**For each pair of maps (global, national, local): [6 marks]**
**1. Describe the projections used: Explain the purpose of each projection and what it preserves (e.g., shape, area, distance, direction). Include key characteristics and typical use cases.**

# Global Maps

**Mercator (World):** This projection is a conformal cylindrical projection and was initially created to provide accurate compass bearings (i.e. the clockwise angle measurement between a point and true north on a compass) for sea travel. This map is best used to depict areas near the equator at a large scale. It is also suited for use in sea navigation charts because of the straight rhumb lines. These lines differ from meridians. Meridians are lines of longitude, while rhumbs represent a constant compass direction or bearing, which is useful for sea navigation. They are equatorial in that they preserve the distances along the equator with increasing distortion near the poles. The orientation spans from east/west. This map is commonly used for topographic and navigational purposes. It is also commonly used by national agencies.

**Winkel Tripel (NGS - world):** This projection is intended for use in general world maps. It is a compromise projection, which strives to make things look less distorted and more pleasing at the expense of preserving the accuracy of shapes, areas, distances, directions and angles. This projection averages the coordinates from the equidistant cylindrical and Aitoff projections to achieve its appearance. It shows the entire world and is generally used for thematic and presentation purposes.

# National

**WGS 1984 Web Mercator (auxiliary sphere):** This projection is a variant of the Mercator projection intended for use with web mapping applications. The coordinates defined on the WGS datum are projected with a sphere-based version of the Mercator Projection. The semimajor axis of the WGS 1984 is 6,378,137.0 meters and is equal to the sphere's radius. Compared to the original Mercator, however, it is not conformal, nor does it project the rhumb lines as straight lines. This projection combines geodetic coordinates on an ellipsoid with spherical equations and assumes the earth's surface is a perfect sphere (when it is not). Therefore, it causes the integrity of the scale to be lost in some areas.

**Canada Lambert Conformal Conic:** This projection is used for topographic and presentation purposes by national agencies. It is suitable for extents covering continents/oceans,

regions/seas, and large-scale extents. Directions, angles and shapes are all preserved in this projection. Distortion is minimized and distances are most accurate at midlatitude where the standard parallels are located.

# Local

**Canada Albers Equal Area:** An Albers equal area conic projection preserves the integrity of the area while sacrificing the accuracy of factors such as shape, angles and distance. All meridians converge at the North pole in the case of the Canada Albers Equal area. This is a secant projection with two standard parallels, where the projection surface intersects with the globe at two lines. This projection is useful for depicting land masses in an east-west orientation at mid latitudes. It is commonly used to depict countries and continents such as the United States, Europe, and Australia. This projection is best suited to depict large scale, continent/ocean and region/sea extents.

**NAD 1983 UTM Zone 17N:** This projection is a transverse Mercator projection that is cylindrical (transverse) and conformal in its properties. This means that it preserves angles and shapes at the expense of accurately depicting area and distance. This projection is best suited to map large scale and small areas, north-south extents and is commonly used for topographic purposes. It is also commonly used by national agencies.

**2. Evaluate the appropriateness: Out of the two projections, explain which you believe is most appropriate for the geographic extent and data being represented.**

**Global**: Since the Mercator projection is most suitable for depicting regions near the equator and the sea, I think the Winkel Tripel Projection is most appropriate for the data being represented. According to the ESRI Quick Note, the Winkel Tripel is best suited to depict the entire world, and this is visually evident by the proportional and pleasant depiction of the continents. On the Mercator projection, there is much distortion nearer to the poles as land masses in the top and bottom of the hemispheres are visibly stretched out. For presenting a view of the world in a pleasing and balanced manner, the Winkel Tripel projection would be the best choice.

**National:** The most appropriate map projection for the map of Canada would be the Canada Lambert Conformal Conic Projection. It is the most widely used projection for the map of Canada at small scales and is often used by stats Canada. Compared to the WGS Web Mercator

Projection, distortion is minimized near the poles in the Lambert Projection and much accuracy of the directions, angles and shapes has been preserved.

**Local**: The Canada Albers Equal Area Projection would be the most appropriate projection out of the two for representing CMAs in southern Ontario because this map is concerned with the representation of area. Since this local map is representing the boundaries of the Census Metropolitan Areas, the Albers Equal Area would be the best choice because it preserves area and would accurately represent the relative size differences of the CMAs. Even though NAD 1983 Zone 17N is commonly used in the GTA and Southern Ontario, it would not be the best option for this purpose since it is more accurate in distance and shape compared to the strengths of the Albers Equal Area projection.