Question 2

(a) Utility maximization problem

$$\underset{x,y}{max} U(x,y) = (x-4)y$$

$$x \geq 4, y \geq 0$$

$$p_x x + p_y y \leq M$$

Demand function for plankton (x).
Marginal utility functions:

$$MU_x = y, MU_y = x - 4$$

Tangental condition:

$$\frac{MU_x}{MU_y} = \frac{p_x}{p_y} = \frac{y}{x-4}$$

$$\Rightarrow p_x(x-4) = p_y y$$

Budget line condition:

$$p_x x + p_y y = M$$

$$\Rightarrow p_y y = M - p_x x = p_x(x-4)$$

$$\Rightarrow 2p_x x = M + 4p_x$$

$$\Rightarrow x(p_x, p_y, M) = \frac{M + 4p_x}{2p_x}$$

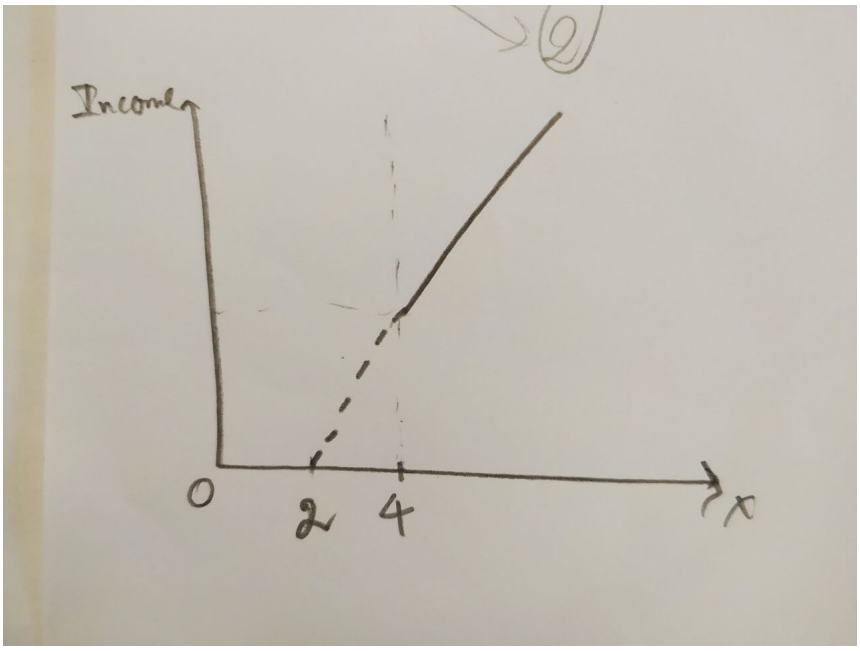
Demand function for algea (y):

$$y(p_x,p_y, M) = \frac{M - p_x x}{p_y} = \frac{M - 4p_x}{2p_y}$$

(b) The consumption of algea (y) decreases as p_y increases. Therefore, algea is a normal good.

(c) The consumption of algea (y) decreases as p_x increases. Therefore, plankton (x) and algea (y) are complement.

(d)


Income
0
2
4
X

Question 3

(a) The optimal basket occurs at the corner of the indifference curve (as this is a perfect complement).

Suppose (x_o, y_o) is the optimal basket

$$\begin{cases} x_o = 3y_o & (i.c.\ corner) \\ x_o + 5y_o = 24 & (budget\ line) \end{cases}$$

$$\begin{cases} x_o & = 9 \\ y_o & = 3 \end{cases}$$

(b) - New optimal basket:

$$\begin{cases} x_o^{'} = 3y_o^{'} & (i.c.\ corner) \\ x_o^{'} + 3y_o^{'} = 24 & (budget\ line) \end{cases}$$

$$\begin{cases} x_o^{'} & = 12 \\ y_o^{'} & = 4 \end{cases}$$

- Substitution effect: The budget line rotate around (x_o, y_o) as the indifference curve is not smooth at this point.

$\Rightarrow$ consumption of y remains unchanged, $\Delta y_{sub} = 0$.

- Income effect = Total change − Subtitution effect.

$\Rightarrow \Delta y_{income} = \Delta y - \Delta y_{sub} = (4 - 3) - 0 = 1$