Exemplar for Internal Achievement Standard
Technology Level 1

This exemplar supports assessment against:

Achievement Standard 91046 (A)

Use design idea to produce a conceptual design for an outcome to address a brief

An annotated exemplar is an extract of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade boundaries.

New Zealand Qualifications Authority
To support internal assessment
<table>
<thead>
<tr>
<th>Grade Boundary: Low Excellence</th>
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| 1. For Excellence, students need to use refined design ideas to produce a conceptual design for an outcome to address a brief.  

This involves:

- testing, refining and evaluating design ideas through functional modelling and ongoing research  
- justifying the potential fitness for purpose of the outcome.

The student tested, refined and evaluated their design ideas to produce the conceptual design for a weights rack. This involved researching a range of products, identifying what was useful in terms of their own design development (1) (7), testing and refining the design ideas (4).

They also drew on knowledge from other disciplines, and confirmed this knowledge through further research to make decisions (1).

The student sketched as a way of visualising, communicating and evaluating developing design ideas (2) (3). They tested their design ideas using mock-ups, trialling them in situ, and evaluating and making refinements accordingly (4) (6).

Through consideration of factors/strategies such as ongoing research (1) (4) (7), stakeholder feedback (1) (4) (9), the results of functional modelling (2) (3) (4) (5) (6) (7) (8) (9) and specifications within the brief (9), the student confirmed why particular design features were necessary, thus justifying the potential fitness for purpose of the weights rack.

For a more secure Excellence, the student would need to further explore other aesthetic and functional features to justify the potential fitness for purpose of the weights rack. This could include exploring, testing and selecting materials and joining systems, and finishing to enhance durability and reduce cost.
I know from geometry in Maths and from learning about forces that a triangle is a strong shape. This is because each side is anchored to the other two sides which makes it rigid. Also the forces are supported by the wide base at the bottom.

I had a look on the internet and I found out that the triangle is the structural shape of choice for structural engineers because of its strength.

A triangle would be a good shape for me to use in my design as it would give the strength I want. Research 1 picture gave me the best start to my own design. I modified it so it wasn't so big and space consuming. I used the footing idea from Research 2 so that my rack will be stable. I also made sure my bars were angled so the weights won't fall off. I made the bars shorter after my stakeholder telling me this would make them stronger.

I included the compactness of Research 4.

After doing this research I thought I had it sussed. I did a rough sketch. I found that sketching worked well as it helped me visualise the ideas that were in my head and it made it easier to describe my ideas to my stakeholders.

I was happy with my idea. I found a rack for sale on the internet that looked very similar to my design so that made me think it should work. I made a mock-up out of timber and took it home and placed it in the shed. It was then that I realised that I had a bit of a problem. Dad wanted me to put it in the corner. While I had designed it so it wouldn't have any weights on the back, I hadn't realised that (because of the corner) I couldn't easily get to the weights from two sides. I also decided that some of the weights were going to be too low lying and my research had taught me that bending over to pick up weights would not be good for my back.

So I had to rethink my design.
Another look at Research 3 gave me the idea to put hooks on the back for my bench press bar. My first mock up made me realise I only wanted access from one side—so it could go in the corner and take up less space. This kept dad happy. I also modified my design so I didn’t have to bend like in Research 4. Also so that it can be flexible in what weights can be stored.

I got some polystyrene and used a hot wire to get bits that were the same thickness as my weights. I then cut out circles the same diameter as my weights. I placed these on my model to make sure the bars were spaced out right so that all my weights would fit. They did.

I wanted to make sure the rack would fit in the area it was intended for properly this time. I took my new mockup home and placed it in the corner of the shed. I found that it fits there well and doesn’t stick out so no one will get hurt, it sits stable on the floor, I can reach the top rack ok, I no longer am trying to get weights off a side that is up against the wall, I can easily get the weights off—all specifications in my brief. And dad said its OK sitting there in his shed.
Grade Boundary: High Merit

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<th>2.</th>
<th>For Merit, students need to use informed design ideas to produce a conceptual design for an outcome to address a brief.</th>
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<td>This involves:</td>
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<td></td>
<td>• creating design ideas informed by research and analysis of existing outcomes</td>
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<td>• evaluating findings from functional modelling and stakeholder feedback to justify the selected design ideas.</td>
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<td></td>
<td>The student created design ideas to produce the conceptual design for a weights rack. Their research was informed by a range of existing products (1), and they identified what was useful in terms of their own design development (4).</td>
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<td>The student also drew on knowledge from other disciplines, and confirmed this knowledge through further research to make decisions about the shape of the rack (1).</td>
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<td>The student sketched as a way of visualising and developing their design ideas (2). The student then tested these design ideas using mock-ups and trialling them in situ (5) (6) (7). Functional modelling included computerised drawings (3) and the mock-ups (5).</td>
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<td>The student used functional modelling to test design ideas and consulted stakeholder to select design ideas. This involved adding a brace to the back bar to enhance strength (2) and other considerations such as space, storage, stability of structure and weights, strength, access, flexibility and safety (4) (6).</td>
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<td>To reach Excellence, the student would need to exploring other design features such as finishing and cost through ongoing research. This involves testing developing ideas using mock ups, consulting stakeholders to make design decisions and refining the conceptual design.</td>
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Research 1

The rack that the weights sit on and are leaning towards on an angle. This design has been put into this design so the weights don’t fall off and damaging the space or someone. I would consider adding a design that also decreases the chance of weights falling and injuring objects.

This product has multiple uses that can cater for many different sizes and shapes of weights. It is also designed to hold a lot of weight. I am going to place a lot of racks on my own desk as well some bowls.

I know from geometry in Maths and from learning about forces that a triangle is a strong shape. This is because each side is anchored to the other two sides which makes it rigid. Also the forces are supported by the wide base at the bottom.

I had a look on the internet and I found out that the triangle is the structural shape of choice for structural engineers because of its strength.

I had, from the research that I had done earlier, many ideas in my head of different types of weights racks to develop. To help me chose an idea that I would carry out and produce I used sketching to show the wide range of ideas in my head. This made it easier to understand and also meant that I could show others the extent of my ideas which made it easier to describe to them.

From my sketching I learnt that there were certain racks that had more positives over the others. For example, one of my designs was a low lying rack which was not ideal as I was still required to bend low to the ground to reach the heavy weights. The sketch that my stakeholder thought to be the best and most ideal was a rack that stood self supported vertically and supported the weights at a height and angle that was easy to get at. I decided to take this sketch and further develop it. Also it meant that I was able to decide on the size of the final product. 1500mm high by 1000mm wide by 1000mm deep.

The sketching helped me to make these decisions as it enabled me to visualize the weights rack and made it easier to get feedback from my stakeholders. The main risks that it helped me to identify were the fact that it needed to be fully braced. So I drew it offset leaning backwards with a back bar to brace it strongly. It also helped me see that this product was going to take a long time to construct. This meant that I had to be concentrated and on task for the whole year ahead.
The results of my research made me understand that a triangle shape would be good. It would give the strength I wanted. Research 1 picture gave me the best start to my own design. I modified it so it wasn’t so big and space consuming.

I used the footing idea from Research 2 so that my rack will be stable. I also made sure my bars were angled so the weights won’t fall off. I made the bars shorter after my stakeholder telling me this would make them stronger.

Research 3 gave me the idea to put hooks on the back for my bench press bar. It (as well as Research 1) made me realise I only wanted access from one side—so it could go up against a wall and take up less space. This kept dad happy.

I included the compactness of Research 4. I designed mine so you didn’t have to bend like in Research 4. Also so that it can be flexible in what weights can be stored.

I got some polystyrene and used a hot wire to get bits that were the same thickness as my weights. I then cut out circles the same diameter as my weights. I placed these on my model to make sure the bars were spaced out right so that all my weights would fit. They did.

I wanted to make sure the rack would fit in the area it was intended for. I took it home and placed it in the corner of the shed.

I found that it fits there well and doesn’t stick out so no one will get hurt, it sits stable on the floor, I can reach the top rack ok, I can easily get the weights off. And dad said its OK sitting there in his shed.
3. For Merit, students need to use informed design ideas to produce a conceptual design for an outcome to address a brief.

This involves:

- creating design ideas informed by research and analysis of existing outcomes
- evaluating findings from functional modelling and stakeholder feedback to justify the selected design ideas.

The student created design ideas to produce the conceptual design for a weights rack. This involved researching a range of existing products (1), identifying what was useful in terms of their own design development, and researching structural shapes (3).

Functional modelling included computerised drawings (2) and mock-ups (4) (6). The student begins to evaluate findings from functional modelling. This included showing consideration for such things as space, storage, stability of structure and weights, strength, access, flexibility and safety (3) (5) (6).

For a more secure Merit, the student would need to undertake more stakeholder feedback to inform/confirm design decisions during design development. This would allow the student to justify the selection of design ideas.
Research 1

The rack that the weights sit on are leaning inwards on a angle. This design has been put onto this device so the weights don’t fall off and damage something or someone. I should consider adding a design that also decreases the chance of weights falling and damaging other objects.

It is in the shape of a triangle. This is a shape that is said to be one of the strongest. I think that I should also make my storage product in the

Research 2!

This weights rack is designed not only to hold weights, but also can cater for the bench press bar, squatting bar, and dumbbells. This is a design that I like and am going to consider applying to my design.

This is a rack that seems to catch my eye and is very easy to look at. I want to build a rack that is also eye sweet and easy to look at.

The negatives about this device are as follows. You must be able to access both sides which means it can’t be by a wall which also makes it very space consuming. You also have a few different materials on this rack which look hard to join together. These are negatives that I will try to avoid.

Research 3

This device is built to sit very low on the ground which means that people using the weights need to bend down to access the weights. This can lead to the person getting injury or damage to their back.

Research 4

This weights rack is small and low to the ground which means it can be stored under a bed to create even more space. I am going to try and make my project so that it can do similar things.

This weights rack is small and low to the ground which means it can be stored under a bed to create even more space. I am going to try and make my project so that it can do similar things.

This design has been made to hold certain weights. It can’t hold lots of different types of weights. Also it can’t hold very many weights because it is so small. These are a few faults that I will try avoid.
The results of my internet research on different shapes made me understand that a triangle shape would be good. It would give the strength I wanted. Research 1 picture gave me the best start to my own design. I modified it so it wasn't so big and space consuming.

I used the footing idea from Research 2 so that my rack will be stable. I also made sure my bars were angled so the weights won't fall off. I made the bars shorter after my stakeholder telling me this would make them stronger.

Research 3 gave me the idea to put hooks on the back for my bench press bar. It (as well as Research 1) made me realise I only wanted access from one side—so it could go up against a wall and take up less space. This kept dad happy.

I included the compactness of Research 4. I designed mine so you didn't have to bend like in Research 4. Also so that it can be flexible in what weights can be stored.

I got some polystyrene and used a hot wire to get bits that were the same thickness as my weights. I then cut out circles the same diameter as my weights. I placed these on my model to make sure the bars were spaced out right so that all my weights would fit. They did.

I wanted to make sure the rack would fit in the area it was intended for. I took it home and placed it in the corner of the shed. I found that it fits there well and doesn't stick out so no one will get hurt, it sits stable on the floor, I can reach the top rack ok, I can easily get the weights off. And dad said its OK sitting there in his shed.
4. For Achieved, students need to use design ideas to produce a conceptual design for an outcome to address a brief.

This involves:

- generating design ideas
- testing design ideas through functional modelling
- using stakeholder feedback to inform decision making
- using findings from functional modelling to select design ideas
- producing a conceptual design for an outcome
- determining the outcome’s potential fitness for purpose.

The student addressed the brief (1) when generating design ideas towards a weights rack. This brief was refined through the development of the conceptual design.

Identifying and having an understanding of the intended location of the weights storage system (2), as well as what was to be stored (3), was an important factor in enabling the generation of design ideas (4) (6).

The student used a range of modelling techniques including sketches (4), computerised drawing (6) (9) and mock-ups (8) (10) (12) to test their design ideas (11).

Computerised drawings enabled the student to determine a weight issue. Design adjustments were accordingly made (6).

Discussing developing ideas with a stakeholder also aided in the selection of design ideas (5) (7).

The fitness for purpose (8) (11) (12) of the proposed outcome (9) (10) is determined.

To reach Merit, the student would need to generate design ideas informed by analysis of existing designs. This may involve examining existing products’ aesthetic and functional features, including material, joining systems, cost and construction techniques, to collect feasible ideas for their design.
Brief
Blanket Statement
At present my bench press weights are sitting in a pile on the floor of my dad’s shed. They are constantly being moved by me and my family dumping things on top. While on the floor they collect moisture and are starting to rust. It’s also a pain having to constantly move or lift them.
I need some way of storing my weights in a safe, secure, and stable way.

My Specifications:
- must be able to store at least 4 x 4kg weights, 4 x 2.5kg weights, 2 x 4kg weights, 4 x 10kg weights, 2 x 20kg weights, and the bench press bar
- mustn’t have any sharp edges that might hurt people or damage other things stored in the shed
- must be rust proof
- must not cost more than $75
- each weight that is placed on and off the product must be able to do so in at least 15 seconds
- must not take up more room than 1m x 1m
- must be the right height so I can reach all the weights

What I am Storing?
(Bench Press Weights)
Size Range: The size of the weights that I am storing are a range of circular objects, with diameters of 50mm down to 100mm. Also the height of the objects range from 30mm to 60mm.
Shape: The weights that I am storing are large circular disks.
Weight(s): The weight of the product that I am storing are many different ones. The lowest is 1.6kg and the highest is 23.5kg.

Materials: The weights are made from two different materials. The first type are metal ends in either enamel paint or also plastic to prevent rust.

Special Considerations:
- I will need to consider making my storage product very strong and have everything so that it will be able to handle the weight that will be placed on it (1182kg)
- I will need to make sure the bars that the weights will sit on are similar lengths apart to ensure the weights are not going to knock on each other.

Specs Evaluation
1. There should be enough provision to store all of my weights. Each bar is strong enough to hold 20 kg weights (tested).
2. The bar size has been reduced (stakeholder feedback). This helped reduce safety hazards. The bars are cylindrical and the frame is made to be made from square bars. These materials are smooth and have round edges. All welding should be gassed off from bars.
3. I will try to use galvanized steel because then I won’t have to paint. But have to check the price. Maybe it’s cheaper to use steel and paint.
4. The design is an open rack, rather than locked cupboards, so it’s very easy to see the weights, remove and replace on the rack.
5. It only takes 1m x 1m and is easy to reach (tested)

Starter 5: The bars that the weights sit on are going to be set off on an angle to ensure the weights don’t fall off. Do you see anything wrong with this design?

Notes on discussion: I agree with them being on an angle as it will mean they cannot accidentally fall off at any time.

A third type of modelling that I performed was computerized drawings of the weights rack on Sketch Up. The purpose of this was to guide the rest of the steps that I would take in the construction of my weights rack as well as reference for me to go back to. It will help me to get shapes, angles and sizes correct, from this I then learnt that because of the materials I was going to use it would be very heavy. To counter this I decided to install heavy duty caster wheels on the bottom of my weights rack to make it more maneuverable. A risk that I found was that to have my product to prepare it for welding was going to be a difficult task and would need to be done so as not to warp the metal in the process. Also to check that my product meets my brief and specification I will use these designs as a reference.

Starter 4: Can you suggest any other ways to make my product do its job better.

Notes on discussion: I would suggest that you make the bars a little shorter and make their differences less as it would make it stronger and more stable.

I was a bit worried about whether the bars would hold the weights. I made a model by welding together some mild steel tubing which is what I think I’d need probably ending up making my prototype in this way. Instead of a piece of steel I used square 3mm X 3mm X 3mm for the uprights and I then stuck tubing with a 25mm diameter for the bars. I anguished the bars up slightly like I think they will be. We bolted it and bound my heaviest weight on it. It was fine.
Grade Boundary: Low Achieved

5. For Achieved, students need to use design ideas to produce a conceptual design for an outcome to address a brief.

This involves:

- generating design ideas
- testing design ideas through functional modelling
- using stakeholder feedback to inform decision making
- using findings from functional modelling to select design ideas
- producing a conceptual design for an outcome
- determining the outcome’s potential fitness for purpose.

The student addressed the brief (1) by generating design ideas for a weights rack. Their response to the brief was refined through the development of the conceptual design. Identifying and having an understanding of the intended location of the weights storage system (2), as well as what was to be stored (3), was an important factor in enabling the generation of design ideas (4) (6).

The student used a range of modelling techniques including sketches (4), computerised drawing (6) (8) and mock-ups (9) to test their design ideas (10).

Computerised drawings enabled the student to determine a weight issue. Design adjustments were accordingly made (6).

Discussing their ideas with a stakeholder as they developed also aided in the selection of design ideas (5) (7).

The student begins to determine fitness for purpose (10) of the proposed final design (8) (9).

For a more secure Achieved, the student could further determine the outcome’s potential fitness for purpose. This may involve further exploration and selection of design ideas that consider materials, cost of manufacture and durability (e.g. rust proof), as required by the brief.
Exemplar for internal assessment resource Technology for Achievement Standard AS91046 (A)

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Brief
Conceptual Statement

At present my bench press weights are sitting in a pile on the floor of my dad’s shed. They are constantly being tripped by me and my family dropping things on them. While on the floor they collect moisture and are starting to rust. It is also a pain having to constantly move or lift them.

I need some way of storing my weights in a safe, secure, and stable way.

My Specification

- must be able to store at least 4 kg weights, 2 2kg weights, 2 1kg weights, 2 13kg weights, 2 23kg weights, and the bench press bar
- must have any sharp edges that might hurt people or damage other things stored in the shed
- must not rust
- must not cost more than $70
- each weight that is placed on and off the product must be able to do so in at least 15 seconds
- must not take up more than 7m of floor space
- must be the right height so I can reach all the weights

What I am Starting? (Bench Press Weights)

Size

Width: The size of the weights that I am using are ranging from 80cm to 100cm, with the diameter of 80cm shown to be different. The differences in the diameter range from 30cm to 40cm.

Shape: The weight product I am using are rigid circular bars.

Weight: The weight product I am using are many different weights. The lowest is 6kg and the highest is 20kg.

Material: The weights are made from a different material. The material is used because it can withstand part of the water and moisture.

Special Considerations

- I will make sure existing storage product won't come into contact with the shelf so it will not rust
- I will make sure that there is at least 50cm weight on the shelf so it is not too long
- I will make sure that the shelf is in a way that the shelf will not cause any damage to the floor and keep the weights at an angle so it does not fall over

I wanted to make sure the rack would fit in the area it was intended for. I took it home and placed it in the corner of the shed. I found that it fits there well and doesn’t stick out so no one will get hurt, it sits stable on the floor, I can reach the two racks, I can easily get the weights off. And dad said it was set there in his shed.

So reckon it will just right for the job.
### Grade Boundary: High Not Achieved

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<th>6. For Achieved, students need to use design ideas to produce a conceptual design for an outcome to address a brief. This involves:</th>
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The student addressed the brief (1) by generating design ideas for a weights rack. This brief was refined through the development of the conceptual design.

Identifying and having an understanding of the intended location of the weights storage system (2), as well as what was to be stored (3), was an important factor in enabling the generation of design ideas (4) (6).

The student used a range of modelling techniques including sketches (4), computerised drawing (6) and mockups (7) to test their design ideas (8).

The student consulted with their father when the mock-up was placed in the garage.

Computerised drawings enabled the student to determine a weight issue. Design adjustments were accordingly made (5).

To reach Achieved, there would need to be evidence that the student is using stakeholder feedback to inform decision making. That is, stakeholder/s should be consulted throughout the development process rather than just at the end.
Student 6: High Not Achieved

Brief

Conceptual Statement
At present my bench press weights are sitting in a pile on the floor of my dad's shed. They are constantly
being buried by me and my family dumping things on top. While on the floor they collect moisture and are
starting to rust. It's also a pain having to constantly move or lift them.
I need some way of storing my weights in a safe, secure, and stable way.

My Specifications!
- must be able to store at least 4 1kg weights, 4 2.5kg weights, 2 5kg weights, 4 10kg weights, 2 20kg
  weights, and the bench press bar
- mustn't have any sharp edges that might hurt people or damage other things stored in the shed
- must be rust proof
- must not cost more than $75
- each weight that is placed on and off the product must be able to do so in at least 15 seconds
- must not take up more room than 1m x 1m
- must be the right height so I can reach all the weights

What I am Storing!
(Bench Press Weights.)

Size Range(s): The size of the weights that I am
storing are a range of circular objects, with diameters of
500mm down to 100mm. Also the thickness of the
objects range from 10mm to 60mm.

Shape(s): The weights that I am storing are large
circular disks.

Weight(s): The weight of the product that I am storing
are many different ones. The lowest is 1kilo and the
highest is 20kilos.

Material(s): The weights are made from two different
materials. The first type are metal coated in either enamel
paint or zinc primer to prevent rust.

Special Considerations:
- I will need to consider making my storage product
  very strong and brace everything to ensure that it
  will be able to handle the weight that will be
  placed on it. (110kilos)
- I will need to make the bars that the weights will
  sit on are certain lengths apart to ensure the
  weights are not going to knock on each other.
A third type of modelling that I preformed was computerized drawings of the weights rack on Sketch Up. The purpose of this was to guide the rest of the steps that I would take in the construction of my weights rack and as a reference for me to go back to. It will help me to get the shapes, angles and sizes correct. From this I learn’t that because of the materials I was going to use it would be very heavy. To counter this I decided to install heavy duty caster wheels on the bottom of my weights rack to make it maneuverable. A risk that I found was that to brace my product to prepare it for welding was going to be a difficult task and would need to be done well so as not to warp the metal in the process. Also to check that my product meets my brief and specifications I will use these designs as a reference.

I wanted to make sure the rack would fit in the area it was intended for. I took it home and placed it in the corner of the shed. I found that it fits there well and doesn’t stick out so no one will get hurt, it sits stable on the floor, I can reach the top rack ok, I can easily get the weights off. And dad said its OK sitting there in his shed.

So I reckon it’ll be just right for the job.