XXX

1. What is the name of the criminal group in the Czech Republic that is causing the National Security Agency problems?
2. Who is Yorgi?
3. Why does Yorgi want to unleash deadly poison gas on major cities throughout the world?
4. Distance is the total length traveled during some motion. Distance, (a scalar), does not depend on which direction you're a traveling, or whether you change direction during the motion. Unlike distance, displacement (a vector) does have a direction associated with it. If an object moves from one point to another it's displacement is the straight-line distance from the beginning to the end of a motion. Displacement represents the overall change in the objects position rather than the total distance traveled.
   a. Suppose XXX, (Van Diesel), is being pursued in a high-speed car chase and enters the highway at mile marker 6 heading north. The highway is straight. At mile marker 8 he skids to a stop and reverses direction due to a roadblock ahead. He drives back to mile 7 where he is force to stop. What is the total distance of the chase?
   b. What is the total displacement?
5. Average speed (a scalar) is defined as the total distance traveled during a motion divided by the time it took to complete the motion. Average velocity (a vector) is defined as the displacement from the beginning to the end of a motion divided by the time it took to complete that motion. In the car chase mentioned in #4, it takes the driver 70 seconds to get from mile marker 6 to mile marker 8, and another 30 seconds to get back to mile marker 7.
   a. What is Van Diesel's average speed for the entire chase?
   b. What is Van Diesel's average velocity for the entire chase? (Remember to give a direction in your answer).
6. If the velocity of an object is changing then the object is accelerating. Acceleration, (a vector), is the rate at which velocity is changing. If an object has a acceleration of 5 m/s^2, this means that each second it will change it's velocity by an amount equal to 5 m/s. A special case of acceleration occurs for freely falling objects near the surface of the Earth. Neglecting air-resistance, all objects will accelerate towards the earth at a rate of 9.8 m/s^2 or 9.8 m/s/s. If Vin Diesel in XXX throws a motorcycle upward at an initial velocity of 25 m/s, then answer the following questions about the motorcycle:
   a. What is the direction of the acceleration on the way up?
   b. What is the direction of the acceleration at the top of it's flight?
   c. What is the direction of the acceleration on the way down?
   d. What is the velocity 1 second later?

    e. What is the velocity 2 seconds later?
    f. What is the velocity 3 seconds later?

7. In situations where the rate of acceleration of an object is constant over some period of time, we can obtain some useful equations that quantify the relationship between the position, velocity, acceleration, and time of motion of the object. X' = initial position; X=final position; v'=initial velocity; v=final velocity; a=acceleration; t=elapsed time;

   $v=v' + at$; $x-x'=v't + 1/2at^2$; $v^2-v'^2=2a(X-X')$

    a. Let's say Vin Diesel's stunt double needs to speed up as fast as he can go on his motorcycle before attempting an extreme jump. If he has an initial speed of just above 50 miles per hour (22m/s), and is able to reach a final speed of 70 miles per hour (31 m/s) over a 50-meter distance just before his jump, what average acceleration must the motorcycle be capable of to do this? (Hint: use $v^2-v'^2 = 2a(X-X')$)
    b. How much time does it take to increase it's speed by this much? (Use $v=v' +at$)

8. In XXX's climatic scene, Yorgi has just released the automated boat containing the toxic gas containers onto the Danube. It is traveling "80 mph at least" according to Vin Diesel, as he and Yelena frantically try to stay parallel with it while driving on the road adjacent to the river in their specially outfitted GTO. They must find a way to board the boat and disarm the containers before it's too late. The situation becomes even more challenging when the road veers away from the waterfront, travels a couple of miles inland, and passes through a charming county village that the two heroes use to blast wooden carts and bales of hay out of their way so they don't have to slow down much. They do have to make a few pretty sharp turns however, and with the extra distance traveled, we might be surprised to see that they return to the river at the exact moment the boat arrives there. Fortunately, we are given some pretty specific information when the scene cuts to the GTO on-board GPS. The screen plots the location of both the car and the boat at the moment on a map:

   From the instant we see it's location on the GPS map, it looks like the car has at least twice as far to travel as the boat before the two routes reconnect.

   a. How do the average speeds of the car and boat compare?
   b. Which vehicle has the greater displacement between the time that the car leaves the river and when it returns? (Hint: Review the definitions for velocity and speed)
   c. Which vehicle has the greater average velocity between the time that the car leaves the river and when it returns?
   d. From the instant we see it's location on the GPS map, Yelena says it's 15 miles back to the river at that moment, so according to the map it looks like the distance the boat travels to the same point can't be more than 7 miles. If the boat is traveling 80 miles/hr, what is the travel time. Use: v = d/t
   e. Because the car travels for the same amount of time, what is it's average speed?
   f. The average speed for an Indy 500 car is 180 mph. Is it reasonable for the GTO to go it's calculated speed through narrow village streets and around sharp turns? Why?
9. Powder avalanches can travel at speeds ranging from 60-90m/s. That's 130-200 miles per hour. According to the Guinness Book of World Records, the fastest recorded snowboard run, which took place on a slick bobsled track, is just less than 50 miles/hour. In a scene in XXX, Vin Diesel purposely starts an avalanche to delay pursuers while he races down the mountain on a snowboard. He stays about 10 yards ahead of the avalanche for at least a mile before he leaps with his board into the air and grabs a power station it's way down the mountain. A few seconds later hour hero pops through the top of the new layer of powder, unscathed. (Note: A few hundred yards up the slope, the tumbling snow completely obliterates a wood frame house).
   a. Let's say that Vin Diesel, motivated by the XXX-treme conditions, completely obliterates the world snowboarding speed record. Let's say he gets to a speed of almost 80 miles per hour (36 m/s), and let's assume the avalanche is traveling at the slower end of the velocity range. How long until the avalanche, moving at 130 mi/hr, catches up to him, considering his 10-meter head start?
   b. How far would he make it down the mountain before being caught?
   c. Can a person on a snowboard outrun an avalanche?
10. Every time a car, boat, or snowmobile crashes or is hit by a bullet in XXX, it explodes. As you know, automobile accidents happen every day, in every city, state and country. Unfortunately, some of them involve high-speed impacts resulting in major damage and fatalities. Yet how often do these cars actually explode?

    (Note: Gasoline will only ignite with the right mixture of gasoline vapor and air. The ratio is confined to a very small range, and the odds that a collision will release sufficient vapor in the right quantity to mix with air and also be exposed to a spark at that time are extremely small. Moreover, it is by no means certain that bullets produce sufficient sparking when they impact metal to generate enough heat to ignite gas vapor.).

11. Our hero executes about a half-dozen astonishing and highly improbable motorcycle leaps in various scenes (i.e. #7 & 8), in XXX. In one of the more dramatic leaps Diesel is racing along the side of a 30-foot-tall barbed wire fence on his motorcycle and there is no escape in front. A helicopter gun ship is bearing down on him, and we can't imagine how he'll get out of this one. Imagine our astonishment when he yanks up on the front end of the bike, and he somehow twists the vehicle up and over the fence sideways without the help of any ramp whatsoever.
    a. What was his vertical speed the instant after losing contact with the ground? (Note: $v'^2 + v^2 = 2a(Y-Y')$ where $a = 9.8\ m/s^2$ and $(Y-Y') = 30$ feet $= 9$ m And at the instant that he achieves the maximum height $v = 0$ m/s)
    b. What forces are acting on the system during the time he is pushing off of the ground? (Hint: 4 forces involved with the axn =rxn)
    c. Draw a free-body diagram, labeling these forces.

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    d. According to biomechanics data, the time to push off of the ground in a jump will be about 0.25 seconds more or less. Calculate the approximate acceleration during the push. Use: $a = (v-v')/t$

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    e. Assuming the motorcycle is a fairly light one with mass of around 200 kg, and Vin Diesel has a mass of 80 kg, what is the combined weight: (Hint: Weight = mg; where $g=9.8m/s^2$ & $1\ Kgm/s^2 = 1$ Newton)
    f. Newton's Second Law and Summation of the vertical forces gives:
       (Net Force) = (Normal Force) – (Weight) = ma
       Solve for the Normal Force:

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    g. How is this normal force applied and who applies it? (Hint: Newton's 3rd Law)

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    h. Is this Reaction force realistic, and can it be accomplished by Vin Diesel?

i. Diesel is moving horizontally. Without a net force in the vertical direction, he will not accelerate upward and off of the ground. Can a vertical force be generated by a ramp? Did you see him jump with a ramp?

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