10 STEM Electric Car Assessment Task **Name ______________________________**

Step 1 – identify parts.

Collect a piece of corflute and an electric car kit. Open your electic car kit components. We will be using all of the pieces, except the copper wires. Identify the following.

Battery holder (with wires). Elecrtic motor (with wires). Switch (with wires). Pinion gears (small gears). Spur gears (large gears). Steel axels. Axel sleeves. Two 52 mm diameter wheels. Two 30 mm diameter wheels. 3 grey connectors.

Step 2 – Choose gears, calculate theoretical top speed.

Complete the Gears and Speed worksheet. Hand it up, it is part of your assessment. What was the theoretical top speed of your car in m/s?

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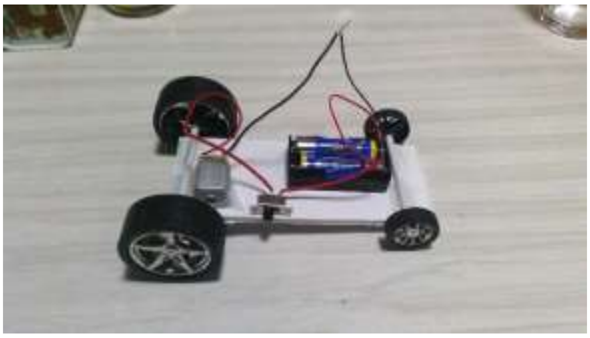
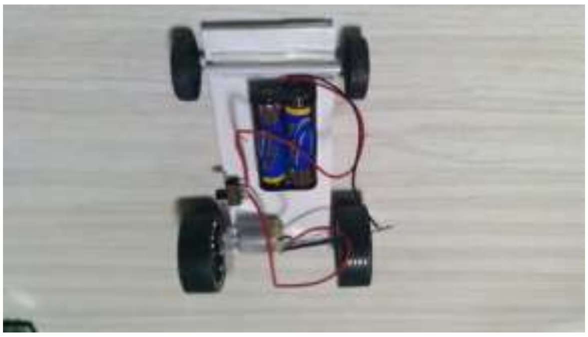
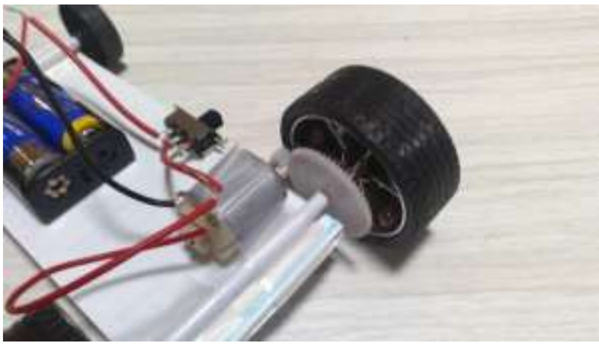
Step 3 – Build the electric car using double sided foam tape and sticky tape.

Follow the instructions in the 'Dragster build Instructions' file on AveSpace.







Great care must be taken with the measurements of the axel length and sleeve length, allowing 1 mm of space to reduce friction, but no more to ensure the gears mesh. The battery must also be placed very carefully to ensure the gears mesh, see diagram to the right. When the car is completed, put the switch in the off position and insert batteries.

Step 4 - Test the car

While holding the car in the air, turn the switch to the on position. The motor should start. The gears should mesh and the large wheels should turn in the direction that will propel the car forward. If any of these things do not happen, you will need to adjust your model.

Turn the switch to off. Take the car to the designated track. Place the car at the start. Prepare a stop watch. With the car on the ground, have a friend simultaneously start the stopwatch while you turn the switch to on. Time the car until it reaches the end of the track.

Time ______________________________

Step 5 – Finding top speed and the motor rpm.

To calculate maximum speed some assumptions need to be made. Assuming the acceleration is constant, then the maximum speed can be found using the formula:

Maximum Speed = 2 × Distance ÷ time

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How does this compare to your theoretical top speed found in the worksheet in part 2?

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Maximum speed can now be used to find the maximum motor revolutions per minute.

Multiply the maximum speed by 1000 to get the car speed in millimetres per second.

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Multiply this answer by 60 to get the car speed in mm per minute.

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Divide this answer by the circumference of the large wheel. This tells us the revolutions per minute of the wheel, and therefore of the spur gear.

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Multiply by the gear ratio. This gives the rpm of the pinion gear, and therefore of the motor.

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How does this answer compare with the theoretical motor top speed of 1000 rpm?

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Explain why your answer is different from 1000 rpm.

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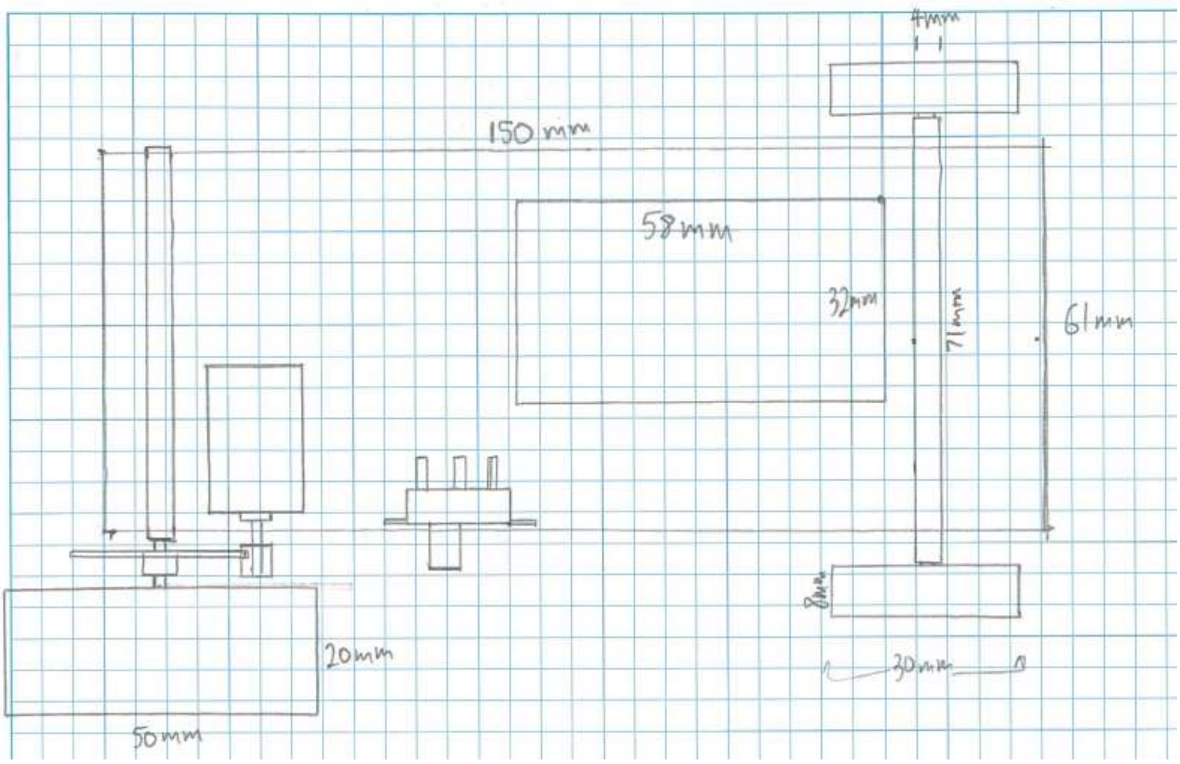
Step 6 – Create scale diagrams of your car

Place your car on a flat surface. You want the chassis to be horizontal, so you may have to place something under the front wheels, depending on how the front axel is connected to your corflute.

Using graph paper in landscape and a ruler, draw an exact top down (plan) view of your car using a scale of 1:1 in the top left hand corner of the page. You do not have to show all of the teeth on the gears. All measurements should be as accurate as possible as you will be using them to design the 3D printed chassis. Use millimetres for all measurements. Include all measurments on your diagram.

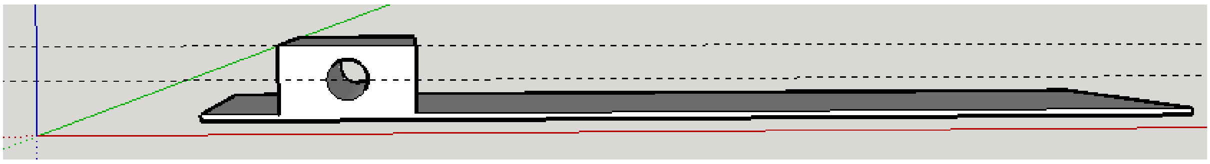


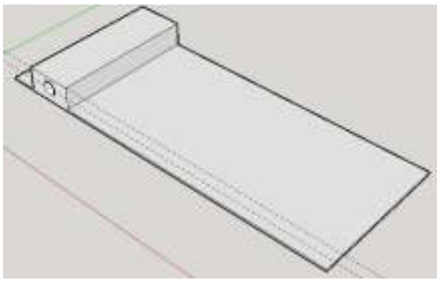
On the same sheet of graph paper directly below the plan diagram, draw a side on view from the side of the car where the gears are. Take special note of the height of the axel compared to height of the motor. This is the most crucial part to get exactly right if the gears are going to mesh correctly.

To the right of your plan view, draw an end on view from the back of your car.

Step 7 – Draw your car using SketchUp

Use SketchUp to draw the chassis of your car. You will not be using any adhesive agents to connect the axels, motor, switch or battery holder, so you will need to add new things to your drawing to hold those components in place. For example, to hold a sleeve of an axel, you might create a rectangular prism with a cylindrical hole through it.





This is 2 different views of the beginning of a chassis. The base is 150 x 60 x 1 mm. At one end is a rectangular prism with a cylindrical hole 'pushed' through it to hold an axcel.

A second one is required for the other axcel, but should these be above the chassis as drawn, or below it? You will also need to consider how the switch, motor and battery holder will be held in place.

Step 8 – 3D Print your chassis.

The file of your car needs to be exported as an STL so that CURA can read it and tell the 3D printer to print it. Once exported to cura, you need to carefully inspect the layers to ensure a print is possible. If so, you need to work out with the teacher when you can print your car. If is will not print, reload the 'skp' file in SketchUp and make the required changes, then export to STL and check layers again in CURA. Repeat until you have a file that will print.

Step 9 – Rebuild your car with the 3D printed chassis

Disassemble your car and rebuild it on the old chassis. Hopefully, there will be no need to undo any of the wiring. All tape will need to be removed. One wheel might need to be removed from each axel, depending on how you are connecting the axels to the 3D printed chassis. Hopefully, the gears mesh, the wheels turn and everything works 1st time. You might get a 2nd go at 3D printing after making some changes, but you may not. If you are able to make a new working car, time it over the track again and see if it is faster or slower than before.

New time ____.

Showing all working, calculate the top speed of your 3D printed car.

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Year 10 STEM Electric Car Assessment Task 2017

Name

Total Score out of 16. ___________ Grade ___________	1.1.3 Theoretical top speed calculated	1.2.3 Protoype moves forward under electric power.	2.1.2 Accurate Plan view includes measurements.	Side and end views line up with plan view	2.2.3 Car chasis able to hold all components without adhesive	3.1.3 3D printed Car moves forward under electric power	**At this level student is precisely applying design skills to make a functional 3D printed electric car**
	1.1.2 Gear choice justified	1.2.2 Series electric circuit created.			2.2.2 Car chassis able to hold axels without adhesive	3.1.2 Car components added to 3D printed chassis	**At this level student is applying design and 3D printing skills to build an electric car**
	1.1.1 Gear ratios calculated.	1.2.1 Axels and gears added to chassis	2.1.1 A plan view of the prototype drawn	Side and end views of the prototype drawn	2.2.1 Car chassis created in Sketchup	3.1.1 Car chassis 3D printed	**At this level student is familiarising herself with creating an electric car**
	Insufficient Evidence	Insufficient Evidence	Insufficient Evidence		Insufficient Evidence	Insufficient Evidence	
Indicators	**1.1 Making an informed gear selection decision**	**1.2 Prototype constructed**	**2.1 Blueprint of prototype drawn**		**2.2 Car chassis designed on sketchup**	**3.1 Evaluates how well 3D print picks up table tennis ball**	
Capabilities	**1. Create a prototype electric car**		**2. Create a 3D designed chassis to hold all components with adhesive**			**3. Create and test a 3D printed electric car**	**LEVEL STATEMENTS**

- *ability to identify a problem and design a solution* Part 1 and 2.1 _______ 10
- *ability to create a precise electric powered solution* Part 2.2 and 3 _______ 6