P160.

#1) a) E_{N-N} : 160 kJ/mol
b) $E_{N=N}$: 418 kJ/mol
c) $E_{N\equiv N}$: 945 kJ/mol

} more energy needed to break double and triple bonds.

#4) c) $BrF_3 + 2H_2 \rightarrow HBr + 3HF$

F-Br-F (with F below Br) (1 molecule) | H-H (2 molecule) | H-Br (1 molecule) | H-F (3 molecules)

React { 3 Br-F bonds · 1 molecule = 3 bonds
1 H-H bond · 2 molecules = 2 bonds

Produ { 1 H-Br bond · 1 molecule = 1 bond
1 H-F bond · 3 molecules = 3 bonds

E_{Br-F} : 280 kJ/mol
E_{H-H} : 436 kJ/mol
E_{H-Br} : 366 kJ/mol
E_{H-F} : 570 kJ/mol

React: $\Delta H_{\text{Bonds Broken}} = (3)(280) + 2(436) = 1712$ kJ/mol
Prod : $\Delta H_{\text{Bonds Formed}} = -\left((1)(366) + (3)(570)\right) = -2076$ kJ/mol

$\Delta H = \Delta H_{\text{Bonds Broken}} + \Delta H_{\text{Bonds formed}}$
$\Delta H = 1712 + (-2076)$
$\Delta H = -364$ kJ/mol → EXOTHERMIC

6) a) $2N \rightarrow N_2$

$N \rightarrow :N \equiv N:$

(2 individual atoms) (1 molecule)
(No Bonds)

PRODUCT { 1 $N \equiv N$ bond • 1 molecule = 1 bond | $E_{N \equiv N} = 945$ kJ/mol

React: $\Delta H_{\text{Bonds Broken}} = 0$ kJ/mol (No Bonds were broken)

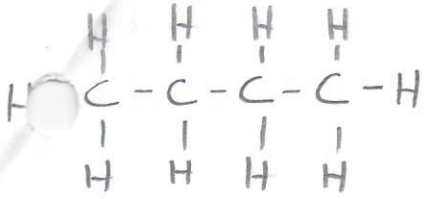
Prod: $\Delta H_{\text{Bonds formed}} = -(945) = -945$ kJ/mol

$$\Delta H = \Delta H_{\text{Bonds Broken}} + \Delta H_{\text{Bonds Formed}}$$

$$\Delta H = 0 + (-945)$$

$$\Delta H = -945 \text{ kJ/mol} \rightarrow \text{EXOTHERMIC}$$

6) b) $2\,C_4H_{10} + 13\,O_2 \rightarrow 8\,CO_2 + 10\,H_2O$



(2 molecules) (13 molecules) (8 molecules) (10 molecules)

Reactants

- 3 C-C bonds × 2 molecules = 6 bonds
- 10 C-H bonds × 2 molecules = 20 bonds
- 1 O=O bond × 13 molecules = 13 bonds

Products

- 2 C=O bonds × 8 molecules = 16 bonds
- 2 O-H bonds × 10 molecules = 20 bonds

E_{C-C} :	347 KJ/mol
E_{C-H} :	413 KJ/mol
$E_{O=O}$:	498 KJ/mol
$E_{C=O}$:	745 KJ/mol
E_{O-H} :	460 KJ/mol

Rct: $\Delta H_{\text{Bonds Broken}} = (6)(347) + (20)(413) + (13)(498) = 16816$ KJ/mol

Prod: $\Delta H_{\text{Bonds formed}} = -\left((16)(745) + (20)(460)\right) = -21120$ KJ/mol

$\Delta H = \Delta H_{\text{Bonds Broken}} + \Delta H_{\text{Bonds formed}}$

$\Delta H = 16816 + (-21120)$

$\Delta H = -4304$ KJ/mol → EXOTHERMIC

6.) c) $CO_2 \rightarrow C + O_2$

(1 molecule) (1 atom) (No Bonds) (1 molecule)

React { 2 C=O bonds × 1 molecule → 2 Bonds | $E_{C=O}$: 745 kJ/mol

Product { ∅ C bonds × 1 atom → ∅ bonds | — —

Product { 1 O=O bonds × 1 molecule → 1 Bond | $E_{O=O}$: 498 kJ/mol

Reactants : $\Delta H_{\text{Bonds Broken}} = 2(745) = 1490$ kJ/mol

Products : $\Delta H_{\text{Bonds formed}} = -((1)(498)) = -498$ kJ/mol

$\Delta H = \Delta H_{\text{Bonds Broken}} + \Delta H_{\text{BONDS FORMED}}$

$\Delta H = 1490 + (-498)$

$\Delta H = 992$ kJ/mol → ENDOTHERMIC

6 d) $2HCCH + 5O_2 \rightarrow 4CO_2 + 2H_2O$

(2 molecules) (5 molecules) (4 molecules) (2 molecules)

Reactants

- 1 C≡C bond × 2 molecules = 2 bonds
- 2 C-H bonds × 2 molecules = 4 bonds
- 1 O=O bond × 5 molecules = 5 bonds

Products

- 2 C=O bonds × 4 molecules = 8 bonds
- 2 H-O bonds × 2 molecules = 4 bonds

$E_{C\equiv C}$	839 kJ/mol
E_{C-H}	413 kJ/mol
$E_{O=O}$	498 kJ/mol
$E_{C=O}$	745 kJ/mol
E_{H-O}	460 kJ/mol

React: $\Delta H_{\text{Bonds Broken}} = (2)(839)+(4)(413)+(5)(498) = 5820$ kJ/mol

Prod: $\Delta H_{\text{Bonds formed}} = -((8)(745)+(4)(460)) = -7800$ kJ/mol

$\Delta H = \Delta H_{\text{Bonds Broken}} + \Delta H_{\text{Bonds FORMED}}$

$\Delta H = 5820 + (-7800)$

$\Delta H = -1980$ kJ/mol → EXOTHERMIC