Show all work clearly and in order, and circle your final answers. Justify your answers alge-
braically whenever possible; when you do use your calculator, sketch all relevant graphs and
write down all relevant mathematics. You have 15 minutes to take this 15 point quiz.

1. (*5 points*) Express the given statements as logical statements using symbols p, q and r.
Define p, q and r as needed.
(a-i) 2 is even but 2 is also prime. (0.5 points)
(a-ii) 9 is neither even nor prime. (1 points)
(a-iii) For 8 to be odd but not prime it is sufficient that 8 be multiple of 4. (1.5 points)

(b) Write the negation of the following statement in English, (2 points)

$$\text{If } |x - 2| > 2 \text{ then either } x < -2 \text{ or } x > 2 .$$

Please use backside of this page for writing and number your answers correctly.

2. (*5 points*) (a) Prove (write every step) or disprove (give counter example) the following,
(a-i) $(p \wedge q) \rightarrow p$ (only use logical equivalences) (0.5 points)
(a-ii) $\neg(p \rightarrow q) \leftrightarrow (p \wedge \neg q)$ (1 points)
(a-iii) $(\neg p \leftrightarrow q) \leftrightarrow (p \leftrightarrow \neg q)$ (only use logical equivalences). (1.5 point)
(b) For the domain over all students in this class. Let,
$D(x)$: x is a dancer
$W(x)$: x is willing to waltz
Write the following sentence in predicate logic form using above symbols. (2 points)

$$\text{No dancers decline to waltz.}$$

3. (*5 points*) Are the following statements TRUE or FALSE. (0.5+0.5+2+2)

1. For $x \in \mathbf{N}$, $\exists x \ x + x = 1$. _____

2. For $x \in \mathbf{Q}$, $\exists x \ x + x = 1$. _____

3. $\exists y \forall x P(x, y) \rightarrow \forall x \exists y P(x, y)$. _____

4. $\forall x \exists y P(x, y) \rightarrow \exists y \forall x P(x, y)$. _____