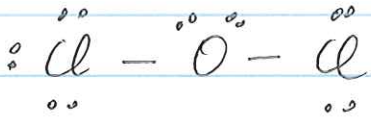
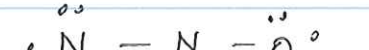
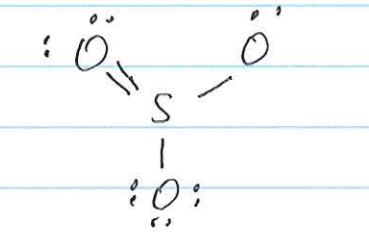
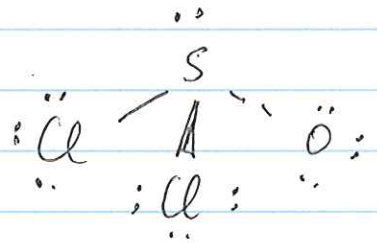
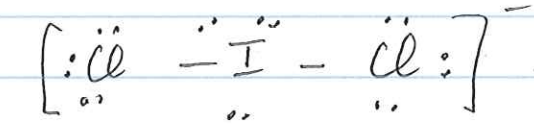
Answers to worksheet "Shapes of molecules and polar molecules"

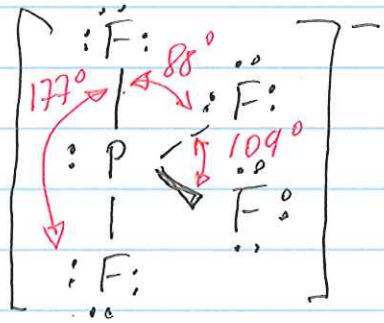
1) (a) Cl_2O (20)  geometry: tetrahedral
shape: bent
angle: 104.5°/105°

(b) N_2O (16)  linear, linear, 180°

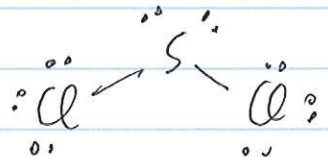
(c) SO_3 (24)  trigonal planar (geometry)
" " (shape)
120°

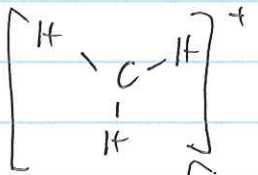
(d) Cl_2SO (26)  tetrahedral
trigonal pyramidal
107°

(e) ICl_2^- (22)  trigonal bipyramidal
linear, 180°

(f) PF_4^- (34) 

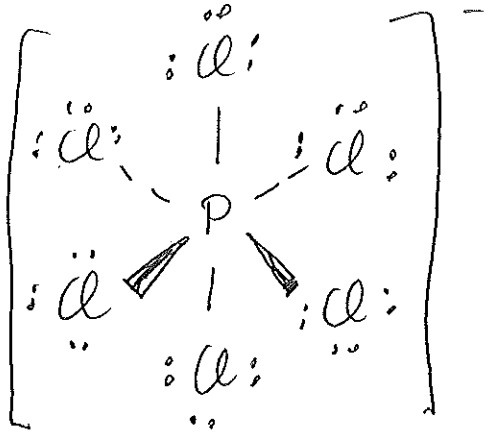
trigonal bipyramidal
tetrahedron (=shape)

(g) SCl_2 (20)  tetrahedral (geometry)
bent, 105°

(h) CH_3^+ (6)  trigonal planar, trigonal planar
120°

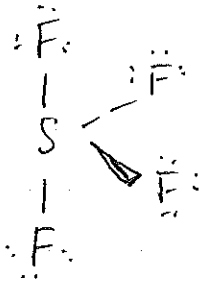
(i) ICl_4^- (36)  octahedral (geometry)
square planar
90°

(j) PCl_6^- (48)



Octahedral
Octahedral
90°

(k) SF_4 (34)



trigonal bipyramidal
tetrahedron
177°/88°/117°

2. NF_3

(shape) trigonal pyramidal
107°
geometry: tetrahedral

↓

* 4 negative charge centres
* 1 non-bonding pair/ 3 bonding pair

BF_3

geometry: trig planar
shape: "
angle: 120°

↓

* 3 negative charge centres
* all 3 bonding pairs

ClF_3

geo: bipyramidal
shape: T-shaped
87.5°

↓

* 5 charge centres
* 3 bonding pairs + 2 non-bonding

3. NO_2^+

$[:\ddot{O}=N=\ddot{O}:]^+$
linear, 180°

* 2 negative charge centres
* 2 bonding pairs (4) (no lone pairs)

N_2O

$:\ddot{O}-\dot{N}=\ddot{O}:$
134°/bent

* 3 negative charge centres
* 2 bonding pairs
* single electron less repulse between single e⁻ + bonding pair

NO_2

$[:\ddot{O}-\underset{\cdot\cdot}{N}=\ddot{O}:]$
115°, bent

* more repulsion from 2 non-bonding electrons

4. NH_2^- NH_3 NH_4^+

- All 3 have tetrahedral geometry (4 negative charge centres)
- but different shapes/ repulsion between electron pairs
- because of different numbr of non-bonding pairs
- the greater the numbr of non-bonding pairs, the greater the repulsion on the bonding pairs, the smaller the angles
- NH_2^- → 2 non-bonding → 105°
  NH_3 → 1 non-bonding → 107°
  NH_4^+ → 0 " → 109°

5. Same answer as 4 NH_2^- = H_2O
   NH_4^+ = CH_4