Name: _____ DISC: _____ Score: _____ / 20

Instructions:

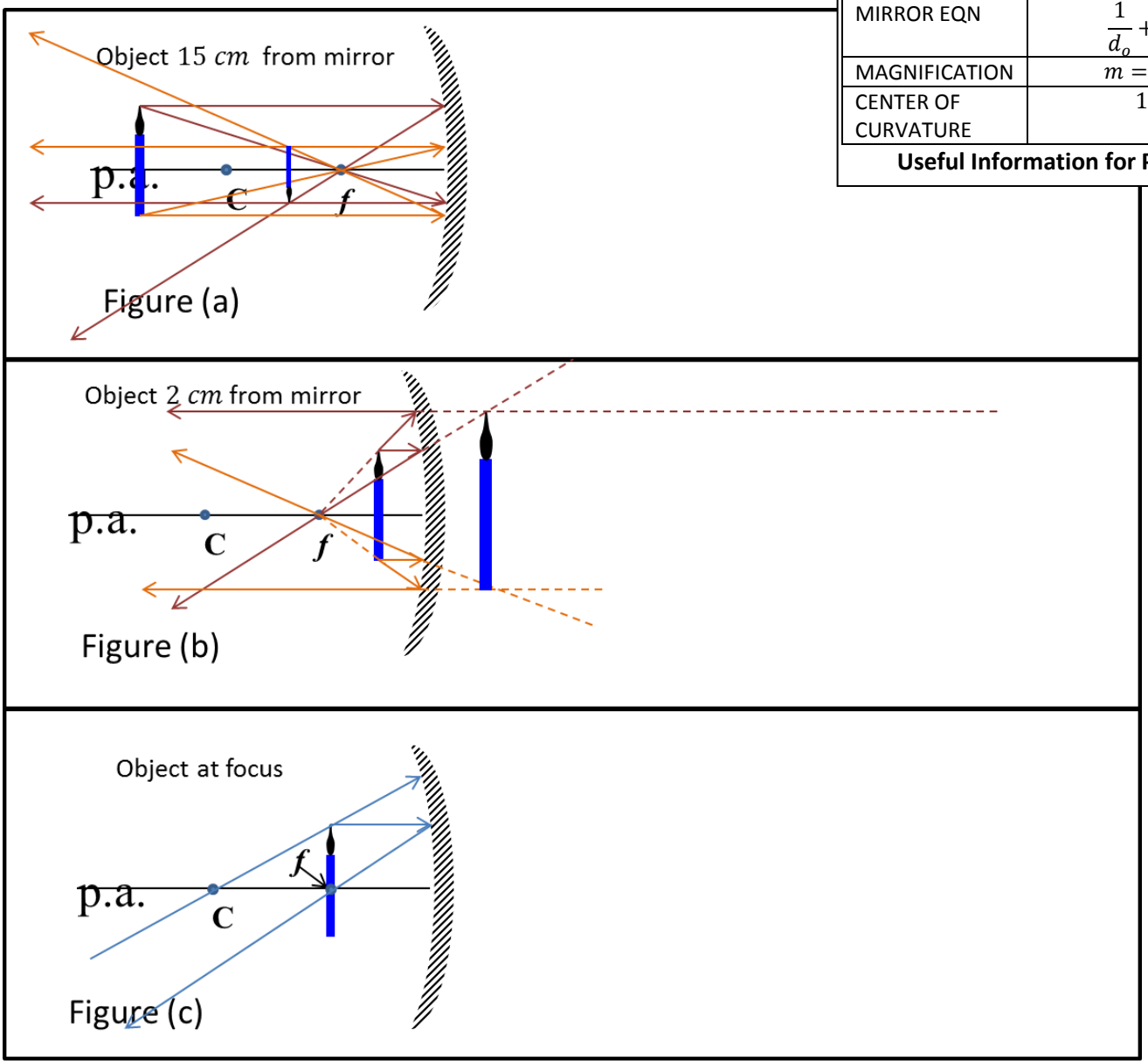
- Do your own work.
- Answer the questions below in the space provided.
- ***You must show all of your work to received credit for these problems***
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers

Q1	Q2	Q3	Q4
10	10	5	5

SPEED OF LIGHT	$c = 3 \times 10^8 m/s$
LAW OF REFLECTION	$\theta_i = \theta_r$
MIRROR EQN	$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$
MAGNIFICATION	$m = -d_i/d_o$
CENTER OF CURVATURE	$10\ cm$

Useful Information for Problem 1

1. Consider the concave mirrors and sets of objects below:



Ray-Traces (6 pts.):

a) Draw the ray-trace diagrams for *at least two (2)* principle rays to locate the image in each diagram.

b) Fill in the following table (use extra page when necessary):

Table (4 pts.):

FIGURE	IMAGE TYPE	IMAGE LOCATION	MAGNIFICATION
a	REAL/VIRTUAL	$7.5\ cm$	$-\frac{1}{2}$
b	REAL/VIRTUAL	$-3.33\ cm$	$\frac{5}{3}$
c	REAL/VIRTUAL **No Image**	**No Image**	**No Image**

Figure a:

$$\frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f}$$

$$\frac{1}{15\ cm}+\frac{1}{d_i}=\frac{1}{5\ cm}$$

$$\frac{1}{d_i}=\frac{1}{5\ cm}-\frac{1}{15\ cm}=\frac{1}{5}\left[\frac{3}{3}-\frac{1}{3}\right]=\frac{1}{5}\left[\frac{2}{3}\right]=\frac{2}{15\ cm}$$

$$d_i=7.5\ cm$$

$$m=-\frac{d_i}{d_o}=-\frac{\frac{15}{2}}{15}=-\frac{1}{2}$$

Figure b:

$$\frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f}$$

$$\frac{1}{2\ cm}+\frac{1}{d_i}=\frac{1}{5\ cm}$$

$$\frac{1}{d_i}=\frac{1}{5\ cm}-\frac{1}{2\ cm}=\left[\frac{2}{10}-\frac{5}{10}\right]=\left[\frac{-3}{10\ cm}\right]$$

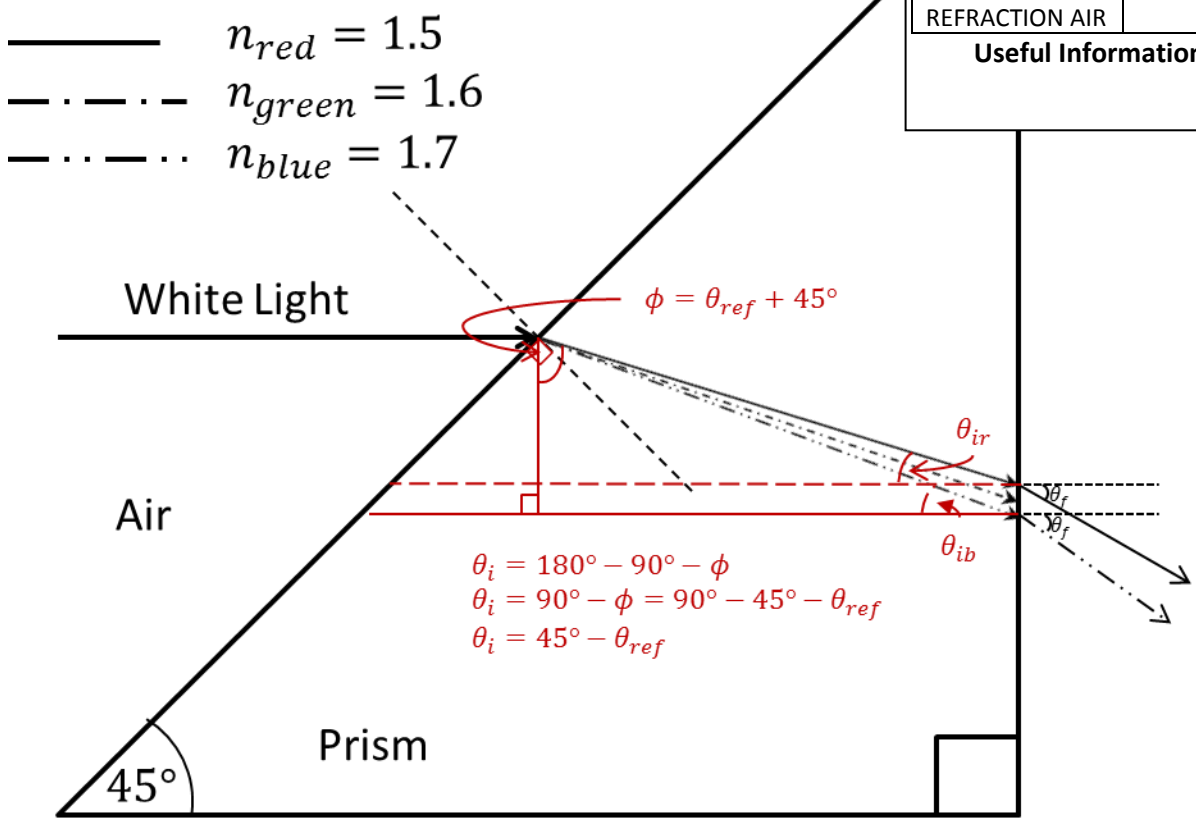
$$d_i=-3.33\ cm$$

$$m=-\frac{d_i}{d_o}=-\frac{-\frac{10}{3}}{2}=\frac{5}{3}$$

2. Consider the *right* prisim below:

LAW OF REFLECTION	$\theta_i = \theta_r$
SNELL'S LAW	$n_1 \sin\theta_1 = n_2 \sin\theta_2$
INDEX OF REFRACTION AIR	$n_{air} = 1$

Useful Information for Problem 2



Fill in the following table of *refracted* angles:

Table (10 pts):

QUANTITY	VALUE
White Light	$\theta_i = 45^o$
Blue θ_r	$\mathbf{24.58^o}$
Green θ_r	$\mathbf{26.23^o}$
Red θ_r	$\mathbf{28.13^o}$
For Blue Light: θ_f the angle the light exits the prism	$\mathbf{36.38°}$
For Red Light: θ_f the angle the light exits the prism	$\mathbf{25.80°}$

Snell's Law—For the prism the incident angle for the white light is the incident angle for all colors.

$$\sin\theta_r = \frac{n_1}{n_2}\sin\theta_i = \frac{1}{n_2}(0.7071)$$

Blue: $\sin\theta_r = \frac{1}{1.7}(0.7071) = 0.4159; \theta_r = 24.58^o$

Green: $\sin\theta_r = \frac{1}{1.6}(0.707158) = 0.4419; \theta_r = 26.23^o$

Red: $\sin\theta_r = \frac{1}{1.5}(0.7071) = 0.4714; \theta_r = 28.13^o$

For the exit angle:

For this part of the problem, we want to find the angle that the ray is refracted as it moves from the glass to the air. First we need the incident angle—to find that, we need to use our triangle rules—see the diagram.

Blue: $\theta_i = 45° - 24.58° = 20.42°$

$$\frac{1.7\sin 20.42°}{1} = \sin\theta_f$$

$$\sin\theta_f = 0.59313 \rightarrow \theta_f = 36.38°$$

Red: $\theta_i = 45° - 28.13^o = 16.87°$

$$\frac{1.5\sin 16.87°}{1} = \sin\theta_f$$

$$\sin\theta_f = 0.4353 \rightarrow \theta_f = 25.80°$$

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