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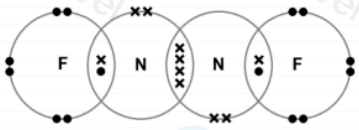
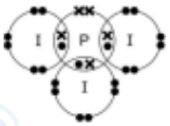
Question	Answer	Marks
3(a)	strong triple bond / high triple bond enthalpy	1
	non-polar (molecule)	1
3(b)(i)	*e.g.* $N_2 + 1½O_2 \rightarrow NO + NO_2$	1
3(b)(ii)	HNO_2 and HNO_3	1
3(b)(iii)	photochemical smog	1
3(c)(i)	0 for both ΔH_f of N_2 and H_2	1
	–46 for ΔH_f of NH_3	1
3(c)(ii)	increases rate by providing a different mechanism with a lower activation energy	1
3(c)(iii)	rate is lowered	1
	lower frequency of successful collisions / number of successful collisions per unit time	1
3(d)(i)	 correct bonding pairs	1
	lone pairs	1
3(d)(ii)	sp^2	1
3(d)(iii)	 M1 shows the pi (π) orbital	1
	M2 refers to overlap of (two) (2)p orbitals side-on / above and below the plane	1

1(f)(i)	 **M1** correct bonding pairs **M2** correct number of remaining outer electrons on each atom	2
1(f)(ii)	hydrolysis	1
1(f)(iii)	proton donor / H^+ donor fully dissociates / fully ionises	2
1(f)(iv)	$H_2PO_3^-$	1

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Question	Answer	Marks
3(a)(i)	(natural =)lightning	1
	(man-made =)internal combustion engines	1
3(a)(ii)	$2NO_2 + H_2O \rightarrow HNO_2 + HNO_3$ **OR** $4NO_2 + O_2 + 2H_2O \rightarrow 4HNO_3$	1
3(a)(iii)	It / NO_2 reacts with (unburned) hydrocarbons / VOCs **ALLOW** reaction of unburned hydrocarbons / VOCs in presence of NO_2	1
3(a)(iv)	$2HNO_3 + CaO \rightarrow Ca(NO_3)_2 + H_2O$	1
3(a)(v)	brown fumes given off	1
3(b)(i)	(+)5 / V	1
3(b)(ii)	aluminium / Al	1
3(b)(iii)	(NH_3 is an) H^+ acceptor	1

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(d)</td><td>
<table>
<tr><td>element</td><td>nitrogen</td><td>phosphorus</td></tr>
<tr><td>state and appearance</td><td>colourless gas</td><td>white solid</td></tr>
<tr><td>electrical conductivity</td><td>• poor</td><td>poor</td></tr>
<tr><td>type of bonding</td><td>• covalent</td><td>• covalent</td></tr>
<tr><td>type of structure</td><td>simple</td><td>• simple</td></tr>
</table>
</td><td>2</td></tr>
<tr><td>3(e)</td><td>simple molecular (lattice structure)</td><td>1</td></tr>
<tr><td>3(f)(i)</td><td>M1 one sigma / σ bond AND head-on (overlap of) p / sp (orbitals)</td><td>1</td></tr>
<tr><td></td><td>M2 two pi / π bond(s) AND side-on (overlap of / involving) p (orbitals)</td><td>1</td></tr>
<tr><td>3(f)(ii)</td><td>P≡P is much weaker so P_2 is more reactive (than N_2)</td><td>1</td></tr>
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