Blue Print (As per PU Board)

Topic	1 mark questions	2 marks questions	3 marks questions	5 marks questions	Total Marks
Work, Energy & Power	1	–	1	1	9

One mark questions

1. **Define scalar product of two vectors.**

   Answer: The scalar product of to vectors is defined as the product of the magnitudes of the two vectors and the cosine of the angle between them.

2. **What is the value of scalar product of a vector with itself ?**

   Answer: Square of its magnitude $\vec{A}\cdot\vec{A} = AA\cos 0 = A^2$

3. **What is the value of dot product of unit vector with itself ?**

   Answer: The dot product of unit vector with itself is unity

   $\hat{i}\cdot\hat{i} = 1$ or $\hat{J}\cdot\hat{J} = 1(J = 0)$

4. **What is power?**

   Answer: The time rate at which work is done or energy transferred is called power.

5. **Write the mathematical equation for dot product of two vectors.**

   Answer: If A and B are the two vectors, and j is the angle between them, then their dot product is given by $\vec{A}\cdot\vec{B} = AB\cos j$

Two marks questions

6. **Mention the two types of multiplication of vectors.**

   Answer: (i) Scalar product

   (ii)Vector product

7. **Explain how commutative law holds good in dot product.**

   Answer: Form definition $\vec{A}\cdot\vec{B} = AB\cos j$.

   $\vec{B}\cdot\vec{A} = BA\cos j = AB\cos j$

   $\vec{A}\cdot\vec{B} = \vec{B}\cdot\vec{A}$

   Hence commutative law holds good in dot product

8. **Explain how distributive law holds good in dot product.**

   Answer: If $A\cdot B$ & C are the vectors then

   $\vec{A}\cdot\left(\vec{B}+\vec{C}\right) = \vec{A}\cdot\vec{B}+\vec{A}\cdot\vec{C}$

   Hence distributive law holds good for dot product

9. **State any two conditions under which a force does no work.**

Answer: A force does no work when

[i] The Displacement is Zero.

[iii] The displacement is perpendicular to the direction of force

Five marks questions

10. **Prove the work-energy theorem for a variable force?**

Answer: We know that $K = \frac{1}{2}\text{mv}^2$ …(1)

The time rate of change of kinetic energy is (on differentiating k w.r.t Time)

$$\frac{dk}{dt} = \frac{d}{dt}\left(\frac{1}{2}\text{mv}^2\right)$$

$$\frac{dl}{dt} = \frac{m\ du}{dt}V \quad \ldots(2)$$

From Newton II law $-m\frac{du}{dt} = F$

then $\frac{dk}{dt} = FU$ …(3)

but $V = \frac{dx}{dt}$

$$ie \frac{dk}{dt} = F\frac{dx}{dt}$$

Then $dk = Fdx$ …(4)

On integrating eqn (4) taking initial position (xi) to final position (xf), we have

$$\int_{ki}^{kf} dk = \int_{xi}^{xf} Fdx$$

Where ki and kf are the initial and final kinetic energies corresponding to xi & kf

$$ie\ kf - ki = \int_{xi}^{xf} Fdx \quad \ldots(5)$$

$$W = \int_{xi}^{xf} F(x)dx \quad \ldots(6)$$

On comparing eqns (5) & (6) we get

$$Kf - Ki = W$$

Thus. The work-energy theorem is verified for a variable force.

We know that for a variable force

11. **Prove that for a particle in rectilinear motion under constant acceleration the change in kinetic energy of a particle is equal to the work done on it by the net force?**

Answer: Consider a particle in rectilinear motion with constant acceleration 'a' then equation of motion is $v^{2-}u^2 = 2as$ …(1)

Where 'u' and 'v' are initial and final speeds.

S the distance traveled

On multiplying equation (1) by $\frac{m}{2}$

We have $\frac{1}{2}mv^2 - \frac{1}{2}mu^2 = mas$ ….(2)

From Newton's II law, $ma = F$

$ie\ \frac{1}{2}mv^2 - \frac{1}{2}mu^2 = FS$ …(3)

in general, for 3 – Dimensions

$\frac{1}{2}mv^2 - \frac{1}{2}mu^2 = F.d$ …(4)

F is the force d is the displacement but $\frac{1}{2}mv^2 = Kf \rightarrow$ Final kinetic energy $\frac{1}{2}mu^2 = Ki \rightarrow$ initial kinetic energy

$F - d = W$ -work done

Then $Kf - Ki = W$ …(5)

12. **Describe the conservation of mechanical energy of a system?**

Answer: Consider a body in one – dimensional motion undergoes a displacement "ΔX" under action f a conservative force F, the form the work – Energy theorem.

We have $\Delta K = F(x)\Delta X$ … (1)

If the force is conservative the potential energy function $V(x)$ is defined as

$\Delta V = F(x)\Delta X$ …(2)

From eqns (1) & (2) $\Delta K + \Delta V = F(x)\Delta\ x) - F(x)\Delta x$

$\Delta K + \Delta V = O$

$\Delta(K + V) = O$ …(3)

Where $(K + V)$ is the sum of the kinetic and potential energies of the body remains a constant for the entire path is from xi to xf

$Ki + V(xi) = Kf + V(xf)$ …(4)

In general, the quantity $K+V(x)$ is called the total mechanical energy of the system. However the kinetic energy K and the potential energy $V(x)$ may vary from point to point, but the sum remains a constant and the force is conservative from $eq(4)-$ it is clear that work done by the conservation force depends on initial & final positions of body.

If $Xi = Xf$. i.e., for a closed path work done by the force is zero.

Thus the total mechanical energy of a system is conserved, if the force doing work on it, are conservative.