NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

QUALIFICATION: BACHELOR OF ECONOMICS	
QUALIFICATION CODE: 07BECO	**LEVEL:** 5
COURSE CODE: MFE511S	**COURSE NAME:** MATHEMATICS FOR ECONOMISTS 1A
DATE: 6th MAY 2023	
DURATION: **2** HOURS	**MARKS:** **50**

CLASS TEST 2 MEMORANDUM	
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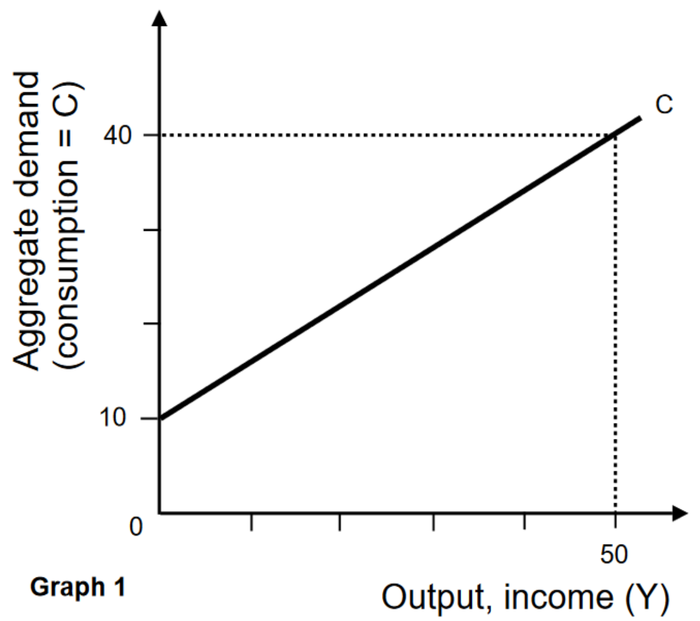
MODERATOR:	MR E. MWAHI

QUESTION 1 (25 MARKS)

1.1 Consider the graph below (not to scale):



Graph 1

1.1.1 **Consider the general form of the consumption function $C = a + bY$. Determine the value of a and b from the graph above.** **[4]**

$a = 10$

$b = \frac{\Delta C}{\Delta Y} = \frac{(40 - 10)}{50} = 0.6$

1.1.2 **Explain the difference between autonomous and induced consumption.** **[2]**

Autonomous Consumption (a): consumption that does not depend on income.

Induced Consumption (bY): consumption that depends on income.

1.1.3 **What happens to the consumption function if a rises and b rises?** **[2]**

If a rises: C shifts upwards

If b rises: C get more steeper

1.1.4 **Why is the sum of MPC and MPS equal to 1?** **[2]**

$MPC = b,$

$MPS = 1 - b$

$MPC + MPS = b + (1 - b) = 1$

Income is either consumed or saved. There is no other alternative.

1.2 A total cost function is given as $C=\frac{a(bh+2)}{1+dh}$ where $\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{d}$, and $\boldsymbol{h}$ are quantities produced. Make $\boldsymbol{h}$ the subject of the formula and then evaluate $\boldsymbol{h}$ when $\boldsymbol{a}=\mathbf{20}, \boldsymbol{c}=\mathbf{10}$, $\boldsymbol{d}=\mathbf{1}$ and $\boldsymbol{b}=\frac{\mathbf{1}}{\mathbf{4}}$. **[5]**

$$c=\frac{abh+2a}{1+dh}$$

$$(1+dh)c=abh+2a$$

$$c+cdh=abh+2a$$

$$cdh-abh=2a-c$$

$$h(cd-ab)=2a-c$$

$$h=\frac{2a-c}{cd-ab}$$

$$h=\frac{2(20)-10}{10(1)-20\left(\frac{1}{4}\right)}=\frac{40-10}{10-5}=\frac{30}{5}=6$$

1.3 An economy shows the following functions,

Compute the equilibrium income and rate of interest? **[10]**

SI : $Y=C+I+G$

$$=200+0.75(Y-T)+200-2000i+300$$

$$=700+0.75Y-0.75(80+0.2Y)-2000i$$

$$=640+0.6Y-2000i$$

$$0.4Y+2000i=640 - - - - - - - - - - - - - - - - - - eqn\ 1$$

LM: $M_s=M_d=M_Z+M_t$

$$400=0.5Y+200-250i$$

$$0.5Y-250i=200 - - - - - - - - - - - - - - - eqn\ 2$$

Solve for Y and i simultaneously,

$$\begin{array}{r|l} 0.4Y+2000i=640 & \times 0.5 \\ 0.5Y-250i=200 & \times 0.4 \\ \hline 0.2Y+1000i=320 & \\ 0.2Y-100i=80 & \\ \hline \end{array}$$

$$1100i=240, \qquad i=0.2182\approx 21.82\%$$

$$Y=N\$509.10$$

QUESTION 2 (25 MARKS)

2.1 **Evaluate** $\lim\limits_{x\to 4}\frac{x^3-16x}{x-4}$ **[3]**

$$\lim_{x\to 4}\frac{x(x^2-16)}{x-4}=\lim_{x\to 4}\frac{x(x+4)\cancel{(x-4)}}{\cancel{x-4}}=\lim_{x\to 4}x(x+4)=32$$

2.2 **Find derivatives of each of the following functions (leave your answers in simplest form),**

2.2.1 $\boldsymbol{g(x)=\left(\frac{2x-1}{3x+5}\right)^7}$ **[3]**

$$g'(x)=7\left(\frac{2x-1}{3x+5}\right)^6\left[\frac{(3x+5)(2)-(2x-1)(3)}{(3x+5)^2}\right]$$

$$=7\left(\frac{2x-1}{3x+5}\right)^6\frac{13}{(3x+5)^2}$$

$$=\frac{91(2x-1)^6}{(3x+5)^8}$$

2.2.2 $\boldsymbol{f(x)=\frac{5}{2x^3}+\frac{7}{3x^{-2}}}$ **[2]**

$$f'(x)=\frac{5}{2}(-3x^{-4})+\frac{7}{3}(2x)$$

$$=-\frac{15}{2x^4}+\frac{14x}{3}$$

2.3 The relationship between the price per barrel of beer (*P*) at the Namibian Breweries and the number of barrels sold annually, x, can be modelled by

$$\boldsymbol{P=209.724x^{-0.0209}}$$

where x is in thousands of barrels.

2.3.1 Find the revenue function. **[2]**

$$R(x)=px=(209.724x^{-0.0209})x$$
$$=209.724x^{-0.0209+1}$$
$$=209.724x^{0.9791}$$

2.3.2 Approximate the marginal revenue when 850 000 barrels of beer are sold. **[3]**

$$MR(x)=\frac{dR(x)}{dx}=209.724(0.9791x^{0.9791-1})$$
$$=205.3407684x^{-0.0209}$$

$$MR(850000)=205.3407684(850000)^{-0.0209}$$
$$=154.37$$

2.4 The daily production function of a small-scale shoe manufacturer is given by $Q = \sqrt[3]{3K^2 + 2L^3}$, where L is the labour input measured in daily work hours and K is the cost of capital investment measured in thousands of dollars and Q represents the daily production of shoes.

2.4.1 Determine the marginal productivity of capital and the marginal productivity of labour **[4]**

$$Q = \sqrt[3]{3K^2 + 2L^3} = (3K^2 + 2L^3)^{\frac{1}{3}}$$

$$MP_L = \frac{\partial Q}{\partial L} = \frac{1}{3}(3K^2 + 2L^3)^{-\frac{2}{3}}\, 6L^2 = \frac{2L^2}{(3K^2+2L^3)^{\frac{2}{3}}}$$

$$MP_K = \frac{\partial Q}{\partial K} = \frac{1}{3}(3K^2 + 2L^3)^{-\frac{2}{3}}\, 6K = \frac{2K}{(3K^2+2L^3)^{\frac{2}{3}}}$$

2.4.2 Calculate the MRTS of the productions of shoes if workers put in 8 hours per day and cost of capital is N$ 4. **[3]**

$$MRTS = \frac{MP_L}{MP_K} = \left(\frac{2L^2}{(3K^2 + 2L^3)^{\frac{2}{3}}} \times \frac{(3K^2 + 2L^3)^{\frac{2}{3}}}{2K}\right)$$

$$= \frac{L^2}{K} = \frac{(8)^2}{4} = 16$$

2.5 Determine $\frac{dy}{dx}$, if $2x^3 - 3y^2 + 7xy = 0$ **[5]**

$$2x^3 - 3y^2 + 7xy = 0$$

$$6x^2 - 6y\frac{dy}{dx} + 7y + 7x\frac{dy}{dx} = 0$$

$$-6y\frac{dy}{dx} + 7x\frac{dy}{dx} = -6x^2 - 7y$$

$$\frac{dy}{dx} = \frac{-6x^2-7y}{-6y+7x} = \frac{6x^2+7y}{6y-7x}$$

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