



Superman: The Movie

1. At the beginning to the Movie, they show a copy of a comic book. It is June 1938, in the decade of the Depression. What do they refer as one of our country's great metropolitan newspaper?
2. In the second scene, we see a giant red sun far away, that is orbited by an eerie blue planet. What is the name of the Planet?
3. On the surface of the planet stands a futuristic dome in which there are people being tried for treason. How many people are on trial?
4. During the trial, the faces of the jury panel are magnified inside the dome as they pass down their ruling of guilty. Then, suddenly, the dome opens and a beam of light from above captures the criminals and imprisons them. Describe the prison as it is shot space bound.
5. The prosecutor of the criminals at the beginning of the movie, knows that their planet is about to explode and tries to convince the ruling council to evacuate the planet. What was their reaction? What is the name of the prosecutor?
6. After the council meeting, the prosecutor goes home and starts a plan to send his son, an infant, to outer space. Where does he and his wife decide to send their son? What was the name of their son?
7. The father explains to his wife that the outward appearances of the boy would virtually indistinguishable from the humans on earth. Yet because their environment was different from Earth in some important respects, the similarities would be largely on the visible, physical scale. Otherwise, the father explains to his wife that the boy will have incredible powers due to the, "dense molecular structure" possessed by the inhabitants of Krypton. While this alien chemistry/physics affords no obvious advantage on Krypton, on Earth it is a completely different matter. Mass on Krypton and mass on Earth must have entirely different properties. Especially, if the Kryptonians and Earthlings look identical. Everything seems to be proportionately more massive on Krypton. However, if so, why does Superman only weigh 225 pounds as he claims later in the movie while he is being interviewed by Lois Lane. What would be his mass?

8. As the star-shape rocket leaves the planet, what happens to the planet? What kind of force would cause this kind of an effect? Do you think the force is from the inside of the planet or from the outside of the planet? Does it appear that the Red Sun is affected in the seen?
9. As the star-shape rocket travels through space, we hear the father's voice instructing his son about the contents of the spaceship. There are crystals containing the total accumulation of all literature and scientific facts known about 28 galaxies. The infant is told that his senses of sight and hearing will be exceptional and that he will have limitless speed. He is expressly forbidden to do something. What was that something?
10. The infant's capsule lands in a field as a middle-aged farmer and his wife drive along the road nearby. They pull the child and his space spacecraft out of the crater. How old does the child appear?
11. The woman wants to keep the child, and her kind sickly husband agrees when the boy lifts up their car. Why did the child lift the car?
12. As a teenager, the boy (now known by his Earth name, Clark Kent) demonstrates that he can kick a football out of a stadium and outrun something. What was that something that his stepfather reprimands him for showing off?
13. After his stepfather dies, Kent leaves home and walks to the North Pole. There, he throws a clear crystal into the snow. What happens to the crystal in the snow?
14. In the Fortress of Solitude, a holographic image of Kent's real father, educates him on a journey through time and space. His father explains that the red sun at the beginning is the source of the young man's strength. If Superman, as a Kryptonian, is the result of evolution under a dimmer, weaker red sun, wouldn't his skin be even less resistant to radiation than ours? Explain.
 - a. Earlier, his father mentioned that Superman would be invulnerable in Earth's environment. Superman's invulnerability to bullets, fire, explosions, and pretty much every other sort of Earthly misfortune is an enviable advantage in his never-ending fight against evil, and one that we relatively puny humans would love to possess ourselves. But is it possible? Could a humanoid being---even a uniquely enhanced one such as Superman---literally be indestructible? If such a being existed

on Earth, how would he be put together? Would his cells be different from ours, or would he possess some kind of impenetrable “force field”?

- b. Suppose we took a being that was conceived on another planet and brought it to Earth before it was actually born. It would be a product of millions of years of evolution in a different environment, a place much different from Earth, with all of the strengths, weaknesses, abilities, vulnerabilities, and traits acquired by its ancestors over those millions of years. Yet it would be born on the world where all those qualities were slowly, laboriously selected and weeded out from others and honed through natural selection, but in wholly new place in which the factors and chances that shaped living creatures were different. How would our newborn guest fare? (Think about it’s susceptibility to Earthly bacteria)
- c. All living creatures use and convert energy of some form in order to live, and most do so in a variety of ways. Human beings and all other mammals consume bulk matter—food—and extract energy from it through chemical conversion processes, (heterotroph). However, another form of life uses radiation to literally create its own food: green plants, through the process of photosynthesis. On Earth, only plants and certain species of bacteria are autotrophs---organisms capable of creating their own food from inorganic material. If Superman’s strength comes from Krypton’s red sun, would that make him autotrophic or heterotrophic?
- d. Kryptonians under higher gravity would need not only stronger and denser bones and muscles to get along, but also the strength to move those heavier parts under a greater gravity load. Storing the required energy could be done by eating huge amounts of food almost continuously, as do many species of earthly birds and other animals. Perhaps Kryptonian hemoglobin would be capable of functioning much as Earthly chlorophyll in photosynthesis. Would this be an advantage on earth? How? (If an autotrophic animal on a planet that has adapted to a weaker radiant red sun, and suddenly come to a stronger radiant yellow sun, would this give them a boost of energy to enable them to act in a super strength way?)
- e. If Superman’s skin has the ability to receive and absorb sunlight just like the leaves of plants, his skin would need to be near-transparent to those wavelengths of solar radiation his body used for energy. However, would it need to repel other types of radiation? What type?

15. After completing his education, Clark Kent emerges from the fortress with his superhero identity, that of Superman. He flies off.
- a. The only way for Superman to get off the ground, and the only way for him to maintain any kind of flight, would be for him to create a situation like a bird or an airplane where a force of forces are acting on him counter to gravity (and air resistance). How do birds lift into the air? (Use Newton's 3rd Law: for every action there is an equal and opposite reaction) [Note: They flap their wings]

How do airplanes get off the ground? (Use Bernoulli's conceptual law and air foil)
[Note: the propeller causes a forward thrust and the wings provide a lift that overcomes gravity]

- b. Let's hypothesize that the forces acting on Superman are similar to those that act on birds and airplanes. Birds and airplanes push on air, and the air pushes back. If Superman is doing something similar, he must be exerting a force on the air in contact with him. How might he do this? (Note: He doesn't have wings, propellers, or jet engines, and he is not shaped like an air foil either).
- c. Suppose, Superman emits thin streams of high-velocity air (through pores in his skin, or other unknown orifices). Suppose he is able to control, adjust, and vary which part(s) of his body expel air in order to control, adjust, and vary his flight direction and speed. Suppose he can replenish the air that he expels by breathing (perhaps that is the real purpose for his lungs, rather than respiration). How would this theory be similar to a rocket or missile? How? To keep him flying, what direction does the orifices need to expel wind?
- d. While the air-rocket theory is a pretty good one, and is able to explain Superman's motion very well, unfortunately, there are some peripheral problems associated

with it. If Superman is emitting high-velocity streams of air, should he be creating a lot of wind around him? Do we see this?

16. Clark Kent then takes a job at “The Daily Planet” where he befriends reporter Lois Lane. Kent acts like a klutz until the day he secretly saves Lane’s life by catching a purse-snatcher’s bullet with his bare hand.

a. Human skin can’t stop a speeding bullet because the physical force propelling those objects is far greater than skin can resist and easily tears apart the bonds that hold the cells together. Why wouldn’t Superman’s skin, enhanced bioelectric field from the sun or not, be just as vulnerable to damage as our own?

b. Suppose Superman’s skin absorbs and retains heavy elements ---iron, silicon, and even titanium, for example----and storing them in the cell walls of the epidermis. Would this enable Superman to be physically more resistant? Why?

17. After meeting Lex Luther and his hideout full of state-of-the-art gadgets, Lois Lane tries to take a helicopter from the roof of “The Daily Planet” building in order to meet Air Force One. But, the helicopter gets entangled with a loose wire on the roof. The chopper ends up dangling over the edge of the roof, with Lane barely holding on. Kent, unable to find the traditional phone booth, changes into his Superman costume in a revolving door and flies up to catch her with one hand as she plunges to certain death. With his other hand he catches the falling chopper and he returns both to safety on the roof.

a. So, when Lois Lane falls from the 50th floor and is inches from impact with the sidewalk, Superman must rush—faster than a speeding bullet----to save her. As she falls she will roughly reach the terminal speed of a sky diver and be closing with the sidewalk at 193 km/h or 53.6 m/s. On the other hand, the man of steel will be closing with her at a velocity in excess of a speeding bullet say around 2250 km/h or 625 m/s. When he catches Lois, he must increase her velocity from zero in the horizontal direction to match his horizontal velocity and stop her downward velocity almost as fast as if she had hit the sidewalk. If it takes 0.1 seconds to do this, what would be her deceleration vertically? What would be her acceleration horizontally? How would this compare with $g = 9.8 \text{ m/s}^2$. [Use: $a = (v_2 - v_1)/t$].

b. If Superman is 225 lbs, how many grams is this? (Use 2.2 lbs = 1,000 g)

- c. If a bullet is 7.62 grams, how much more Kinetic Energy does Superman have? (Use $K.E. = \frac{1}{2}mv^2$)
 - d. The law of conservation of energy demands that something be done with the Kinetic Energy of Superman. Where does all that energy go? Would Lois Lane survive this?
18. Next, Superman apprehends a thief scaling a building, captures criminals escaping on a boat, and rescues a little girl's cat which is caught in a tree. When Air Force One is hit by lightning outside of Metropolis and starts to fall, Superman steers the jet to safety. Is it possible for lightning to strike an airplane that is not grounded? If so, can it knock off an engine on the airplane?
19. The editor of "The Daily Planet" orders his staff to get the real story on Superman. Now in love with Lane, Kent arranges to meet her at her apartment for dinner. While Lane waits for Kent on her balcony, Superman flies in, answers questions about himself, and then takes Lane flying.
- a. Earlier: The reason for Superman's incredible powers on Earth, (as explained by his father to his wife), are due to the "dense molecular structure" possessed by the inhabitants of Krypton. While this alien chemistry/physics afford no obvious advantage on Krypton, on Earth it is a completely different matter. Mass on Krypton and mass on Earth must have entirely different properties. Everything seems to be proportionately more massive on Krypton. However, if so, why does Superman only weigh 225 lbs as he claims during the interview. He seems to be telling the truth (he always does). If not, would the furniture be able to hold him while he sits?
 - b. On Superman's flying date with Lois Lane, he holds on to Lois only by her hand as she flies side by side. How does Lois stay aloft? (Presumably she is not emitting powerful streams of air herself and because her only support against gravity acts on her hand she should be dangling below Superman like a rag doll caught in a tornado).
 - c. During the Lane interview, Superman indicates that he eats and apparently breathes just like we all do, and yet clearly, despite the amazing similarity with humankind, his body functions must be quite different. For example, Superman can go into space and exist quite comfortably there without air. What happens to your lungs full of air if your taken to outer space? (Maybe his lungs are merely vestigial, a decorative internal ornament that activates only in the mating season).
 - d. Also, during this scene, Superman alludes to his X-Ray vision. If he emits x-rays from his eyes it is unclear how the image actually gets back to his eyes, because x-rays are going to penetrate the object, (purse), that he is looking at and come out the other side. Perhaps "x-ray" is just a convenient metaphor for some other type of probing

radiation that is, in fact, reflected back off of the interior of the objects of interest. Maybe his eyes gather and focus the x-rays already present in his environment. Is that enough to see through walls or purses? (Note: Because of their extremely short wavelength, stray x-rays tend to be scattered and absorbed by the atmosphere. Fortunately for us, there just isn't much random x-ray radiation bouncing around us most of the time.) If Superman is able to tune in his vision to see the x-ray range, would the world look light or dark? Suppose Superman can tune in his visual brain to other electromagnetic waves that can see through things. What EM radiation would be best for Superman to see through and into things?

- e. Suppose Superman can consciously "slide" the range of his vision up and down the electromagnetic spectrum. Why would LEAD be a problem to see through?
20. While talking to his editor, Kent (and all the dogs in the neighborhood) hears an ear-splitting, high-pitched sound. Lex Luthor's voice tells Superman that in 5 minutes a capsule filled with deadly propane lithium gas will be detonated. Would it be possible to send out a sound that only Superman can hear? Is it Infrasound (below 20 Hz) or Ultrasound (above 20,000 Hz)? (Note: High frequency sounds cannot travel very far in the atmosphere without dissipating. However, elephants can communicate up to 20 miles away by using infrasound). What would be more realistic for Lex Luthor to use for Superman's ears only sound wave? Would Superman need elephant ears to hear this infrasound?
21. Towards the end of the movie, Lane is in the middle of the desert covering a land-scam story when her car runs out of gas. Meanwhile, Superman successfully intercepts the Hackensack missile and shoves it into outer-space. Unfortunately, the other missile hits the San Andreas fault, which starts a massive earthquake. Luther calculates that this explosion will knock everything west of the fault into the ocean. Luther's plan is that this will drive real estate prices up on thousands of acres of land that he has purchased just east of the fault, because it will consequently become oceanfront property.
- a. Do you believe that is possible for a massive earthquake to cause large sections of California to "fall into the ocean"? (Note: Volcanoes usually explode with thousands of times more energy as one nuclear bomb. Volcanoes are often found along the boundaries of plates in Plate Tectonics).
 - b. Superman of course must divert these two missiles (into space) before they cause massive death and destruction. Complicating matters is the fact that the missiles are due to detonate within a few seconds of each other on opposite sides of the country! Superman is able to divert the Hackensack attack successfully, and then he must get to California (a distance of about 4,830,000 m) in less than a minute. He seems to arrive a few moments after the bomb actually goes off. If it took 30 seconds to do this, how fast did Superman go? (Use $v = d/t$)

- c. If the space shuttle enters the atmosphere at 8,000 m/s, how much faster is Superman than the re-entry of the Space Shuttle?
 - d. Anything traveling 8,000 m/s inside the atmosphere will heat up to temperatures of thousands of degrees Celsius in less than a few minutes and vaporize. Why doesn't this happen to the space shuttle? Would the Space Shuttle burn up if it were traveling as fast as Superman?
 - e. The frictional heating between the air and Superman's body should raise his surface temperature to thousands of degrees. What does this say about not only Superman's skin, but about his hair, his eyes, the inside of his mouth, and so on?
 - f. Should Superman glow during this spectacular stunt?
22. In order to reduce the effects of the massive San Andreas fault earthquake, Superman lifts a long segment of rock back into place. The rock would have weighed hundreds of thousands, if not millions, of tons. If Superman exerts a force upward on the rocks, then by Newton's Third Law the rock slab would exert a force downward on Superman and push him into the earth. Are the rocks on which his feet are standing, be able to support a weight of millions of tons force? ($\text{Pressure} = F/A$)
Does it matter how strong Superman is?
23. In the climax of the movie Superman goes out into space and causes Earth to spin backwards somehow by flying around it really fast opposite to the normal spin direction. How does he effect the Earth's rotation when he is not actually in contact with it?
24. When Superman reverses the Earth's direction there are no inertial effects whatsoever. Considering Newton's first law of motion imagine what might happen if the Earth stopped spinning relatively suddenly?
25. Superman decides to change the course of history in order to save Lois Lane from being killed. Thinking that motion in one-direction is equivalent to time going forward, and motion in the opposite direction is equivalent to time going backward, Superman zooms around the Earth in a direction opposite to it's rotation, thereby reversing time. Does the two physical phenomenas—the direction of rotation and the passage of time---- have anything to do with each other?
26. We know, based on the Doppler shift of light arriving from distant galaxies, that the universe is expanding. However, due to the gravitational attraction between the mass contained in the universe, the rate of expansion should be decreasing. Amazingly, in recent year it has been shown that there are places in universe where the expansion rate is actually increasing. Clearly, this increased expansion rate represents something completely unfamiliar going on. It appears that there may be a previously unknown

fundamental force that actually acts to repel mass----a sort of “repulsive gravity”. While the explanation for this observation at present is highly speculative, the phenomenon lends itself very well to a theory of flight for Superman. Moreover, who knows, the planet Krypton may have been located in one of these distant corners of the known universe before it exploded.

- a. In the famous “circle the earth backwards” scene, Superman appears to be entirely outside of the atmosphere. If he requires air for fuel, would this present an insurmountable obstacle towards our flying hypothesis? How?

- b. All right, here’s our new hypothesis: Superman is able to generate force between himself and any other mass via a mechanism of “repulsive gravity”. Because Superman is not always accelerating away from everything, would need to turn on and off this fundamental force of repulsion? Why?

- c. Suppose Superman has a previously undisclosed organ, located in the area where his spleen should be, that is able to mediate this force effectively. It could be that the response of this organ is involuntary like the heart. In any case, whenever he wants to fly, he uses this organ to generate repulsion between himself and any other relevant objects. Does this “repulsive gravity” theory allow the advantage of Superman to fly in the emptiness of outer space?

- d. Does the “repulsive gravity” theory explain how Superman is able to effect the Earth’s rotation without actual physical contact? How?

- e. Because this organ can manipulate the “repulsive gravity” field around him, can Superman hold Lois aloft by a single hand? Would Lois Lane need a “repulsive gravity” field around her to work? Wouldn’t Superman be repulsed by Lois too? (Note: When Lois accidentally releases Superman’s hand, she plummets earthward)

- f. When Superman circles the Earth he seems to be exerting an attractive force. How does this contradict the “Reverse Gravity” Theory?

- g. Another consideration is the enormous amount of energy this organ must produce. How is it provided with sufficient fuel?

[When we foray into the rarefied world of “the extremely super-powered superhero” we have a lot of fun seeing them do amazing things that we all wish we could do. Yet, it is often the most basic physics that get thrown out of the window when superpowers come into play]

