Thoughts on the Exam: Read the whole test before you begin – find the problems you can do and work on them first. DON'T get jammed up on one problem – move on and come back to it. Use sunscreen. If you can’t work a problem through to the end, tell me what you’d do if you had time. If you think you need something not given, ask me (but DON’T ask me whether you need it). Tell me who you are!!! Say your mantra. RELAX. Trust me on the sunscreen.

1) A Porsche 911 can (supposedly) travel a quarter mile (~400 m) in 13.2 seconds, from a standing start.

A) Estimate the acceleration a Porsche 911 experiences.

\[
\frac{dV}{dt} = \frac{V_f - V_0}{t} = \frac{V_f}{t} = \frac{2V_{avg}}{t}
\]

\[
= 2 \left( \frac{x}{t} \right) = \frac{2x}{t^2} = \frac{2(400 \text{ m})}{(13.2 \text{s})^2}
\]

\[
= 4.60 \text{ m/s}^2 \text{ (approximate because assumed constant acceleration)}
\]

B) Estimate the time it would take to accelerate to 20 mph.

\[
V = V_0 + at = 0 + (4.60 \text{ m/s}^2)t = 9 \text{ m/s}
\]

\[
t = \frac{2.0 \text{ sec}}{9 \text{ m/s}}
\]

Assume low speed acceleration is same as average acceleration.

C) Is your estimate in B) too long, too short, or about right? Explain.

Too long. At low speeds, drag is less of an effect so acceleration is higher than average.
2) When I come to work, I travel on I-10 a displacement of about 30 miles at an angle of 152 degrees and on I-55 a displacement of 30 miles at 90 degrees (all angles measured counterclockwise from due East).

A) Sketch these two vectors and find the net displacement when I come to work (by whatever means you desire).

\[
\begin{align*}
\Delta R_x &= 30 \cos 152 + 30 \cos 90^\circ \\
&= -26.5 \text{ mi} \\
\Delta R_y &= 30 \sin 152 + 30 \sin 90^\circ \\
&= (14.1 + 30) \text{ mi} = 44.1 \text{ mi} \\
|\overrightarrow{R}| &= \left[ (44.1 \text{ mi})^2 + (-26.5 \text{ mi})^2 \right]^{1/2} = 51.4 \text{ mi} \\
\theta &= \tan^{-1}\left(\frac{44.1 \text{ mi}}{-26.5 \text{ mi}}\right) = -59^\circ + 180^\circ = 121^\circ
\end{align*}
\]

B) If it takes an hour, what is my average velocity?

\[
\overrightarrow{U}_{avg} = \frac{\overrightarrow{R}}{\Delta t} = \frac{51.4 \text{ mi}}{1 \text{ hr}} @ 121^\circ
\]
3) One of the tasks performed by Alan Shepherd when he landed on the moon in the Apollo 14 spacecraft was to hit the first golf ball on another planet. A reasonable golf ball will go about 100 mph off the club at an angle of maybe 30 degrees. About how far did Shepherd's ball go before it landed and how long was it in the "air"?

Assume no drag:

\[ v_0 = 100 \text{ mph} \approx 45 \text{ m/s} \]

\[ R = \frac{v_0^2 \sin 2\Theta_0}{g} = \frac{(45 \text{ m/s})^2 \sin 60^\circ}{1.6 \text{ m/s}^2} \]

\[ \approx 1100 \text{ m} \left( \approx 1100 \text{ yards!} \right) \]

\[ x = v_0 \cos \Theta_0 t = \frac{X}{v_0 \cos \Theta_0} \]

\[ t = \frac{X}{v_0 \cos \Theta_0} = \frac{(1100 \text{ m})}{(45 \text{ m/s}) \cos 30^\circ} \]

\[ \approx 28 \text{ sec} \]
Anthropologists argue about whether South and Central America were settled by people from Siberia who walked down, or people from the South Pacific who used big canoes. One argument is that there wasn’t time for people to walk from Alaska to the tip of South America (Tierra del Fuego). Estimate the time (in years) needed to walk from Alaska to Tierra del Fuego (HINT: The distance is almost halfway around the world).

\[ t = \frac{d}{v} = \frac{\pi R e}{v} \]

\[ = \frac{(3.14)(4000 \text{ mi})}{2 \text{ mi/hr}} = 6280 \text{ hrs} \]

\[ = (6280 \text{ hr})(\frac{1 \text{ dy}}{24 \text{ hr}})(\frac{1 \text{ yr}}{365 \text{ dy}}) \]

\[ \approx 0.7 \text{ years pure walking time} \]

If you only spend 1 hr a day walking:

\[ t \approx 17 \text{ years} \]
On the next page you see a plot of position (in one dimension) as a function of time (i.e., x(t)). Use it to sketch the velocity and acceleration as a function of time (i.e., sketch v(t) and a(t)).

In short, $v(t) = \text{slope of } x(t)$ graph

and $a(t) = \text{slope of } v(t)$.