Pennsylvania PLTW PROJECT LEAD THE WAY	***Project Lead The Way - Pennsylvania 2011 Penn State Berks Eastern PA Design Challenge - "The Hybrid Maglev Vehicle"***	PENNSTATE Berks 1855

IMPORTANT: Read through this entire document before starting.

Introduction: Maglev - the stuff of science fiction or a potential source of high speed transportation? Maglev is short for magnetic levitation, which means that these vehicles will float over a guide way using the basic principles of magnets. Maglev has the potential to help lessen our reliance on foreign oil and reduce vehicle emissions.

Design Challenge: Using the materials provided, design and build a functioning magnetically levitated vehicle. The maglev you design today will be a hybrid. It will use magnetic forces to float above the test track but it will use a DC motor to propel it along the track.

If you have questions, you may ask the Facilitator however, neither the facilitator, nor any Project Lead The Way teacher, will answer any design-related questions. If the answer to your question should be public knowledge, it will be announced to the group.

Your vehicle should meet the following specifications:

Design Specification and Restrictions:

No part of the vehicle may touch any horizontal surfaces.

The motive power for driving the maglev vehicle shall be derived from the test track and the motor supplied.

Your maglev may **not** use a propeller for forward motion.

Any forward motion of your maglev must be derived from electric power. No car can have only mechanical propulsion. Example: You may not use a rubber band powered vehicle.

Teams will have approximately 2 ½ hours to complete all the steps necessary. **At 10:55 am, all work will cease on your design, project, and presentation.** When the facilitator informs teams they must stop, they shall stop and email their presentation to

contest@pltwpa.org

and save it to a Flash drive. (The Flash drive is a backup in case the email system does not function correctly). The presentation will be received and loaded onto the presentation laptop.

Performance Specification:

The maglev vehicle shall be able to successfully negotiate one or both test tracks at least once in the given presentation period. The test will be timed to see which vehicle can negotiate the track the fastest, however this is only a portion of your team's evaluation.

If the vehicle successfully traverses the horizontal track, there will be an inclined track that will test how steep an incline the vehicle can negotiate in a timed period.

There shall be no human intervention on either track other than to place the maglev vehicle at the starting position on the track.

Teams may not adjust the DC voltage supply for either track.

The demonstration of the maglev hybrid is in addition to your presentation.

Construction and Use of Materials Specification:

The maglev vehicle shall be constructed only from the Common Team materials supplied.

Each team has been supplied with 10 magnets. **Only 8 of these magnets may be used on the competition vehicle.** The extra magnets are supplied in case one becomes unusable during construction; it breaks, is covered in glue, etc.

Presentation Specification:

Your presentation shall be sufficient to **briefly** explain how you arrived at your design, and to demonstrate your design, within the prescribed time period which is **six (6) minutes** for each school. Your team may want to practice and time your presentation at least once. You must use Microsoft Power Point for your presentation. No other program shall be used for the presentation. At the completion of the design and building phase of the competition, your presentation shall be emailed to

contest@pltwpa.org

Documentation:

The following documentation will be expected:

- Sketches of several different ideas
- Detailed sketches of the final solution
- Test results and evaluation statement (compared to the design brief)

- Re-design statement if required.

Presentation Order:

The Project Lead The Way facilitator has determined the presentation order using random number generation. Your team will be allowed **only six (6) minutes** to make your presentation **and** demonstration. It is expected your team should make at least one demonstration attempt. Your team is permitted to make any number of attempts to demonstrate your vehicle within the presentation period.

There will be a two (2) minute break between each presentation while the next team comes to the presentation lectern. The Facilitator shall announce who is "on deck" prior to the start of a presentation. Please be prepared to come to the lectern as the times will be **strictly enforced**. When your team's time has expired, the Facilitator will say STOP and your presentation and demonstration will cease.

School Name	*Start Time*	*Stop Time*
Radnor Middle School	**11:00 AM**	**11:06 AM**
Donegal Middle School	**11:08 AM**	**11:14 AM**
Forest City Middle School	**11:16 AM**	**11:22 AM**
Abington Heights High School	**11:24 AM**	**11:30 AM**
Hamburg Area High School	**11:32 AM**	**11:38 AM**
Wilson High School	**11:40 AM**	**11:46 AM**
Radnor High School	**11:48 AM**	**11:54 AM**
Delaware Valley High School	**11:56 AM**	**12:02 PM**
Twin Valley High School	**12:04 PM**	**12:10 PM**
Judges Break	**12:10 PM**	**12:16 PM**
Parkland High School	**12:16 PM**	**12:22 PM**
Reading High School	**12:24 PM**	**12:30 PM**
Manheim Township High School	**12:32 PM**	**12:38 PM**
Hempfield High School	**12:40 PM**	**12:46 PM**
Brandywine Heights Area HS	**12:48 PM**	**12:54 PM**
Forest City High School	**12:56 PM**	**1:02 PM**
Donegal High School	**1:04 PM**	**1:10 PM**
Norristown Area High School	**1:12 PM**	**1:18 PM**
Lakeland High School	**1:20 PM**	**1:26 PM**
Susquehanna High School	**1:28 PM**	**1:34 PM**
Awards – Immediately following last presentation, approximately 1:40 pm		

Supplies:

Common Team Materials:

1 motor
1 Box of gears
10 magnets
6 Rubber bands
1 Glue stick
1 Styrofoam block
4 Binder Clips
1 Small sandpaper sheet (folded)
4 soda straws
1 Masonite board
2 L brackets
4 Wooden blocks
2 3x5 notecards
6" lollipop stick
10 wiggle eyes
1 Super glue
2 sheets of cardstock
1 manila folder (folded)
6 Craft sticks
6 Paper clips
4 Eye screws
Length of Velcro
7 #6 washers
7 #10 washers
7 ¼" washers
2 #8x3/4 wood screws
4 Nylon washers
9" Length of 1/4" dowel rod
1 pen
17" Tin Foil
2 wires

Tools: these common design supplies will be available for each design team:

12-inch ruler	**Pencil(s)**
Graph Paper*	**Eraser**
Isometric graph paper*	**Protractor**
Cutting knife	**Cutting board**

***In the rear of this packet**

Tool Resource Center:

If you do not know how to use a tool, you may ask any PLTW teacher to demonstrate the correct usage. Safety First please! They may not provide any other advice regarding the contest.

The following tools (at minimum) will be in the **Tool Resource Center** and are shared tools. The Facilitator reserves the right to ensure all teams have equal access to the **Tool Resource Center**. Tools may only be used at the **Tool Resource Center** and may not be taken back to your work area.

Hot glue guns	**hand saw**
miter box	**Cordless drill**
Drill bits	**Duct Tape**
Masking Tape	**Scroll Saw**

STUDENTS MUST USE SAFETY GLASSES AT THE TOOL RESOURCE CENTER. FAILURE TO USE SAFETY GLASSES CAN RESULT IN DISQUALIFICATION FROM THE CONTEST

IF YOU INJURE YOURSELF, NO MATTER HOW MINOR, YOU MUST REPORT IT TO YOUR PROJECT LEAD THE WAY TEACHER IMMEDIATELY!

AWARDS:

In the high school division, there are four awards to be given today. They are:

Best Overall Solution
Best Design
Best Presentation
Best Teamwork

A school may only win one award.

In the middle school division there will be one award presented.

Best Overall Solution

Judges will use rubrics to determine winners for each category. The rubrics start on page 8.

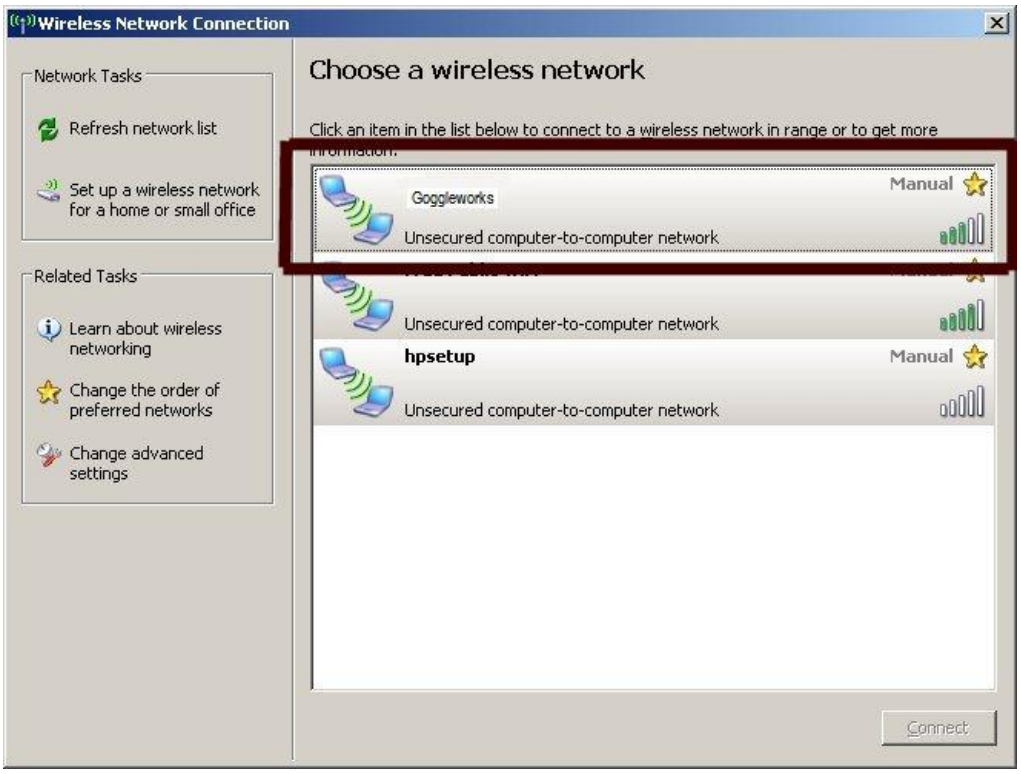
Internet Resources:

The Internet is available at Goggleworks if you feel you need to perform research. To access it:

1. Boot your wireless enabled laptop computer
2. Right-click on the wireless icon in your taskbar. **(see image - your window may look different than this)**
3. 

   and select View Available Wireless Networks

4. Select Goggleworks from the Wireless Network Connection window and then click Connect



5. Your computer will connect to the Goggleworks wireless system. No password is required. If you have problems connecting, you may ask for PLTW teacher for assistance in connecting.

GENERAL NOTES:

This is a difficult Design Challenge given the time you have. There are many designs that you may believe might accomplish this task. If the criteria in the design brief are met, you can feel a definite sense of accomplishment. Remember that no matter how good your solution is, you can make some suggestions as to how your design can be made better.

If your team feels it needs more of a challenge, factors such as **how quickly your Maglev Vehicle can negotiate the test track, the use of a minimum amount of materials, extra mass transported, and the originality and esthetics of your design** should be considered as an additional "challenge" to set your solution apart from others.

There is also the chance that your team may not be successful in completing the task. If this occurs, please be prepared to explain what issues your team encountered and, given more time, what your team might have done to complete the vehicle. Be specific as to what problems you encountered and the next steps you would take.

You may want to return to your schools and discuss your design with your classmates and teachers after you have had a chance to review it. We also recommend a “de-brief”

by your team and your teacher to review how your team compared to other teams and what you learned from the competition and from the other teams.

When you return to your schools, Project Lead The Way PA will send a link to your teacher that will allow you to complete an online survey about the Design Challenge. It is completely optional and confidential. Your feedback, and your teacher's feedback, will allow Project Lead The Way PA to improve the Design Challenge in future years.

Thank you for coming today, and good luck!

Data Sheets:

	2 in 1 gearbox: Ratios: 1:60, 1:288
	Maglev Motor: Voltage Range: 3V-6V. Nominal Voltage: 6V. Current: 0.26A. RPM: 17,000 max. Torque: 20.72g/cm. Terminal Type: Solder. Shaft Dia.: 2mm. Shaft Length: 6.5mm. Size: 23.5mm dia. x 27mm length.

Judging Rubrics:

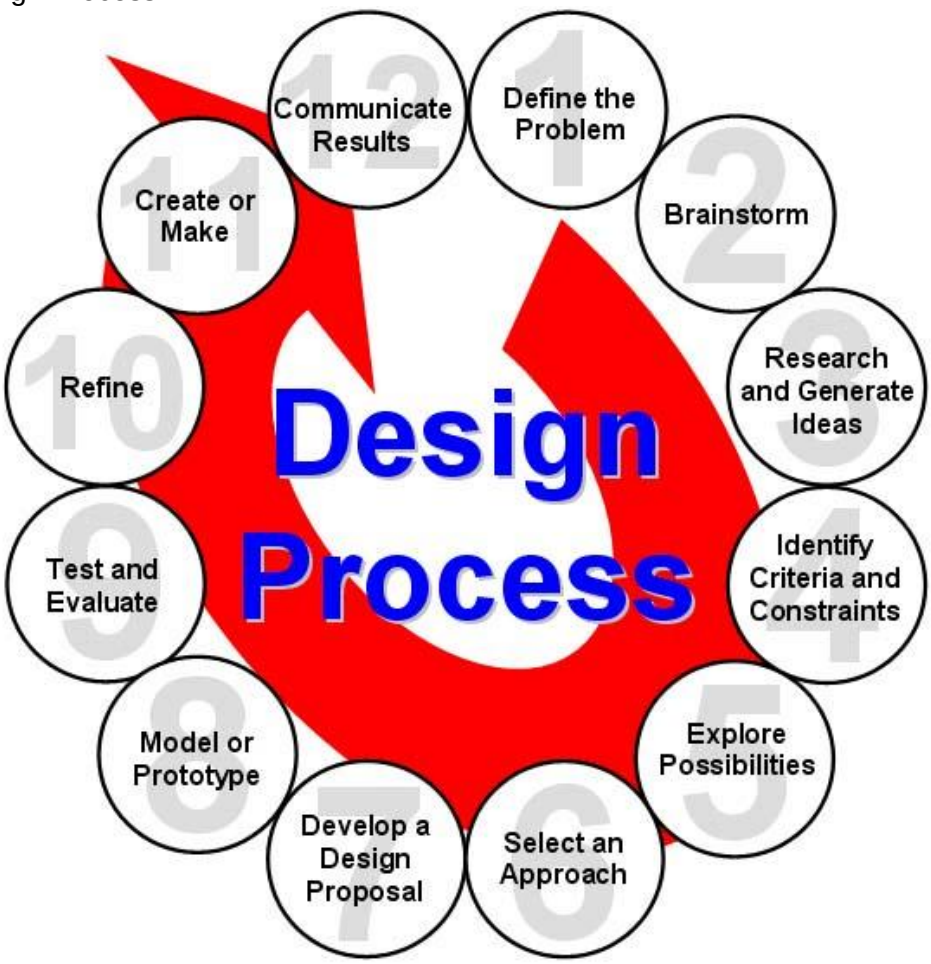
Best Presentation: you will be judged for Best Presentation from the following rubric. Remember that you will have **only six (6) minutes** to make your presentation and demonstrate your solution. You should plan accordingly and practice your presentation and demonstration at least once.

Category	4 points	3 points	2 points	1 point
Content	Thoroughly states the main points focused on the Design Challenge	Adequately states the main points focused on the Design Challenge	States most of the main points focused on the Design Challenge. May include unnecessary information	States few main points on the Design Challenge or, does not relate to the topic
Organization	Clearly organized into a logical sequence. Excellent use of an outline. Excellent introduction and conclusion.	Adequate evidence of a logical sequence of information. Good use of an outline. Satisfactory introduction and conclusion.	Fair evidence of a logical sequence of information. Some use of an outline. Weak introduction and conclusion.	Minimal or no outline followed. No logical organization; some digressions. Unclear, confusing. No introduction or conclusion.
Delivery	Effectively and creatively delivers the information while staying on the topic and considering the audience. Uses voice variation; interesting and vivid to hear.	Adequately delivers the information while staying on the topic and considering the audience. Speaks clearly and confidently.	Delivers the information but does not stay on the topic. Little consideration of audience. Uses incomplete sentences.	Little or no attempt is made to stay on the topic. Does not consider audience. Difficult to understand.
Preparation	Clearly and completely describes the design and the design process, including all necessary information in the most appropriate order. Excellent use of content vocabulary.	Adequately describes the design process, including most of the necessary information in a correct order. Good use of content vocabulary.	The design and design process are not clearly described; includes most necessary information but the order is not correct. Fair use of content vocabulary.	The design and design process is not described, includes very few pieces of necessary information. Is weak or has no use of content area vocabulary.
Time Management	Demonstrates highly effective use of time management skills in developing and presenting.	Demonstrates adequate use of time management skills in developing and making the presentation.	Some time management skills are evident but are not effectively used in the creation or presentation.	Few or no time management skills are evident in the development or presenting of the presentation.

Best Design: you will be judged for the Best Design portion of the contest on the following rubric. You should remember, and follow, the Design Process as you have been taught by your teachers. For your review, the Design Process is repeated on the next page.

Category	4 points	3 points	2 points	1 point
Design Process	Thoroughly shows evidence of following the Design Process.	Adequately shows evidence of following the Design Process.	Sometimes shows evidence of following the Design Process.	Seldom shows evidence of following the Design Process.
Selection Process	Thoroughly shows how the selection of their final design was determined.	Adequately shows how the selection of their final design was determined.	Sometimes shows how the selection of their final design was determined.	Seldom shows how the selection of their final design was determined.
Functional Testing	Thoroughly explains how their design was tested.	Adequately explains how their design was tested.	Sometimes explains how their design was tested.	Seldom explains how their design was tested.
Performance	Thoroughly explains how their design was changed or improved, and the effects of the changes.	Adequately explains how their design was changed or improved, and the effects of the changes.	Sometimes explains how their design was changed or improved, and the effects of the changes.	Seldom explains how their design was changed or improved, and the effects of the changes.
Further Modifications	Thoroughly describes how their design could be improved upon given sufficient time.	Adequately describes how their design could be improved upon given sufficient time.	Sometimes describes how their design could be improved upon given sufficient time.	Seldom describes how their design could be improved upon given sufficient time.

The Design Process:



- defining a problem
- brainstorming
- researching and generating ideas
- identifying criteria and specifying constraints
- exploring possibilities
- selecting an approach
- developing a design proposal
- making a model or prototype
- testing and evaluating the design using specifications
- refining the design
- creating or making it
- communicating processes and results

Source: International Technology Education Association (ITEA). (2002). *Standards for technological literacy*. pp. 97.

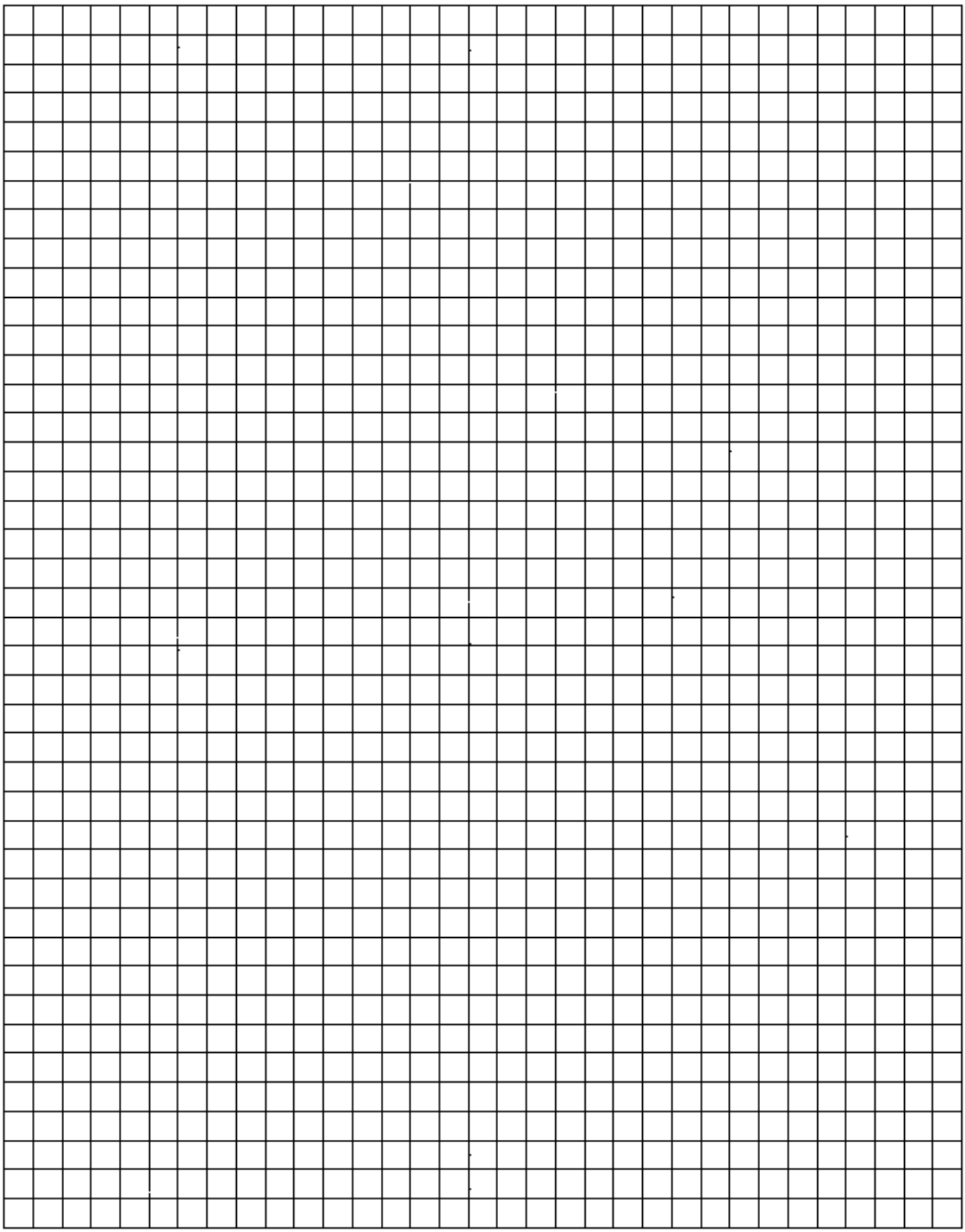
Best Teamwork: you will be judged for the Best Teamwork portion of the contest based on the following rubric.

Category	4 points	3 points	2 points	1 point
Helping	Students were offering assistance to each other **all** of the time.	Students were offering assistance to each other **most** of the time.	Students were offering assistance to each other **some** of the time.	Students were offering assistance to each other **seldom or none** of the time.
Participating	All students on a team were observed working on the Design Challenge **all** of the time.	All students on a team were observed working on the Design Challenge **most** of the time.	All students on a team were observed working on the Design Challenge **some** of the time.	All students on a team were observed working on the Design Challenge **seldom or none** of the time.
Persuading	Students were observed exchanging, defending, and rethinking ideas **all** of the time.	Students were observed exchanging, defending, and rethinking ideas **most** of the time.	Students were observed exchanging, defending, and rethinking ideas **some** of the time.	Students were observed exchanging, defending, and rethinking ideas **seldom or none** of the time.
Questioning	Students were observed interacting, discussing, and posing questions to members of the team **all** of the time.	Students were observed interacting, discussing, and posing questions to members of the team **most** of the time.	Students were observed interacting, discussing, and posing questions to members of the team **some** of the time.	Students were observed interacting, discussing, and posing questions to members of the team **seldom or none** of the time.
Respecting	Students were observed encouraging and supporting the ideas and efforts of all members of the team **all** of the time.	Students were observed encouraging and supporting the ideas and efforts of all members of the team **most** of the time.	Students were observed encouraging and supporting the ideas and efforts of all members of the team **some** of the time.	Students were observed encouraging and supporting the ideas and efforts of all members of the team **seldom or none** of the time.

Best Overall Solution: you will be judged for the Best Overall Solution of the contest, by the Attending Judges using this rubric. This rubric is perhaps, the most subjective of all the rubrics, and affords the judges some leeway

Category	4 points	3 points	2 points	1 point
Design	Thoroughly creates a design that meets the design standards of the competition	Adequately creates a design that meets the design standards of the competition	Sometimes creates a design that meets the design standards of the competition	Seldom, or does not, create a design that meets the design standards of the competition
Performance	The design thoroughly meets the performance standards established for the competition.	The design adequately meets the performance standards established for the competition.	The design sometimes meets the performance standards established for the competition.	The design seldom, or does not, meet the performance standards established for the competition.
Use of Materials	The team thoroughly shows optimal use of materials supplied.	The team adequately shows optimal use of materials supplied.	The team sometimes shows optimal use of materials supplied.	The team seldom, or does not, show optimal use of materials supplied.
Originality	The design thoroughly shows creativity, innovation, or uniqueness.	The design adequately shows creativity, innovation, or uniqueness.	The design sometimes shows creativity, innovation, or uniqueness.	The design seldom, or does not, show creativity, innovation, or uniqueness.
Construction	The solution thoroughly shows neat and effective construction techniques.	The solution adequately shows neat and effective construction techniques.	The solution sometimes shows neat and effective construction techniques.	The solution seldom, or does not, show neat and effective construction techniques.

School Name: _____



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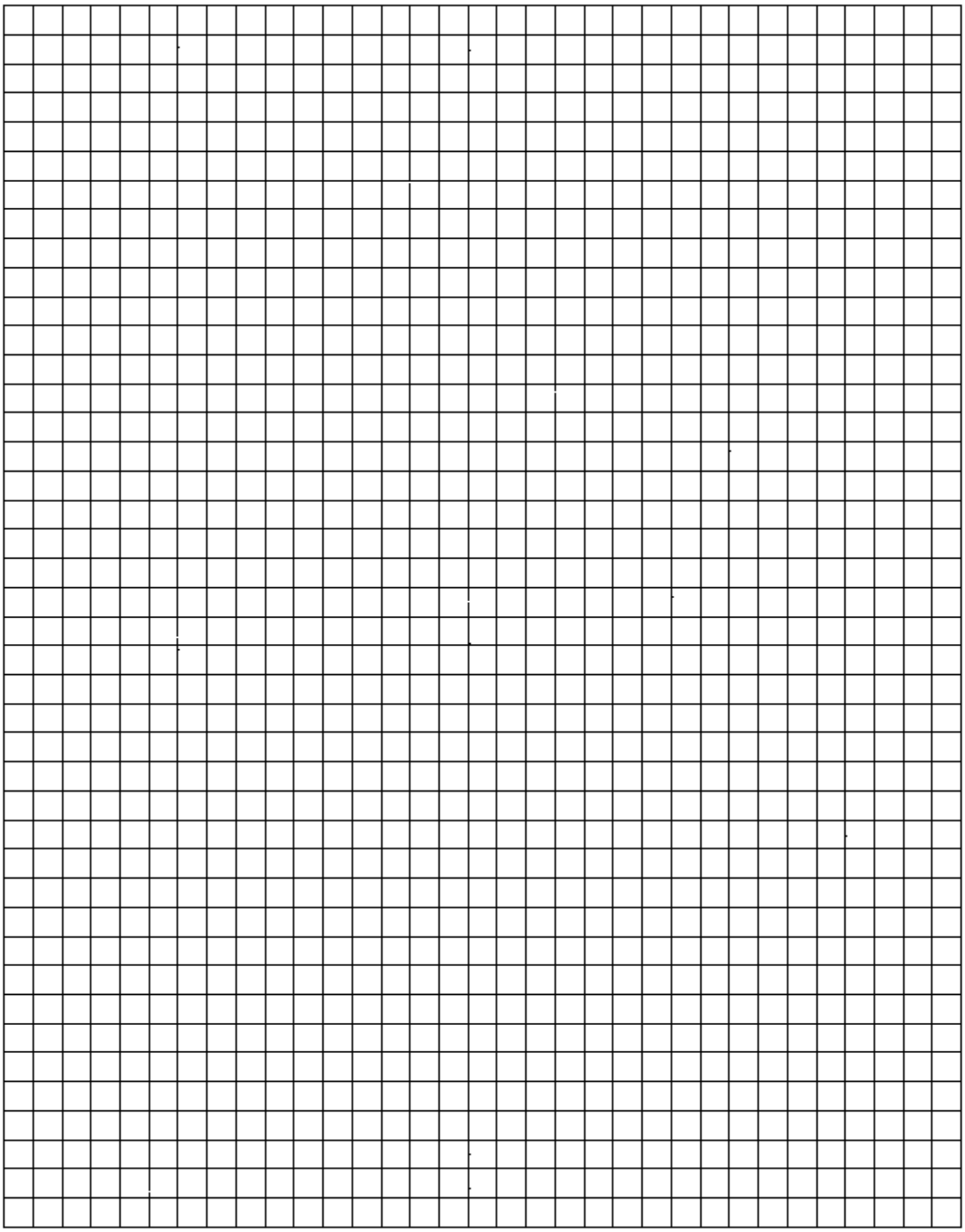

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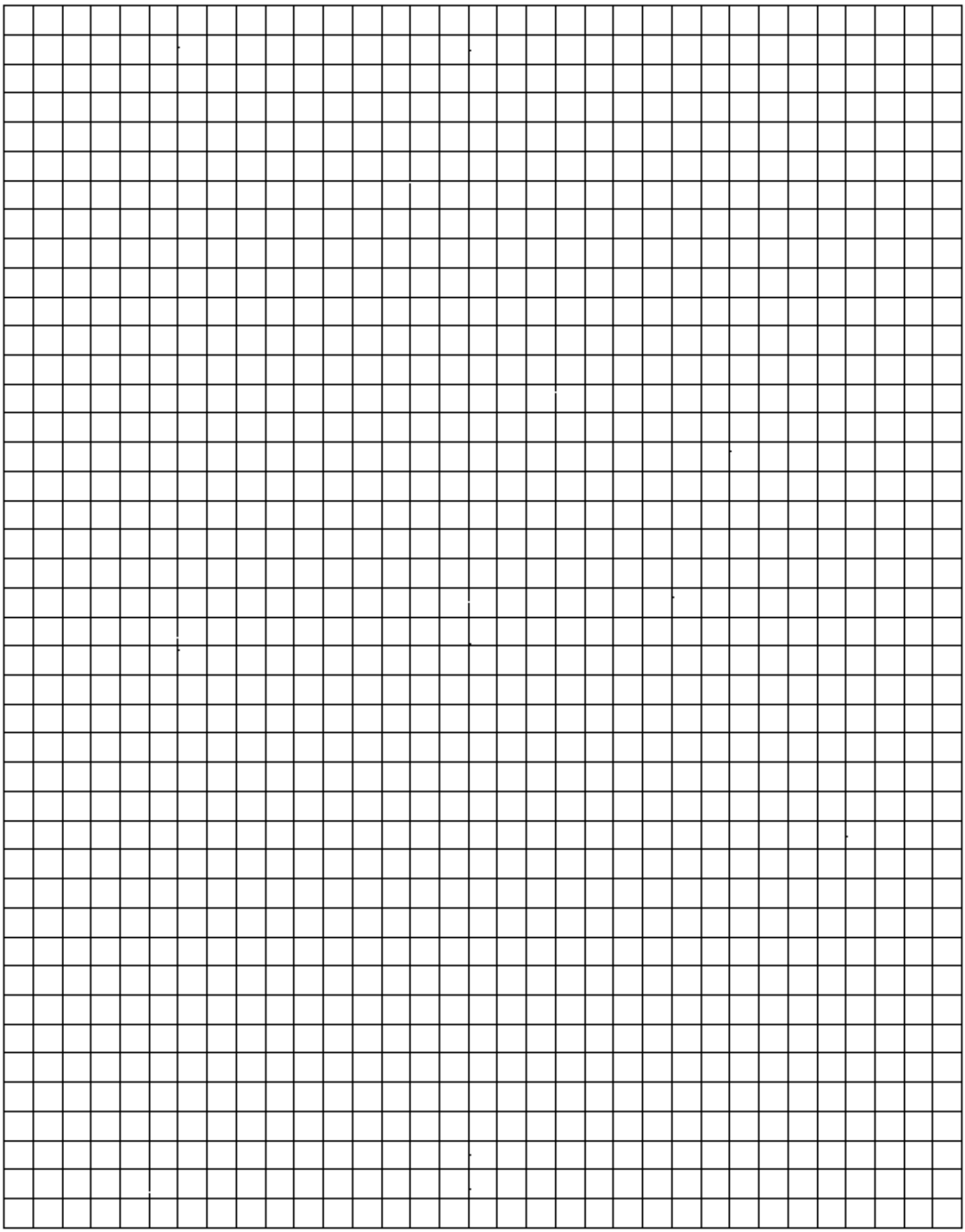

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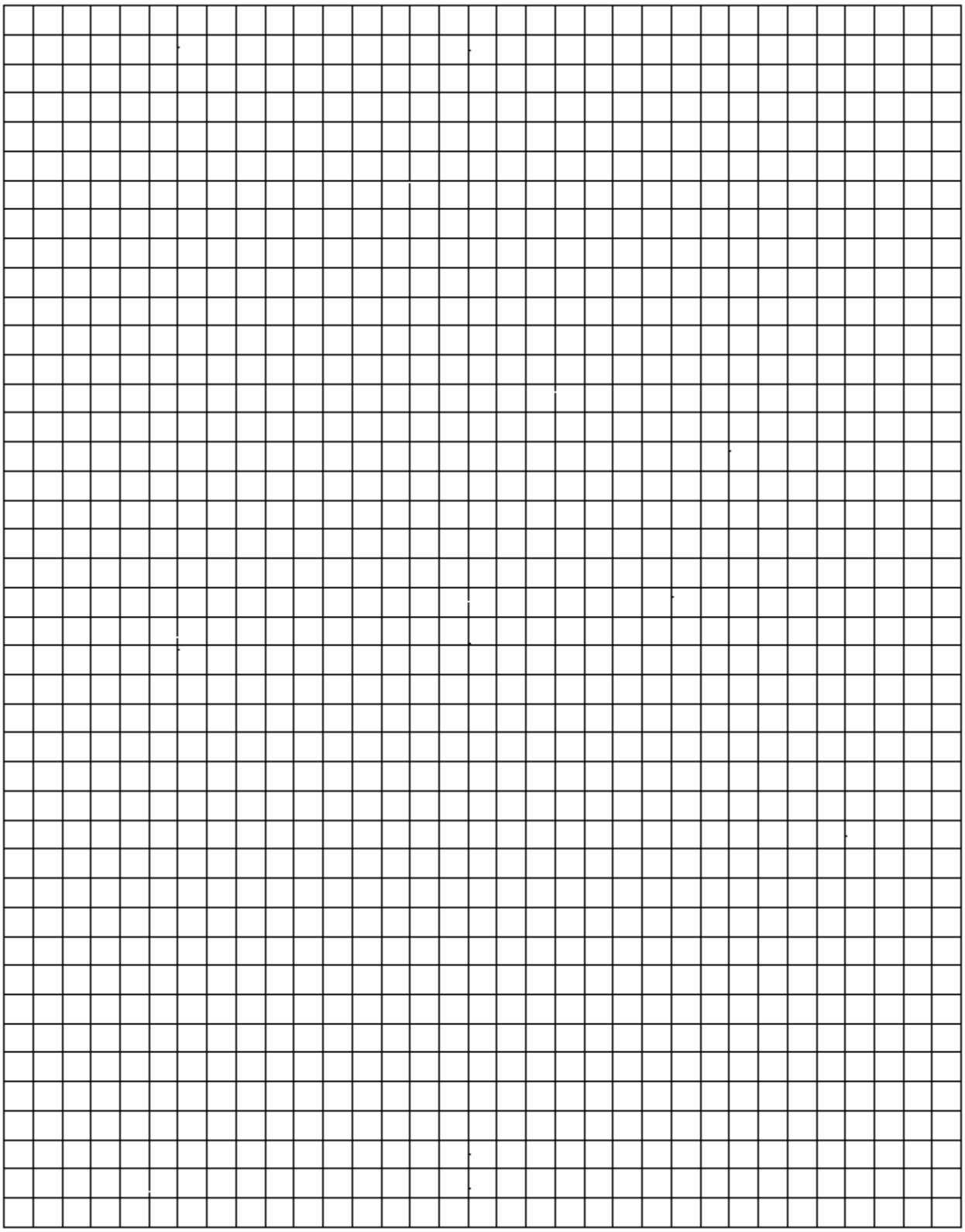

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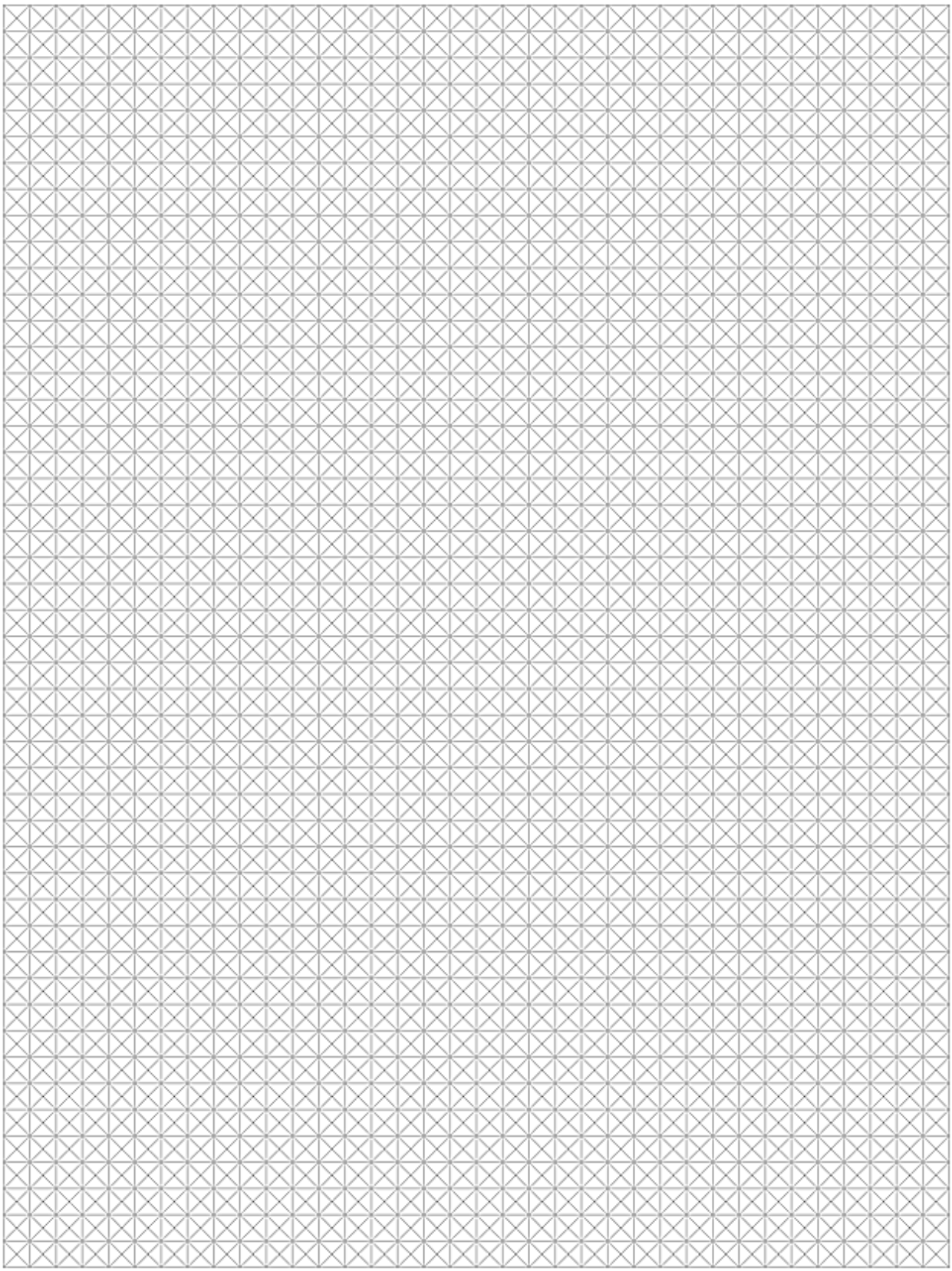

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