For each of the following two questions, select *all* correct answers. There is at least one correct answer, and possibly more than one. A fully correct answer gives **one point**, if there is one mistake, it gives $\frac{1}{2}$ *point*, and if there are two mistakes or more, it gives *zero point.*

(1) Which statements are correct?

(a) The map $f\colon \mathbf{R}^\times \to]0,+\infty[$ given by $f(x) = x^2$ is a trivializable covering space.

(b) The map $f\colon \mathbf{R} \to [0,+\infty[$ given by $f(x) = x^2$ is a universal covering space.

(c) The map $f\colon \mathbf{R}^2 \to \mathbf{S}_1 \times \mathbf{S}_1$ given by $f(s,t) = (e^{2i\pi t}, e^{2i\pi s})$ is a universal covering space.

(d) The map $f\colon \mathbf{C}^\times \to \mathbf{C}^\times$ given by $f(z) = 1/z^3$ is a trivializable covering space.

(2) Which of the following are correct?

(a) The space

$$\{z \in \mathbf{C} \mid 1 < |z| < 2\} \subset \mathbf{C}$$

is simply connected.

(b) The space

$$\{(x_1,\ldots,x_n) \in \mathbf{R}^n \mid x_n > 0\} \subset \mathbf{R}^n,$$

where $n \geq 1$ is an integer, is simply-connected.

(c) The quotient space $\mathbf{S}_2/G$, where

$$\mathbf{S}_2 = \{(x,y,z) \in \mathbf{R}^3 \mid x^2 + y^2 + z^2 = 1\}$$

and the group $G = \{-1,1\}$ acts by $\varepsilon \cdot (x,y,z) = (\varepsilon x, \varepsilon y, \varepsilon z)$, has fundamental group at any point isomorphic to $\mathbf{Z}/2\mathbf{Z}$.

(d) The quotient space $\mathbf{R}^2/\mathbf{Z}$, $\mathbf{Z}$ acts by $n \cdot (x,y) = (x+n, y+2n)$, has fundamental group at any point isomorphic to $\mathbf{Z}^2$.