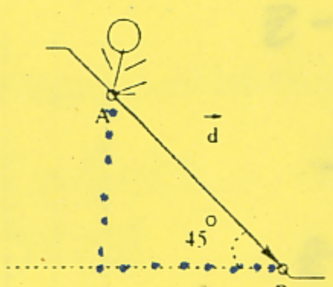
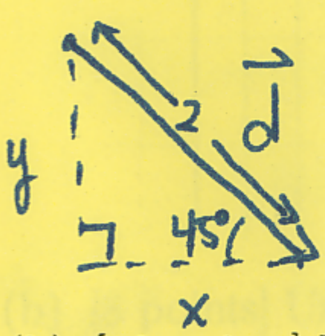
2. If you have a child sitting on a slide, the force of gravity, G, is working on that child in pulling him down the slide. If the child goes a distance of 2 meters down the slide from point A to point B, as shown, and the slide is at an incline of 45°, answer the following questions: (Note $\vec{G} =< 0, -98 >$ if we assume the child weighs 10 kg)



(a) [8 points] Give the child's displacement in the form of a coordinate vector.

$\vec{d} =< \sqrt{2}, -\sqrt{2} >$ where the y-component is negative, because $\vec{d}$ points in the negative y direction.



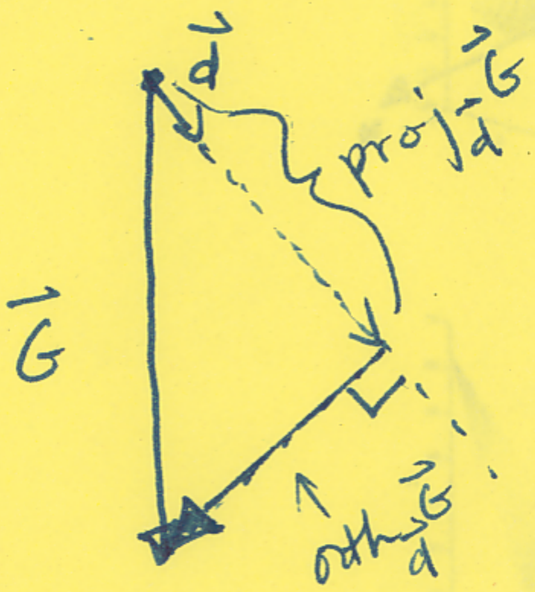
$\Rightarrow x = 2\cos 45° = \sqrt{2}$, $y = 2\sin(45°) = \sqrt{2}$

(b) [10 points] Find $proj_{\vec{d}}\vec{G}$ and $orth_{\vec{d}}\vec{G}$. Sketch $\vec{G}$, $\vec{d}$, $proj_{\vec{d}}\vec{G}$, and $orth_{\vec{d}}\vec{G}$ below. Recall that $proj_{\vec{d}}\vec{G} + orth_{\vec{d}}\vec{G} = \vec{G}$.

$$\text{proj}_{\vec{d}}\vec{G} = \frac{\vec{d}\cdot\vec{G}}{|\vec{d}|^2}\vec{d} = \frac{\langle\sqrt{2},-\sqrt{2}\rangle\cdot\langle 0,-98\rangle}{2^2}\langle\sqrt{2},-\sqrt{2}\rangle$$

$$= \frac{98\sqrt{2}}{2}\langle\sqrt{2},-\sqrt{2}\rangle = \left\langle\frac{98(2)}{4}, -\frac{98(2)}{4}\right\rangle$$

$$= \langle 49, -49\rangle$$



$$\text{orth}_{\vec{d}}\vec{G} = \vec{G} - \text{proj}_{\vec{d}}\vec{G}$$

$$= \langle 0,-98\rangle - \langle 49,-49\rangle$$

$$= \langle -49,-49\rangle$$

(c) [10 points] Is more of the gravitational force going to move the child or to pushing him into the slide? How much work does gravity do in moving the child from point A to point B?

- Work $= \vec{G}\cdot\vec{d}$
  $= \langle 0,-98\rangle\cdot\langle\sqrt{2},-\sqrt{2}\rangle$
  $= 98\sqrt{2}$

- from part (b) the amount of $\vec{G}$ that is aligned with motion down the slide will be the magnitude of $\text{proj}_{\vec{d}}\vec{G}$

$$|\text{proj}_{\vec{d}}\vec{G}| = \sqrt{(49)^2+(-49)^2} = 49\sqrt{2}$$

and the amt pushing him into the slide ($\perp$ to $\vec{d}$) is

$$|\text{orth}_{\vec{d}}\vec{G}| = \sqrt{(-49)^2+(-49)^2} = 49\sqrt{2}.$$

So there is as much force pushing him into the slide as down it.