20S-PHYSICS1C-1 Quiz 4

CHARLES ZHANG

TOTAL POINTS

14 / 30

QUESTION 1

1 4a **7 / 10**

- ✓ **+ 1 pts** Value of q
- **+ 2 pts** Position of image
- ✓ **+ 2 pts** Real/Virtual
- ✓ **+ 2 pts** Orientation
- ✓ **+ 2 pts** Height of image
- **+ 1 pts** Correct Ray tracing
- **+ 0 pts** Incorrect

QUESTION 2

2 4b **7 / 10**

- ✓ **+ 1 pts** Value of q
- ✓ **+ 2 pts** Position of image
- ✓ **+ 2 pts** Real/Virtual
- ✓ **+ 2 pts** Orientation
- ✓ **+ 2 pts** Height of image
- **+ 1 pts** Correct Ray tracing
- **+ 0 pts** Incorrect
- ✓ **- 2 pts** Mistake carried over

QUESTION 3

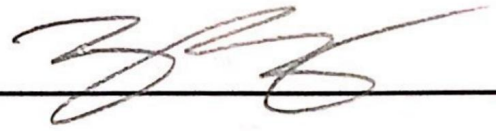
3 4c **0 / 10**

- **+ 1 pts** Value of q
- **+ 2 pts** Position of image
- **+ 2 pts** Real/Virtual
- **+ 2 pts** Orientation
- **+ 2 pts** Height of image
- **+ 1 pts** Correct Ray tracing
- ✓ **+ 0 pts** Incorrect
- **- 2 pts** Mistake carried over

gradescope

1CS20 QUIZ 4

Full Name (Printed) Charles Zhang

Full Name (Signature) 

Student ID Number 3054136 59

- The exam is open-book and open notes. You will probably do better to limit yourself to a single page of notes you prepared well in advance.
- **All work must be your own.** You are not allowed to collaborate with anyone else, you are not allowed to discuss the exam with anyone until all the exams have been submitted (after the close of the submissions window for the exam).
- You have 30 minutes to complete the exam and sufficient time to scan the exam and upload it to GradeScope. The exam *must* be uploaded to GradeScope within the time alloted (that is, by the end of the lecture hour). We will only except submissions through GradeScope and will not accept any exam submitted after the submission window closes (CAE students must contact Corbin for instructions).
- **Given the limits of GradeScope, you must fit your work for each part into the space provided.** You may work on scratch paper, but you will not be able to upload the work you do on scratch paper, so it is essential that you copy your complete solution onto the exam form for final submission. We can only consider the work you submit on your exam form.
- **For full credit the grader must be able to follow your solution from first principles to your final answer.** ***There is a valid penalty for confusing the grader.***
- It is **YOUR** responsibility to make sure the exam is scanned correctly and uploaded before the end of the submission window. The graders may refuse to grade pages that are significantly blurred, solutions to problems that are not written in the correct place, pages submitted in landscape mode and/or work that is otherwise illegible - if any of this occurs, you may not receive *any* credit for the affected parts.
- Focus on the concepts involved in the problem, the tools to be used, and the set-up. If you get these right, all that's left is algebra.
- **Have Fun!**

The following must be signed before you submit your exam:

By my signature below, I hereby certify that all of the work on this exam was my own, that I did not collaborate with anyone else, nor did I discuss the exam with anyone while I was taking it.

Signature 

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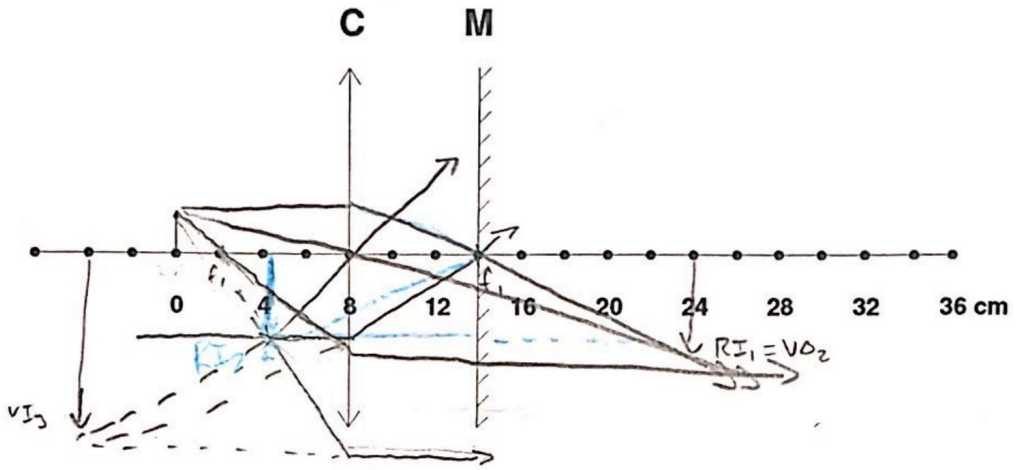

4) Marks are made along an optical axis every 2 cm, as shown. A converging lens ($|f_1| = 6$ cm) is placed at $x = 8$ cm, a planar mirror is placed at $x = 14$ cm, and an object (2 cm tall), is placed upright at the origin. **For full credit** answer the following questions analytically (that is, compute the answer). It might not be a bad idea to confirm your answers with some rigorous ray-tracing on the diagram above (it will almost certainly be worth some partial credit).

- 4a) (10 points) At what point along the optical axis is the first image produced by the converging lens located? Is it real or virtual? ... Oriented upward or down? How tall is it?

$p = +8\text{cm}$, $q = ?$, $f_1 = +6\text{cm}$, $p > f$

$q \to +$ because converging lens + RO

$$\frac{1}{p_1} + \frac{1}{q_1} = \frac{1}{f_1}$$

$$\frac{1}{8} + \frac{1}{q_1} = \frac{1}{6}$$

$$\frac{1}{q_1} = \frac{1}{6} - \frac{1}{8}$$

$$\boxed{q_1 = 24\text{cm}}$$

check: $q = \frac{pf}{p-f} = \frac{48}{2} = 24\text{cm}$ ✓

real image $\to q > 0$

downward $\to M = \frac{-q}{p} < 0$

$$M = -\frac{q}{p} = \frac{h_i}{h_o}$$

$$h_i = -\frac{q}{p} h_o$$

$$h_i = \frac{-24}{8}(2\text{cm})$$

$$\boxed{|h_i| = 6\text{cm}}$$

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- 4b) (10 points) At what point along the optical axis is the image produced by the planar mirror located? Is it real or virtual? ... Oriented up or down? How tall is it?

Virtual Object

$p = -10\text{cm}$, $q = ?$, $R = \infty$ ← treating planar mirror as a really large sphere

$$\frac{1}{p} + \frac{1}{q} = \frac{2}{R}$$

$$\frac{1}{-10} + \frac{1}{q} = 0$$

$$\frac{1}{q} = \frac{1}{10}$$

$q = 10\text{cm}$ → 4cm on the axis

$q > 0$ → real

$$M = -\frac{q}{p} = -\frac{10}{-10} = 1$$

$M > 0$ → same orientation as the object → down

$$\frac{h_i}{h_o} = 1, \quad h_i = h_o$$

$|h_i| = 6\text{cm}$

- 4c) (10 points) At what point along the optical axis is the final image located? Is it real or virtual? ... Oriented up or down? How tall is it?

$p = +4\text{cm}$, $q = ?$, $f = +6\text{cm}$, pcf

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

$$\frac{1}{4\text{cm}} + \frac{1}{q} = \frac{1}{6\text{cm}}$$

$$\frac{1}{q} = \frac{1}{6\text{cm}} - \frac{1}{4\text{cm}}$$

$q = -12\text{cm}$ → -4cm on axis

$q < 0$ → virtual

$$M = -\frac{q}{p} = \frac{+12\text{cm}}{4\text{cm}} = 3$$

$M > 0$ → same orientation as the object → down

$$\frac{h_i}{h_o} = 3, \quad h_i = 3h_o$$

$|h_i| = 18\text{cm}$

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