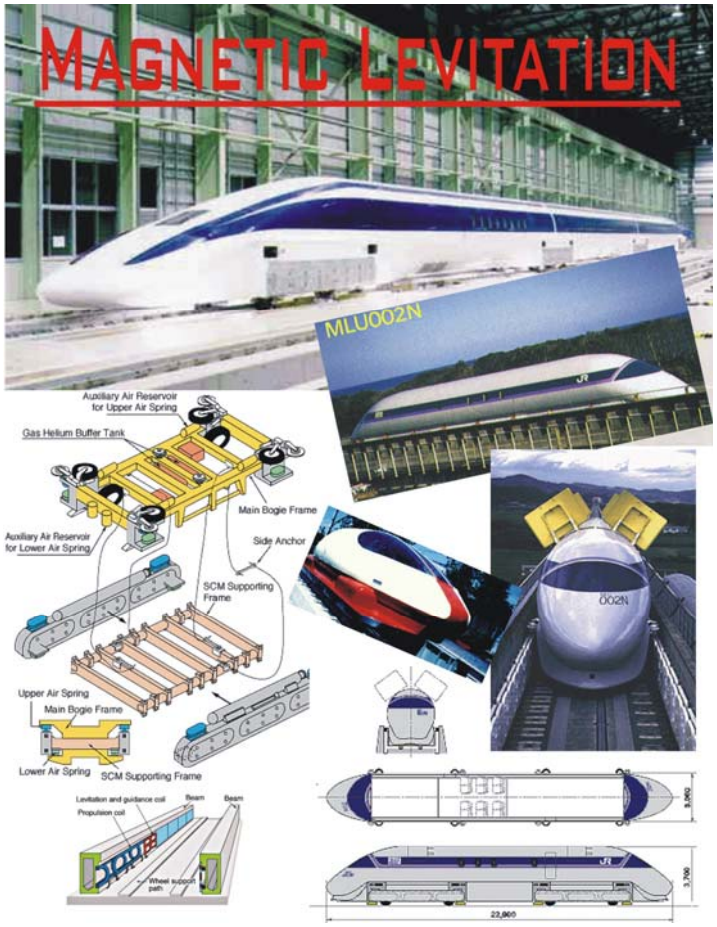
Magnetic Levitation

How do I Make it Fast



Western Technical-Commercial School

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Integrated Technologies, TTI1O

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Mag Lev Project

Project:

16

Pages:

Table of Contents

Magnetic Levitation

The Future of Magnetic Levitation

The Situation

National Engineering Transportation of Canada (NET) is under pressure to come up with a new public transportation vehicle. The Government has deemed pollution too high and needs inter-provincial transportation to be made more available and therefore is investing a lot of money into the idea of magnetic levitation transportation. Initially they will be looking for some innovative engineers (you) that they can depend on for some great ideas through an outstanding model and a portfolio of process. This super modern transportation system will excel economic and business growth and future Canadian development. The top two models will be presented to NET for immediate rewards and further consideration.

The Challenge:

The Western IT Group has taken on this challenge and are going to play it smart using the design process, a tri-fold portfolio and project box to track all of their research and development (R&D) in order to create a working design backed with working proof and findings. They want a magnetic levitation model that runs fast is lightweight, stable, and travel straight over flat country. It should be finished with complimentary colour graphics that are eye-catching including your technology logo.

Your Resources:

Two 20' track bases have been supplied with a magnetic platform with a power source feeding 9V direct current through track frames for the motor that is propelling the vehicle. Net is loaning the major components to be used to design and build the model for a consignment deposit of $5.00. Parts to be used are; a heavy-duty 5-volt DC motor ($1.33), a 3 bladed propeller ($2.33), and 4 permanent magnets ($1.36). This equipment must be returned to NET in good condition for a full refund. Any additional recycled materials may be used in order to build this mag-lev transportation vehicle such as the motor base and mag-lev base. The vehicle has no size or weight limitations, however the placement of permanent magnets must be no more than 175 mm apart measured from their outside edges.

Rough Due Dates:

Research _____, 10 Thumbnails_____, 3-Iso Sketches _____, Iso Sketch _____, Ortho_____,

Tri-fold Portfolio_____, Soldering practice _____, Mag-Lev Race _____ Final Report _____,

Project Guide

1) Make a custom tri-folder portfolio with the usual components showing project design process as follows:

   a) All rough and final papers including:

      i) Research notes – yours and peers (as many as you can trade)

      ii) All required drawings (10 Thumbnails, 3 iso's, 1 final iso, 1 ortho, 1 final ortho)

      iii) Module papers and notes

      iv) All other related papers generated

   b) Design process and schedule using a log chart, showing information, research, trial and error results, etc the suggested form showing different weights, drags, roll times, speed times, dimensions, magnet displacement, new ideas and etc.

   c) One page research paper ½ a page typed 12 information, ½ page illustrations

   d) Title page with picture of finished racer, name, class, date, title, logo, etc.

   e) Business Tech. Card and electronic media

   f) Advertisement in the form of presentation software with at least 5 different screen transitions totaling a finished Ad with final screen to be printed out for presentation in portfolio

   g) Bill of materials in the form of a spreadsheet

   h) Proper Bibliography and Resources page

   i) Reflection typed half a page on Mag-lev project

All above work must include title, name, date, and course section with electronic media including a tech logo

2) The one page research paper on one related topic area about mag-lev which you are encouraged to research with another student in groups of two, later to be shared with four other students to amplify research background information. Final research paper must be shared and copied so that each student will have his or her own final research paper along with two peer final research papers. Names of those students must accompany your "Bibliography and Resource" page and researched topics must be different.
3) Sketch ten thumbnails showing different materials, shapes, sizes as to what could fit the requirements for the proposed mag lev vehicle on one page.
4) Once you have sufficient information and understanding draw three neat detailed isometric sketch proposals, half a page for each, showing different ideas, material type and sizes in your designs with labels in gothic font.
5) Out of these three sketches make a final sketch choosing one or a combination of your proposals that you feel will be most suitable for a "working design". Note: be aware that you may want to make design changes as you further develop and test the model, as it is rarely working perfectly the first time.
6) The "working design" will require a preliminary three view, scaled, orthographic drawing on a blank boarded page to show the top, front and right side view done in Traditional format. It should also include a border with an information block showing your name, material, date, drawing title (name of your design or model) and scale used in gothic font.
7) Build and test your finished design starting with the base. Initial testing should include free roll test from an elevated position on track to test base/platform free directional movement and stability to detour future twist torque action from motor/propeller.
8) Before soldering wires to motor each person must practice soldering so that motor terminals do not get ruined. Practice soldering with four wires 15 cm long. Two wires splice together using a western and one joint to be a rat-tail. The last two connections should be tinned.
9) Once you are sure the base is ready for motor, then continue by adding motor base, motor and wires to your mag lev platform to prepare for a power test, but remember if the base is not stable to begin with you will be wasting your time. If your Mag-Lev model turns out to not perform as intended or improved design ideas can be implemented (this is normal, and most likely will happen), then make the needed changes and modifications and record in your log what details and improvements have been made and why, including improved recorded results such as weight, drag, size, free roll, power time, propeller angle, etc.
10) Do any kind of testing and modifications needed to finalize your mag-lev model that you feel are necessary, but remember to record all your information in your log. Note: use mag lev questions to assist you with your testing and modification to your working design.
11) Once the model is completed and ready for final testing, make a final three view, scaled, orthographic drawing (with specifications, dimensioning, weight, drag and material used) on one page and a isometric drawing on another page, to show your current finished model (computer generated).

If you are not sure of how a certain process is done, please ask for a demonstration!

Research Guide

Here are some suggestions that may be useful to you when research needs to be done.
There are basically two types of research namely pure research and existing information search

Pure research.

You are finding out things that have not been found before and therefore are not available in any books or periodicals. This you do by experimentation and keeping careful notes on what you are doing. This is to make for continuity of your research on a day-to-day basis and also to prove that you actually did it and to validate your findings. Proof is usually your research notes and possibly actual products that you tested (e.g. An example of a new type of airfoil)

Existing Information Search

This type of information, created others can usually be found in books, periodicals, newspapers etc. You are allowed to use this information providing you recognize that this is not your own information. This you do by clearly indicating where you found this information. A reasonable way of doing this is in the following manner. State where you found it (Name of book, Magazine, etc. when it was published and by what organization, and who was the author of this particular article).

Group Work Method and Format:

A number of subject areas are presented and each student signing up for a topic to research must sign up for each topic, when there is none left, the following students may select a topic already chosen, up to a maximum of two students per subject area. Each student will at a later point decide which two other topics that they wish to trade, with two other students to pool information after initial research is done. They are to include a copy of the two other students' research paper in their portfolio as assisted final research papers.

Research What?

Whenever you research a topic, key words should be used to look up related area whether it is in a library, index, table of contents, the internet, etc. A lot of times it is normal to start by using one key word and end up finding more exacting terms or key words that will result in finding more information. It is important that you do select some of the most common and key related terms to the topic that you are trying to find. Topic areas include the following terms:

1. Magnetism
2. Electro-magnetism
3. Aerodynamics
4. Propellers
5. Small motors
6. Direct current
7. Low moving objects
8. Gears and pulleys
9. Electricity/Ohms law
10. Material Characteristics
11. Traditional Drafting Basics
12. Magnetic Levitation Trains
13. Soldering
14. Project Prototype Ideas
15. Fastening Systems

Materials and Resource Ideas:

It is important to know what you have to use prior to designing, construction and testing of your project. It is also critical that you know identify characteristics that you require for your Mag-lev vehicle so that it can be built to suit requirements that you intend to accomplish in order to make the vehicle quick and efficient. For example the base must be made light, but strong enough to house the motor base and motor, therefore certain materials may work better than others.

- Paper mache
- Styrofoam
- Thin plastic
- Styrene
- Wood strips
- Solid cardboard
- Corrugated cardboard
- Bristol board
- Plaster
- Newspaper
- Wire
- Popsicle sticks
- White glue
- Hot glue
- Masking tape
- Packaging tape
- Glue stick
- Solder

Questions?

In any design problem there are a number of questions one should ask in order to guide them to a finished product or result. The following is just a guide of questions that should be answered through testing, research, and developing to solve the situation. These and other questions should be answered in you presentation in one form or another.

1) Why and how does the magnetic levitation track work?

2) Explain in detail what causes the Racer to float (suspended) above the track?

3) Where should the motor with the propeller to be placed on the racer?

4) Are propellers more efficient at pulling or pushing and can efficiency be increased? If so HOW?

5) Is there a way of testing if a propeller has been made more efficient?

6) What effect does the rotation of the propeller have (if any) on a suspended object?

7) What are the resultant effects of a rotating propeller, which is close to objects? (Such as the track)

8) What can be done to minimize the racer from deviating from a straight path?

9) Would streamlining help to increase speed (even with possible additional weight?) and if so what should it look like?

10) Should the design be tested in the wind tunnel? And if so what should you be looking for?

11) What are the ground effects of a fast moving object just above the ground?

12) What can be done about these ground effects?

13) Why are preliminary sketches so important to the success of your design?

14) Why is research so important and why you should keep notes on your own pure research or give recognition to research done by others?

15) Racer platforms, which did not have the magnets mounted as close as possible to the rail, experienced difficulties in stability. Why?

16)When the motor started, the racer tended to tip sideways: What caused that and why?

17) In some cases when the racer tipped at the start the motor stopped running and then started up again and stopped again etc. What was happening here?

18)In other cases the motor started and stopped completely. Why?

19)There were instances where the racer tipped, the motor continued to run, but the racer was not moving forward. Why?

20)After substantial use, the motor appeared to have some loss of power. What created this situation and what could be done about it?

21) The motor rpm appeared to be higher when the propeller was mounted on the motor shaft in one way than the other way. What was happening here?

22)The greatest power output of the propeller (the forward thrust) occurs at higher or lower rpm? Explain your answer.

23)Although each racer was subject to tipping at the start, some practically flipped out of the track and had to be put back into the track again. Why and what had to be done to avoid this?

24)The use of 4 magnets rather than six on the racer could increase stability and speed substantially. Name several reasons for this and explain the principles behind it.

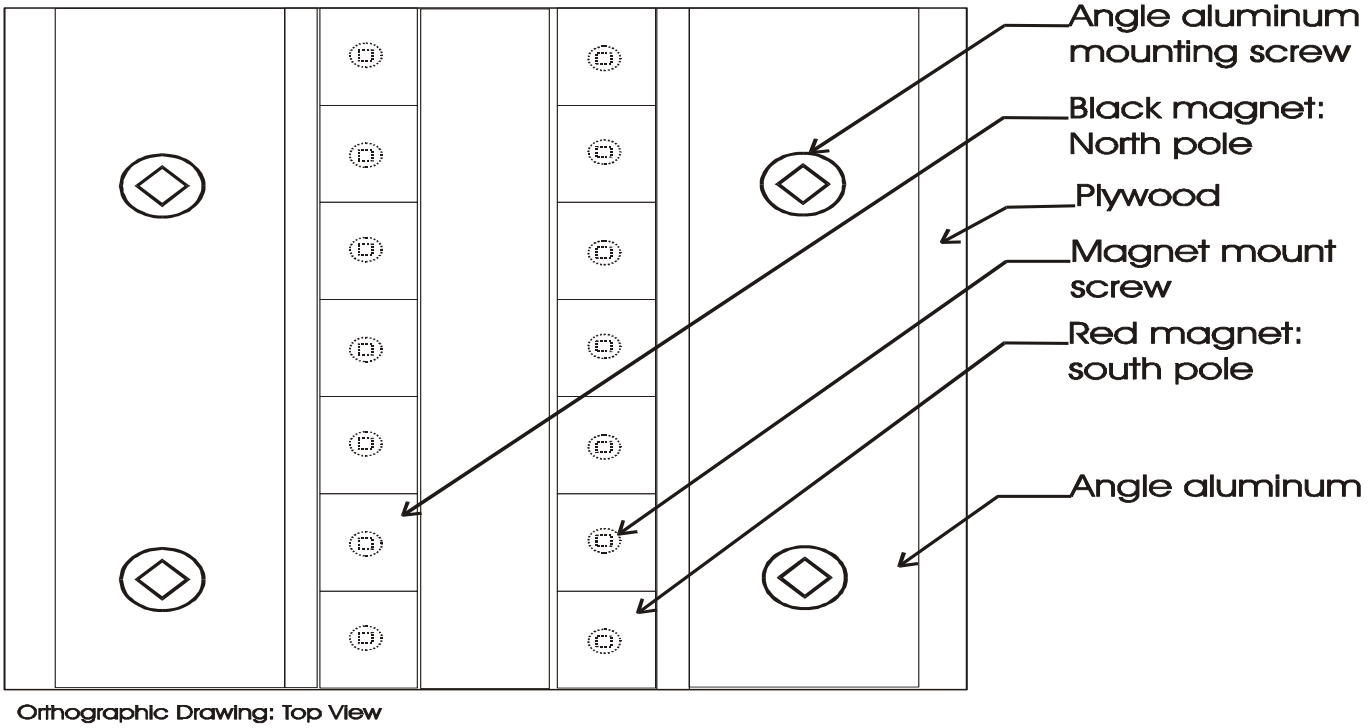
25)The wining racer appeared to be less bothered by tipping and had a faster start. What do you think are the aspects that made this model faster than all the others and why was this so?

26)What causes the bouncing up and down or tipping and how can these effects be avoided, minimized, or counteracted?

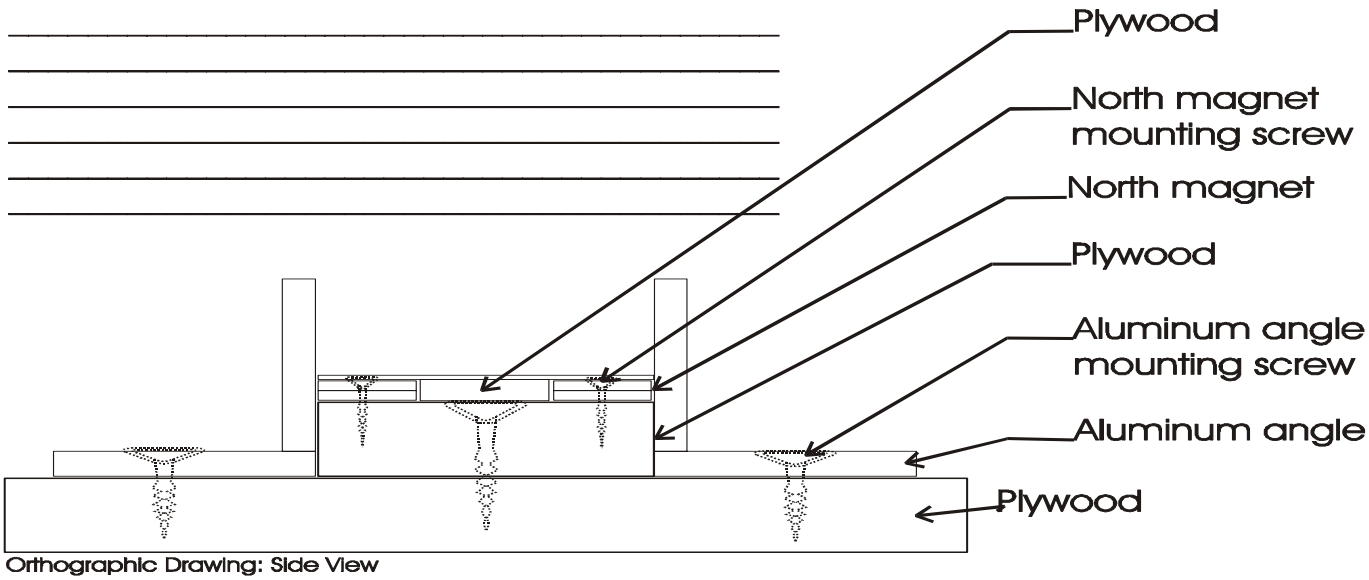
27)What are the dimensions within which your design will have to be made?

Mag-Lev Track Parts

MAG-LEV TRACK PARTS

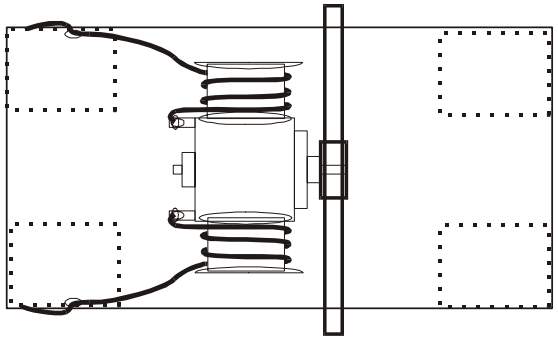


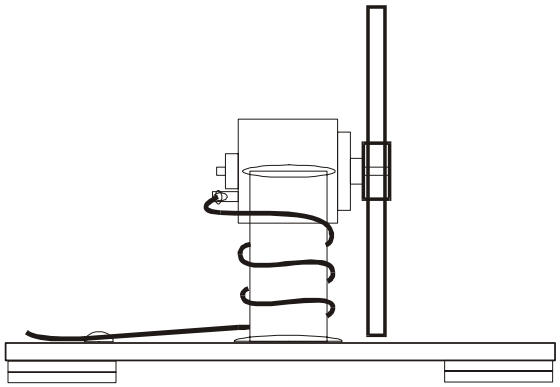
Orthographic Drawing: Top View

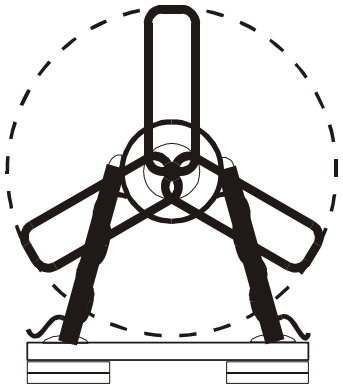


Orthographic Drawing: Side View

Sample Orthographic showing one possible design



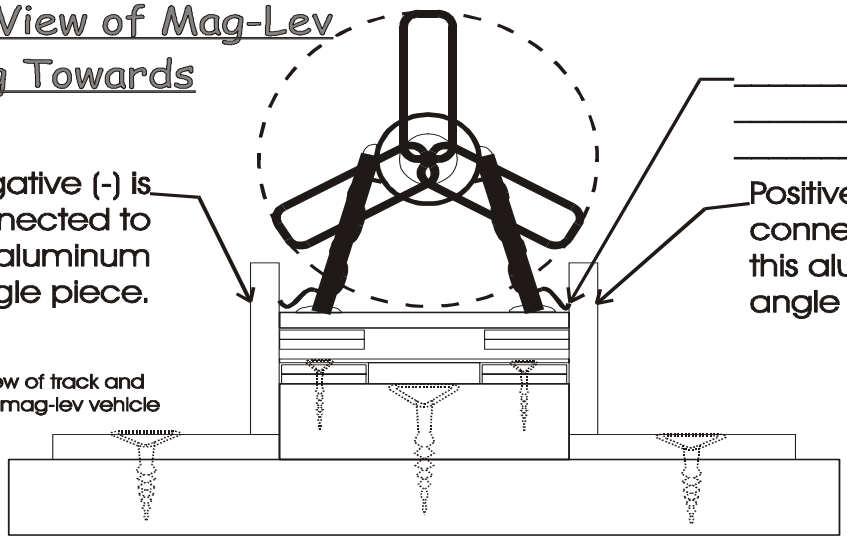




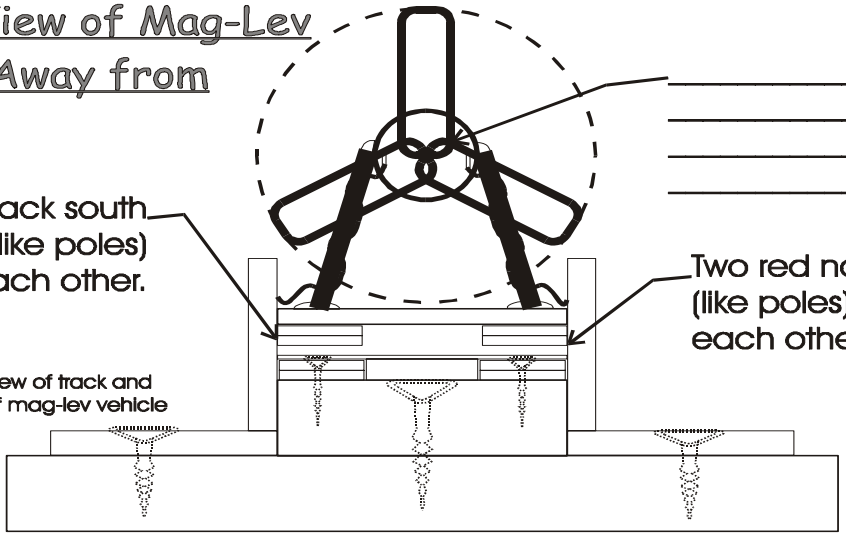
Mag-Lev and Track Construction

Mag-Lev and Track Construction

Front View of Mag-Lev Coming Towards You



Rear View of Mag-Lev Going Away from You



Information Log Tracking Sheet

	Test Stages and/or New Racer Models			
Category	#1	#2	#3	#4
Date				
List major modifications: For example Weight change or distribution Propeller direction or angle Relocation of magnets Relocation of motor Redesign of motor base Modified wire contacts Finishing techniques Etc.	_____ _____ _____ _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____ _____ _____ _____
Dimensions in mm L*W*H				
Weight				
Motor spindle Height				
Base material				
Motor base material				
Roll on speed, meter/sec				
Power run, meter/sec				
Drag				
Motor resistance				
Motor current based on 9V				

Check List for Project Module

When handing in everything, double check prior to handing in by checking off the following items with work in respective locations. Roughs in left pocket, Process and module info in right pocket, and your final papers in centre:

- ☐ Report with title page, Log and time Schedule summary
- ☐ All related rough work
- ☐ Business tech card
- ☐ Module information
- ☐ Research –Yours and as many peers as you can (minimum 4)
- ☐ *10 Thumbnail ideas,
- ☐ *3 half page detailed isometric sketches
- ☐ *1 full page detailed isometric sketch
- ☐ *1 full page orthographic scaled drawing
- ☐ Advertisement using Presentations Software with final screen printed
- ☐ Solder activity completed (prior to soldering motor terminals)
- ☐ Information log tracking sheet filled out
- ☐ Material sheet using Quattro Pro
- ☐ SPICE ½ a page related to this project
- ☐ Finishing up with a conclusion reflection
- ☐ This check list- with items handed in, checked off
- ☐ Final self and peer evaluation paper completed
- ☐ Diskette holder and diskette with your files saved in proper conventions

*All due date components handed in will have the teachers initial along with a plus #, OT, or minus # showing if they were completed on time. These positive and negatives will directly affect your mark

Index of Key Terms and Phrases:

Find ten new key terms or phrases and include the page number in the table below:

	New Key Term or Phrase	Page #
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Name:

Date: Section #

Magnetic Levitation

How great was it?

Peer Marker: _____

Project Due_____

Note: All rough work must be handed in with this evaluation sheet stapled on the top in portfolio!

Activity Process and Product Steps	Total Marks	Self Mark	Peer Mark	Earned Marks
Requirements Met: Finished mag lev racer 1) Research paper 2) Magnets are no more than 175 mm 3) Presentation software advertisement of product(s) 4) Spreadsheet showing materials, sizes, and weight 5) Portfolio-3fold technological logo/headers on all final papers and project	10			
Research and Information: 1) Research paper done, included 4 peer research papers. 2) Resources and bibliography shown including 2 other students names 3) Sample ideas that rough were based on	15			
Solutions: rough Ideas: Rough Designs: 1) Research, notes, diagrams, illustrations, etc. 2) Racer-thumbnails, iso sketches, orthographics, and prototypes 3) Advertisement- rough notes, rough illustration, 5 transitions 4) Spreadsheet- material lists, supplies, amounts, sizes, and weight etc.	25			
Final Design: Solution: 1. Your final scaled orthographic drawing showing dimensions 2. Advertisement with 5 transitions	10			
Workmanship & Construction of Product: 1. Racers practical, functionality, efficient, well put together 2. Bill of materials in the form of a spread sheet 3. Portfolio construction and finish	20			
Finished Product: Solution: 1. Meters/sec speed_____ Weight in grams_____ 2. Position in Race _____, Does it look, eye catching, innovative 3. Size dimensions in mm length * width * height _____ 4. Portfolio completion, process all present including reflection If you had to do this project again, what would you change or include: _____ _____	20			
Final mark: Total your Mark!→ Based on % finished and completion and fulfillment of requirements of the problem Fill in your total evaluation both peer and self →	**100**			