 

# MTH 111, Math for the Architects , Final Exam

Ayman Badawi

**QUESTION 1. (16 points)** Find $y' = dy/dx$ do not simplify

(i) $y = 2Sec(4x + 3) + (1 + cos(5x + 1))^4$

(ii) $y = [ln(3x + 1)][e^{(3x+1)}]$

(iii) $y = ln\left(\frac{(x^3+x+1)^3}{(e^x+4x-5)^2}\right)$

(iv) $y = e^{(tan(4x)+3x-1)} + ln(4x^2 + x - 1) + 2x - 11$

**QUESTION 2. (6 points)** Find the equation of the tangent line to the curve $(x+1)sin(y-4)+ye^x+cos(x)+2y-13=0$ at the point $(0,4)$

**QUESTION 3. (10 points)** Sketch the graph of $f(x)=cos(x)+sin(x)+3$ defined on $[-\pi,\pi]$ by considering the first derivative and the second derivative of f(x). [Between 0 and $\pi$ note that $cos(x)=sin(x)$ when $x=\pi/4$ and sin(x) = -cos(x) when $x=3\pi/4$]

**QUESTION 4. (8 points)** You want to construct a right triangle with area = $2m^2$ so that the length of the hypotenuse is minimum. What should be the length of the base, length of the height, and length of the hypotenuse?

**QUESTION 5. (4 points)** Rotate the graph $y = \sqrt{4 - x^2}$ (note that the graph is a semi-circle) around the $x$-axis where $x$ is between $x = -2$ and $x = 2$. Find the volume of the object you generated.

**QUESTION 6. (6 points)** Find the area of the region bounded by $y = x^3 + 2x^2 - 3x$, $x$-axis, $x = 0$, and $x = 2$.

**QUESTION 7. (6 points)**

$$Lim_{x \to 0} \frac{e^x - x - 1}{sin(x) - x^2 - x}$$

(ii) $$Lim_{x \to 1} \frac{\sqrt{x} - x}{e^{(x-1)} - 1}$$

**QUESTION 8. (8 points)** Given the ellipse $x^2 + 4y^2 - 4x + 4y^2 = 0$. Find the center, the foci, and the constant $k$. Sketch a rough graph of the given ellipse.

**QUESTION 9. (8 points)** Given $(-4, 3)$ is the vertex of a parabola that has the directrix $x = 1$. Find the standard equation of the parabola and find its focus, say $F$. Let $Q$ be a point on the parabola. Find $|QF|$. Sketch a rough graph of the given parabola.

**QUESTION 10. (5 points)** given $f'(x) = 2x + cos(x) + e^x$ and $f(0) = 4$. Find the function $f(x)$.

**QUESTION 11. (6 points)** Given $Q = (2, \frac{14}{3})$ lies on the graph of $f(x) = \frac{1}{3}x^3 + ax^2 + bx + c$ such that $f'(2) = 0$ but $Q$ is neither a local minimum point nor a local maximum point. Find the values of the constants $a, b, c$.

**QUESTION 12. (5 points)** Find a point, say $Q$, on the graph $y = \sqrt{x}$ that is the nearest to the point $(4.5, 0)$

**QUESTION 13. (12 points)**

(i) $\int \frac{1}{x+\sqrt{x}}\, dx$ [Hint: you may want to factor $x + \sqrt{x}$ some how!!!]

(ii) $\int e^{2x}(3 + e^{2x})^7\, dx$

(iii) $\int \frac{sin(x)+1}{cos^2(x)}\, dx$

**Faculty information**

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