2 Innovation

1 Complete the description of a sailboard, using the words in the box.

aerodynamic apparent wind direction drag friction inclined keel lift like polycarbonate propels relies rigid similar

A sailboard (1) *relies* on a flexible nylon and polyester sail, (2) _____ to a sail on a small boat. The flow of wind across the sail (3) _____ the craft forwards. This force, combined with the very low (4) _____, or friction, of high-performance boards, enables the craft to plane across the surface of the water. In high winds, aerodynamic (5) _____ is maximised, while (6) _____ (or drag) is minimised.

A high-performance sailboard is (7) _____ a sailing yacht, in that the wind pushes the sailboard in the (8) _____ of travel. However, in 'displacement sailing' a yacht moves through the water, whereas in aquaplaning, or 'planing', a sailboard skims over the surface at high speeds. In addition, the mast is (9) _____ in the direction of the wind, so the wind lifts the mast and sailboard, thereby reducing drag over the water. This occurs when sailing at high speed at right angles to a strong wind.

A long sailboard is wind-powered, like a sailing boat, but instead of a (10) _____, it has a fixed fin at the rear, and a rigid daggerboard in the centre that can be raised or lowered. The mast is made of light but flexible (11) _____, and the rigid boom is made of aluminium, coated with rubber.

Once a sailboard starts to move, it creates an (12) _____, which can be stronger and faster than the true wind. With the smallest and lightest boards, there is very little surface area in contact with the water and so very little drag. (13) _____ efficiency combined with a (14) _____ board with low drag results in high speeds, with the world speed record currently close to 100 kph.

2 Write sentences about the similarities and differences between these pairs of vehicles, using the characteristics in the table below.

Example: *1 A helicopter doesn't resemble a glider in any way. It uses revolving blades to fly instead of wings. A helicopter is powered, whereas a glider is unpowered.*

1 helicopter / glider
2 submarine / submersible
3 drone / glider
4 space shuttle / helicopter
5 jet ski / hovercraft
6 hovercraft / helicopter

Vehicle	Characteristics	Vehicle	Characteristics
Helicopter	flies at low altitude and can hover; carries passengers and goods; flies by means of revolving blades, not wings	Glider	piloted, unpowered; one- or two-person versions
Space shuttle	piloted; carries out research in space; has wings and lands on a runway	Drone	powered, unmanned small plane, guided by remote control; used for photography and defence purposes
Submarine	manned; propels itself under water; used when submerged for defence purposes	Jet ski	travels over water, propelled by water thrust; can carry one passenger but not goods
Submersible	unmanned device; carries out underwater operations or research tests; can reach extreme ocean depths	Hovercraft	hovers on a cushion of air; travels over land, water and marshy ground; carries passengers, goods and vehicles