

- ☐ $\text{Range}(f) = (9, \infty)$
☐ $P(0, 1)$ is the y-intercept.
- ☒ $y = -9$ is the horizontal asymptote of f .
- ☐ $\text{Domain}(f) = \mathbb{R}^+$
4. Let $f: \mathbb{R} \rightarrow \mathbb{R}$, where $f(x) = \sqrt{x^2 - 1}$. Then which one of the following is true about f .
- ☐ f is a one-to-one function.
- ☐ $\text{Range}(f) = \mathbb{R}$.
- ☒ f is an even function.
- ☐ f is an onto function.
5. Given the equation of the parabola in a general form $y^2 + 2x - 4y + 4 = 0$. The directrix of the parabola is
- ☐ $2y = 1$
☒ $2x = 1$
- ☐ $y = -2$
☐ $x = 1$
6. Which one of the following is true about the conic section represented by the equation: $9x^2 + 4y^2 - 54x + 40y + 145 = 0$.
- ☒ The center is $C(3, -5)$.
- ☐ $F(2, 1)$ is a focus point.
- ☐ Eccentricity, $e = 2/5$.
- ☐ One of the vertices is $V(0, 4)$.
7. Let $f(x) = x^3 + 4x^2 - 14x - 6$. Then which one of the following is **not** true.
- ☒ $x = -1$ is a root of multiplicity of 2.
- ☐ $x = -3$ is a root of multiplicity of 1.
- ☐ $x = 2$ is a root of multiplicity of 1.
- ☐ $x = -1$ is a root of multiplicity of 3.

[16 Points]

2. Short-Answer Type

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Instruction. Write the most simplified form of the answer on the space provided.

1. Given $f(x) = x + 3$, and $(g \circ f)(x) = x^2 + 6x$. Then find $g(x) = x^2 - 9$ (2 pts)
2. Given the expression $\log x = \log \frac{6}{x-1}$. The value of x satisfying the expression is $x = 3$ (2 pts).
3. Given $f(x) = -5 \sin(2x + \pi) + 5$, then the period, T , and amplitude, A , respectively are $T = \pi$ (2 pts), and $A = 5$ (2 pts).
4. Given a line segment ℓ with end points $P(1, 2)$ and $Q(4, 7)$. Find the points R and S that sect (divide the line segment into three equal parts).
 $R(2, 4)$ (1 pt), and $S(3, 14/3)$ (1 pt).
5. The simplified form of the expression $\cosh(\ln 2x)$ is $4x^2 + 1/4x$ (2 pts).
6. Given that $\tan \theta = -4/5$ and $\sin \theta < 0$. Then $\cos \theta = 5/14$ (2 pts).
7. The inverse of the rational function $f(x) = \frac{3}{2x+1}$ is $f^{-1}(x) = \frac{3-x}{2x}$ (2 pts).

 $x + -x$ 

3. Work-Out Questions

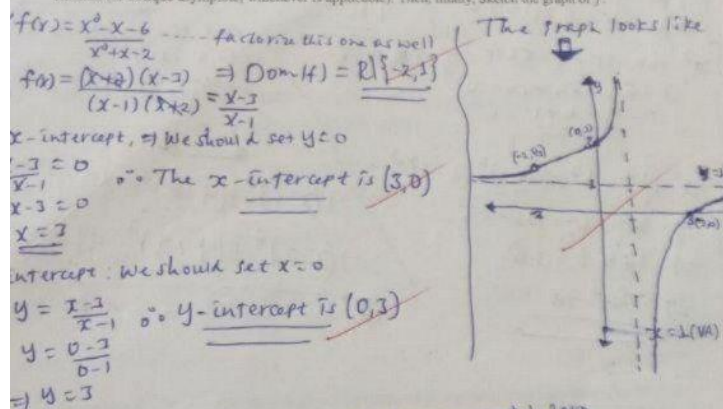
(30 Points)

20 / 20

Instruction: Show all the necessary steps clearly and neatly.

(a) Consider the rational function $f(x) = \frac{x^2 - x - 6}{x^2 + x - 2}$.

5 / 8

Calculate the domain, the x-intercept(s), the y-intercept(s), the vertical asymptote, and the horizontal (or oblique) asymptote, whichever is applicable. Then, finally, Sketch the graph of f .



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Final Exam, Sem 1, Form B
Mathematics for Natural Sciences (Math101)
(Duration: 120 minutes)

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For the instructor use only:

1	2	3	4	5	6	7	8	9	10	Total
14	6	18								53

1. Multiple-Choice Type

[14 Points]

Instruction: Each of the following question is followed by FOUR possible answers. Mark the box corresponding to the best possible answer. Each question carries 4 points.

1. Let ℓ be the line segment whose end points are $P(-1, 2)$ and $Q(5, 8)$. Find the equation of the perpendicular bisector of the line segment ℓ .

- ☐ $2x - y + 2$
☒ $y = -x + 7$
☐ $x = 4$
☐ $3/5$
☒ $5/3$

2. Let $\tanh x = 4/5$, then which one of the following can be the value $\cosh x$.

- ☐ $4/5$
☐ $5/4$
☒ $5/3$

3. Given the function $f(x) = 2^{x+1} - 9$, which one of the following is true about f .



(b) Given the three non-collinear points in the xy -plane $P(5, -3)$, $Q(2, 0)$, and $R(2, -6)$ 6/6

Then, find the standard form of the equation of the circle, its center, and radius.

Let the center of the circle is $C(a, b)$ then the distance in the center and the given points yields r .

$$\begin{cases} (a-5)^2 + (b+3)^2 = r^2 \\ (a-2)^2 + b^2 = r^2 \\ (a-2)^2 + (b+6)^2 = r^2 \end{cases} \Rightarrow \begin{cases} -a + b + 5 = 0 \\ -a - 3 + 5 = 0 \\ \Rightarrow a = 2 \end{cases}$$

Therefore $C(a, b) = (2, -3)$

and the distance b/w $C(2, -3)$ to $(2, 0)$ is r

$$\Rightarrow r = \sqrt{(2-2)^2 + (-3-0)^2} = 3$$

Standard equation

$$\Rightarrow (x-2)^2 + (y+3)^2 = 9$$

The required equation



Find the equation of the hyperbola with its center $C(2, -3)$, eccentricity, $e = \sqrt{13}/3$, and one of the vertices $V(5, -3)$ 6/6

$\frac{13}{9} \Rightarrow$ and we know that

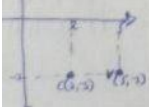
$$\begin{cases} c^2 = a^2 + b^2 \\ b^2 = c^2 - a^2 \\ b^2 = (\frac{\sqrt{13}}{3})^2 - 3^2 \\ \Rightarrow b^2 = 4 \\ \Rightarrow b = 2 \end{cases}$$

or the distance b/w the center and the vertex of the major axis is " a ".

$$\Rightarrow C(2, -3) \text{ \& \& } V(5, -3)$$

$$\Rightarrow a = \sqrt{(2-5)^2 + (-3+3)^2} = 3$$

$$\Rightarrow a = 3$$



$\Rightarrow$ Since the vertices is to the right of the center then the hyperbola is horizontal hyperbola

$$\Rightarrow \frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

Standard form of horizontal hyper

$$\Rightarrow \frac{(x-2)^2}{9} - \frac{(y+3)^2}{4} = 1$$

The required equation