# Work, Energy and Power Questions – OCR A Level Physics

Praneel Physics

**1.** Calculate the work done when a force of 10 N moves an object 3 m. **(P)**

*Working and Answer:*

$$W = F \times d = 10 \times 3 = 30 \text{ J}$$

*Answer:* 30 J

**2.** A car engine does 2000 J of work in 5 s. Calculate the power output. **(P)**

*Working and Answer:*

$$P = \frac{W}{t} = \frac{2000}{5} = 400 \text{ W}$$

*Answer:* 400 W

**3.** Calculate the kinetic energy of a 2 kg mass moving at 3 m/s. **(P)**

*Working and Answer:*

$$KE = \frac{1}{2}mv^2 = \frac{1}{2} \times 2 \times 3^2 = 9 \text{ J}$$

*Answer:* 9 J

**4.** Calculate the gravitational potential energy of a 5 kg object lifted 10 m. **(P)**

*Working and Answer:*

$$GPE = mgh = 5 \times 9.8 \times 10 = 490 \text{ J}$$

*Answer:* 490 J

**5.** Calculate the work done by friction if a 10 N force acts opposite to a displacement of 4 m. **(P)**

*Working and Answer:*

$$W = F \times d \times \cos 180^\circ = 10 \times 4 \times (-1) = -40 \text{ J}$$

*Answer:* -40 J

**6.** A cyclist applies a 50 N force over a distance of 100 m. Calculate the work done. **(PP)**

*Working and Answer:*

$$W = F \times d = 50 \times 100 = 5000 \text{ J}$$

*Answer:* 5000 J

**7.** Calculate the power needed to raise an 80 kg person at 0.6 m/s vertically. **(PP)**

*Working and Answer:*

$$P = mgv = 80 \times 9.8 \times 0.6 = 470.4 \text{ W}$$

*Answer:* 470.4 W

**8.** A 2 kg object is dropped from 10 m. Calculate the velocity just before hitting the ground ignoring air resistance. **(PP)**

*Working and Answer:*

$$v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 10} = 14 \text{ m/s}$$

*Answer:* 14 m/s

**9.** A spring with constant 200 N/m is compressed 0.1 m. Calculate the energy stored. **(PP)**

*Working and Answer:*

$$E = \frac{1}{2}kx^2 = \frac{1}{2} \times 200 \times 0.1^2 = 1 \text{ J}$$

*Answer:* 1 J

**10.** A car engine produces 100 kW of power. Calculate the work done in 10 s. **(PP)**

*Working and Answer:*

$$W = P \times t = 100000 \times 10 = 1000000 \text{ J}$$

*Answer:* 1,000,000 J

**11.** A ball of mass 0.5 kg is thrown vertically upward with 10 m/s. Calculate its maximum height. **(PPP)**

*Working and Answer:*

$$KE_{\text{initial}} = GPE_{\max} \Rightarrow \tfrac{1}{2}mv^2 = mgh \Rightarrow h = \frac{v^2}{2g} = \frac{10^2}{2 \times 9.8} = 5.1 \text{ m}$$

*Answer:* 5.1 m

**12.** Calculate the work done to stop a 1500 kg car moving at 20 m/s. **(PPP)**

*Working and Answer:*

$$W = \Delta KE = \tfrac{1}{2}mv^2 = \tfrac{1}{2} \times 1500 \times 20^2 = 300000 \text{ J}$$

*Answer:* 300000 J

**13.** A weightlifter lifts a 150 kg barbell through 2 m in 3 seconds. Calculate the power output. **(PPP)**

*Working and Answer:*

$$P = \frac{W}{t} = \frac{mgh}{t} = \frac{150 \times 9.8 \times 2}{3} = 980 \text{ W}$$

*Answer:* 980 W

**14.** A pendulum of mass 0.5 kg swings to a height of 0.8 m. Calculate the speed at the lowest point. **(PPP)**

*Working and Answer:*

$$mgh = \tfrac{1}{2}mv^2 \Rightarrow v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 0.8} = 3.96 \text{ m/s}$$

*Answer:* 3.96 m/s

**15.** A 1500 kg car accelerates from 0 to 20 m/s. Calculate the change in kinetic energy. **(PPPP)**

*Working and Answer:*

$$\Delta KE = \tfrac{1}{2}m(v^2 - u^2) = \tfrac{1}{2} \times 1500 \times (20^2 - 0) = 300000 \text{ J}$$

*Answer:* 300000 J

**16.** A force of 100 N is applied to push a box 5 m across a rough surface. Calculate the work done against friction if the frictional force is 30 N. **(PPPP)**

*Working and Answer:*

$$W_{\text{fric}} = F_{\text{fric}} \times d = 30 \times 5 = 150 \text{ J}$$

*Answer:* 150 J

**17.** Calculate the power output of a motor lifting a 500 kg load at 0.5 m/s against gravity. **(PPPP)**

*Working and Answer:*

$$P = F \times v = mg \times v = 500 \times 9.8 \times 0.5 = 2450 \text{ W}$$

*Answer:* 2450 W

**18.** A vehicle with mass 1200 kg traveling at 15 m/s applies brakes to stop in 5 s. Calculate the power dissipated by the brakes. **(PPPP)**

*Working and Answer:*

$$\text{Power} = \frac{\text{Change in KE}}{t} = \frac{\frac{1}{2} \times 1200 \times 15^2}{5} = 27000 \text{ W}$$

*Answer:* 27000 W

**19.** A force of 20 N acts on a 3 kg box for 5 seconds, starting from rest. Calculate the power output at the end of the 5 seconds. **(PPPPP)**

*Working and Answer:*

$$a = \frac{F}{m} = \frac{20}{3} = 6.67 \text{ m/s}^2$$

$$v = a \times t = 6.67 \times 5 = 33.33 \text{ m/s}$$

$$P = F \times v = 20 \times 33.33 = 666.6 \text{ W}$$

*Answer:* 666.6 W

**20.** A car of mass 1000 kg accelerates uniformly from rest to 25 m/s in 10 seconds. Calculate the power output after 10 seconds. **(PPPPP)**

*Working and Answer:*

$$a = \frac{25}{10} = 2.5 \text{ m/s}^2$$

$$P = F \times v = ma \times v = 1000 \times 2.5 \times 25 = 62500 \text{ W}$$

*Answer:* 62500 W

**21.** A 1000 kg car engine outputs 50 kW of power. Calculate the maximum speed the car can achieve if the driving force is 200 N. **(PPPPP)**

*Working and Answer:*

$$P = F \times v \Rightarrow v = \frac{P}{F} = \frac{50000}{200} = 250 \text{ m/s}$$

*Answer:* 250 m/s