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MTH 111, Math. for the Architects, Exam I, Spring 2014

Ayman Badawi

(**Each question = 10 points, total points 100 points**)

QUESTION 1. Find an equation of the ellipse with the vertices $(4, 3)$, $(1, 7)$, and $(-2, 3)$. Find the constant k. Find the foci. Make a rough sketch of such ellipse.

QUESTION 2. Find an equation of the hyperbola that is centered at $(2, 1)$ and with constant $k = 6$ such that (2, 6) is one of the foci. Find the second foci, find the vertices, and make a rough sketch of such hyperbola.

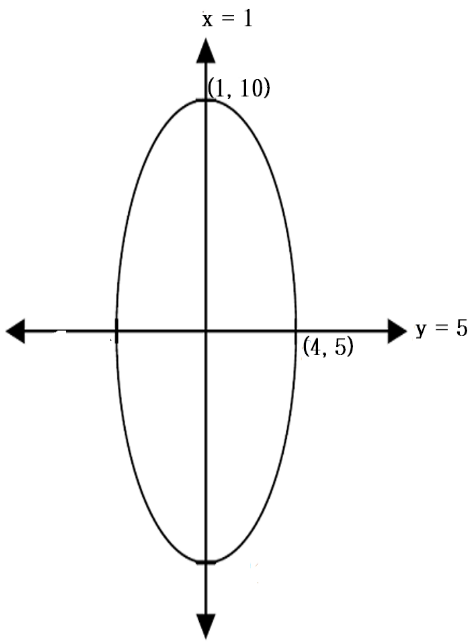
QUESTION 3. Given $x = 1$ is the directrix line of a parabola that passes through the point $(6, 5)$ and the line $y = 2$ passes through the vertex of the parabola. Find the vertex, the focus, and make a rough sketch of such parabola. Then find an equation of the parabola. [Hint: there are two such parabolas, just find one]

QUESTION 4. Find the directrix, the focus, and the vertex of the parabola $y = 0.5(x + 5)^2 + 4$

QUESTION 5. Find the foci, the constant k, and the vertices of the ellipse $(x + 2)^2/25 + (y - 3)^2/9 = 1$

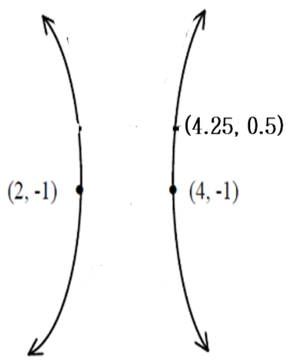
QUESTION 6. Find the center, the foci, the vertices of the hyperbola $x^2 - 2y^2 - 4y = 18$

QUESTION 7. Find the foci, and the equation of the below ellipse:



QUESTION 8.

Find the foci, and the equation of the below hyperbola:



QUESTION 9. Find an equation of the plane P that contains the line $L : x = t, y = 1 - t, z = 2t$ and the point $Q = (1, 0, 5)$ [note that the point Q does not lie on L]

QUESTION 10. a) Find the distance between the point $Q = (2, 2, 1)$ and the plane $x + 3y + 5z = 15$

b) The line $L_1 : x = 5t, y = 4 - t, z = 3 + t$ intersects the line $L_2 : x = 1 + 2s, y = 9 - 3s, z = 2s$ at a point Q. Find Q

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MTH 111, Math for Architects, Exam II, Spring 2014

Ayman Badawi

QUESTION 1. (i) Let $f(x) = -x^2 + 8x - 1$. The slope of the tangent line to the curve at the point $(1, 6)$

a. 6
b. -2
c. 5

(ii) Let $f(x) = -x^3 + 12x + 1$. Then $f(x)$ increases on the interval

a. $x \in (-\infty, -2) \cup (2, \infty)$
b. $x \in (-2, 2)$
c. $x \in (-\sqrt{12}, \sqrt{12})$
d. none of the above

(iii) let $f(x) = 3e^{(x^2-2x)} + 4$. Then $f'(2)$

a. 6
b. 3
c. 2
d. none of the above

(iv) Let $f(x) = xe^{(x-2)} + e^{(x-2)} + 3$. Then

a. $f(x)$ has a local minimum at $x = -2$
b. $f(x)$ has a local maximum at $x = 2$
c. $f(x)$ has a local minimum at $x = -1$
d. $f(x)$ has a local maximum at $x = -1$
e. none of the above

(v) Let $f(x) = -x(x - 18)^5$. Then

a. $f(x)$ has a local maximum at $x = 3$
b. $f(x)$ has a local minimum at $x = 18$
c. $f(x)$ has a local maximum at $x = 18$
d. $f(x)$ has a critical value when $x = -18$
e. none of the above

(vi) Given $x^2 + y^2 - xy = 0$. Then $dy/dx =$

a. $\frac{2y-x}{y-2x}$
b. $\frac{y-2x}{x-2y}$
c. $\frac{2x-y}{2y-x}$
d. $\frac{y-2x}{2y-x}$

(vii) Given $f(x) = \sqrt{4x-3} + \frac{1}{x} + 2$. Then $f'(1) =$

a. 4

b. 2

c. 1

d. 3

(viii) Given the curve of $f'(x)$. Then

a. $f(x)$ is decreasing on the the interval $(1,2)$

b. $f(x)$ is decreasing on the interval $(-\infty,0)$

c. $f(x)$ is increasing on the interval $(-\infty,2)$

d. $f(x)$ is decreasing on the interval $(-\infty,0)$

e. above, there are more than one correct answer.

(ix) Using the curve of $f'(x)$ above. Then

a. $f(x)$ has a local min. value at $x=0$ but no local max. values.

b. $f(x)$ has neither local min. values nor local max. values

c. $f(x)$ has a local max. value at $x=2$

d. $f(x)$ has a local min. value at $x=0$ and a local max. value at $x=1$.

(x) Using the curve of $f'(x)$ above. Then

a. the curve of $f(x)$ must be concave down on the interval $(0,1)$.

b. the curve of $f(x)$ must be concave up on the interval $(2,\infty)$

c. the curve of $f(x)$ must be concave down on the interval $(-\infty,-1)$

d. above, there are more than one correct answer.

(xi) Given $f'(3) = f'(-1) = f'(6) = 0$, $f^{(2)}(2) = 4$, $f^{(2)}(-1) = -5$, and $f^{(2)}(6) = 0$ (note that $f^{(2)}$ means the second derivative of $f(x)$). Then

a. $f(x)$ has neither local min. value nor local max. value at $x=6$.

b. $f(x)$ has a local max. value at $x=3$

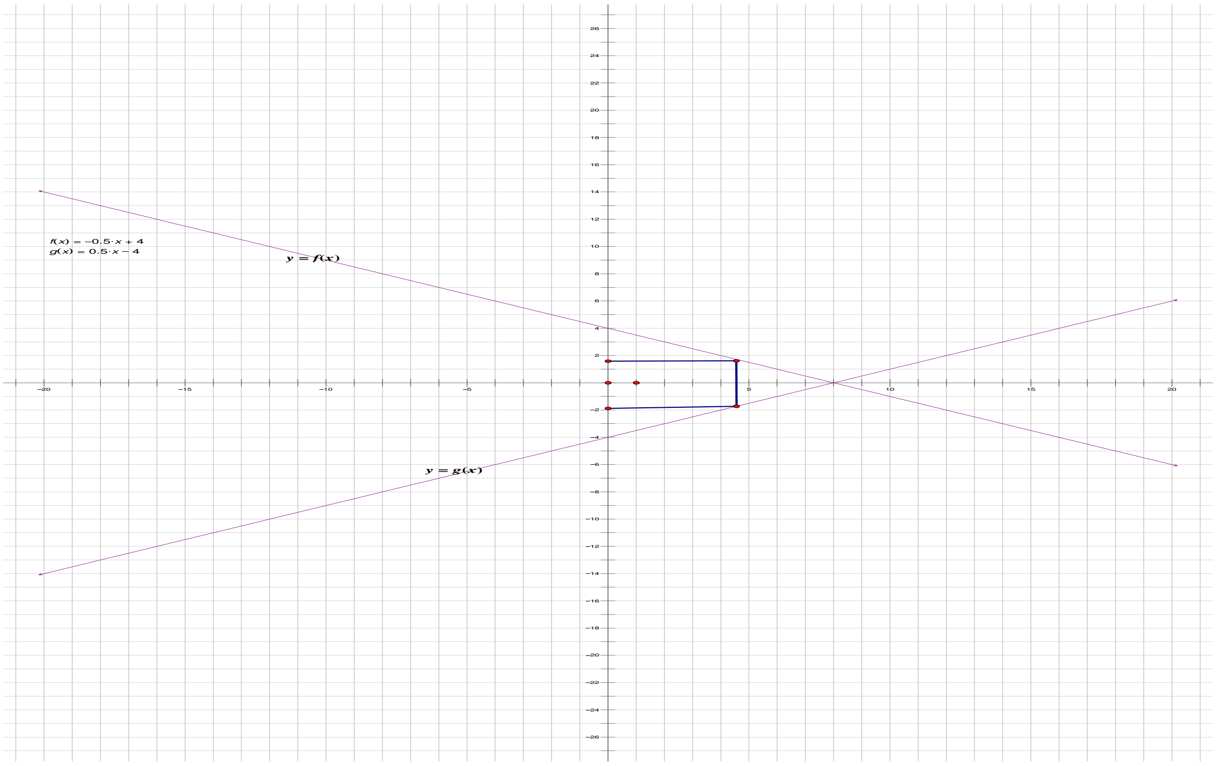
c. $f(x)$ has a local max. value at $x=-1$.

d. None of the above

(xii) Given x, y are two positive real numbers such that $x + 2y = 26$ and xy is maximum. Then $xy =$

a. 52
b. 84.5
c. 78
d. 169
e. none of the above

(xiii) What is the area of the largest rectangle that can be drawn as in the figure below (note $f(x) = -0.5x + 4$ and $g(x) = 0.5x - 4$)?



a. 16
b. 32
c. 64
d. none of the above

(xiv) Given the points $A = (2, 4)$ and $B = (0, 6)$. What is the point c on the $x-axis$ so that $|AC|+|CB|$ is minimum?

a. (2, 0)
b. (1.2, 0)
c. (1.5, 0)
d. (1, 0)
e. None of the above

(xv) A particle moves on the curve $4x^2 + 6y^2 = 22$. If the x-coordinates increases at rate 0.3/second, what is the rate of change of y when the particle reaches $(2, 1)$?

a. 0.4
b. -0.4
c. -0.3
d. none of the above

(xvi) Given $f(x) = (4x - 7)^{11}$, $f'(2)$ =

a. 11
b. 44
c. 4
d. non of the above

(xvii) Given $f(x) = ln[\frac{5x-14}{3x-8}]$. Then $f'(3)$

a. 2
b. $\frac{5}{3}$
c. 15
d. None of the above

(xviii) Given $(-4, 2), (0, 0), (6, 8)$ are vertices of a triangle. The area of the triangle is

a. 44
b. 22
c. $\sqrt{44}$
d. $\sqrt{22}$
e. None of the above.

(xix) $lim_{x \to 2} \ \frac{e^{(3x-6)}+x-3}{x^3-x^2-4} =$

a. 0.5
b. 0
c. 0.25
d. none of the above

(xx) $lim_{x \to 3} \ \frac{x^2-18}{(x-3)^2} =$

a. 0
b. $-\infty$
c. ∞
d. DNE (does not exist)
e. -9

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MTH 111, Math for Architects, Final Exam, Spring 2014

Ayman Badawi

QUESTION 1. (i) Let $f(x) = -x^3 + 8x - 1$. The slope of the tangent line to the curve at the point $(1, 6)$

a. 5
b. 6
c. 13

(ii) Let $f(x) = -2x^3 + 24x + 1$. Then $f(x)$ increases on the interval

a. $x \in (-\infty, -2) \cup (2, \infty)$
b. $x \in (-\infty, -\sqrt{12}) \cup (\sqrt{12}, \infty)$
c. $x \in (-\sqrt{12}, \sqrt{12})$
d. $x \in (-2, 2)$

(iii) let $f(x) = 3e^{(x^2-x-2)} + 4x + 5643217689$. Then $f'(2)$

a. 13
b. 11
c. 9
d. 7

(iv) Let $f(x) = (x+1)e^{(x-2)} + 3x + 14523$. Then

a. $f(x)$ has an inflection point at $x = -3$
b. $f(x)$ has an inflection point at $x = -2$
c. $f(x)$ has no inflection points
d. $f(x)$ has an inflection point at $x = -1$
e. $f(x)$ has an inflection point at $x = 2$

(v) Let $f(x) = -x(2x - 32)^7 + 1550$. Then

a. $f(x)$ has a local maximum at $x = 32/9$
b. $f(x)$ has a local maximum $x = 2$
c. $f(x)$ has a local minimum at $x = 32/9$
d. $f(x)$ has a critical value when $x = -16$

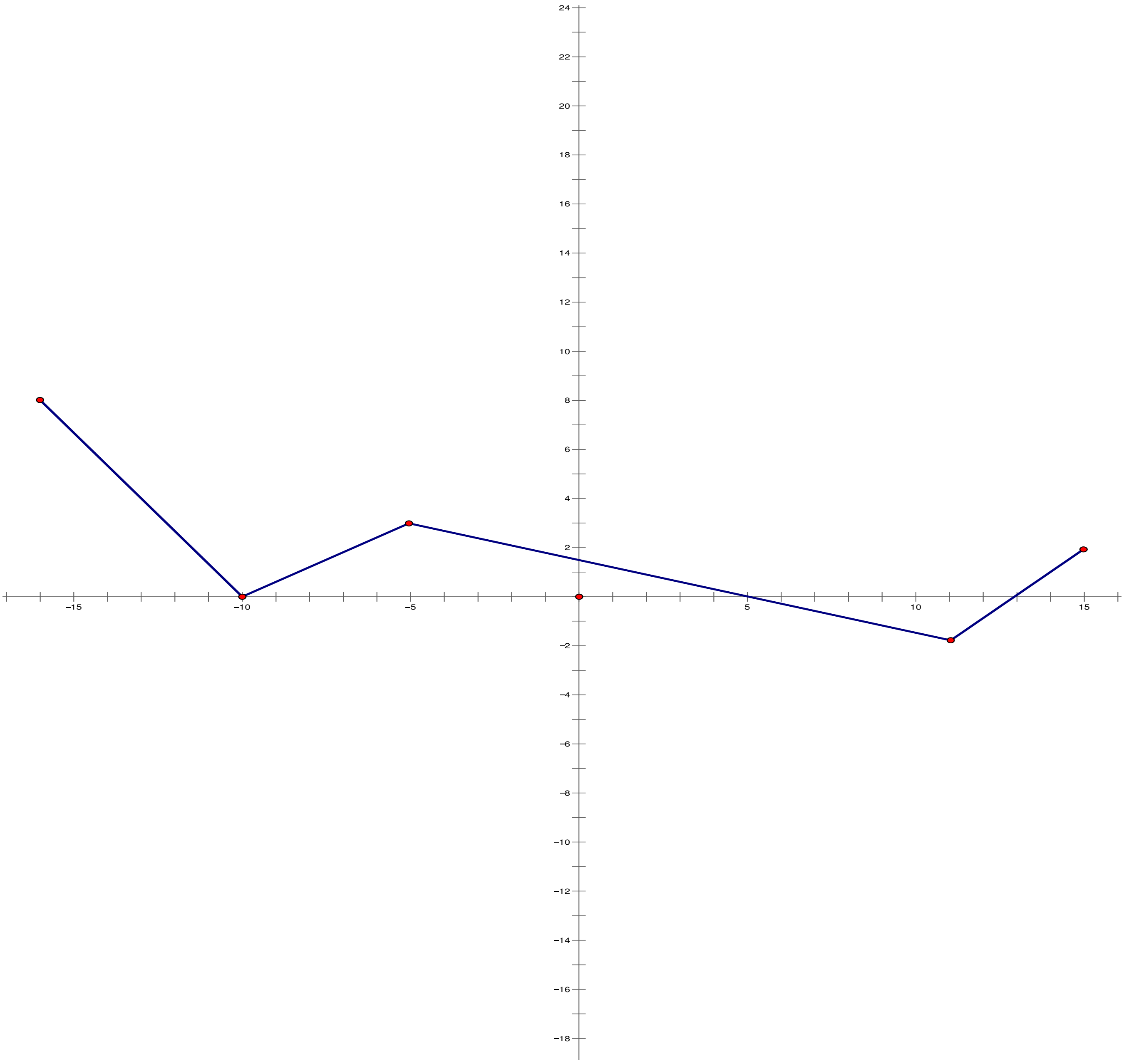
(vi) Given $x^2 + y^2 - xy + xe^y + ye^x - 203421897654 = 0$ Then $dy/dx =$

a. $\frac{2y-x+e^x}{y-2x-e^y}$
b. $\frac{y-2x-e^y}{x-2y-e^x}$
c. $\frac{2x-y+e^y}{2y-x+e^x}$
d. $\frac{y-2x-e^y}{2y-x+e^x}$

(vii) $lim_{x\to 3}\ \frac{x^2-10}{(x-2)^2} =$

a. -1
b. $-\infty$
c. ∞
d. DNE (does not exist)

(viii) Given the curve of $f'(x)$ on the interval [-16, 15] (i.e., $-16 \le x \le 15$). Then



a. $f(x)$ is decreasing on the the intervals $(-16,-10) \cup (-5, 11)$

b. $f(x)$ is decreasing on the interval $(5, 13)$

c. $f(x)$ is increasing on the intervals $(-10,-5) \cup (11, 15)$

d. $f(x)$ is increasing on the interval $(-16, 13)$

(ix) Using the curve of $f'(x)$ above. Then

a. $f(x)$ has a critical value at $x = -10$ but $f(x)$ has neither min. value nor max. value at $x = -10$.

b. $f(x)$ has a local max. value at $x = -5$ and a local min. value at $x = 11$ and $x = -10$.

c. $f(x)$ has a local min. value at $x = 5$

d. $f(x)$ has a local max. value at $x = 11$.

(x) Using the curve of $f'(x)$ above. Then

a. the curve of $f(x)$ must be concave down on the intervals $(-16,-10) \cup (-5, 11)$.

b. the curve of $f(x)$ must be concave up on only the interval $(-16,-5)$

c. the curve of $f(x)$ must be concave up on the intervals $(-16,-5) \cup (5, 15)$

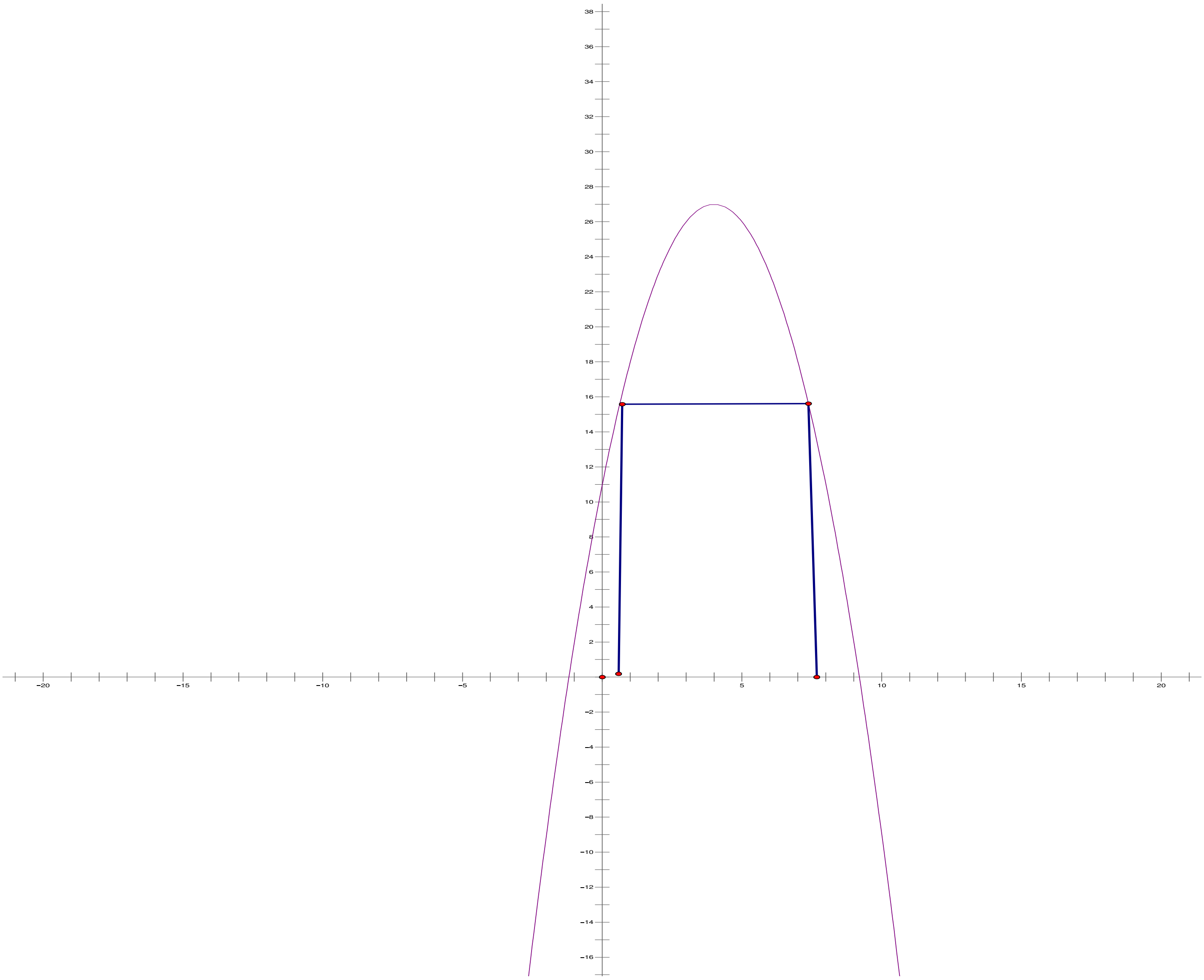
d. the curve of $f(x)$ must be concave down on the interval $(-10, 11)$

e. the curve of $f(x)$ must be concave down only on the interval $(-10, 5)$

(xi) Given x, y are two positive REAL numbers such that $xy = 3$ and $x + 12y$ is minimum. Then $x + 12y =$

a. 37
b. 15
c. 12
d. 6.5
e. 13

(xii) What is the area of the largest rectangle that can be drawn as in the figure below (note $f(x) = -x^2 + 8x + 11 = 27 - (x-4)^2$)?



a. 54
b. 144
c. 126
d. 216
e. 108

(xiii) the distance between the point $Q = (1, 1, 6)$ and the plane: $3x - 4z - 9 = 0$ is

a. 6
b. 2
c. 0.2
d. 1.2

(xiv) Given the points $A = (3, 4)$ and $B = (8, 10)$. What is the point c on the horizontal line $y = 2$ so that $|AC| + |CB|$ is minimum?

a. $(5\frac{1}{7}, 2)$
b. (4, 2)
c. $(5\frac{6}{7}, 2)$
d. (3, 2)
e. (8, 2)
f. (5.5, 2)

(xv) Given $f(x) = ln[\frac{(4x-7)^5}{3x-5}]$. Then $f'(2)$

a. 17
b. $\frac{20}{3}$
c. $\frac{4}{3}$
d. 4
e. 5
f. 2

(xvi) $lim_{x\to 2} \ \frac{e^{(4x-8)}+x^2-5}{x^3+x^2-12} =$

a. 0.5
b. $\frac{5}{16}$
c. 0.25
d. 0.8
e. 0

(xvii) Let C be an arbitrary point on the ellipse $\frac{(x+1)^2}{4} + y^2 = 9$, and let c_1, c_2 be the foci of the ellipse. Then $|Cc_1| + |Cc_2| =$

a. 4
b. 12
c. 6
d. 2

(xviii) Given the parabola $y = 0.1(x-2)^2 - 2$. Then the directrix is

a. x = 4.5
b. y = 4.5
c. y = 2.5
d. y = - 4.5
e. y = - 2.5

(xix) Let P be the parabola as in the above question. Given that the point $Q = (12, 8)$ lies on its curve, and C be its focus. Then $|QC|$ =

a. 7.5
b. 3.5
c. 5.5
d. 12.5
e. 10.5

(xx) The intersection of the plane $x + y = 0$ and the plane $2x - z = 0$ is the following line.

a. $x = -t, y = t, z = -2t$
b. $x = -t, y = -t, z = -2t$
c. $x = t, y = t, z = -2t$
d. $x = t, y = -t, z = -2t$

(xxi) Given the hyperbola $\frac{(x-1)^2}{9} - \frac{y^2}{16} = 1$. Let c_1, c_2 be the foci of the hyperbola, and C be an arbitrary point on the curve. Then $||Cc_1| - |Cc_2||$

a. 6
b. 10
c. 4
d. 8
e. 3
f. 5

(xxii) One of the following is a foci of the above hyperbola.

a. $(1, 5)$
b. $(-1, 5)$
c. $(6, 0)$
d. $(1 + \sqrt{7}, 0)$
e. $(1, \sqrt{7})$

(xxiii) $\int (2x-7)^8 \, dx =$

a. $\frac{(2x-7)^9}{18}$ + c
b. $\frac{(2x-7)^9}{4.5}$ + c
c. $\frac{(2x-7)^9}{9}$ + c
d. $\frac{(2x-7)^9}{2}$ + c

(xxiv) $\int \; xe^{(x^2+4)} + 4x - 1 \; dx =$

a. $0.5e^{(x^2+4)} + 2x^2 - x + c$
b. $2e^{(x^2+4)} + x^2 - x + c$
c. $e^{(x^2+4)} + 2x^2 - x + c$
d. $2e^{(x^2+4)} + 2x^2 - x + c$

(xxv) Given $f'(x) = 4e^{(2x-6)} + 4x + 1$ and $f(3) = 27$. Then $f(x) =$

a. $4e^{(2x-6)} + 2x^2 + x + 2$
b. $2e^{(2x-6)} + 2x^2 + x + 4$
c. $e^{(2x-6)} + 2x^2 + x + 5$
d. $0.5e^{(2x-6)} + 2x^2 + x + 5.5$

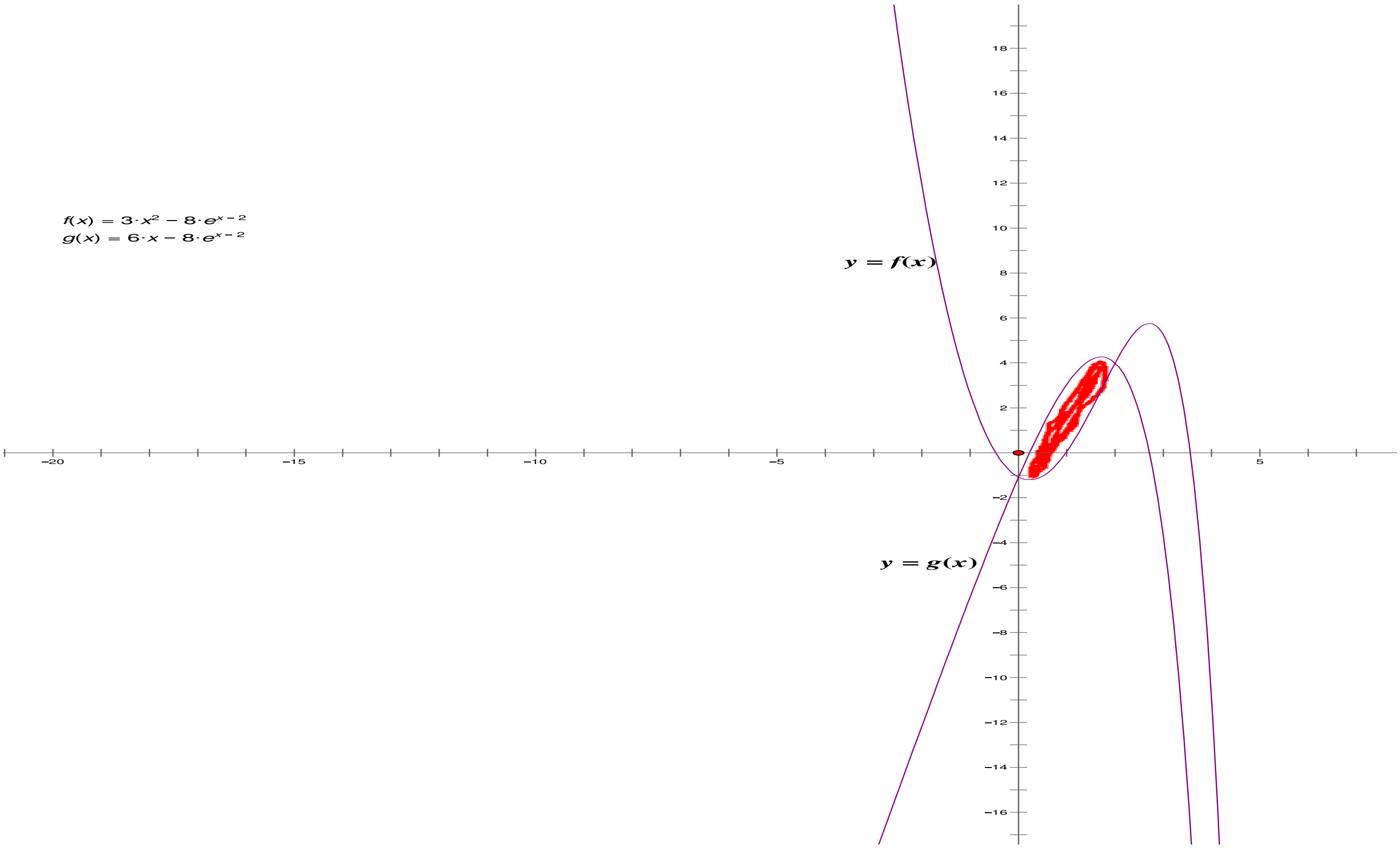
(xxvi) one of the following vectors can be drawn inside the plane : $3x - 2y + z = 4$

a. $2i + 3j + k$
b. $3i - 2j + k$
c. $3i - 2j - k$
d. $3i - 2j - 13k$

(xxvii) Given the points $(0, 1, 1), (0,\ 2.5\, 3), (2, 1, 1)$ are vertices of a triangle. The area of the triangle is :

a. 25
b. 12.5
c. 5
d. 2.5

(xxviii) Find the area of the region bounded by $f(x) = 3x^2 - 8e^{(x-2)}$ and $g(x) = 6x - 8e^{(x-2)}$ (see the region below and notice that the region is between $0 \le x \le 2$)



a. 20
b. 4
c. 36
d. 16

(xxix) One of the following lines lies entirely inside the plane: $x + 2y + 3z - 6 = 0$

a. $x = 1 - 2t, y = 1 + 4t, z = 1 - 2t$
b. $x = 1 + 3t, y = 1 + 2t, z = 1$
c. $x = 1 + t, y = 1 + 2t, z = 1 + 3t$
d. $x = t, y = t, z = 3 - t$

(xxx) $L_1 : x = t, y = 2t, z = 1 + t$, $L_2 : x = 1 + 2s, y = 2 - s, z = 3 + 2s$. Then

a. L_1 intersects L_2 at $(1, 2, 3)$
b. L_1 intersects L_2 at $(1, 1, 2)$
c. L_1 intersects L_2 at $(1, 2, 2)$
d. L_1 does not intersect L_2

(xxxi) Given $(0, 1, 1), (0, 2, 3), (2, 1, 1)$ lie in a plane P. Then an equation of P is

a. $-4(y - 1) - 2(z - 1) = 0$
b. $2x + 4(y - 1) - 2(z - 1) = 0$
c. $4(y - 1) - 2(z - 1) = 0$
d. $4(y - 1) + 2(z - 1) = 0$
e. $-2x - 4(y - 1) - 2(z - 1) = 0$

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