Announcements

- HW8 due on Monday!
- Sign-up slots for final chapter topics will be going up later this weekend
  - A limited number of potential problems from each chapter
  - First come, first serve
  - I'll send out an email blast with the link to sign-up for your preferred chapter
- Responses: `rembold-class.ddns.net`

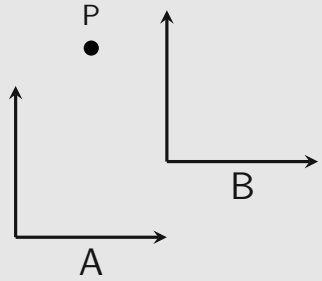
Today's Objectives

- Be able to adjust Newton's 2nd law to account for linearly accelerating reference frames
- Reason about how this correction factor relates to tides
- Start to bridge the gap between linear accelerations and angular accelerations

Q1

The image below right is one we have seen a few times already this semester, with two separate reference frames and one object viewed in both reference frames. What is the relationship between the position of the object as seen in each frame and the position of the frames relative to one another? I will use the notation $\vec{r}_{XY}$ to mean "the position of X as seen in frame Y".

A) $\vec{r}_{PA} = \vec{r}_{PB} + \vec{r}_{BA}$
B) $\vec{r}_{PB} = \vec{r}_{PA} + \vec{r}_{BA}$
C) $\vec{r}_{BA} = \vec{r}_{PB} - \vec{r}_{PA}$
D) $\vec{r}_{BA} = \vec{r}_{PB} + \vec{r}_{PA}$



Q2

We can view motion in accelerating frames as motion in a non-accelerating frame but with a correction factor added on. Suppose you are in a semi which is decelerating at a rate of $5\,\mathrm{m/s^2}$ with respect to the ground. You toss a ball straight upwards (as seen by the you) at $1\,\mathrm{m/s}$. How far does the ball miss your hand by? You can take $g \approx 10\,\mathrm{m/s^2}$ for this quick calculation.

A) $0.1\,\mathrm{m}$
B) $0.4\,\mathrm{m}$
C) $0.5\,\mathrm{m}$
D) $0.6\,\mathrm{m}$

Q3

Looking at Figure 9.4, the tidal force squeezes inwards from the top and bottom and outwards from the middle. Earth has a radius of approximately 6400 km and is an average of 380 000 km away. Approximately what then is the ratio between the stretching force and the compressing force on the Earth's oceans?

A) 1:1
B) 2:1
C) 4:1
D) 10:1

Q4

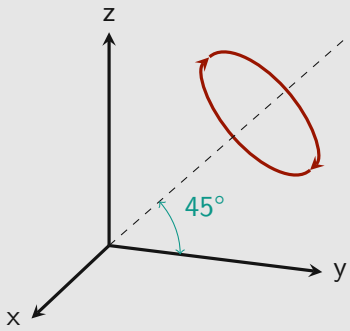
The object to the right completes one revolution every 6 seconds as it orbits with radius 1 m about the axis shown. How would you describe its angular velocity vector?

A) $\langle 1.47,\ 0,\ -0.71 \rangle$ rad/s

B) $\langle 0,\ -0.74,\ -0.74 \rangle$ rad/s

C) $\langle 0,\ 0.74,\ 0.74 \rangle$ rad/s

D) $\langle 0,\ 0.71,\ 0.71 \rangle$ rad/s



Q5

I take a black pen and draw a small dot on a baseball (r=3.65 cm) before tossing it into the air. One second later, the ball is traveling at a velocity given by (1,-1,3) m/s and is spinning about its center with $\vec{\omega} = (0, -100, 10)$ rad/s. At this point it time, the black dot is precisely on the top of the baseball.

What is the linear velocity of the black dot with respect to the ground at this point in time?

A) (3.65, 2.65, 3) m/s
B) (-2.65, -1, 3) m/s
C) (4.65, -1.65, 2.43) m/s
D) None of the above