**Discuss the work a pitcher exerts on a baseball as he throws a fast ball. Over approximately what distance is the force exerted? Please explain your reasoning thoroughly.**

**Appropriate distance clearly identified**

The work done is equal to force times the displacement. The amount of work that is done by the pitcher on the baseball is equal to its kinetic energy when the ball leaves the arm of the pitcher. The force caused by the pitcher is applied to the baseball over a distance equal to the length of his arm.

**Good discussion of force and distance vs energy, some improvable word choices**

The pitcher has to exert however much energy it requires to get the ball to leave his hand at a fast pace. He is therefore putting that energy into the ball and the ball is gaining said energy while he is losing it. However, since the force he is creating is a contact force the force is only exerted when the ball is in his hand, once the ball has left his hand he is no longer exerting force on the ball. I know this because the speed and acceleration of the ball will change once it is out of his hand and no longer receiving the force/energy.

**Another curious wording choice**

I think that the ball would no longer have the force of the pitchers throw after it leaves his hand, but the work that the pitcher did on the ball is still pushing on it.

**Clearly expressed misconception**

W = delta x (F cos theta), F=ma

the pitchers mound is 25 meters away from the plate (catcher), so the force is exerted over 25 m

the ball is thrown at 50 m/s by the pitcher, this does not work as the acceleration would be zero because the velocity is constant

the ball is thrown at some angle that will remain constant by pitcher

the ball can weigh 1 kg

can say the ball momentarily accelerates at 50 m/s^2 as it comes out of the pitchers hand

therefore the work done by the pitcher at the moment of release is 25m*50N* some constant angle of cosine

= 1250 J * cosine theta

Estimate how much work (in joules) is done by gravity when you roll out of bed and fall to the floor. How much different would the work done by gravity be if instead you climbed out of bed on your own and gently curled up on the floor.

**Some geometric inconsistencies**

While rolling out of bed and proceeding to fall on the floor; the work done by gravity is zero. That is because the angle between displacement and gravitional force is 90. If we were to climb out of bed and curl up on the floor, the difference would be that the work done by gravity would be negative.

**Using the relationship between work and kinetic energy**

Assuming the person weighs around 68kg and their velocity after rolling out of bed and falling to the floor would be 2 m/s.

Using the kinetic energy formula we find that,

$K= 1/2mv^2$

Thus, giving us $K = 1/2(68kg)(2m/s)^2 + 130J$ , as the work done by gravity is positive, the persons Kinetic energy is increasing.

It would be much different in the second situation due to an upward motion occurring which is in the negative direction of gravity it is losing a certain amount of kinetic energy since the displacement and forces are in the opposite direction

**Key illustration of why energy arguments are so powerful**

My bed is a convenient 1 meter off the ground, and here the direction of the displacement is parallel to that of the of the force, so we can use the equation W= delta x* F.

The force of gravity is given by F=m*g, and luckily I have a mass of 100 kg, so

F=10 N/Kg * 100 Kg = 1000 N

Now plugging in to the equation for work we get:

W= 1m *1000N= 1000 Nm.

Were I to have gently curled up on the floor instead of falling, the work done by gravity would still be the exact same because I had the same displacement, and mass in both situations, and hopefully the value of g doesn't go changing overnight.

An object is moving in such a way that the rate at which gravity does work on it equals the rate at which it gains kinetic energy. You can conclude that

a. the object is falling freely
b. there is a net non-zero force on the object
c. both 1 and 2
d. neither 1 nor 2