As an object falls freely near earth, work is done on it by the gravitational force of earth. If an object has a mass of 3 kg and falls 20 m, how much work is done by gravity?

a) 30 J  
b) 60 J  
c) 200 J  
d) 300 J  
e) 600 J  
f) None of the above is within 10%.
The answer is e) 600 J; as follows,

- The work done is given, in general, by
  \[ W_G = F_G \cdot d \cdot \cos \theta_{Fd} \cdot \]
- For this object the displacement, \( d \), is vertically downward, and so is the gravitational force. Therefore \( \theta_{Fd} = 0 \),
- and \( \cos \theta_{Fd} = 1.0 \). Also, \( F_G = mg \).
- Thus \( W_G = m \cdot g \cdot d = 3 \cdot 10 \cdot 20 \text{ kg-m/s}^2 = 600 \text{ J} \). (e)