

מחברת בחינה

שלום לך הנבחן !

קרא בעיון את ההוראות בדף זה ונהג בדיוק לפיהן. אי מילוי ההוראות עלול לגרום לתקלות שונות ואף להביא לידי פסילת בחינתך. הבחינה נועדה לבדוק את הישגיך האישיים, ולכן עבוד עבודה עצמית בלבד. בזמן הבחינה אין להיעזר בזולת ע"י קבלת חומר כתוב או בשיחות בע"פ, ואין לעזור לנבחנים אחרים גם אם פנו אליך.

אין להכניס לחדר הבחינה חומר עזר – ספרים, מחברות, רשימות מכשירי קשר למיניהם וכו' – פרט ל"חומר עזר מותר בשימוש" המפורט בגוף השאלון או בהוראות מוקדמות של המשרד.

אם ברשותך חומר עזר שאינו מותר בשימוש, מסור אותו לידי המשגיח לפני תחילת הבחינה. לאחר שסיימת את כתיבת הבחינה, מסור את המחברת לידי המשגיח ועזוב בשקט את חדר הבחינה.

אנא הקפד על טוהר הבחינות!

הוראות לנבחן

1. ודא כי במדבקות הנבחן שקיבלת מודפסים פריטי האישיים, ובמדבקות השאלון שקיבלת מודפסים פריטי השאלון שתיבחן בו.
2. הדבק על כריכת המחברת, במקום המיועד לכך מדבקת נבחן (ללא שם) ומדבקת שאלון.
3. אם לא קיבלת מדבקות, מלא בכתב יד את הפרטים במקום המיועד למדבקת הנבחן.

הוראות לנבחנים

1. אסור לכתוב בשולי המחברת (החלק המקווקו), היות וחלק זה לא ייסרק.
2. עמודים ששימשו כדפי טיוטה, יש לציין בראש העמוד את המילה טיוטה.
3. אין להשתמש בטיפקס במחברת הבחינה. אם ברצונך למחוק – העבר קו או (X) על הכתוב.
4. במחברת הבחינה יש לכתוב בעט בלבד.
5. אין לכתוב שם בתוך המחברת, משום שהבחינה נבדקת בעילום שם.
6. אין להוסיף או לשנות שום פרט במדבקות, על מנת למנוע עיכובים בזיהוי הנבחן וברישום הציונים.

ב ה צ ל ח ה !

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הערכה ראשונה

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وزارة التربية والتعليم

القسم الكبير للامتحانات

الإدارة التربوية

دفتر امتحان

تحية للممتحن!

اقرأ بتمعن التعليمات في هذه الصفحة واعمل وفقاً لها بالضبط. عدم تنفيذ التعليمات قد يؤدي إلى عواقب مختلفة وحتى إلى إلغاء امتحانك. أعد الامتحان لفحص تحصيلاتك الشخصية، لذلك اعمل بشكل ذاتي فقط. أثناء الامتحان، لا يُسمح طلب المساعدة من الغير بواسطة الحصول على مواد مكتوبة أو الحديث، كما لا يُسمح مساعدة ممتحنين آخرين، حتى لو توجهوا إليك.

لا يُسمح إدخال مواد مساعدة - كتب، دفاتر، قوائم، أجهزة اتصال بأنواعها وما شابه - إلى غرفة الامتحان ما عدا "مواد مساعدة يُسمح استعمالها" المفصلة في نموذج الامتحان أو في تعليمات مسبقة من الوزارة. إذا كانت لديك مواد مساعدة لا يُسمح استعمالها، سلّمها للمراقب قبل بدء الامتحان. بعد أن تنتهي من كتابة الامتحان، سلّم الدفتر للمراقب، وغادر غرفة الامتحان بهدوء.

نرجو التقيد بنزاهة الامتحانات!

تعليمات للممتحن

1. تأكد بأن تفاصيلك الشخصية مطبوعة على ملصقات الممتحن التي حصلت عليها، وبأن تفاصيل نموذج الامتحان الذي تُمتحن به مطبوعة على ملصقات نموذج الامتحان التي حصلت عليها.
2. ألصق على غلاف الدفتر، في المكان المخصص لذلك، ملصقة ممتحن (بدون اسم) وملصقة نموذج امتحان.
3. إذا لم تحصل على ملصقات، اكتب بخط يد التفاصيل في المكان المخصص لملصقة الممتحن.

تعليمات للممتحنين

1. لا يُسمح الكتابة في هوامش الدفتر (في المنطقة المخططة)، لأنه لن يتم مسح ضوئي لهذه المنطقة.
2. اكتب كلمة "مسودة" في رأس كل صفحة تستعملها مسودة.
3. لا يُسمح استعمال التيبكس (спрай) في دفتر الامتحان. إذا أردت المحو - مرر خطاً أو ضع (X) على المكتوب.
4. يجب الكتابة في دفتر الامتحان بقلم حبر فقط.
5. لا يُسمح كتابة الاسم داخل الدفتر، لأن الامتحان يُفحص بدون ذكر اسم.
6. لا يُسمح إضافة أو تغيير أية تفاصيل في الملصقات، وذلك لمنع عواقب في تشخيص الممتحن وفي تسجيل العلامات.

نتمنى لك النجاح!



1

State of Israel

Ministry of Education

Type of Examination:

Highschool matriculation

Exam date: Summer 2016

Exam Code: 917554

Appendices: – Millimeter paper booklet for marking the edges of the diffusion stain (4 sheets)
– Physics data and formulas for 5 units

מדינת ישראל

משרד החינוך

סוג הבחינה: בגרות לבתי-ספר על-יסודיים

מועד הבחינה: קיץ תשע"ו, 2016

סמל השאלון: 917554

נספחים: – נייר מילימטרי לסימון נקודות

קצה כתם הפעפוע (4 גיליונות)

– נתונים ונוסחאות בפיזיקה לחמש יח"ל

תרגום לאנגלית (3)

Physics – Research Laboratory

For students of 5 units of study

Instructions

- Duration of the exam:** two hours
- Questionnaire structure and evaluation key:**
This questionnaire consists of ten questions.
You need to answer **all** questions 1-8
and **one** of questions 9-10.
Total: 100 points.
- Allowed materials:** calculator and ruler.
- Special instructions:** pencil may be used for drawing/
sketching only.
- Pages 12-13 may be used as draft paper.
- Note:** The experiment kit includes candies. These were
found fitting for the experiment due to their unique
characteristics, and using them does not constitute
deliberate commercial advertisement.

This questionnaire consists of 14 pages, 4 sheets of appendices and formulas.

Good Luck!

פיזיקה – מעבדת חקר

לנבחנים ברמת חמש יחידות לימוד

הוראות לנבחן

- משך הבחינה:** שתיים.
- מבנה השאלון ומפתח הערכה:**
בשאלון זה עשר שאלות. עליך לענות על **כל** השאלות 1-8,
ועל שאלה **אחת** מבין השאלות 9-10.
סה"כ – 100 נקודות.
- חומר עזר מותר לשימוש:** מחשבון וסרגל.
- הוראות מיוחדות:** מותר להשתמש בעיפרון לסרטטים בלבד.
- העמודים 12-13 משמשים כטיוטה.
- שים לב:** ערכת הניסוי כוללת סוכריות. הסוכריות האלה נמצאו
מתאימות לביצוע הניסוי הודות לתכונותיהן הייחודיות,
ואין בשימוש בהן משום פרסומת מסחרית מכוונת.

בשאלון זה 14 עמודים, 4 עמודי נספח ונוסחאות.

בהצלחה!

Continue to next page ►

המשך מעבר לדף ►



Part A: Exploring the diffusion rate of a color stain within water

Please answer all questions 1–8.

Theoretical background

Diffusion is the process by which molecules of matter become dispersed. The molecules move from areas of higher concentration to areas of lower concentration until a state of equilibrium is reached. When two different materials at different concentrations are present alongside each other in the same system, a process of diffusion, which is largely dependent on the temperature of the system, takes place. The phenomenon of diffusion occurs mainly in liquids and gasses. If one of the materials is colored, a stain will form.

The following expression describes the spreading of the diffusion stain, which begins from a single point, as a function of time:

$$(1) \quad \ell^2 = \frac{4}{\pi} D \cdot t$$

Where ℓ is the distance which the spreading material passes, t is the time it takes the material to pass the distance ℓ , and D is the diffusion coefficient between the two materials.

The time derivative of expression (1) is expression (2), which describes the velocity of the stain spreading:

$$(2) \quad v = \sqrt{\frac{D}{\pi \cdot t}}$$

Object of the experiment

In this experiment you will explore the diffusion of colored material in water. To do so you will use a piece of candy coated with colored material, and this material will undergo diffusion. When you place the candy in water, a stain will spread around it. In ideal conditions the stain should spread uniformly in all directions and its shape should approximately be a circle, the diameter of which is "the diameter of the spreading stain".

During the first minute after inserting the piece of candy into the water, a process of dissolution, which we will not touch on in this questionnaire, will take place. Therefore expression (1) holds only after 60 seconds ($t > 60$).

Equipment

- a plastic measuring cup
- a stopwatch
- 4 sheets of millimeter paper with a sketch drawn on each (in the appendix to this questionnaire)
- a clear plate with a diameter of 13.5 cm, its center marked with a green dot
- a pack of candy
- 10 paper wipes
- 12 stickers
- a plastic box into which the leftover water should be poured
- a 500 ml bottle of mineral water at room temperature

Note: The candy is not to be eaten.

Continue to page 3 ►



3

Setting up the experiment apparatus

Do not move the table when setting up the experiment and taking the measurements.

Question 1 (5 pts.)

(2 pts.) a. Measure the diameter of the candy and record it. $2r =$ _____

(3 pts.) b. What is the absolute error in this measurement? _____

Set up the experiment apparatus as described in Figure A and according to instructions I-III which follow.

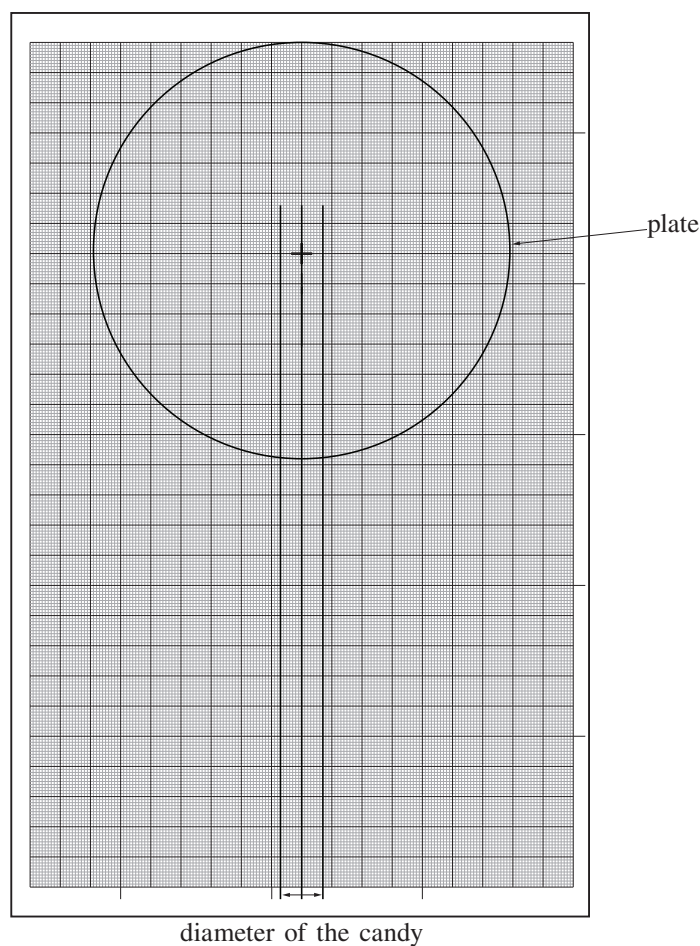


Figure A: the experiment apparatus

Instructions

- I. Place the clear plate on the millimeter paper so that the dot marking the center of the plate coincides with center of the "+" marked on the millimeter paper. Do not glue the paper to the table yet.
- II. Fill the plate with about 50 milliliters of water using the measuring cup.

Observation

- III. Place a piece of candy at the center of the plate, and observe the stain spreading through the water for 3 minutes.

Continue to page 4 ►



4

Question 2 (2 pts.)

If you identify a stain spreading to one direction more than to others, determine the preferred direction (see Figure B). **Rotate the millimeter paper** so that the direction to which the stain is spreading is aligned with the central line marked on the millimeter paper (see Figure C). If you wish to run through the observation again, perform instructions I-III once more.

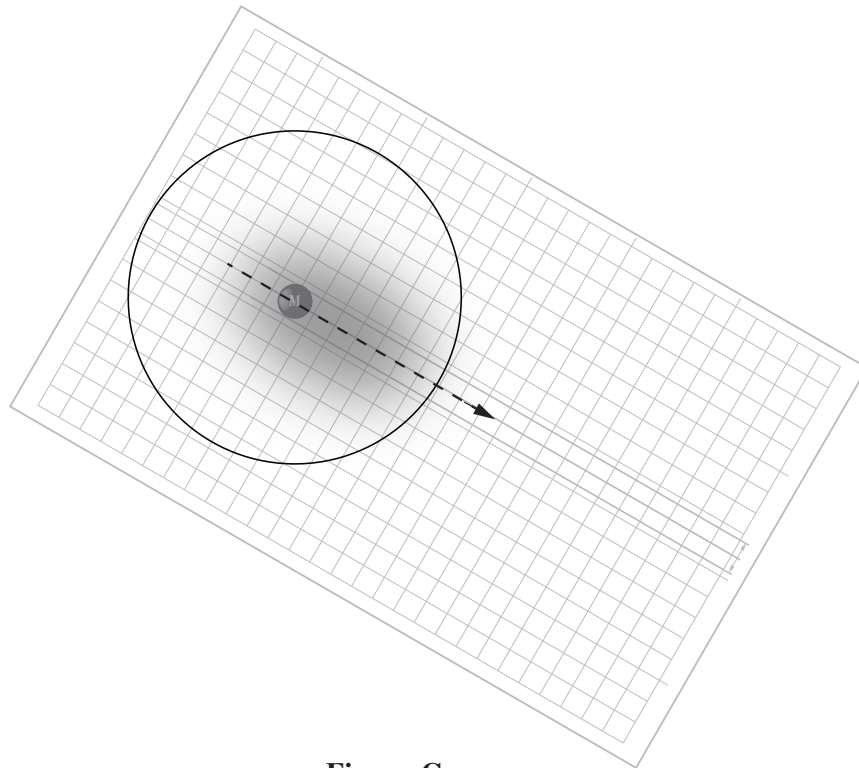


Figure C

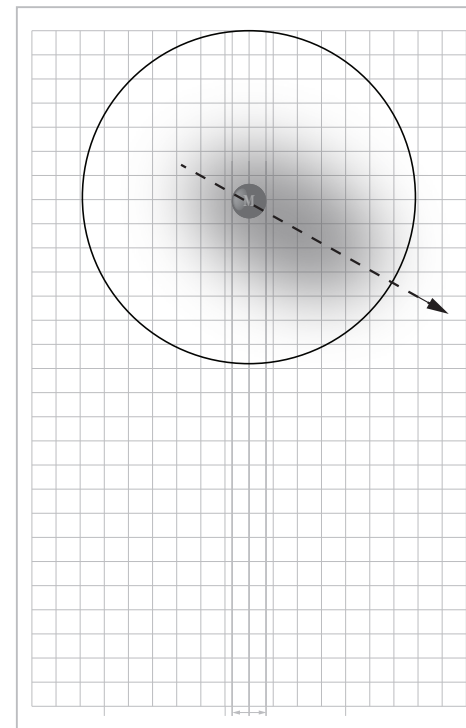


Figure B

Preferred
direction of the
stain spreading

What do you think caused the stain to not spread uniformly in all directions?

If the stain spread to the preferred direction, at the end of this stage:

IV. Secure the millimeter paper to the **table** using the stickers in the kit, without changing its position.

V. Empty the water from the plate and wipe it with the paper towels.

The experiment

Question 3 (8 points)

Note:

- First read all the instructions and examine the figure on the next page, and only then begin to carry out the instructions.
- Carry out instructions I–VI several times before collecting the measurement results, to gain experience in carrying them out.
- To mark your measurements you will need one sheet of millimeter paper (found in the appendix). You have 3 other sheets at your disposal, if necessary.

Continue to page 5 ►



5

Instructions

- I. Reset the stopwatch.
- II. Place the clear plate on the millimeter paper so that the dot marking the center of the plate coincides with center of the "+" marked on the millimeter paper.
- III. Fill the plate with about 50 milliliters of water using the measuring cup.
- IV. Place a piece of candy at the center of the plate and start the stopwatch simultaneously.
- V. **Every 20 seconds, from the moment the candy is placed inside the water until 240 seconds later (4 minutes), mark both edges of the spreading diffusion stain.**

Altogether you need to take a total of 12 measurements.

- Carry out the measurement in the following way: when the stopwatch reaches, for example, 20 seconds, mark **two short lines** on the millimeter paper (outside the plate) indicating the approximate location of the diffusion stain at that moment, as described in Figure D. The distance between these two lines will be called X .

- VI. For each pair of lines, write the time when they were marked; e.g. " $t = 20$ sec".

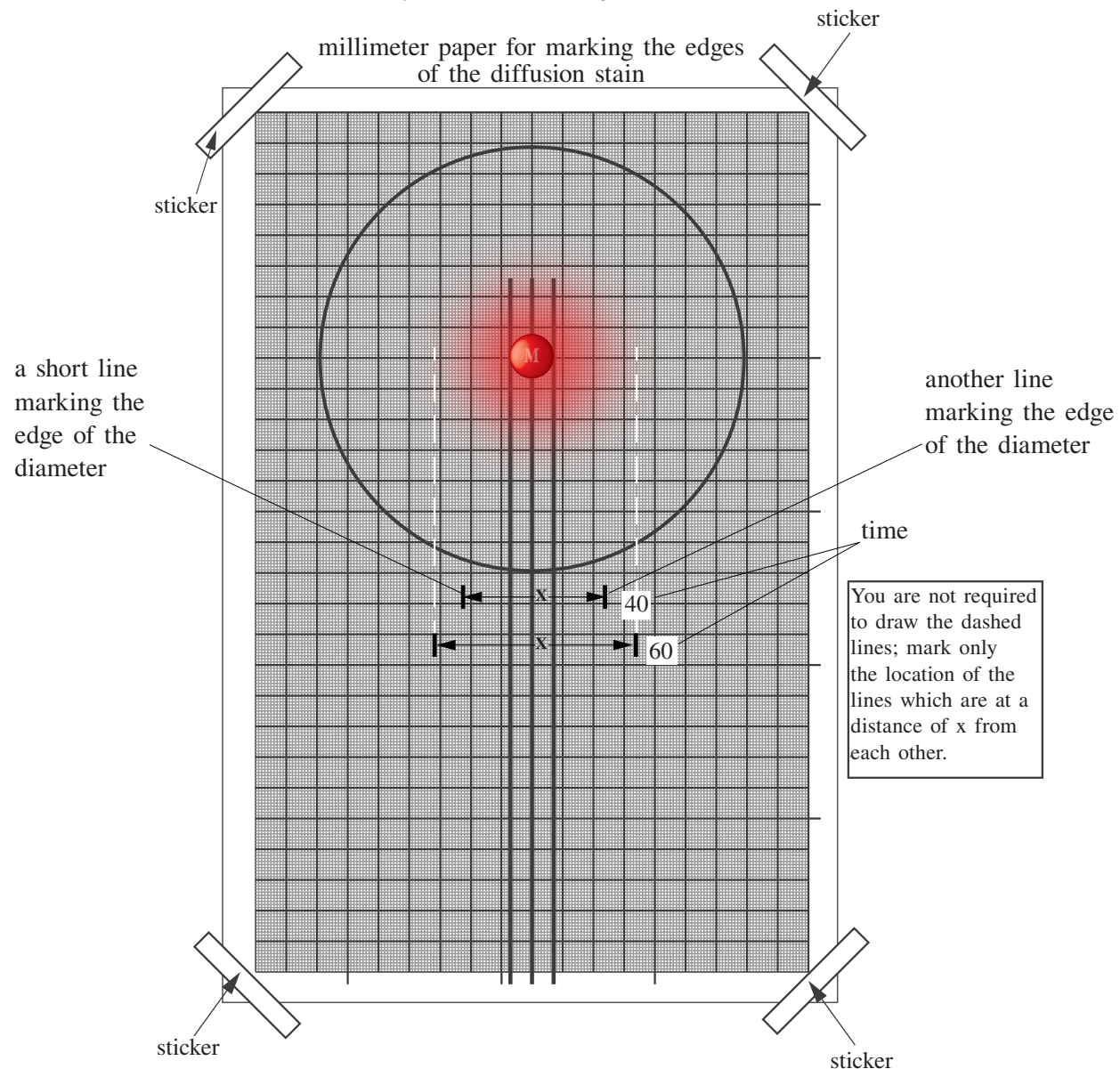


Figure D: an example for marking the edges of the diffusion stain at two consecutive points in time

Continue to page 6 ►



6

Question 4 (13 pts.)

Measure the distance, X, which you marked for each point in time. The relation between X and ℓ from expression (1), which was described in the theoretical background, is given in the expression $\ell = \frac{X}{2} - r$. Record the measurement results and the values of ℓ at the different points in time in the table, and specify the units of measurement in the table headings (inside the parentheses).

Note: the last column in the table is to be filled later on.

Measurement number	t ()	X ()	$\ell = \left(\frac{X}{2} - r\right)$ ()	
1	0			
2	20			
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				

Question 5 (10 pts.)

(4 pts.) a. Using the variable ℓ , calculate the average velocity of the stain spreading **during** the first minute.

In the following sections you must calculate the average velocity of the stain spreading during the following three minutes.

(2 pts.) b. Calculate the average velocity of the stain spreading during the second minute.

(2 pts.) c. Calculate the average velocity of the stain spreading during the third minute.



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- (2 pts.) d. Calculate the average velocity of the stain spreading during the fourth minute.

Question 6 (11 pts.)

Figure E is a graph which qualitatively describes the radius of the diffusion stain as a function of time, starting from the end of the first minute ($t > 60$ sec).

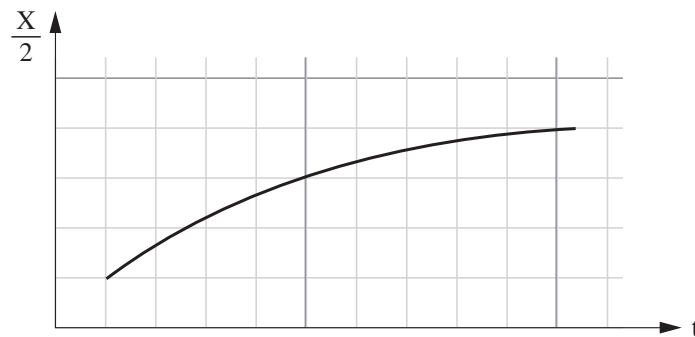


Figure E

- (5 pts.) a. Describe (with words) the spreading of the stain based on the graph. You may use the following concepts: distance, velocity and time.

- (6 pts.) b. Are the measurement results you collected in accordance with the graph? Explain your answer.



8

Question 7 (25 pts.)

The diffusion process takes place most prominently for $t > 60$ sec.

According to expression (1) in the theoretical background, the relationship between X and time, t , is not represented by a graph with a straight line.

(3 pts.) a. Explain this claim.

(3 pts.) b. Define a new variable whose relationship with time, t , is represented by a graph with a straight line. Explain your choice.

(7 pts.) c. Write the values of the new variable you defined in the empty column in the table on page 6. Give the column a heading, and specify the units of measurement in the heading.

(12 pts.) d. Draw a graph* which describes the relationship between the variable you have defined and time, t , for $t > 60$ sec.



* **Note:** On page 11 you will find additional millimeter paper that you may use if necessary. You may also use an electronic worksheet according to the examiner instructions. **If you use electronic worksheets, print it, stick your examinee sticker to the printout and add it to the questionnaire.**



9

Question 8 (16 pts.)

- (6 pts.) a. Calculate the slope of the graph you drew. If you used an electronic worksheet, specify the slope of the graph and the units of the slope.

- (10 pts.) b. What is the diffusion coefficient, D , and what are its units?

Note: Stick your examinee sticker to the designated places on the millimeter paper and electronic worksheet printout, and add them to the questionnaire.

Part B: Questions about the compulsory experiments

Answer one of questions 9–10 (10 points per question).

Question 9 (10 pts.)

This question relates to the experiment "An object and its image in a concentrating lens".

- (4 pts.) a. At the beginning of the experiment you were asked to estimate the focal distance of the lens using direct measurement. Describe the way this measurement is carried out.

A student carried out the measurement you described in your answer to section (a), and found that the focal distance of the lens is approximately 10 cm.

He then carried out the rest of the experiment "An object and its image in a concentrating lens". He first had to determine values for the independent variable in the experiment.

- (3 pts.) b. What is the dependent variable and what is the independent variable in this experiment?

- (3 pts.) c. Determine eight values for the independent variable, so that the student can perform the experiment in the best way possible. Specify your considerations.



10

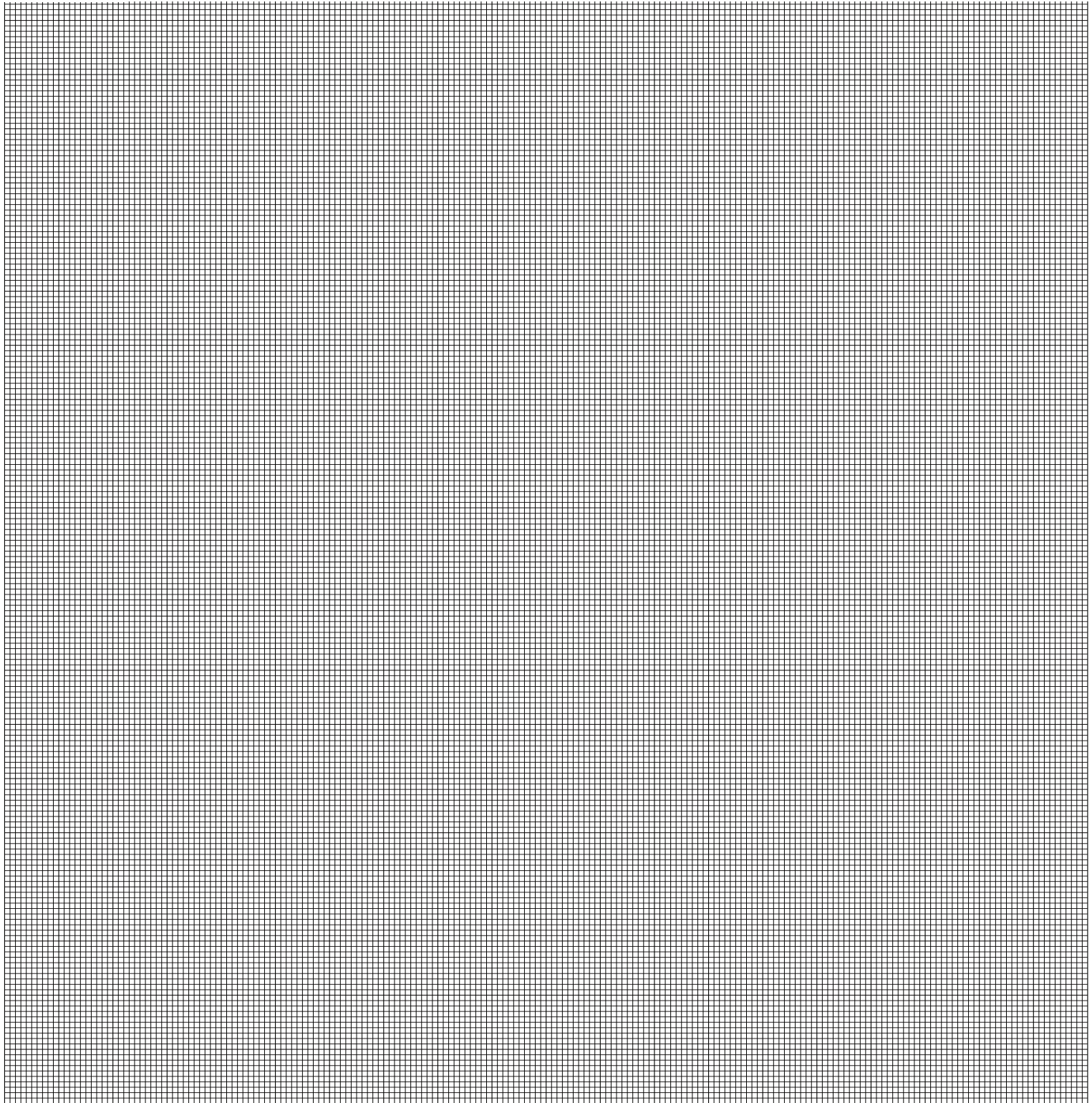
Question 10 (10 pts.)

This question relates to the experiment "Newton's Second Law", and specifically to the part dealing with relationship between the mass of the system and its acceleration.

(4 pts.) a. Describe how the acceleration of the system is measured in this experiment.

(3 pts.) b. What are the dependent variable, the independent variable and the constant in this experiment?

(3 pts.) c. How did you change the values of the independent variable during the experiment?





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Draft paper



Administrator comments

Good Luck!

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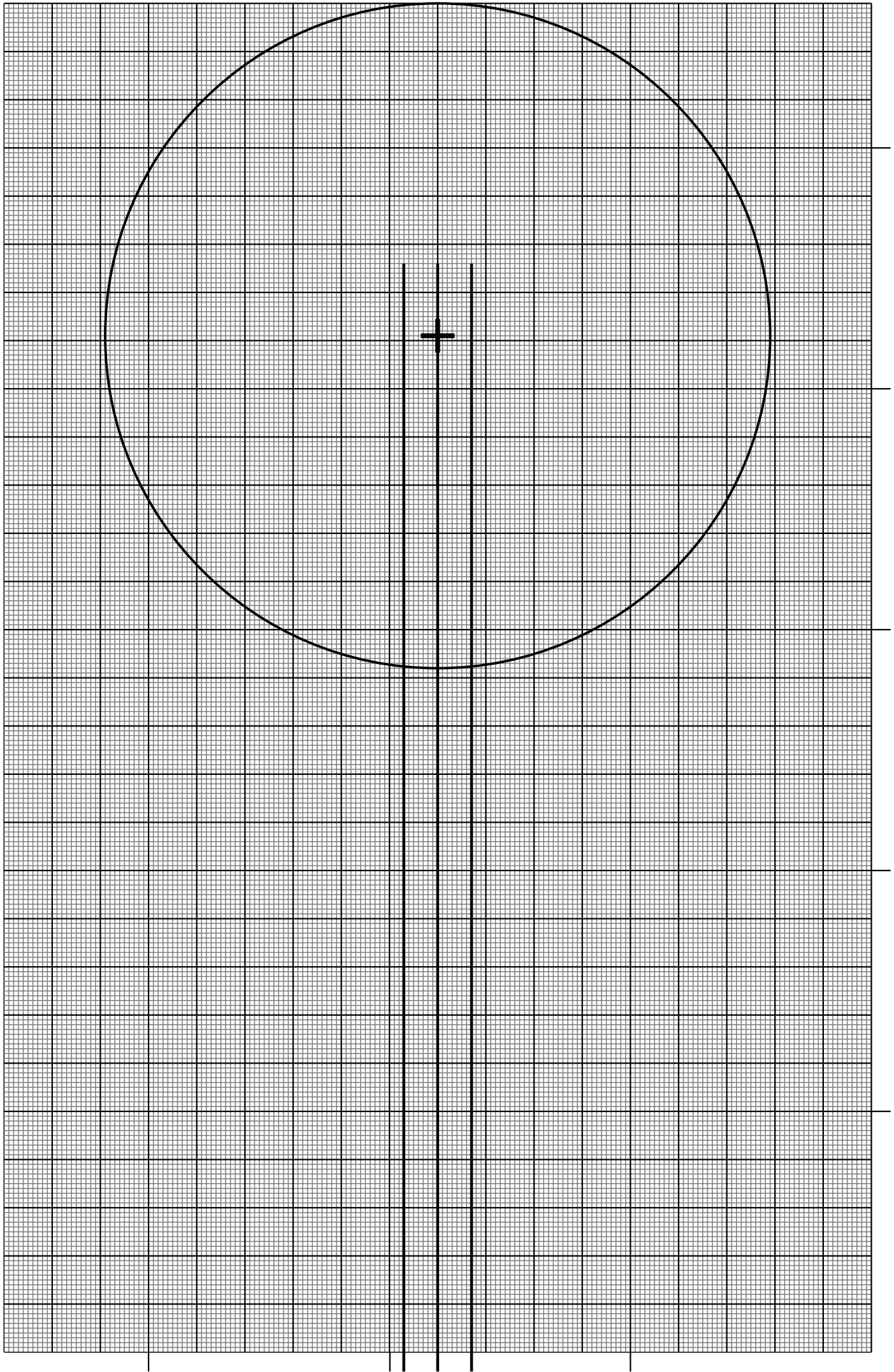


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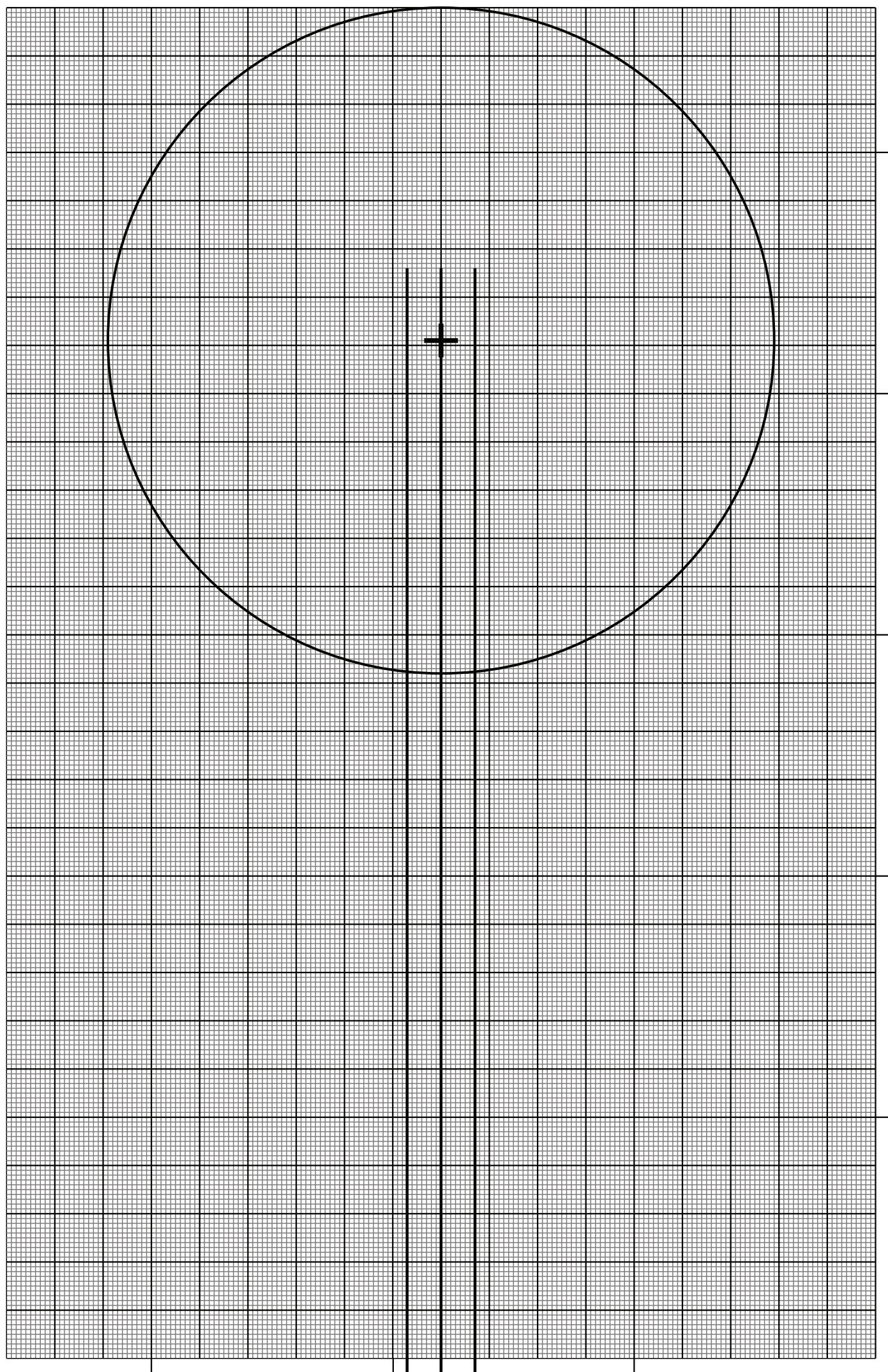
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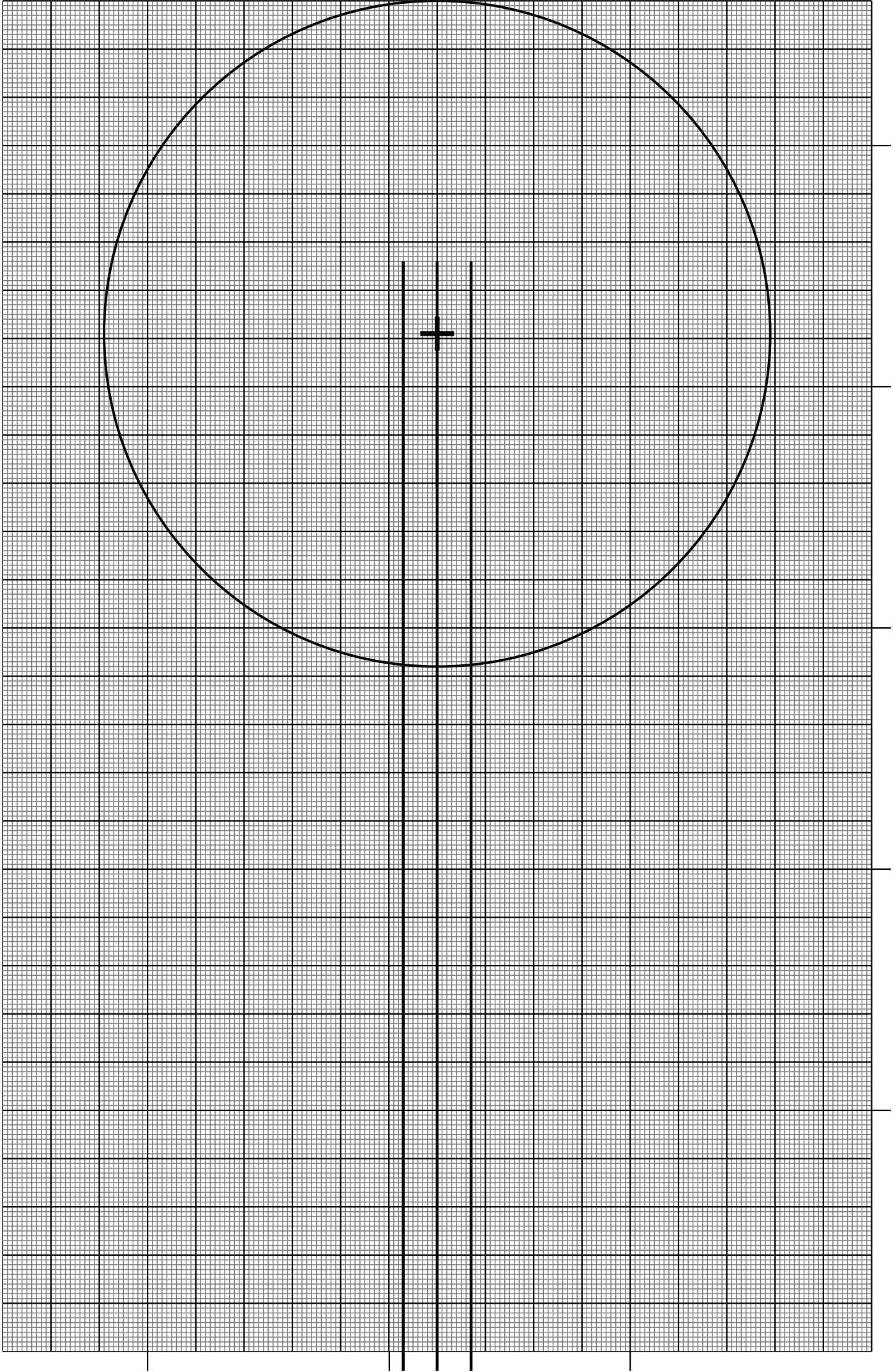
Millimeter paper for marking the edges of the diffusion stain



Millimeter paper for marking the edges of the diffusion stain



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