ENGINEERING PHYSICS

2-1 The first law of thermodynamics

1. work done = 90 J so W = + 90 J

Internal energy loss = 120 J so ΔU = - 120 J

ΔU = Q – W therefore Q = ΔU + W = -120 + 90 = -30 J energy is transferred out of the gas

2. e.p.e. stored = 12 J

g.p.e. gained = 5 J

e.p.e. remaining = 3 J

(a) change in internal energy stored by the band = 12 – 3 = 9 J

(b) (i) work done by the band = energy given to the vehicle = 5 J

(ii) ΔU = - 9J (the internal energy of the band has decreased), W = + 5 J (as work is done by the band)

heat transfer, Q = ΔU + W = -9 + 5 = - 4 J , heat is transferred out of the band and into the surroundings

3. (a) (i) When the gas ignites, no force moves through a distance so no work is done.

(ii) When the gas expands it does so very quickly, so no heat transfer can take place from the surroundings in that time.

(b)

STAGE	Q	ΔU	W	
Gas ignites	> 0	> 0	0	Temperature rises so + Q, ΔU increases so + ΔU
Gas expands	0	< 0	> 0	Gas does work expanding so + W, ΔU decreases so - ΔU

4.

	Q	ΔU	W
a	+ 80 J	0	+80 J
b	- 220 J	- 400 J	+ 180 J
c	0 J	+ 30 J	- 30 J
d	- 500 J	- 260 J	- 240 J

(a) ΔU = Q – W therefore, 0 = 80 – W therefore W = 80 J

Work is done by the system, heat energy is transferred in, no net change in internal energy

(b) – 400 = Q – 180 therefore Q = -220 J

Work is done by the system, heat energy is transferred out of the system, the internal energy decreases

(c) + 30 = Q – (-30) therefore Q = 0 J

Work is done on the system, there is no heat energy transfer, the internal energy increases

(d) ΔU = - 500 – (- 240) therefore ΔU = - 260 J

Work is done on the system, heat energy is lost by the system, there is a net loss in internal energy