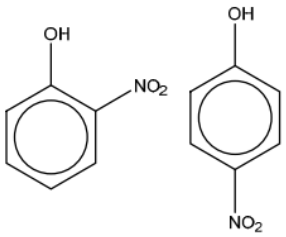
32. Hydroxy compounds

32.2 Phenol

Paper 4

Marking Scheme

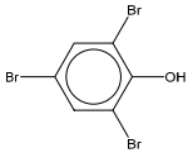
Q1.

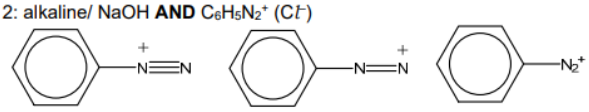
(a)(i)	$C_6H_5OH + Na \rightarrow C_6H_5ONa + ½H_2$	1
(a)(ii)	 both structures for one mark	1

Q2.

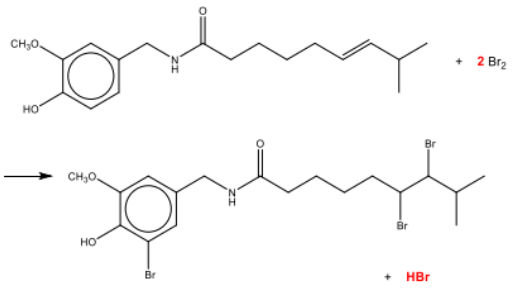
(a)	**M1** p-orbital / lone pair from **O** atom is overlaps / delocalised into the ring **M2** greater π electron density around the ring **OR** makes the ring more electron rich / positions 2,4,6 more electron rich **M3** polarises electrophiles **more** easily	3

Q3.

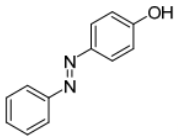
(c)(i)	C_6H_6O / $C_6H_5OH + Na \rightarrow C_6H_5O^-Na^+ + ½H_2$	1
(c)(ii)		1

(c)(iii)	**M1** reaction 1: aqueous HNO_3 / dilute HNO_3 **M2** reaction 2: alkaline/ NaOH **AND** $C_6H_5N_2^+$ (Cl^-)  **OR** alkaline / NaOH **AND** benzene / phenyl diazonium ion / salt	2

Q4.

(b)	 + 2 Br_2 + HBr M1: HBr [1] u / c M2: structure of the organic product[1] M3: correct balanced equation [1] ecf	3

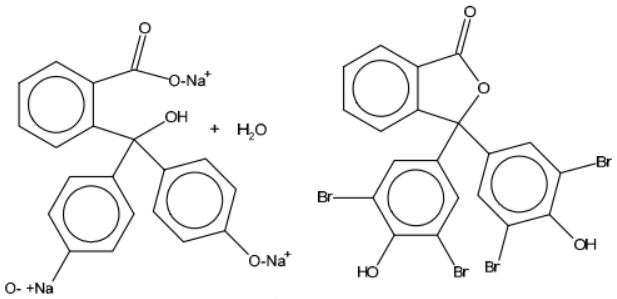
Q5.

(a)	$C_6H_5O^-$ / $C_6H_5O^-Na^+$ / C_6H_5ONa [1] $C_6H_5O^-$ / $C_6H_5O^-Na^+$ / C_6H_5ONa [1] $C_6H_5N_2C_6H_4O^-$ or $C_6H_5N_2C_6H_4OH$ or  [1] $C_6H_5OCOC_6H_4CO_2C_6H_5$ [1]	4
(b)	2 and 4 [1]	1

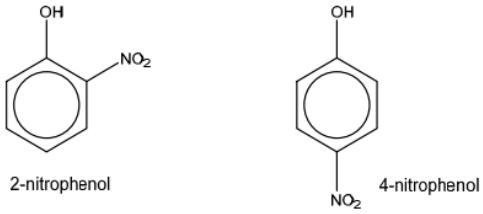
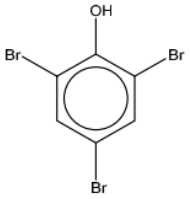
Q6.

(b)	lone pair of oxygen is delocalised into the ring any one from: • phenol has a higher electron density in the ring • phenol can polarise/induce a dipole in Br_2	2

Q7.

(d)(i)	phenol **AND** ester	**1**
(d)(ii)	 **M1** correct hydrolysis product of ester **M2** (di)phenoxide salt **M3** bromination of **both** phenol rings at position 2 or/and 6 **M4** hydrolysis **AND** (electrophilic) substitution	**4**

Q8.

(a)	**M1:** HNO_2 **OR** $NaNO_2$ + HC*l* [1] **M2:** T ⩾ 10 °C / warm **AND** water [1]	**2**
(b)	 2-nitrophenol 4-nitrophenol 2 × [1]	**2**
(c)(i)	 2,4,6-tribromophenol ✓ ✓ [2]	**2**
(c)(ii)	bromine is decolourised **AND** white precipitate is formed **BOTH** [1]	**1**
(d)	$C_6H_5OH + NaOH \rightarrow C_6H_5ONa + H_2O$ [1] **ALLOW** any equation for phenol acting as an acid	**1**

(e)	phenol>water>ethanol [1] • (phenol:) lone pair on oxygen is delocalised into the benzene ring • (ethanol:) positive inductive effect / electron donating effect of alkyl / ethyl group • correct statement about stabilisation of anion/ conjugate base **OR** weakening of O-H bonds once *in the context of phenol / ethanol* • correct statement about ease of proton/H^+ donation *in the context of phenol / ethanol* [2] Two correct statements = 1 mark	**3**