path.

Teacher note: This activity can be adapted so that each student uses a common course or a unique course by providing students with sets of pre-determined co-ordinates and instructions.

Resource requirements

None.

Additional information

None.

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2014

Achievement Standard Mathematics and Statistics 91574

Apply linear programming methods in solving problems

Resource reference: Mathematics and Statistics 3.2B (v.1)

Credits: 3

**Credits:** 3 Level 3

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| **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| Apply linear programming methods in solving problems. | Apply linear programming methods, using relational thinking, in solving problems. | Apply linear programming methods, using extended abstract thinking, in solving problems. |

Resource title: Machine parts

You should answer ALL questions in the answer booklet.

Show ALL working for ALL questions.

**YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE ASSESSMENT.**

**Time: 60 minutes.**

**Internal Assessment Resource**

**Achievement Standard Mathematics and Statistics 91574:**

Apply linear programming methods in solving problems

**Resource reference:** Mathematics and Statistics 3.2B

**Resource title:** Machine parts

**Credits:** 3

**Student instructions**

**Introduction**

Ace Machine Company produces machine parts called rods and pillars for the construction industry.

This activity requires you to use linear programming to model the constraints the company has for the production of the rods and pillars and to make recommendations about the optimum mix of these two machine parts and whether the company should invest in new technology or not. You will present your findings as a written report supported by graphs, equations, and relevant calculations.

The quality of your thinking and how well you link this to the context will determine the overall grade.

You have **60 minutes** in which to independently complete this task.

**Task 1**

Ace Machine Company wants to maximise the profit it makes from making rods and pillars. Producing these parts requires drilling, grinding, and polishing. Using the constraints outlined in Resource A, write a report recommending the number of rods and pillars the company should produce each week to maximise its profit. You can assume that all products will be sold.

Your report needs to answer the following questions:

* How many rods and pillars should Ace Machine Company produce to maximise profit?
* How much is the maximum profit the company can achieve using the constraints outlined in Resource A?

As you write your report, take care to clearly communicate your findings using appropriate mathematical statements. Include graphs, equations, and relevant calculations.

Task 2

The company is considering investing $250 000 in to new technology to cut down the cost of production of rods and pillars ***without changing*** constraints outlined in Resource A. If the company uses the new technology rods will bring in a profit of $500 each while pillars will bring in a profit of $1000 each.

If the company uses the new technology explain how it will affect the number of rods and pillars needed to maximise the new profit. ***Explain your findings with reference to your graphs or equations of the constraints.***

Your report needs to answer the following questions:

* If the company uses the new technology, how many rods and pillars should Ace Machine Company produce to maximise profit? ***Explain*** ***your findings***.
* How much is the maximum profit the company can achieve using the new technology ***without changing*** constraints outlined in Resource A?
* Is it cost-effective to invest $250 000 in to the new technology?

**Resource A**

Ace Machine Company produces two types of machine parts (rods and pillars) for the construction industry. Note that:

* Currently rods bring in a profit of $400 each. Pillars are less profitable, bringing in a profit of $300 each, so the company’s profit ($F) each week is given by the equation F = 400r+ 300p, where r is the number of rods sold and p is the number of pillars sold.
* Market conditions mean that the company can sell at least 20 rods each week.
* The company can provide:
* Up to 120 drilling hours per week – each rod requires ***one hour*** of drilling and each pillar requires ***two*** ***hours*** of drilling
* Up to 80 hours of grinding per week – each rod requires ***one hour*** of grinding and each pillar requires ***one hour*** of grinding
* Up to 72 hours of polishing per week – each rod requires ***one hour*** of polishing and each pillar requires ***36 minutes*** of polishing. This constraint can be written as 60r + 36p ≤ 4320
* In future the company is considering investing $250 000 in to new technology to cut down the cost of production of rods and pillars ***without changing constraints*** outlined above. If the company uses the new technology rods will bring in a profit of $500 each while pillars will bring in a profit of $1000 each.

Note: the last pages of the Answer Booklet are designed to plot your graphs.