M1. (penalty for sig fig error =1mark per question)

(a) (i) moles KNO_3 = 1.00/101.1 = 9.89 × 10⁻³ (mol)

1

(ii) pV = nRT or n = pV/RT

1

moles O2 = n = $\dfrac{pV}{RT}$ = **(1)** $\dfrac{100000 \times 1.22 \times 10^{-4}}{8.31 \times 298}$ **(1)**

2

= 4.93 × 10⁻³ (mol)

1

(mark answer first – check back if wrong)
(transcription error lose M3, mark M4 conseq on error)
(if 'untraceable' figures used M3=M4=0)
(if wrong temp conversion – lose M3 – conseq M4)
(if n = RT/pV CE, lose M3 and M4)

(b) (i) <u>simplest/lowest ratio of atoms of each / element/<u>s</u></u> in a compound / substance / species / entity / molecule

1

(ii) *K*　　　　*N*　　　　*O*

$\dfrac{45.9}{39.1}$　　$\dfrac{16.5}{14}$　　$\dfrac{37.6}{16}$ (1)

(1)

1.17　　　1.18　　　2.35

1　　　　1　　　　2　　　KNO_2　(1)

(M3 tied to M2), (M3 can be transferred from equation if ratio correct but EF not given) (if calc inverted, lose M2 and M3), (if used At N¹ / wrong No for Ar then CE, lose M2 and M3) (if % of O missing, award M2 only)

3

(c) $2KNO_3 \rightarrow 2KNO_2 + O_2$ or fractions/multiples
　　　(accept $2KNO_3 \rightarrow K_2N_2O_4 + O_2$)
　　　(do NOT accept 'Y' in equation)

1

[10]

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M2. A

[1]

M3. A

[1]

M4. A

[1]

M5. C

[1]

M6. (a) (i) $100 \times 10^{-3} \times 0.500 = 5.00 \times 10^{-2}$ (mol)

accept 5×10^{-2} / 0.05

1

(ii) $27.3 \times 10^{-3} \times 0.600 = 1.64 \times 10^{-2}$ / 1.638×10^{-2} (mol) <u>only</u>

1

(iii) 1.64×10^{-2} (mol)

Mark conseq on (ii)

1

(iv) $5.00 \times 10^{-2} - 1.64 \times 10^{-2} = 3.36 \times 10^{-2}$ (mol)

Mark conseq on (i) & (iii)

1

(v) $3.36 \times 10^{-2} \times \frac{1}{2} = 1.68 \times 10^{-2}$ (mol)

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If 2.78 × 10⁻² used 1.39 × 10⁻²

Mark conseq on (iv)

1

1.68 × 10⁻² × 132(.1) **or** 1.39 × 10⁻² × 132(.1)

Mark for M_r

1

= 2.22 g **or** 1.83 g

1

(b) pV = nRT

1

$n = \dfrac{0.143}{17}$ = 8.4(1) × 10⁻³ (mol)

1

$T = \dfrac{pV}{nR} = \dfrac{100000 \times 2.86 \times 10^{-4}}{8.31 \times 8.4 \times 10^{-3}}$ (1)

1

= 408.5 – 410.5 (K)

Mark conseq on moles

Note *Sig. fig. penalty - apply once if single sf given, unless calc works exactly*

1

[11]

M7.B

[1]

M8.D

[1]

M9.B

[1]

M10. (a) moles HNO_3 = 175 × 10⁻³ × 1.5 = (0.2625 mol); **1**

moles $Pb(NO_3)_2$ = ½ × 0.2625 = (0.131 mol); **1**

M_r $Pb(NO_3)_2$ = 331(.2); **1**

mass $Pb(NO_3)_2$ = 331.2 x 0.131=43.5 g;
(accept 43.2 - 43.8)
(M1 & M2 are process marks. If error in M1, or in M2, do not mark M4 consequentially, i.e. do not award M4)
(if atomic numbers used in M3, do not award M4) **1**

(b) (i) pV = nRT; **1**

$$n = \frac{pV}{RT} = \frac{100000 \times 1.5 \times 10^{-4}}{8.31 \times 500}$$; **1**

= 3.61 X 10⁻³;
(If pressure not converted to Pa, max 2)
(If n = $\frac{RT}{pV}$ used = CE; M2 = M3 = 0) **1**

(ii) moles NO_2 = 4/5 × 3.61 × 10⁻³;
[mark is for use of 4/5] **1**

= 2.89 × 10⁻³ *OR* 1.78×10⁻³; **1**

M_r NO_2 = 46; **1**

massNO_2 = 46 × 2.89 × l0⁻³ = 0.1.33(g)

OR 0.0821 (g);
(if atomic numbers used, M3 = M4 = 0) **1**

[11]

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M11. (a) (nucleophilic) addition-elimination;
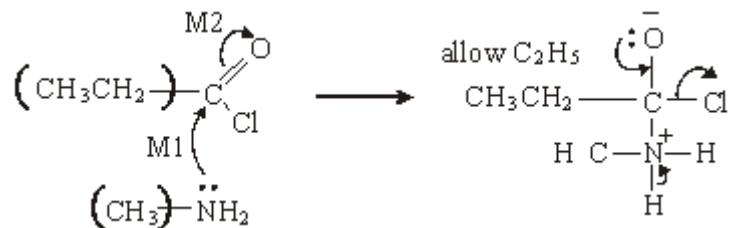

(M3 for structure)
(M4 for 3 arrows and lone pair)
(M2 not allowed independent of M1, but allow M1 for correct attack
on C+ if M2 show as independent first.)
(+on C of C=O loses M2 but ignore δ+ if correct)
(Cl⁻ removing Ft loses M4)

1
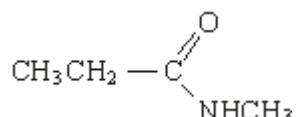
(If MS lost above for wrong C chain, do not penalise same error again here)

5

(b) $CH_3CH_2COCl + AlCl_3 \rightarrow [CH_3CH_2CO]^+ + AlCl_4^-$;

(penalise wrong alkyl group once at first error)

(position of + on electrophile can be on O or C or outside [ ])

*(penalise wrong curly arrow in the equation or lone pair on $AlCl_3$)*

1

	(horseshoe must not extend beyond C2 to C6 but can be smaller)
	(+ not too close to C1)
	(penalise M2 if CH_3 chain wrong again but allow M1 and M3)

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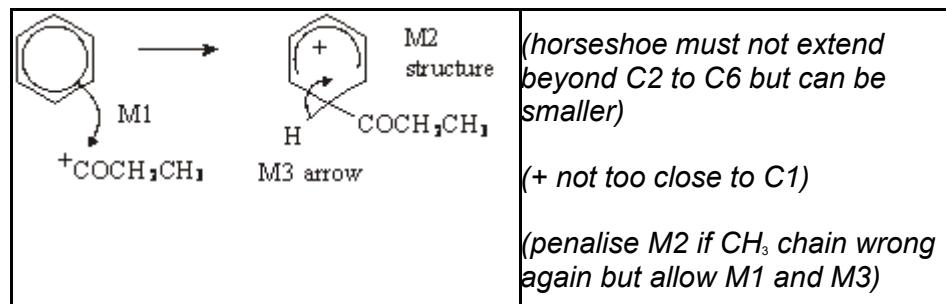
	(M3 arrow into hexagon unless Kekule)
	(allow M3 arrow independent of M2 structure)
(M1 arrow from within hexagon to C or to + on C)	
(don't penalise position of + on C of RCO+)	

3

$$AlCl_4^- + H^+ \rightarrow AlCl_3 + HCl;$$
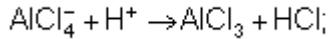
(or can be gained in mechanism);

1

(c)　M1 $CH_3CH_2COCl + H_2O \rightarrow CH_3CH_2COOH + HCl$ 1
(penalise wrong alkyl group once at first error)

1

M2 M_r of CH_3CH_2COCl = 92.5 1
(if Mr wrong, penalise M2 only)
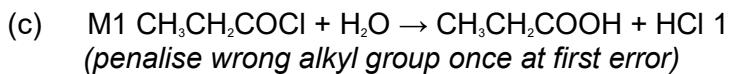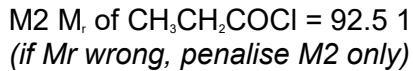
1

M3 moles of CH_3CH_2COCl = 1.48/92.5 = 0.016 1

1

M4 moles NaOH = 2 × 0.016 = 0.032 1
(allow for × 2 conseq to wrong no of moles)

1

M5 volume of NaOH = 0.032/0.42 = 0.0762 dm^3 or 76.2 cm^3 1
(with correct units)
(if ×2 missed in M4 lose M5 also)

1

[16]