4. Energy & Fields Exercise Questions

E1 Chemical energy store in the man is transferred mechanically to elastic potential store in the bow by the force exerted by the man acting over a distance. As the arrow is released, the elastic potential store is transferred to kinetic store.

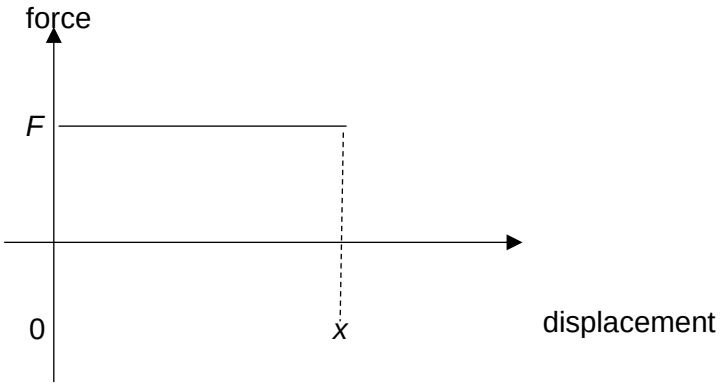
E2(a) Work done by Denise = Fx cos θ
= (30) (5.0) (cos 60°) = 75 J

(b) Hilda does not do work on the book because the book's displacement is zero.

E3 (a) Yes, work done can be positive or negative.
When force and displacement are in same direction, work done is positive.
When force and displacement are in opposite direction, work done is negative.

(b) Yes. Conditions: - force is zero
- Displacement is zero
- Force and displacement is perpendicular to each other.

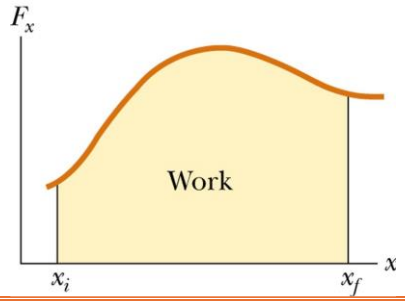
E4 (a)



(b) Area under force against displacement graph represent the work done by force on object.
Work done = $F(x)$

E5 **(a)** No. The formula work done = Fx(x) is only for a constant force.

(b) Work done by a varying force is equal to the area under the force–displacement graph.



E6(a) Initial energy of the kinetic store = 0
Change of KE = Work done on the sack
Final KE – Initial KE = WD
Final energy of the kinetic store = $2.0 \times 0.35 = 0.70$ J

E6(b)

$$\frac{1}{2}mv^2 = 0.7 \Rightarrow v = 0.37 \text{ ms}^{-1}$$

E7(a) By Principle of COE,
Sum of initial energy + energy supplied = sum of final energy
GPE at A + KE at A + 0 = GPE at B + KE at B
m (9.81) (30) + ½ m $(2.80)^2$ = 0 + ½ m v^2
v = 24.4 m s^{-1} (3 s.f.)

E7(b) By Principle of COE,
Sum of initial energy + energy supplied = sum of final energy
GPE at A + KE at A + 0 = GPE at C + KE at C
m (9.81) (30) + ½ m $(2.80)^2$ = m (9.81) (25) + ½ m v^2
v = 10.3 m s^{-1} (3 s.f.)

E8(a)

Work done in compressing spring = Energy in the elastic potential store of the spring

$$= \frac{1}{2}kx^2$$
$$= \frac{1}{2}(500)(0.10)^2$$
$$= 2.5 \text{ J}$$

E8(b)

Assume all the energy in the elastic potential store in the spring is converted to kinetic energy.

$$\Rightarrow \frac{1}{2}mv^2 = 2.5$$
$$\Rightarrow v = \sqrt{\frac{2(2.5)}{2.0}} = 1.6 \text{ ms}^{-1}$$

E9

Power of engine P = $F_e(v)$ where F_e is driving force from engine.

At maximum speed, acceleration = 0

$$D = F_e$$
$$P = F_e v$$
$$P = Dv$$
$$D \propto v^2$$
$$P \propto v^3$$
$$72k \propto 12^3$$
$$36k \propto v_{one}{}^3$$
$$v_{one} = 9.5\ ms^{-1}$$