Proportional reasoning practice: On your own paper, draw diagrams and write out reasoning for your solutions to these problems. DO NOT just try to jump to the answer (ESPECIALLY ON THE LAST 2 PROBLEMS). Try to piece together things that you know, the explanations to all of the problems are on the back, and we will be seeing which concepts you have/don't have.

2. An object experiences an acceleration, g, when it is on the surface of a planet of radius R. What will be the acceleration on the object after it has been moved to a distance of $4R$ from the center of the planet?

A) $16g$

B) $4g$

C) $\frac{1}{4}g$

D) $\frac{1}{16}g$

14. A person weighing 800 N on Earth travels to another planet that has twice the mass and twice the radius of Earth. The person's weight on this other planet is most nearly

A) 400 N

B) $\frac{800}{\sqrt{2}}$ N

C) 800 N

D) $800\sqrt{2}$ N

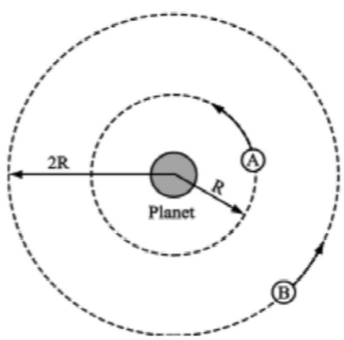
17. Satellite A has mass M. Satellites A and B have circular orbits around a planet with distances of R and $2R$, respectively. The gravitational force between the planet and satellite A is F. The mass of satellite B is $3M$. In terms of F, what is the gravitational force between the planet and satellite B?

A) $\frac{1}{4}F$

B) $\frac{2}{3}F$

C) $\frac{3}{4}F$

D) $\frac{3}{2}F$



18. How does the velocity of satellite B compare to the velocity of satellite A?
a) 0.5 times as fast
b) 1/sqrt(2) times as fast
c) sqrt(2) times as fast
d) 2 times as fast

19. How would the period of B compare to the period of A?
a) 0.5 times as long
b) 1/sqrt(2) times as long
c) sqrt(2) times as long
d) 2 times as long
e) 2*sqrt(2) times as long

Problem 2: Simple problem.
Distance was quadrupled. Relationship between distance and force is inverse square. If it were inverse, the force would be ¼ as much, but since it is squared, it will be 1/16 as much force. Since the mass of the object is the same, and the force is reduced by 1/16, the acceleration will be 1/16 as much as it was before.

Problem 14: Simple problem.
Force equation: GmM/R^2. If M doubles, F doubles. If distance to center of planet doubles, F is reduced by a factor of four. Overall effect: reduced by half.

Problem 17: Simple problem.
Radius doubled, but mass triples. ¼ due to distance, 3x due to mass, ¾ overall.

Problem 18: This is a hard, multi-step problem
If we doubled the radius of this orbit, the force of gravity would be ¼ as strong (inverse square reasoning). If the force is ¼ as strong, the acceleration can only be ¼ as much, because a=F/m (m is constant). The acceleration is center pointing, and this is a circular motion problem. That means the centripetal acceleration has to be ¼ as much as before. a=v^2/r We know r doubled, but that doesn't decrease the right hand side enough, v needs to be less as well (1/sqrt(2) as much so that when it gets squared you get the other velocity).
->speed is slower, slower by a factor of 1/sqrt(2) (which is a bigger number than a half)

Problem 19:
Use the same reasoning for the velocity as in 18. This question isn't looking for the new velocity, it is looking for the new period (time for one rotation). If the radius is doubled, the circumference of the circle is doubled (it has to go twice as far).
->distance to travel is twice as much
->speed is slower, slower by a factor of 1/sqrt(2) (which is a bigger number than a half)
->time is greater by a factor of 2*sqrt(2).