
1.1Db Write definitions of the words *safety*, *imagination*, *ingenuity*, *ecology*, and *ergonomics* using a dictionary and compare with the ways in which these words are used in Section 1.2-1.5.

SOLUTION 1.1Db:

Safety --the condition of being protected from or unlikely to cause danger, risk, or injury ... "they should leave for their own safety"

Imagination. -- Imagination, also called the faculty of imagining, is the creative ability to form images, ideas, and sensations in the mind without direct input from the senses, such as seeing or hearing

Ingenuity -- the quality of being clever, original, and inventive

Ecology -- the branch of biology that deals with the relations of organisms to one another and to their physical surroundings

Ergonomics. -- the study of people's efficiency in their working environment

Comment: Also see Section 1.2-1.5 and/or a Webster dictionary at www.merriam-webster.com. The remainder of this problem is left as an exercise for the student to "encourage" them to read the textbook.

1.2Db The Segway two-wheeled-self-balancing electric vehicle invented by Dean Kamen and used for short distance personnel transportation reportedly travels at 12.5 mph. The vehicle is controlled and powered with computers and electric motors. Lean forward, you move forward. Lean back and you go backward. Lean the handlebars to the left or right and you turn in that direction—see www.youtube.com for a video. When you need to brake, the motor acts as a dynamometer. Review several articles written about the Segway and address the following statements that appeared recently and written by Jordan Golson, a technology and automotive reporter based in Durango, Colorado. Email: jlgolson@gmail.com Twitter: @jlgolson. He states that the Segway "has found a measure of success in industrial and fleet applications where employees are on their feet or moving around a lot." But he also states that the Segway "as a personal transporter, the Segway was a near complete failure" and he also says that "for a device that was said to have cost more than \$100 million in research and development, it's impossible to call the Segway anything but a dud." Review several articles written about the Segway, list the articles you reviewed, and discuss (pro and con) the statements written by Jordan Golson.

Background: Wikipedia, the free encyclopedia, in an article dated September 4, 2010, entitled "Segway PT," presents a comprehensive review of the history, sales, technology, uses, operation, and safety of the Segway vehicle. In what follows, we

present segments from the Wikipedia article:

1. History: The product was unveiled December 3, 2001, in Bryant Park on the ABC News morning program *Good Morning America*.
2. Sales: The product was unveiled December 3, 2001, in Bryant Park on the ABC News morning program *Good Morning America*. In a March 2009 interview, company official said the firm "has shipped over 50,000" Segways.
3. Technology: The dynamics of the Segway PT are identical to a classic control problem, the inverted pendulum.

The side effect of this balancing system is that as the Segway PT balances itself the entire unit changes position in the direction it has moved to restore balance. (For example, if the rider leans forward, the entire Segway PT will move forward from its original position, until the rider restores an upright position on the unit.) This is precisely how the Segway PT is controlled - the balancing and movement is essentially one combined system.

The Segway PT features a governor (speed limiting) mechanism. When the Segway PT approaches the maximum speed allowed by the software, it intentionally begins to tilt slightly backwards. This moves the platform out in front, and leans the handlebars backwards towards the rider, eventually nudging the rider to lean back slightly and slow the Segway PT down. If not for the governor, riders would be able to lean farther than the motor could ever compensate for. The Segway PT also slows or stops immediately if the handlebar of the unit (or forward bag) nudges into any obstacle.

4. Uses: Segways perform best in areas with adequate sidewalks, curb cuts at intersections, and ramps. They are used in cities for tours and in theme parks by visitors and employees. The special police forces trained to protect the public during the 2008 Summer Olympics used the Segway for mobility.

5. Operation: The original Segway models were activated using one of three keys: *Black Key*: for beginners. Slowest speed (electronically limited to no more than 6 mph); slower turning rate.

Yellow Key: for intermediate users and/or pavements. Faster speed-up to 8 mph (13 km/h); faster turning rate.

Red Key: for more advanced users in open areas. Maximum speed-up to 10 mph (16 km/h) on p-Series and 12.5 mph (20.1 km/h) on i-Series; and max turning rate.

In September 2003, the Segway PT was recalled because if users ignored repeated low battery warnings on the PTs, it could ultimately lead them to fall. With a software patch to version 12.0, the PT would automatically slow down and stop in response to detecting low battery power. Any units sold before September 2003 with a label 12.0 have the upgraded software.

In August 2006, Segway discontinued all previous models and announced second-generation designs. The Gen II PT, marketed under the two product lines, i2 and x2, allows users to steer by leaning the handlebars to the right or left, which matches the intuitive nature of leaning forward and backward to accelerate and decelerate.

6. Safety: Because the Segway can reach speeds over 20 km/h (12 mph), the Bicycle Helmet Safety Institute recommends that all riders wear helmets when using Segways. The US Consumer Product Safety Commission does not have Segway-specific recommendations but does say that bicycle helmets are adequate for "low-speed, motor-assisted" scooters.

SOLUTION 1.2Db: The student is asked to address the following statements:

(a) the Segway “has found a measure of success in industrial and fleet applications where employees are on their feet or moving around a lot.”

(b) “as a personal transporter, the Segway was a near complete failure”

(c) “for a device that was said to have cost more than \$100 million in research and development, it’s impossible to call the Segway anything but a dud.”

This exercise is left for the student.

Comment 1: The title of Jordan Golson’s article is: *“Well, That Didn’t Work: The Segway is a Technological Marvel. Too Bad it Doesn’t Make Any Sense.”* For the article, please search www.wired.com under heading “GEAR” for JORDAN GOLSON, Segway, 01.16.15.

Comment 2: The Segway invented by Dean Kaman, a brilliant engineer, is indeed a technological marvel. For additional information about Dean Kaman and his many accomplishments, please see Wikipedia.

1.3Db A hands-free self-balancing two-wheeled board or scooter also sometimes referred to as a hover board is described in Wikipedia as a portable, rechargeable battery powered scooter having a wheel on each side of a platform on which a rider stands. Review several videos at www.youtube.com and address the question as to whether the hands-free board is a “reasonable safe design” using the following categories:

- (a) The usefulness and desirability of the product
- (b) The availability of other and safer products to meet the same or similar needs
- (c) The likelihood of injury and its probable seriousness
- (d) The obviousness of the danger
- (e) Common knowledge and normal public expectation of the danger (particularly for newer versus established products)
- (f) The avoidability of injury by care in use of the product (including the effect of instructions and warnings)
- (g) The ability to eliminate the danger without seriously impairing the usefulness of the product or making it unduly expensive.

SOLUTION 1.3Db: We are asked to address the question as to whether the hands-free self-balancing two-wheeled board or scooter also sometimes referred to as a hover board is a “reasonable safe design”

Background: Additional information can be obtain from various web sites such as:

<http://hands-free-skooter.com>

See section: 8: Frequently Asked Questions and Answers

<https://www.cnet.com/news/why-are-hoverboards-exploding-and-catching-fire/>
www.cnet.com, search gadgets for the articles titled “hoverboard”. One of several articles found was titled: “Here are the reasons why so many hoverboards are catching fire”

An analysis would involve an objective review of items (a) to (g) as listed in problem 1.3Db and repeated below:

(a) The usefulness and desirability of the product

Product helps promote ... for users. Allows users to ... Product is desirable, as...

(b) The availability of other and safer products to meet the same needs

There are currently personal transporters with more... No other skooter has a safer ... design incorporating tamper resistant screws, guard interlocks, motor guard warnings and/or owners manual holders.

(c) The likelihood of injury and its probable seriousness

The likelihood of injury from riding ... The seriousness of the injury is very high with great probability of serious but not life threatening injury ...

(d) The obviousness of the danger

The danger of a ... and the ... is open and obvious. Everyone knows that ... and ... can cause harm

(e) Common knowledge and normal public expectation of the danger
(Particularly for established products)

People see hoverboards as ... I believe the public knows that you can fall from a ... and then be injured from the ... The public may also be aware of ... My thought is that the public would see ... as slightly more dangerous than ... the major cause of injury. I do not believe the public is aware of the danger of the ...

(f) The avoid ability of injury by care in use of the product
(Including the effect of instructions or warnings)