Mark schemes

Q1.

B

CH_4

[1]

Q2.

C

XeF_4

[1]

Q3.

A

H–O

[1]

Q4.

D

They form giant structures.

[1]

Q5.

B

SO_2

[1]

Q6.

D

silicon dioxide

[1]

Q7.

C

C_6H_5Cl

[1]

Q8.

B

NH_3

[1]

Q9.

B

graphite

[1]

Q10.

A

Kevlar

[1]

Q11.

Shapes:

Must show lp on NCl_3

1

Must have some indication that shape is 3D

1

Name of shape of NCl_3 = Pyramidal

Allow tetrahedral

1

Bond Angle = 109.5°

Allow 109 – 109.5°

1

(4 bp and 0 lp) electron pairs repel equally / electron pairs repel to be as far apart as possible

Do not allow atoms repel equally

Allow bonds repel equally

1

[5]

Q12.

D

NH_4Cl

[1]

Q13.

(a) **M1** idea that pentan-2-ol has stronger intermolecular forces

***M1** idea that hydrogen bonds are stronger than van*

der Waals' forces

*Penalise **M1** for any reference to idea of breaking covalent bonds*

1

M2 pent-1-ene has van der Waals' forces (only)

***M2** allow London forces or temporary/induced dipole forces or vdW forces for van der Waals' forces*

1

M3 pentan-2-ol (also) has hydrogen bonds

***M3** Ignore reference to dipole-dipole forces in pentan-2-ol*

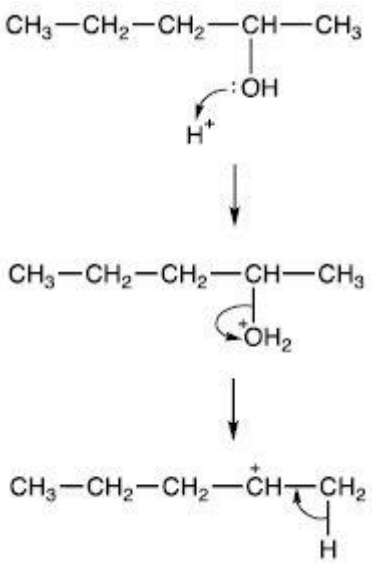
1

(b) **M1** reagent = conc sulfuric acid or conc phosphoric acid

***M1** penalise incorrect name or formula (even if both name and formula are given)*

1

M2 condition = hot / temperature in range 150-200°(C)



***M2** allow high temperature*

***M2** reagent must indicate an acid in some way in order for **M2** to be awarded*

***M1/2** allow 1 mark if H_2SO_4/H_3PO_4 given as reagent and conc(entrated) given as condition*

1

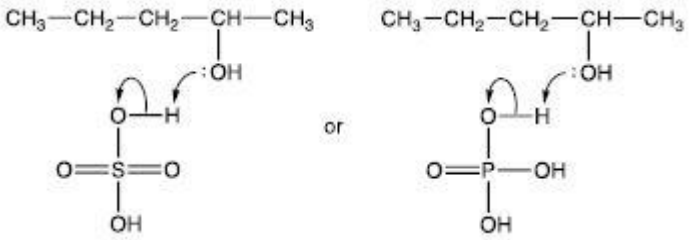
M3 curly arrow from lone pair on alcohol O to H^+

M3-5

*penalise **M3/4/5** for any additional arrow(s) in addition to the correct one at each stage*

*If incorrect reactant (or product if shown), maximum 2 marks of **M3-5***

Alternatives for M3



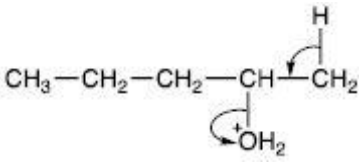
1

M4 curly arrow from C-O bond to O on correct intermediate

1

M5 arrow from C-H bond on C1 to C-C bond between C1 and C2 on correct carbocation

*allow **M4** and **M5** concurrent:*



1

[8]

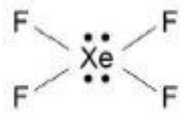
Q14.

This question is marked using levels of response. Refer to the Mark Scheme Instructions for Examiners for guidance on how to mark this question.	
Level 3 **5-6 marks**	All stages are covered and the description of each stage is generally correct and virtually complete. Answer is communicated coherently and shows a logical progression from stage 1 to stage 2 and stage 3.
Level 2 **3-4 marks**	All stages are covered but the description of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete. Answer is mainly coherent and shows progression from stage 1 to stage 2 and/or stage 3.
Level 1 **1-2 marks**	Two stages are covered but the description of each stage may be incomplete or may contain inaccuracies, OR only one stage is covered but the explanation is generally correct and virtually complete. Answer includes isolated statements and these are presented in a logical order.
Level 0 **0 marks**	**0 marks** Insufficient correct chemistry to gain a mark.

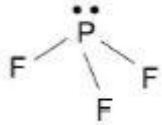
Indicative chemistry content

Stage 1 electron pairs
1a XeF_4 4BP and 2LP around Xe
1b PF_3 3BP and 1LP around P

Stage 2 explanation of shapes
2a XeF_4 is square planar
Or



2b PF_3 is pyramidal (allow tetrahedral)
Or



2c Electron pairs repel as far as possible or Lone pair repels more than bonding pairs

Stage 3 IMF
The relative strength of the intermolecular forces in the molecules must be explained to gain maximum marks.
3a XeF_4 has vdw forces and PF_3 has dipole-dipole forces (and vdw)
3b Stronger/more intermolecular forces in XeF_4
3c Due to larger M_r or more electrons or larger molecules or packs more closely together

[6]

Q15.

A

[1]

Q16.

(a) Fluoride ion has (two) fewer protons/lower nuclear charge

Do not allow fluorine, but allow fluorine ion.

Any reference to different numbers of electrons in the ions loses M1

1

Weaker attraction between nucleus and (outer) electrons

Allow answers in terms of sodium ion but must be explicit.

Ignore references to atomic radius

1

(b) (Electrostatic) forces of attraction between oppositely charged ions/Na^+ and F^-

Mention of IMF, covalent, macromolecular, metallic, electronegativity of ions loses both marks

1

Lots of energy needed to overcome/break forces

Allow strong ionic bonding

Allow strong forces/bonds of attraction (need to be broken)

1

(c) Type of Bond: Coordinate bond / dative (covalent) bond

If just covalent, then do not award M1 but mark on

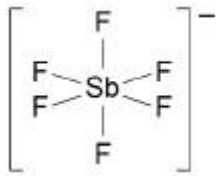
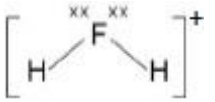
1

Explanation: A (lone) pair of electrons is donated <u>from F</u>

Allow both electrons (in the shared pair) come from F

1

(d)

Shape		
Name of shape	Octahedral	Bent / V-shaped / angular

Lone pairs on H_2F^+ are essential (can be shown in lobes)

Ignore missing charges

Mark independently

4

(e) ΔH = ΣΔH(Bonds broken) - ΣΔH(Bonds Formed)

Allow M1 if 2785 <u>and</u> 1996 seen (or allow M1 if 1961 <u>and</u> 1172 seen)

-179 = 2(412) + 837 + 2(562) – [348 + 4(412) + 2(C—F)]

1

-179 = 2785 – (1996 +2(C—F))

2(C—F) = 968

M3 consequential on any M2 if it is clear that M2 is for 2(C-F)

1

C—F = 484

-484 scores 2

1

[13]

Q17.

A

[1]

Q18.

C

[1]

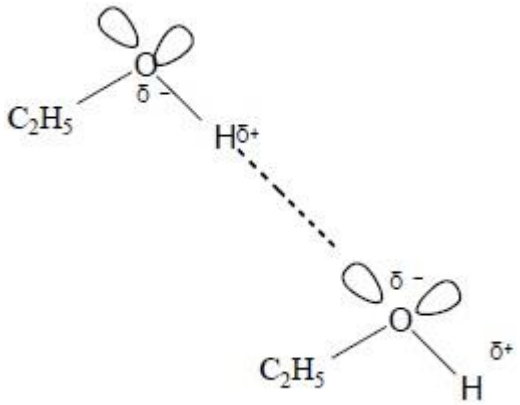
Q19.

D

CH_3CH_2COOH

[1]

Q20.



M1 *two lone pairs on each O atom*
<u>and</u>
δ+ and δ- on each H-O bond

1

M2 *<u>dotted/broken</u> line shown between lone pair on one molecule and the correct H on another*

1

M3 *O·····H–O in straight line, dependent on* ***M2***
Ignore any partial charges on C–H or C–O bonds
For straight line in ***M3****, allow a deviation of up to 15°*

1

If a different molecule containing hydrogen bonding due to O–H bond drawn (e.g. methanol, water) or an incorrect attempt at the structure of ethanol, then maximum of 2 marks (i.e. only penalise if would score all three marks otherwise)

(b) Hydrogen bonds (between ethanol molecules)

1

(permanent) dipole-dipole <u>OR</u> van der Waals force (between methoxymethane molecules)

Allow vdW

1

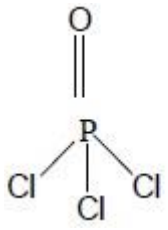
Hydrogen bonds are stronger/est intermolecular force

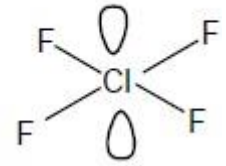
Allow more energy to break/overcome hydrogen bonding

Allow converse arguments

1

(c)





$POCl_3$: allow any shape showing 1 double bond between P and O and 3 P-Cl bonds

1

ClF_4^-: allow any shape showing 4 Cl⁻F bonds and 2 lone pairs

1

(distorted) Tetrahedral

1

Square planar

1

90°

1

[11]

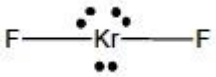
Q21.

D

[1]

Q22.

(a)



Allow diagram with 2 bonds <u>and</u> 3 lone pairs

1

<u>Linear</u>

1

<u>180°</u>

1

(b) Lone pairs repel more than bond pairs

1

Allow idea of reducing bond angle

bond angle will be lower (than regular tetrahedral angle) / bond angle of 103-106°

1

(c) Van der Waals forces

Allow London forces, dispersion forces, induced dipole-dipole

Apply List for M1.

Allow M2 if vdW mentioned in M1, otherwise CE=0

1

(Uneven distribution of electrons in) one molecule induces dipole in neighbouring/another/nearby molecule

1

symmetrical molecule / dipoles cancel

OR

no hydrogens bonded to F (N or O), therefore no hydrogen bonding

1

[8]

Q23.

C

[1]

Q24.

D

[1]

Q25.

(a) Power of an atom to attract a pair of electrons in a covalent bond.

Allow power of an atom to attract a bonding/shared pair of electrons

Allow power of an atom to withdraw electron density from a covalent bond

Not lone pair Not Element

1

(b) Difference in electronegativity leads to bond polarity

If chloride (ions) mentioned then CE = 0

1

(dipoles don't cancel therefore the molecule has an overall permanent dipole) and there is an attraction between $\partial+$ on one molecule and $\partial-$ on another

partial charges should be correct if shown and can score M2 from diagram

1

(c)

SiH_4	**Tetrahedral**		1 shape &

			no tick
PH_3	**Pyramidal (trigonal)** **Allow tetrahedral**	✓	1 shape & tick
$BeCl_2$	**Linear**		1 shape & no tick
CH_3Cl	**(Distorted)Tetrahedral**	✓	1 shape & tick

If shapes are drawn rather than named then penalise first mark gained

4

[7]

Q26.

A

[1]

Q27.

A

[1]