In what sense is The Wave a wave in the physics sense? In what sense does it not qualify as a wave? (Yes, it has both aspects, so please address them both!)

Acts like a wave but doesn't propagate anything

In a physics sense, **The Wave is representative of a wave because it consists of many small parts of the medium oscillating in perpendicular motion to the general trend of the wave**, kind of like an ocean wave. However, it is not actually like a wave because **it doesn't actually transfer energy between each person.**

Physical motion occurs locally

The wave qualifies as a wave in the physics sense because it consists of a **large group of particles (in this case people) moving individually.** When one person moves, this **causes** the person directly next to them to move. This process continues around the stadium. Although each particle is moving up and down, the wave itself appears to be moving in a circle (or whatever shape the stadium is). This is an example of a transverse wave because the particle is moving perpendicular to the direction of the wave. However, **it isn't the transferring of energy of the 1st person moving that causes the 2nd person to move**, like in the physics sense of a wave. The people simply know to stand up when it is their turn.

Energy apparently moves with the wave but that's an illusion

"The Wave" is a wave in that **it transfers energy from one place in a medium to another without actually moving the medium.** In this case, the medium is the crowd. No individual in the crowd is displaced from their position prior to the wave. The wave itself is when a person stands up and sits down. This wave moves through the crowd rather clearly. **Each person in the wave starts to stand presumably because somebody adjacent has, and similarly, their neighbor stands in response to them.** This wave would be considered transverse, as the people move up and down, perpendicularly to the horizontal motion of the wave itself.

This wave is clearly, however, not a true wave. For one, the people in the wave are in no way physically moved by the people next to them. No physical interaction obligates that they stand and sit according to their neighbors. Additionally, **the speed of "The Wave" is variable. It is wholly dependent on how quickly the members of the audience decide to react to the people adjacent to them. In reality, the speed at which a wave travels through a medium is fixed and constant depending on the properties of the medium.** The individual parts of the medium cannot "decide" to react slower or quicker. Additionally, the wave can only transfer energy through adjacent parts of a medium. Meanwhile, in the wave, **not everybody must participate in order for the wave to propagate. Several members of the crowd can simply opt to stay seated, and the wave can still move from one side of them to the other.** Moreover, due to the variations of human height, the wave also has a non-constant amplitude.

For The Wave just discussed, estimate the typical speed at which it propagates in m/s, explaining your logic.

Simple kinematics is sufficient

According to the video it took **roughly 54 seconds** for the wave to come back around to its starting point. The **track is half a mile** which is about 850 yards which is roughly 850 meters. To find the speed of 'The Wave" we can simply put the distance over time to find the wave speed in m/s. As a result, **850m/54s = about 17m/s.**

Similar calculation with more details

The Wave took about a minute to make three complete circles. The nascar track seems to have straight-aways and curves proportionally equal to that of a running track, meaning that each segment is equal to the other three. **One straight-away in the stands is divided into thirteen sections. Each of them can be estimated as being five meters wide.**

(5m)*13*4 is about 5m*60 or 300 m

60 s / 3 turns = 20 s per turn

300m/20s = 15 m/s

This seems reasonable as the wave appears to travel through a segment of bleachers per second.

Resist the temptation to squeeze a situation into a particular formula!

The speed of the wave in a tight rope making transverse waves can be similarly compared to the idea of The Wave, so we can use the same formulas to describe them. **The "tension" of the crowd is related to the equilibrium force that restores the individual parts back to equilibrium. In this case, we can determine that to be the force of gravity on each person. If the typical person is about 100 kg, then the restoring force for each person is roughly 1000** N. From there, **We can determine the "density" of the crowd to be about one person per cubic meter**, so about 100 kg/m^3. To find the velocity of the wave, **we can divide the "tension" by the "density" to get a value of 10 m/s, which square rooted is about 3 m/s.**

Which of the following is not a classification of waves mentioned in the notes?

a. Longitudinal
b. Latitudinal
c. Transverse
d. Torsional
e. all of the above were mentioned