MCQ-Set5

1. C

Impulse = Δp. This can be seen by re-arranging the momentum principle: $\vec{p}_i + \vec{J} = \vec{p}_f$

$$\vec{J} = \vec{p}_f - \vec{p}_i$$

$$\boxed{\vec{J} = \Delta\vec{p}}$$

So I need to find the impulse. $\vec{J} = \int \vec{F}dt$, which is the area under the curve on a Force vs. time graph.

From $0 \to t$, the area is $\frac{1}{2}bh = \frac{1}{2}(t)(F) = \boxed{\frac{1}{2}Ft}$

2. B

2. $\Delta\vec{p} = \vec{J}$

and $\vec{J} = \int \vec{F}dt$

so, $\vec{J} = \int_{0s}^{.1s} (400t - 4000t^2)\,dt$

$$= 400\left(\frac{t^2}{2}\right) - 4000\left(\frac{t^3}{3}\right)\Big]_0^{.1}$$

$$= 200t^2 - \frac{4000}{3}t^3\Big|_{0s}^{.1s}$$

$$= \left(200(.1s)^2 - \frac{4000}{3}(.1s)^3\right) - \left(200(0)^2 - \frac{4000}{3}(0)^3\right)$$

$$= 2 - 1.33$$

$$= \boxed{.67\ Ns}$$

3. C

If force and time is the same, then impulse is the same because impulse $= \int \vec{F} dt$.

And $\vec{J} = \Delta\vec{p}$, so if they have the same impulse, they must experience the same change in momentum.

4. D

Work $= \int \vec{F} \cdot d\vec{s}$, which is the area of a Force vs. position graph.

From $0 \to 10$ m, the area is $W = \text{area} = \frac{1}{2}(5m)(10N) + (5m)(10N)$

$= 25\,Nm + 50\,Nm$

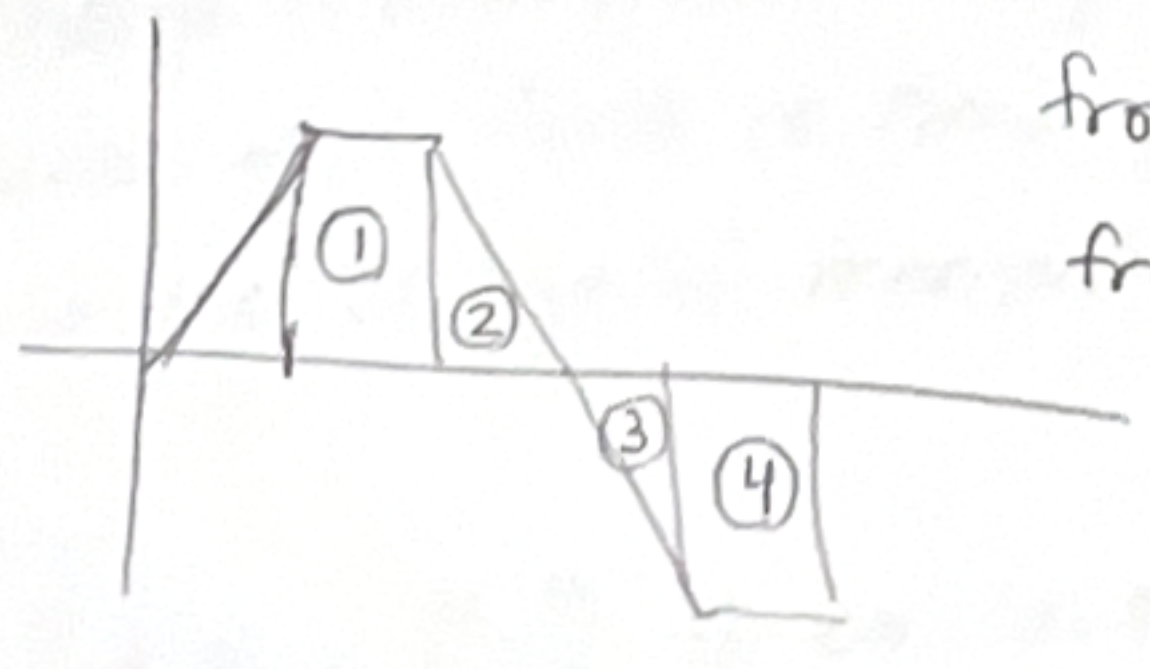
$= 75\,Nm$

5. B

The work done by the force is causing the kinetic energy to change.

When work is +, the area is +, and the K increases.

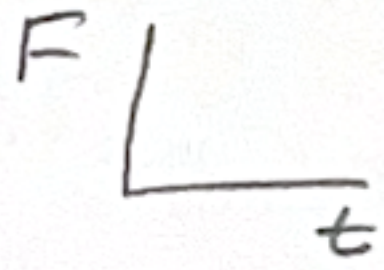
When work is −, the area is −, and the K decreases.



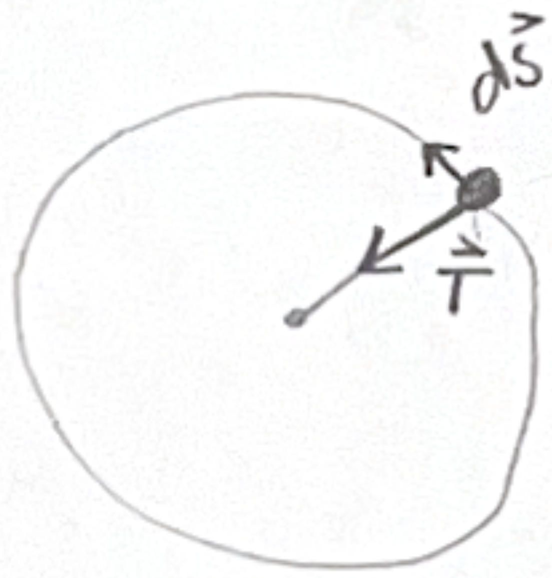
from $0 \to 5$m, the total area is the same as from $0 \to 20$m because areas ① and ③ cancel each other, and areas ② and ④ cancel each other.

Because no net work is done from 5m to 20m, the object's kinetic energy will be the same at 5m as at 20m.

6. B

A padded wall will cause the time of the collision to be greater. But since the same $\Delta\vec{p}$ has to occur, there has to be the same impulse as for the hard wall. Impulse is the area under the  graph. To have the same area when Δt is greater, the maximum force must be less.

7. A



At every instant, the force $\vec{T}$ is $\perp$ to the displacement $d\vec{s}$ that is tangential to the circular path.

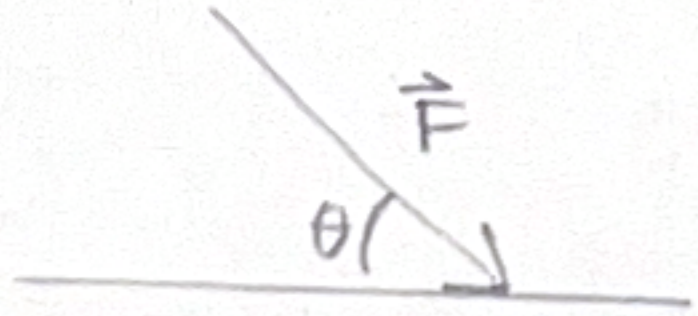
$$W = \int \vec{F} \cdot d\vec{s} = \int F\, ds \cos\theta = \int T\, ds \underbrace{\cos 90}_{=0} = 0$$

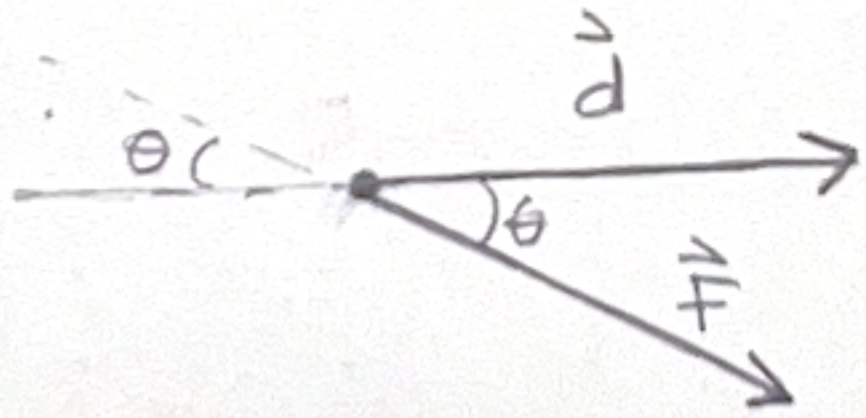
8. C

Change in momentum is equal to the impulse. Impulse is given by the area of a Force vs. Time graph. The area from $0 \to 4$ seconds is 0, so the change in momentum is 0.

9. B $W = \vec{F} \cdot \vec{d}$ for constant forces

so, $W = Fd\cos\theta$, where θ is the angle between $\vec{F}$ and $\vec{d}$ vectors





Drawing the $\vec{F}$ and $\vec{d}$ vectors with their tails together to show that the given θ actually is the angle between them.