Quiz 3

Your **name** (neatly):

Notation: TM = Turing machine. [Turing] acceptable = [Turing] recognizable = recursively enumerable = r.e. [Turing] decidable = recursive. L is co-r.e. iff $\overline{L}$ is r.e.

1. We defined a **Turing Machine** (TM) as a seven-tuple $M = (Q, \Sigma, \Gamma, \delta, q_0, q_A, q_R)$ where, among other requirements, δ was a function with domain [ ] and range [ ]. We defined the **configuration** of M as an element of $\Gamma^* \times Q \times \Gamma^*$, writing $\alpha q \beta$ for (α, q, β). We let $\vdash$ be the moves-in-one-step relation on configurations, defined, e.g., by asserting that $\alpha aqb\beta \vdash$ [ ] if $\delta(q, b) = (r, c, L)$. We let $\overset{*}{\vdash}$ be the reflexive-transitive closure of $\vdash$ and said that machine M **accepts** a string w if $q_0 w \overset{*}{\vdash}$ [ ] *(follow conventions of class and your book).*

2. Darken (fill in) the **correct** answer. No justification is required.

   (a) **True** **False** If a TM M decides a language L then M halts on every input x.

   (b) **True** **False** A TM must **accept** or **reject** every string; otherwise, it is **invalid**.

   (c) **True** **False** A language L that is **not** r.e. is co-r.e.

   (d) **True** **False** The language $A_{\text{TM}} = \{\langle M, w\rangle : M \text{ accepts } w\}$ is r.e.

   (e) **True** **False** Every context-free language is Turing-decidable.

   (f) **True** **False** The Church-Turing Thesis was proven by Alonzo Church and Alan Turing.

   (g) **True** **False** A TM M can be provided its own description, $\langle M\rangle$, as its input.

   (h) **True** **False** The language $\{\langle M\rangle : L(M) \text{ is finite}\}$ is r.e.

   (i) **True** **False** There is a language L that can be recognized by a 2-tape TM but that cannot be recognized by any 1-tape TM.

   (j) **True** **False** If $A \leq_{\text{m}} B$ and A is r.e. then B is r.e.

   (k) **True** **False** To show L undecidable, it is enough to show that $A_{\text{TM}} \leq_{\text{m}} L$.

   (l) **True** **False** To show L undecidable, it is enough to show that $L \leq_{\text{m}} A_{\text{TM}}$.

3. Give a clear and self-contained **proof** for the following:

   If L is recognizable and $\overline{L}$ is recognizable then L is decidable.