Representative Infrared Spectra

Use these slides to study the general characteristics of the infrared spectra of various functional groups

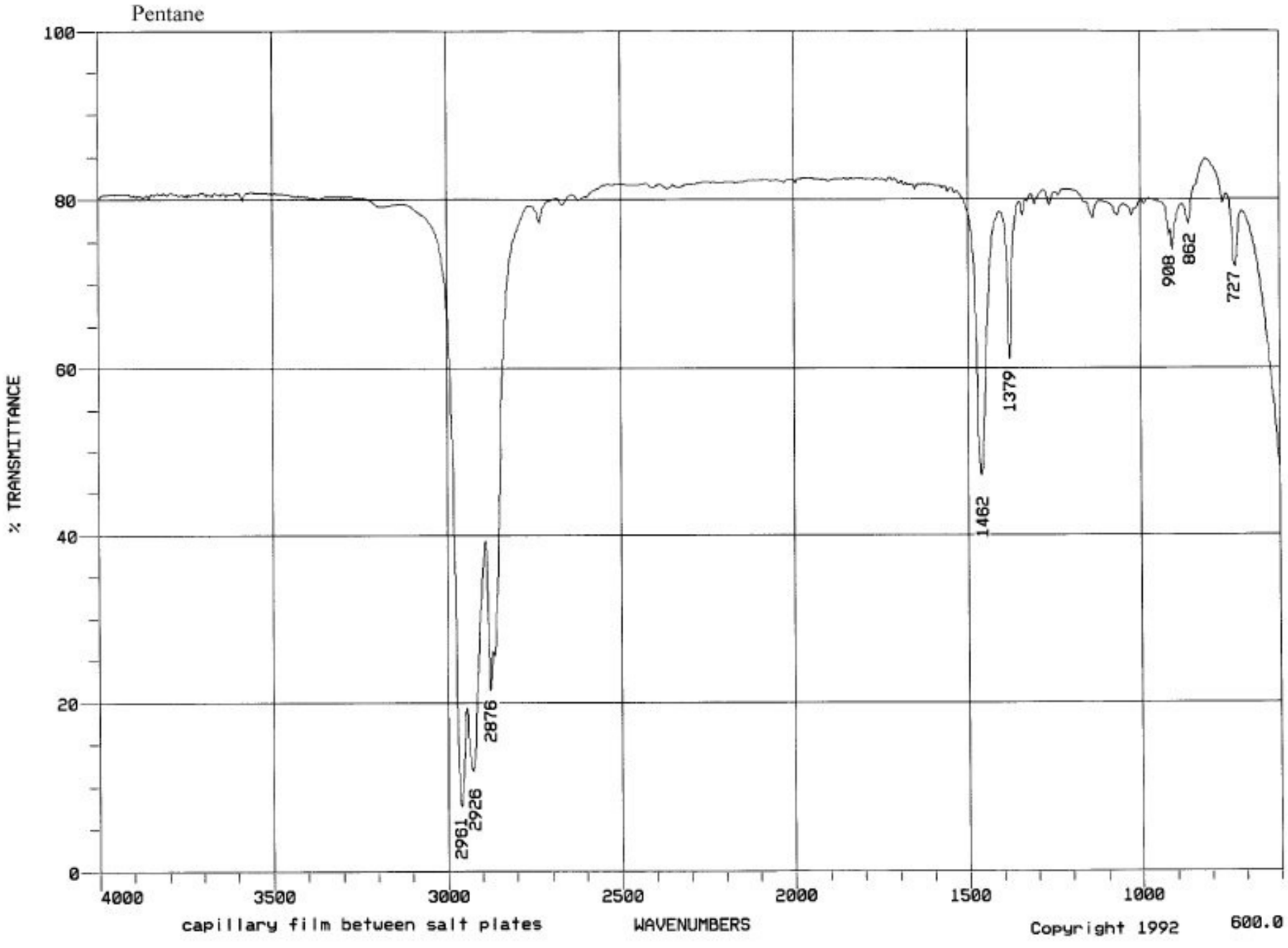
If you are viewing in a web browser, each slide will first display the name of the upcoming compound, then its structure, and then its spectrum. You can use this behavior to practice drawing structures given a name and also to predict important spectral features given the structure. Use the arrow keys on your keyboard to advance through the slides.

The functional group title slides list some characteristic absorption frequencies (in cm^{-1}). Remember, hydrogen bonding and structural features such as conjugation can cause considerable variation in stretching frequencies.

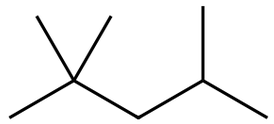
Alkanes

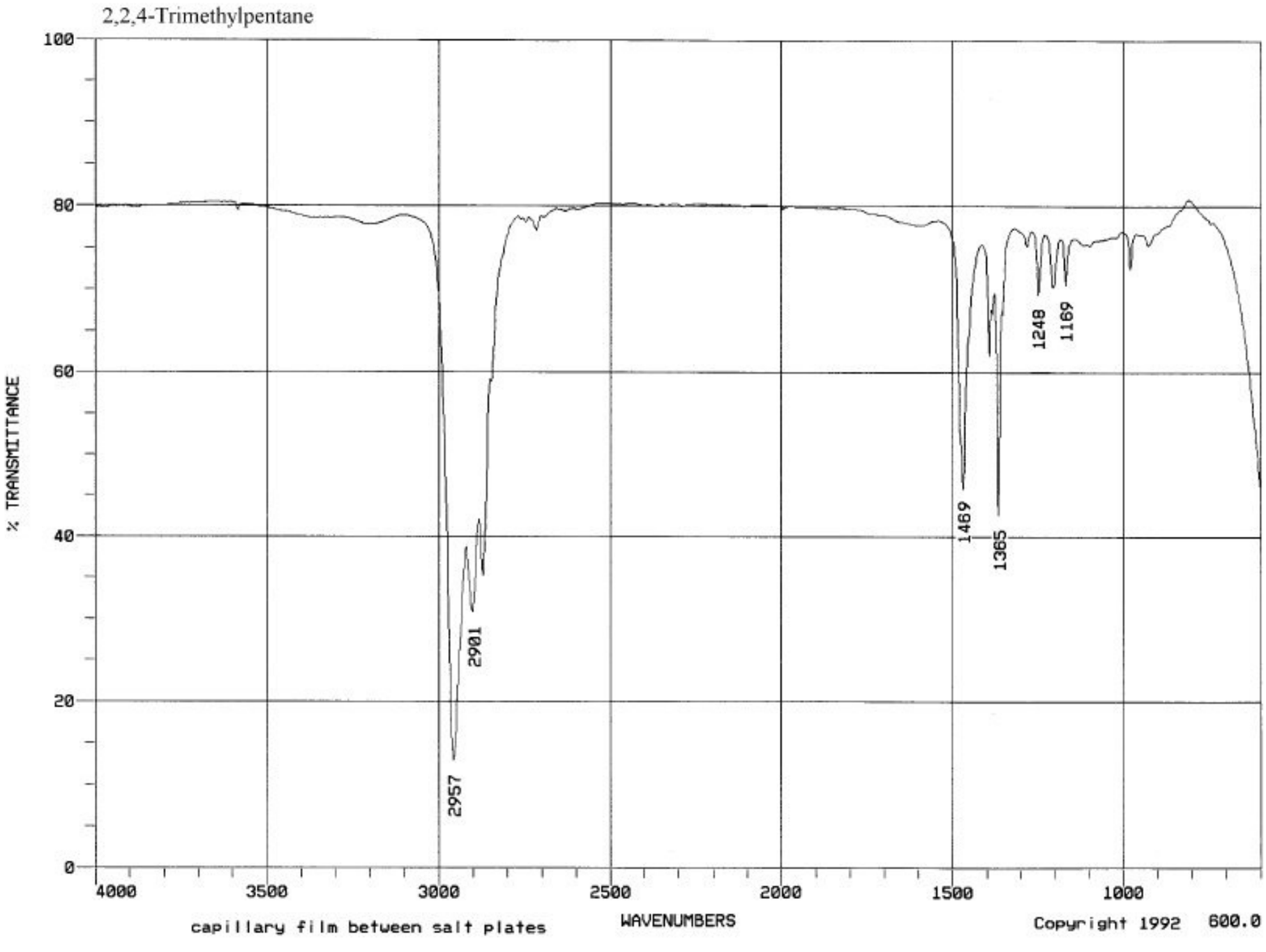
C-H stretches at 2950-3000 cm^{-1}.

pentane


Pentane
100
80
60
40
20
0
% TRANSMITTANCE
4000
3500
3000
2500
2000
1500
1000
600.0
WAVENUMBERS
2961
2926
2876
1462
1379
908
862
727
capillary film between salt plates
Copyright 1992

2,2,4-trimethylpentane

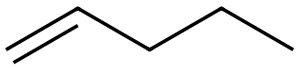


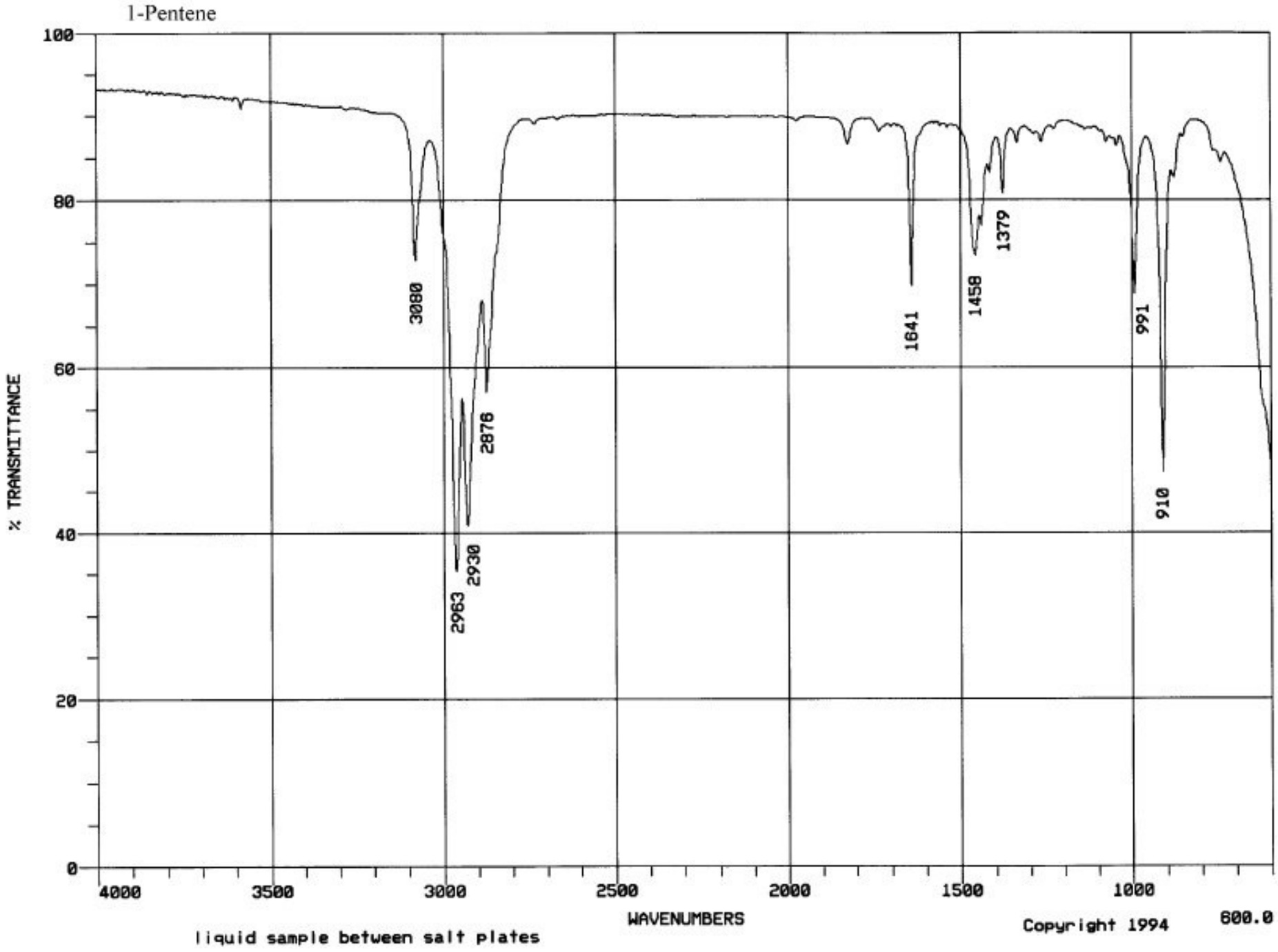


Alkenes

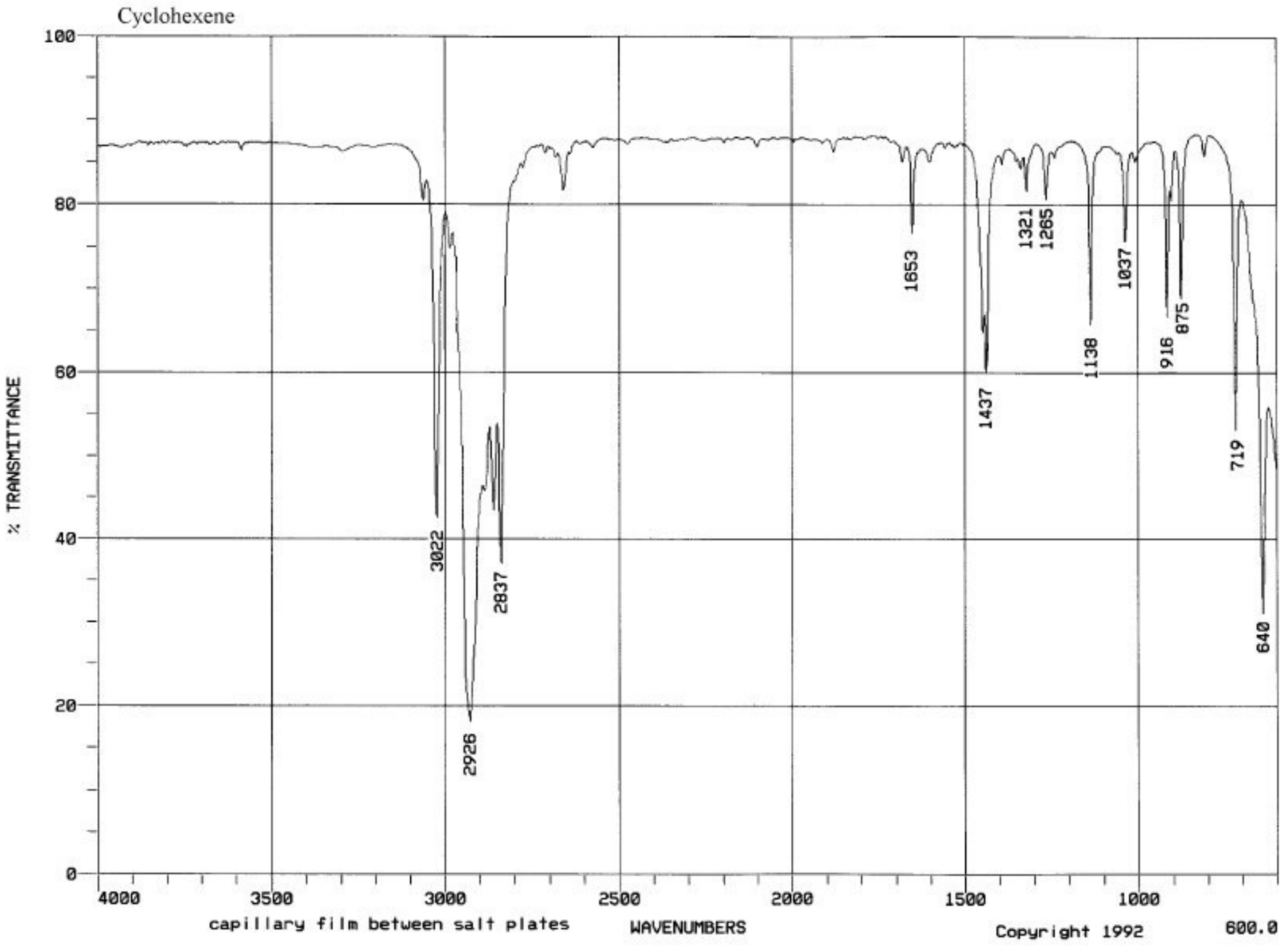
C=C-H stretch at 3050 cm^{-1}.
C=C stretch at 1650 cm^{-1}.

1-pentene




1-Pentene
100
80
60
40
20
0
% TRANSMITTANCE
3080
2963
2930
2876
1641
1458
1379
991
910
4000
3500
3000
2500
2000
1500
1000
600.0
WAVENUMBERS
liquid sample between salt plates
Copyright 1994

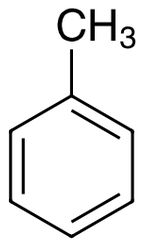
cyclohexene

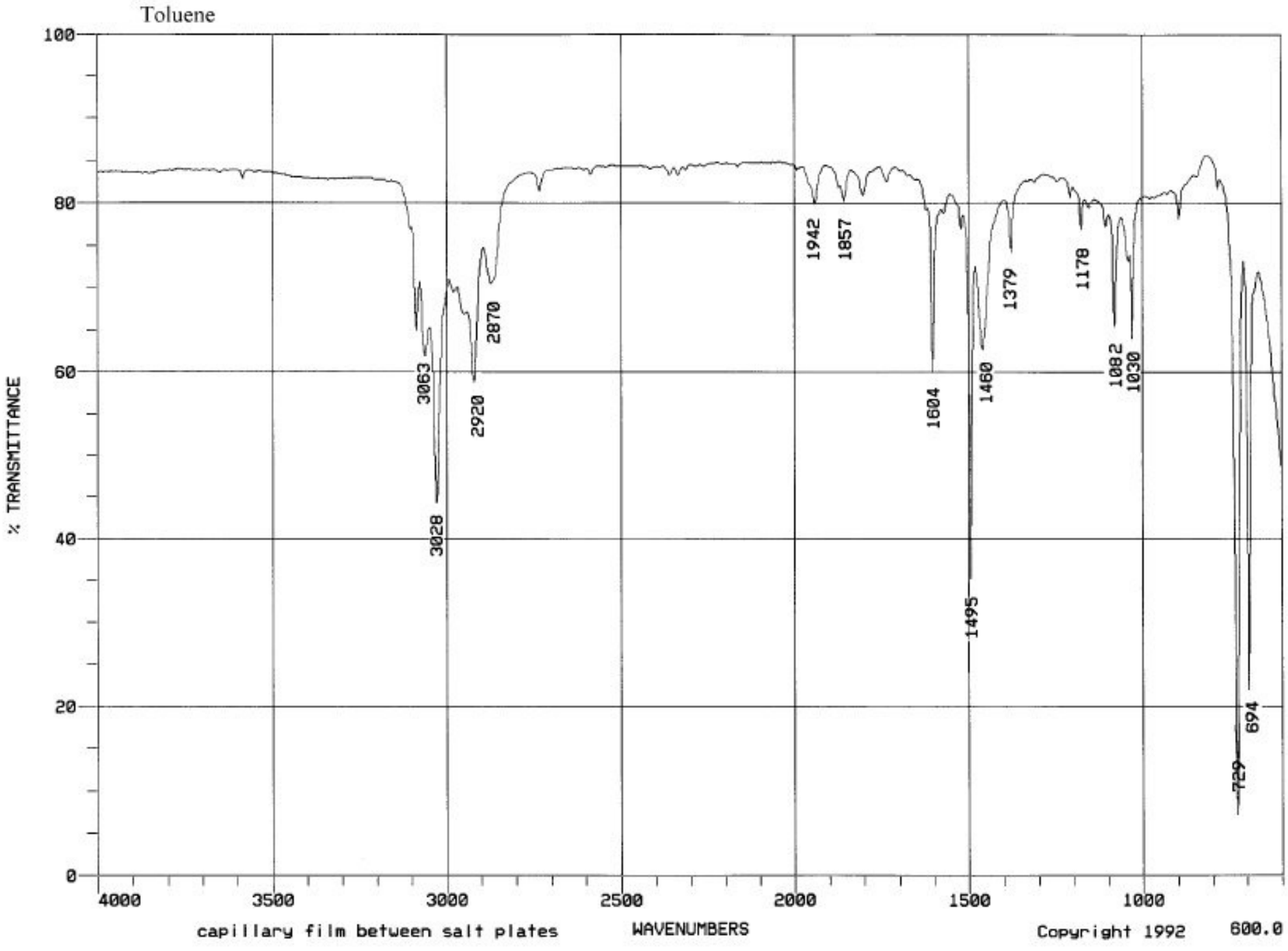


Aromatic Hydrocarbons

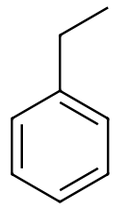
aromatic C-H stretch at 3050 cm^{-1}.
aromatic C=C stretch at 1650 cm^{-1}.

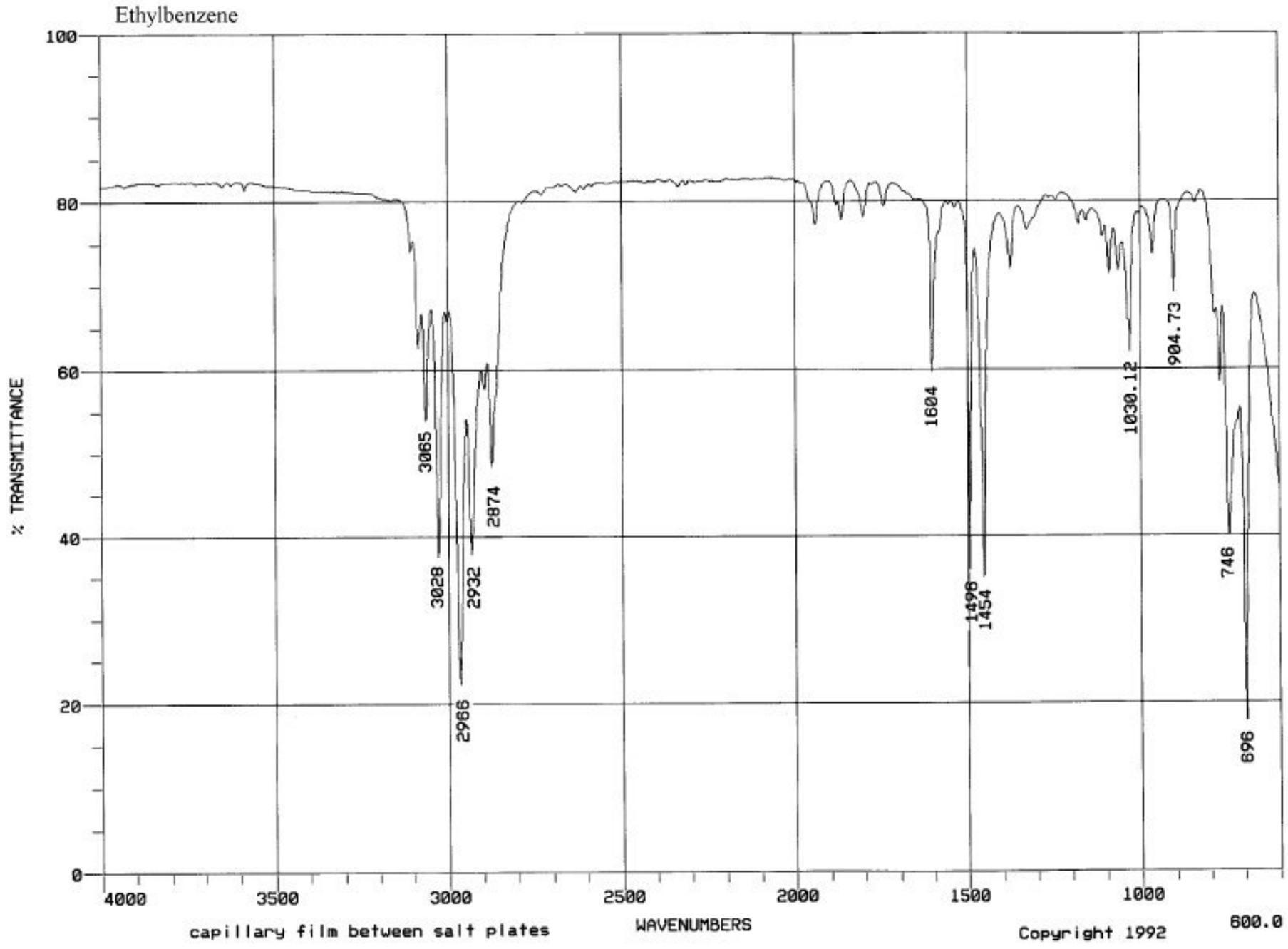
toluene


CH3


Toluene
100
80
60
40
20
0
% TRANSMITTANCE
3063
3028
2920
2870
1942
1857
1604
1495
1460
1379
1178
1082
1030
729
694
4000
3500
3000
2500
2000
1500
1000
600.0
capillary film between salt plates
WAVENUMBERS
Copyright 1992

ethyl benzene

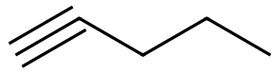


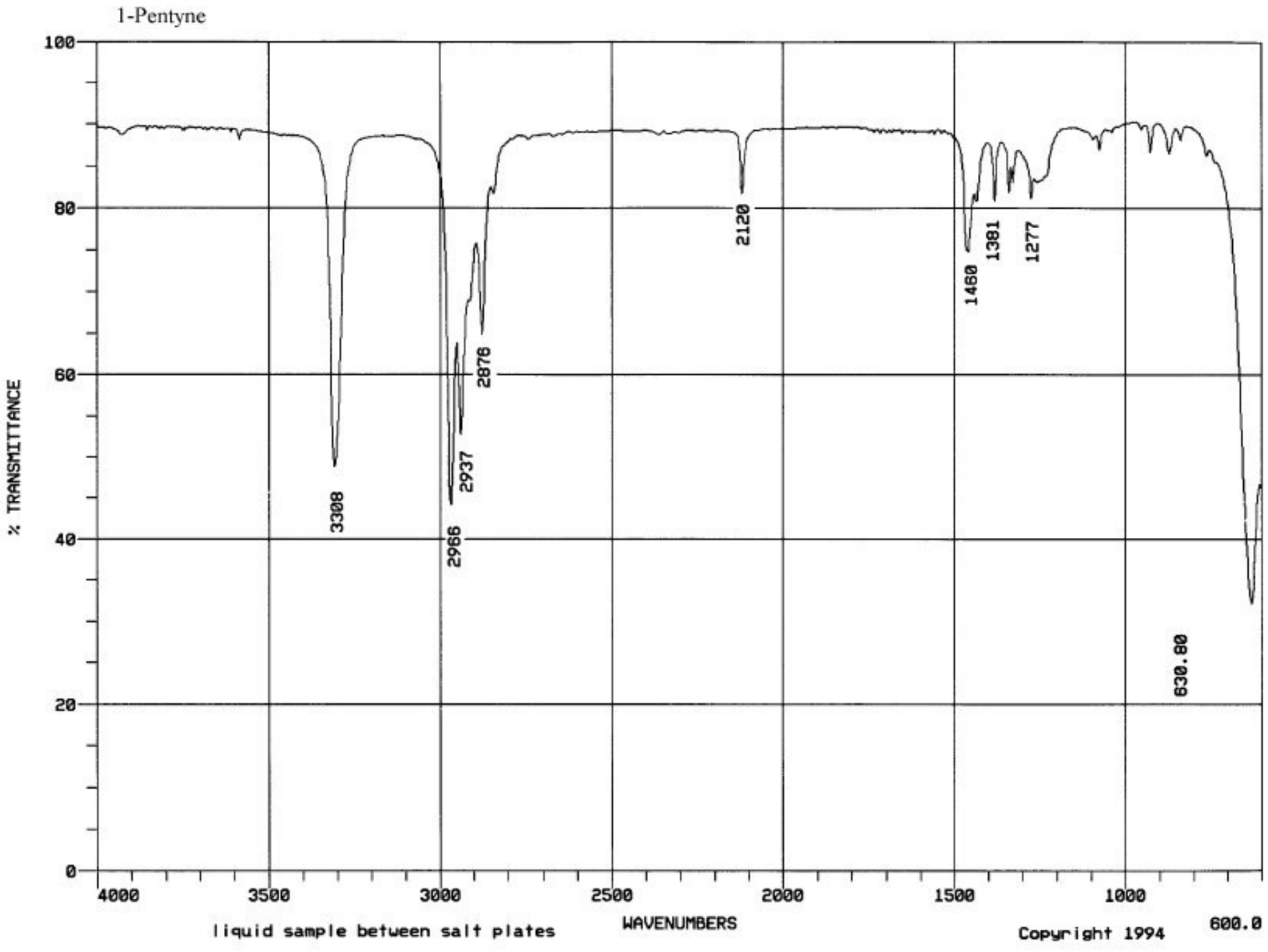


Alkynes and Nitriles

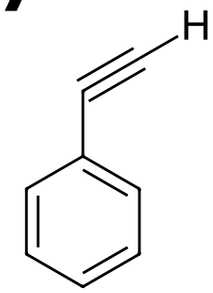
Triple bond stretch at 2250 cm^{-1}(nitriles) or 2150 cm^{-1} (alkynes).
In terminal alkynes, the sp C-H stretch occurs at 3300 cm^{-1}.

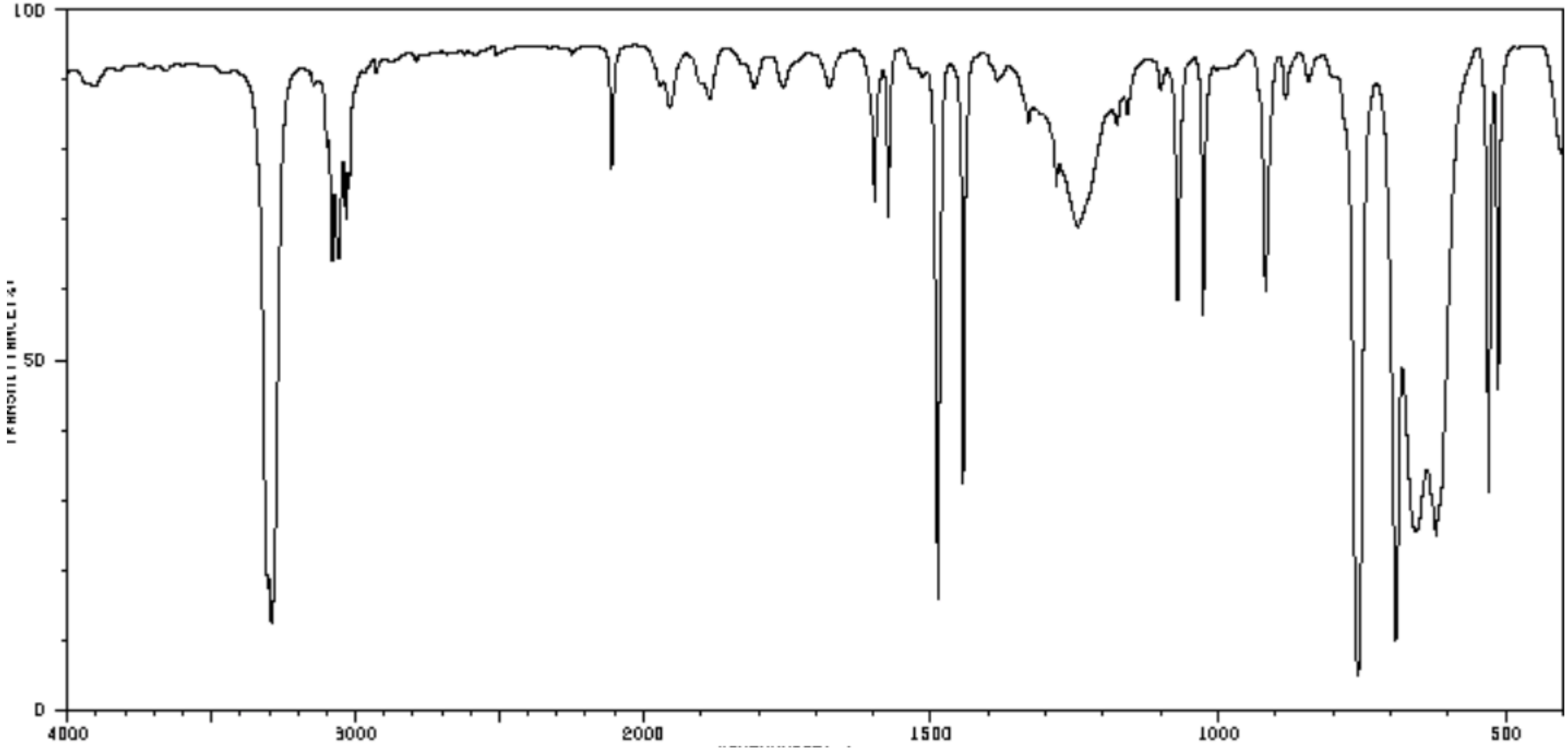
1-pentyne




1-Pentyne
100
80
60
40
20
0
% TRANSMITTANCE
3308
2966
2937
2876
2120
1460
1381
1277
630.80
4000
3500
3000
2500
2000
1500
1000
600.0
WAVENUMBERS
liquid sample between salt plates
Copyright 1994

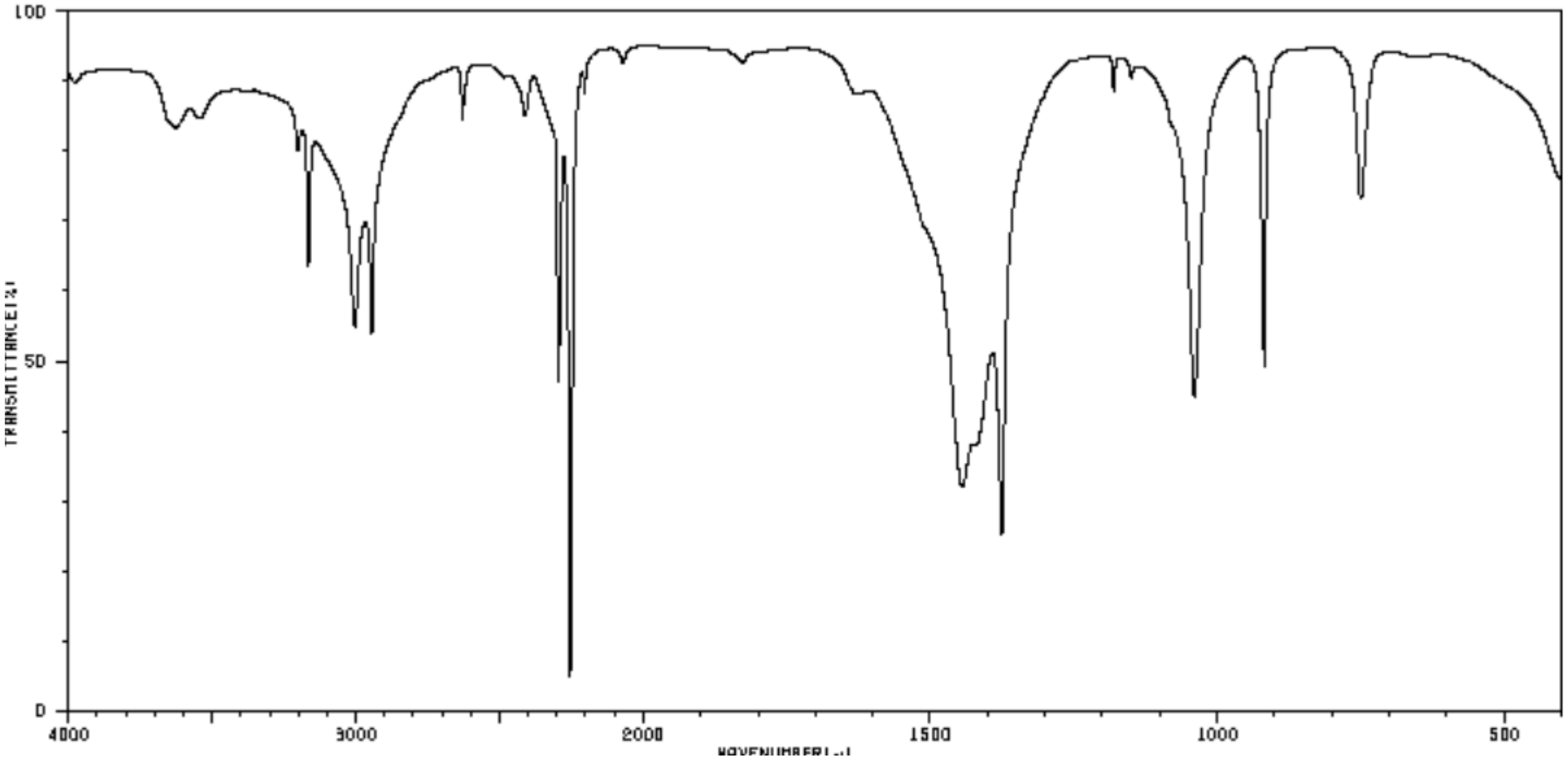
phenylacetylene





acetonitrile

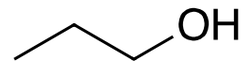
$H_3C-C\equiv N$

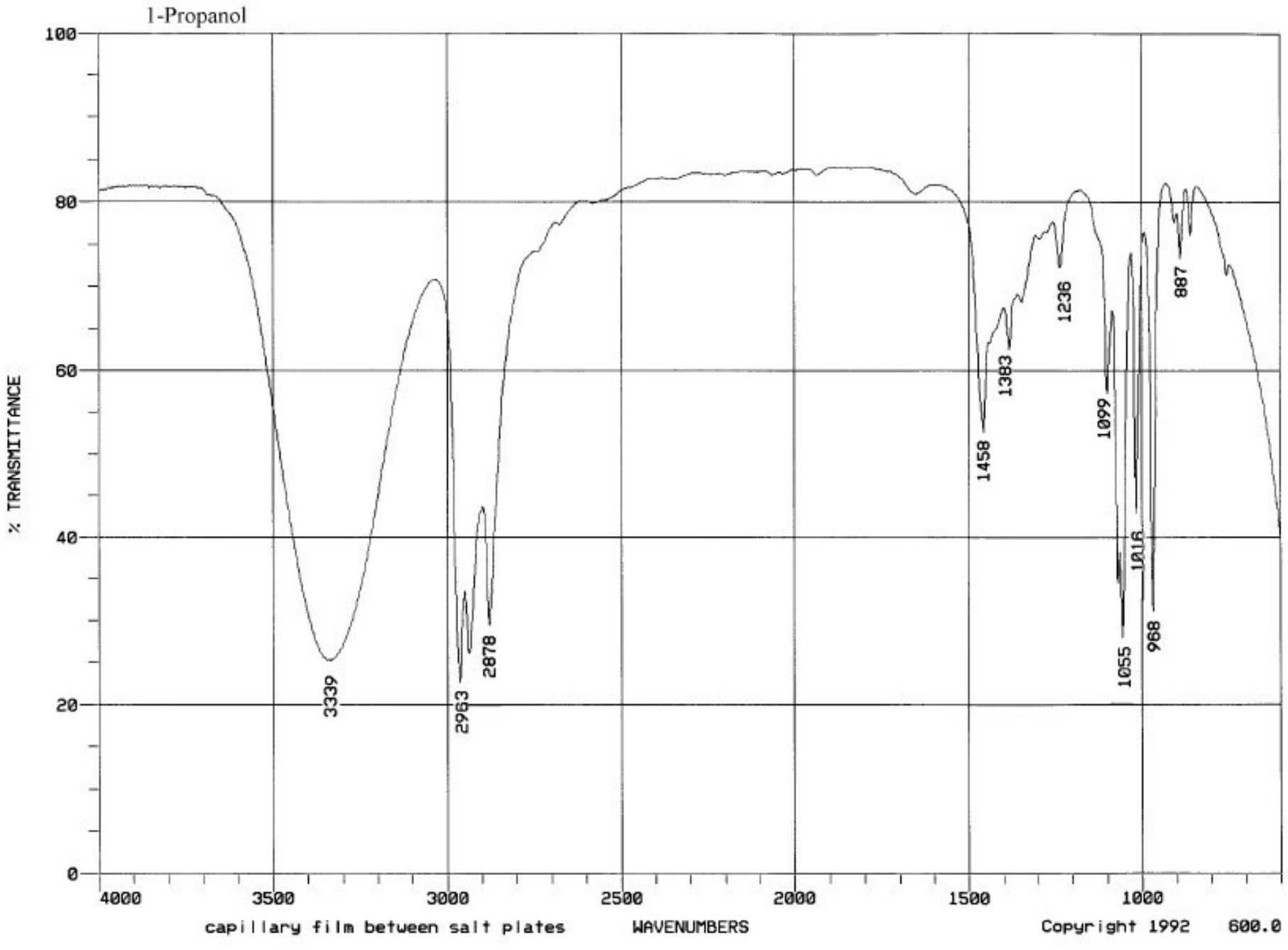


Alcohols

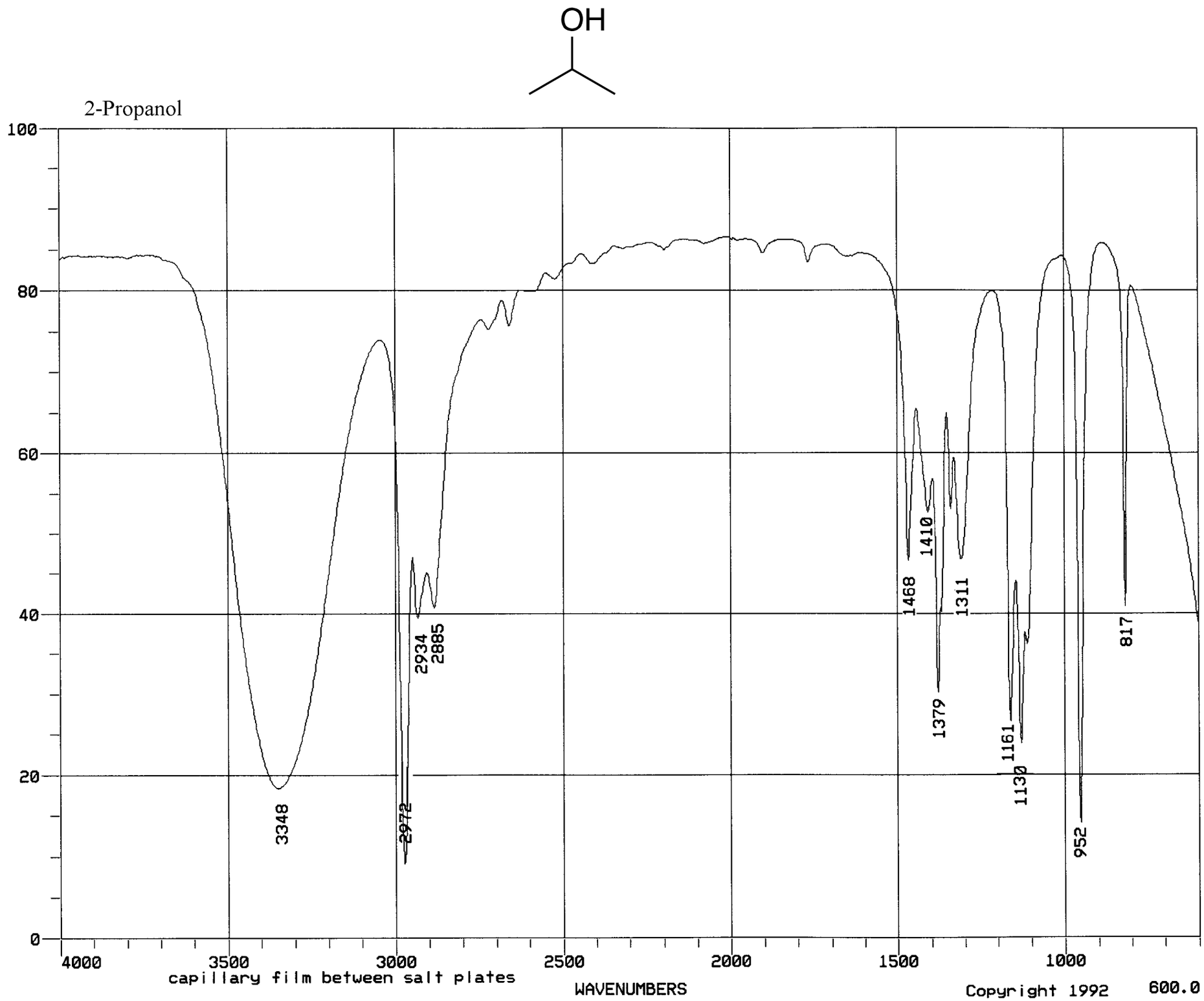
O-H stretch from 3600-3400 cm^{-1}.

1-propanol

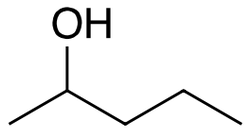

OH

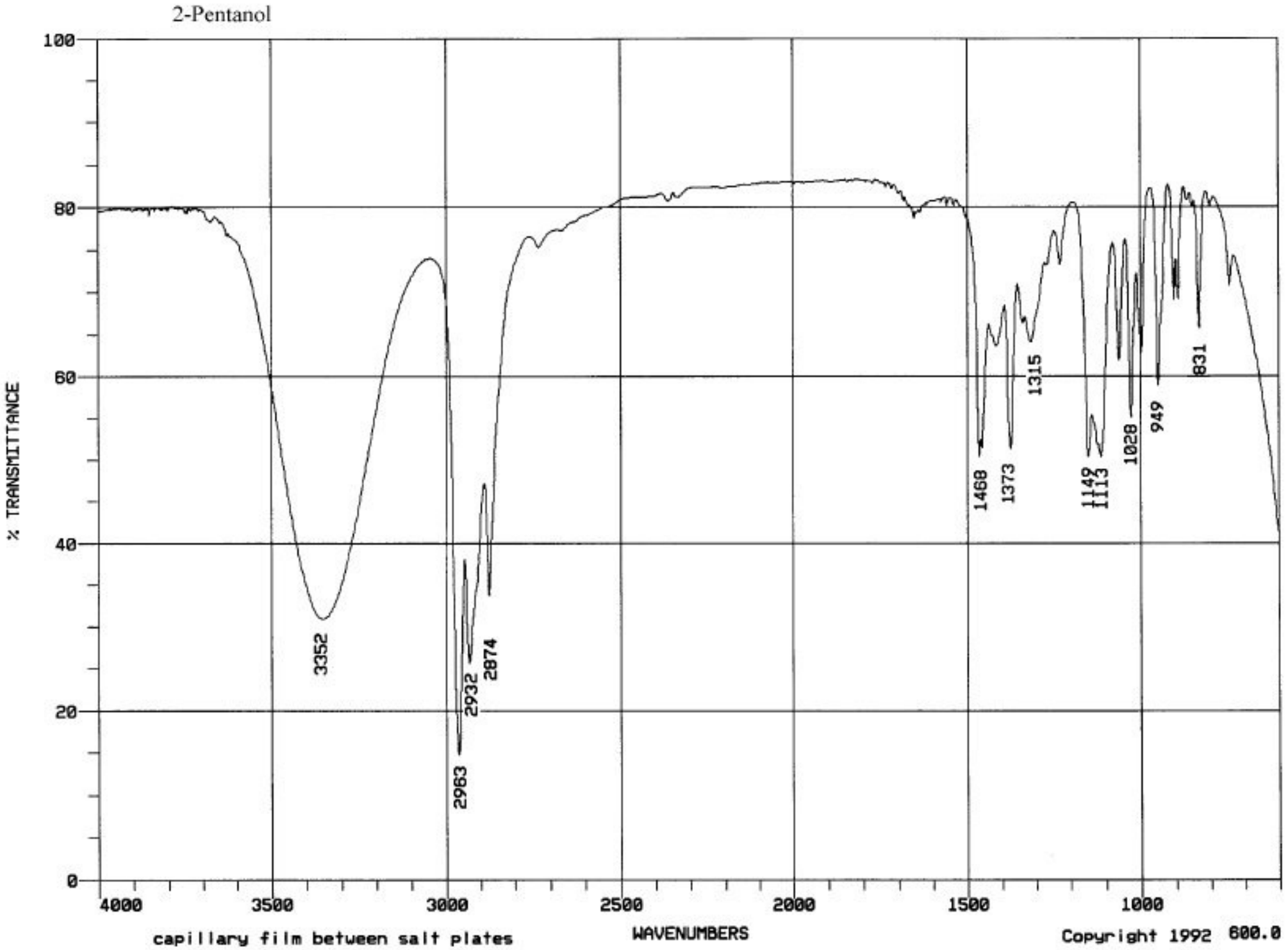

1-Propanol
100
80
60
40
20
0
% TRANSMITTANCE
4000
3500
3000
2500
2000
1500
1000
3339
2963
2878
1458
1383
1236
1099
1055
1016
968
887
capillary film between salt plates
WAVENUMBERS
Copyright 1992
600.0

2-propanol

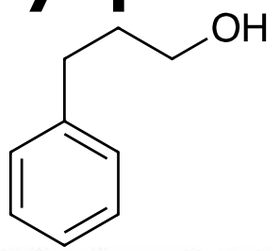

OH
2-Propanol
100
80
60
40
20
0
% TRANSMITTANCE
3348
2972
2934
2885
1468
1410
1379
1311
1161
1130
952
817
4000
3500
3000
2500
2000
1500
1000
capillary film between salt plates
WAVENUMBERS
Copyright 1992
600.0

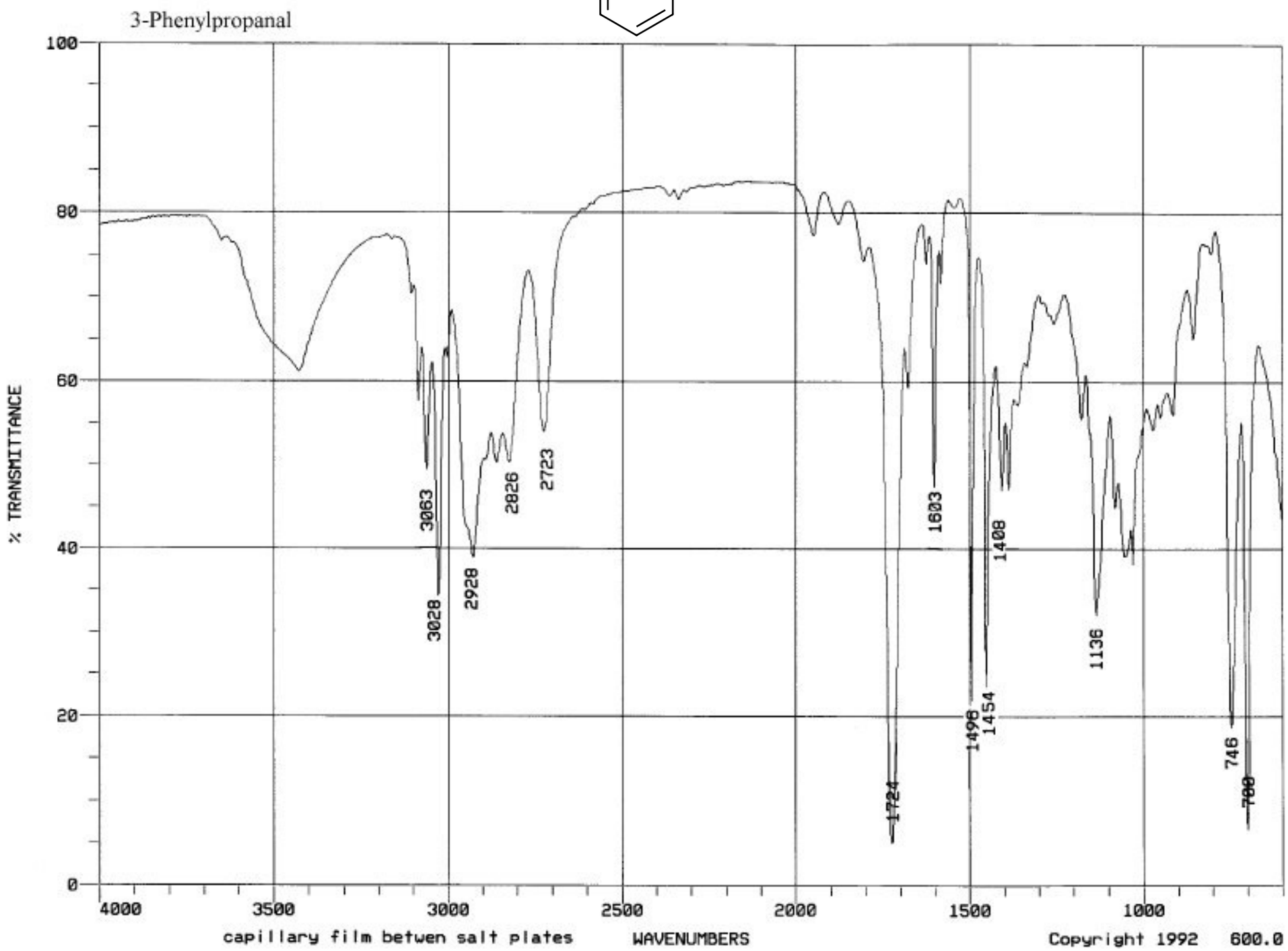
2-pentanol


OH


2-Pentanol
100
80
60
40
20
0
% TRANSMITTANCE
4000
3500
3000
2500
2000
1500
1000
WAVENUMBERS
3352
2963
2932
2874
1468
1373
1315
1149
1113
1028
949
831
capillary film between salt plates
Copyright 1992
600.0

3-phenylpropanol

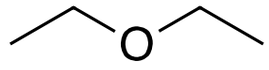


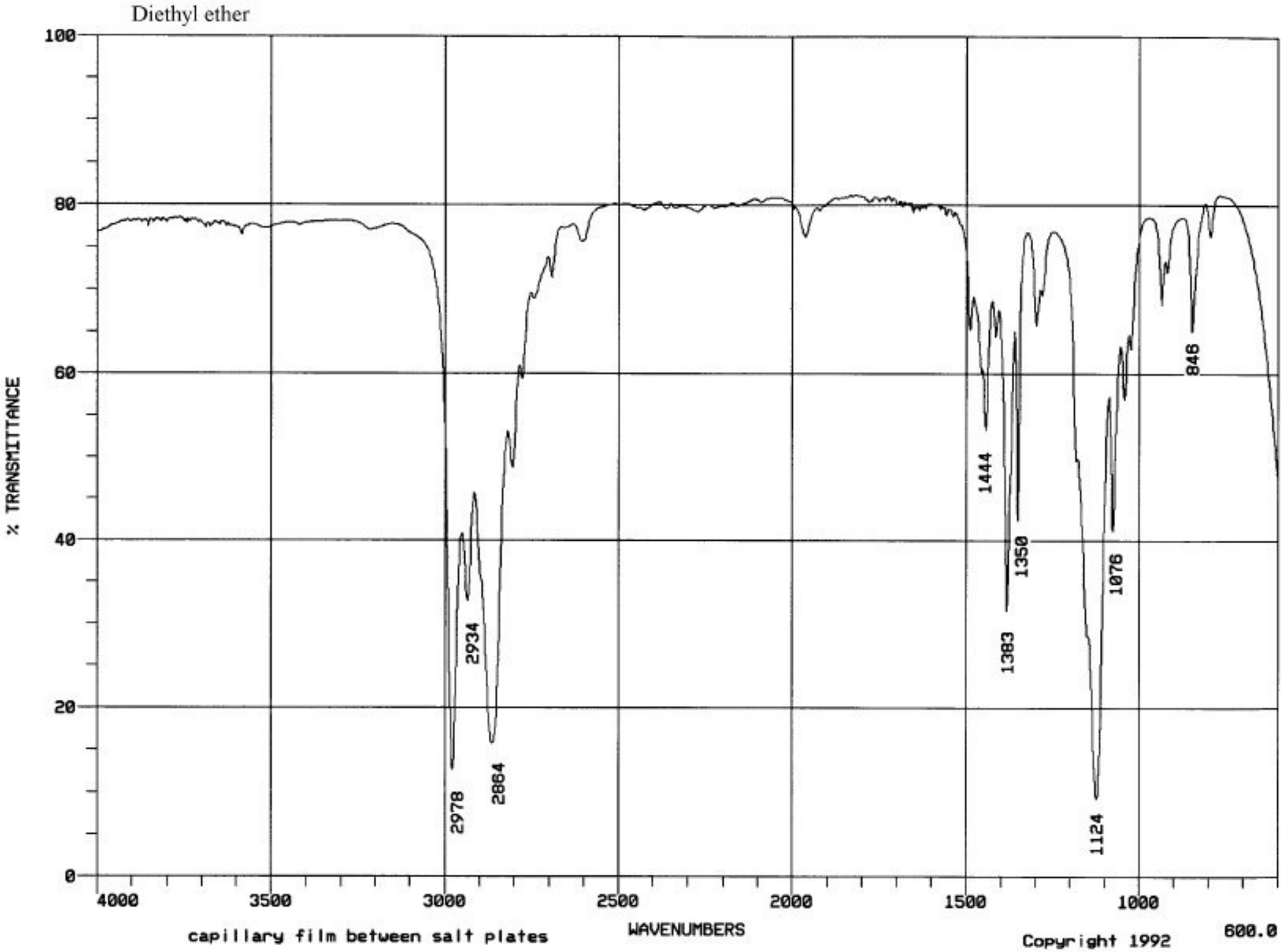


Ethers

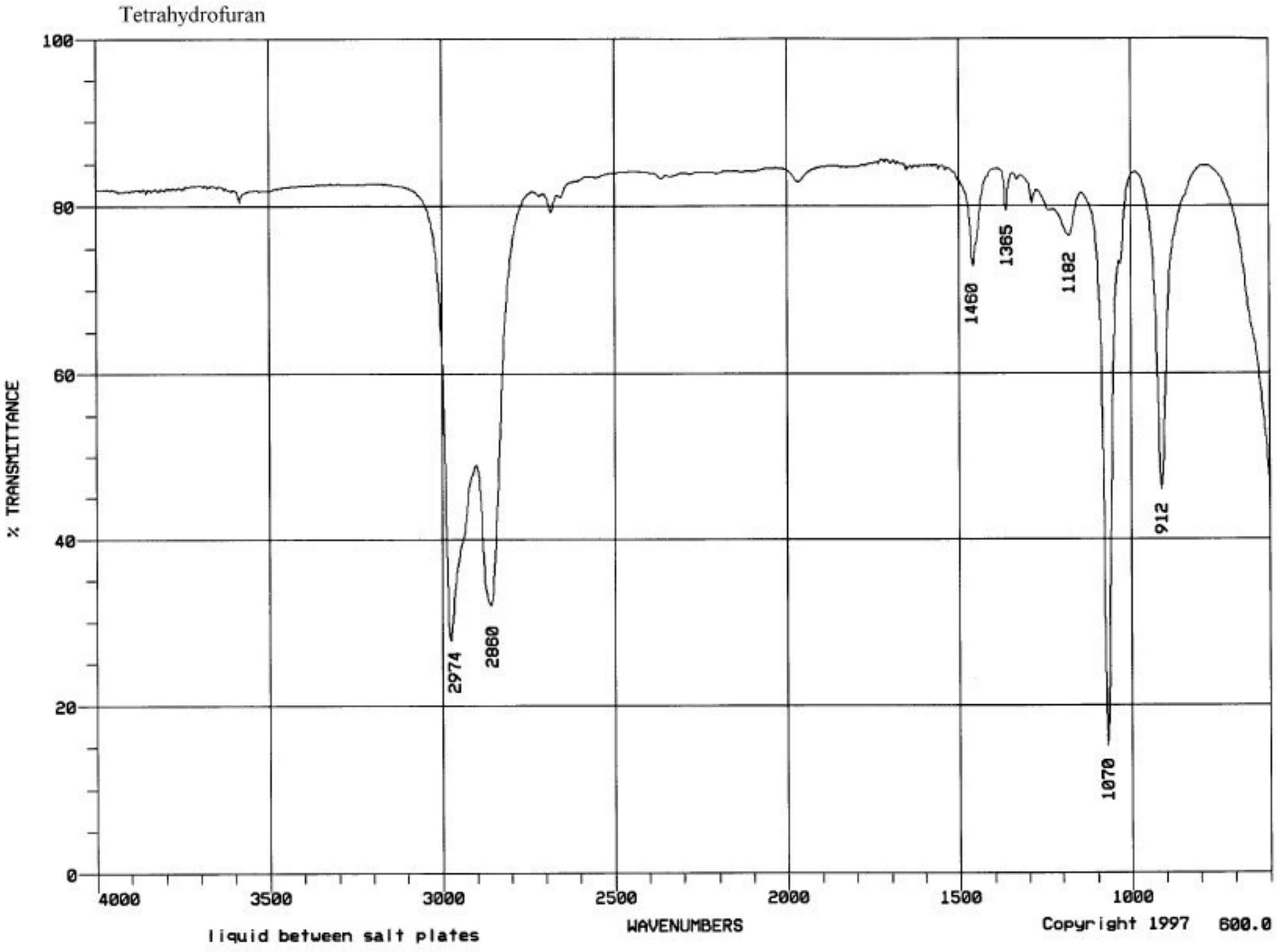
No ether specific characteristic absorptions above 1600 cm^{-1}.

diethyl ether





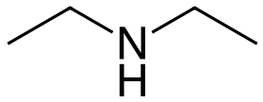
tetrahydrofuran

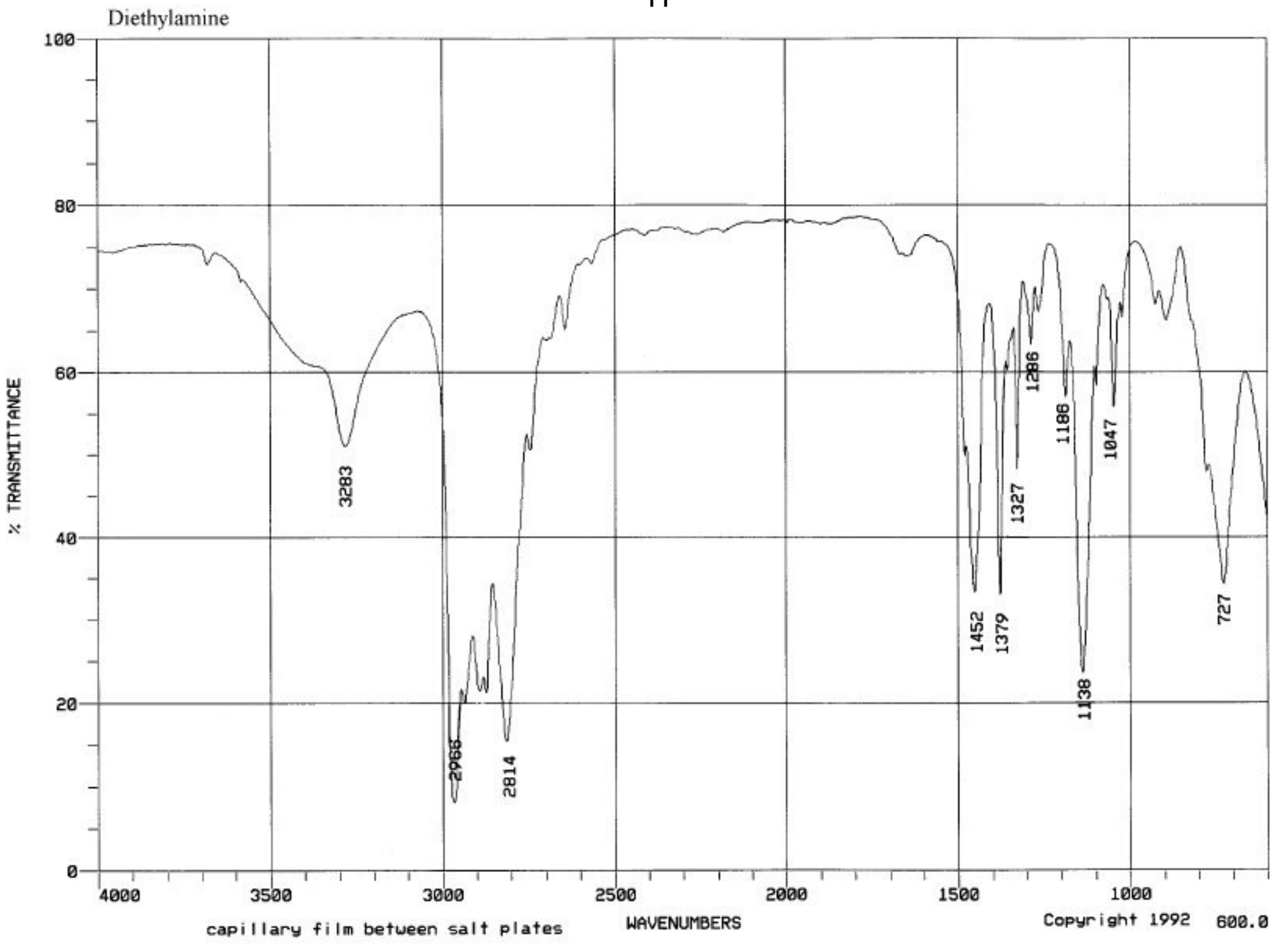


Amines

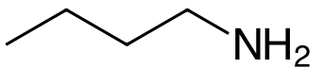
N-H between 3400-3200 cm^{-1}.

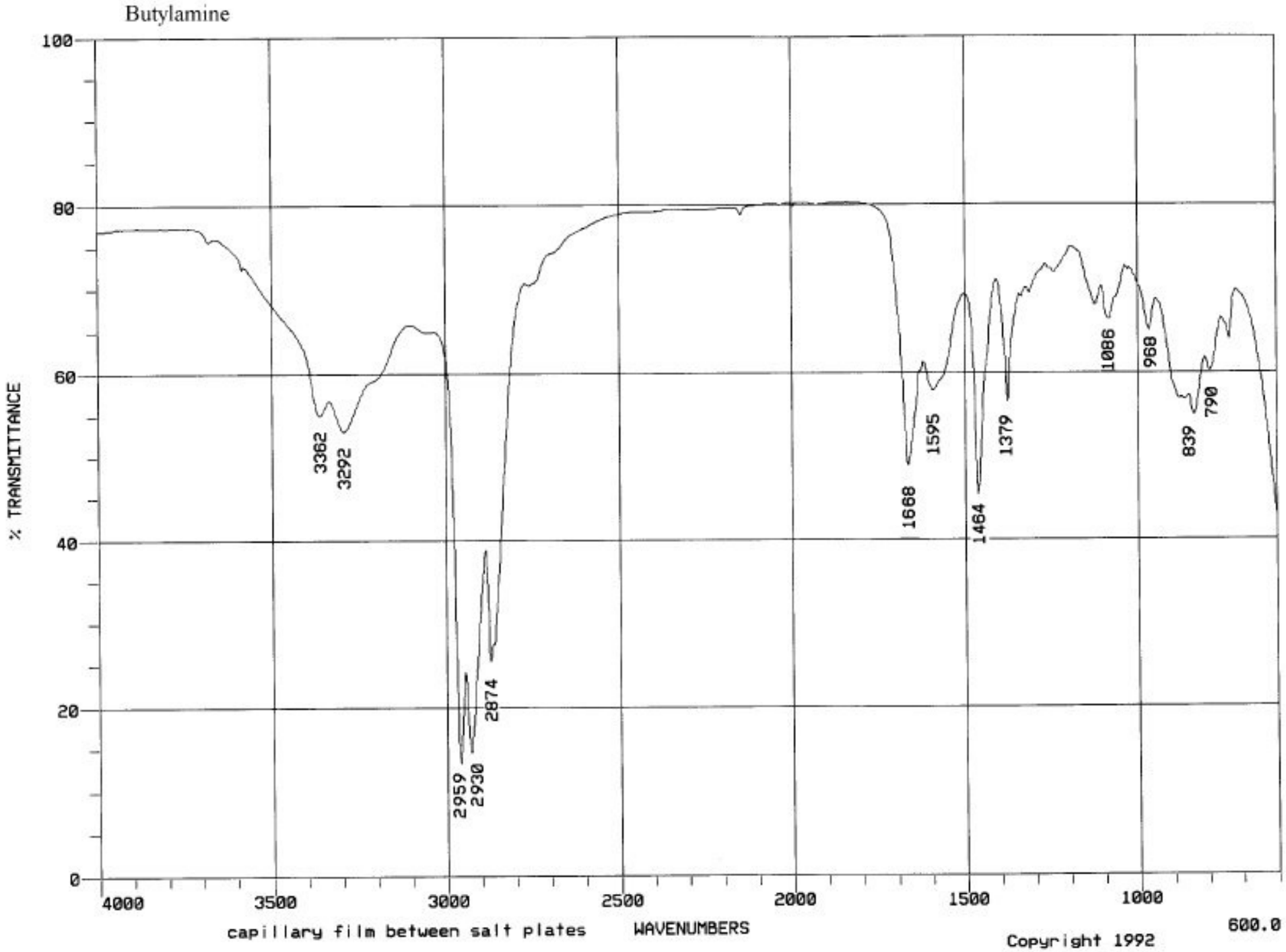
diethylamine





butylamine


NH2


Butylamine
100
80
60
40
20
0
% TRANSMITTANCE
3362
3292
2959
2930
2874
1668
1595
1464
1379
1086
968
839
790
4000
3500
3000
2500
2000
1500
1000
600.0
capillary film between salt plates
WAVENUMBERS
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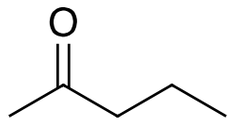
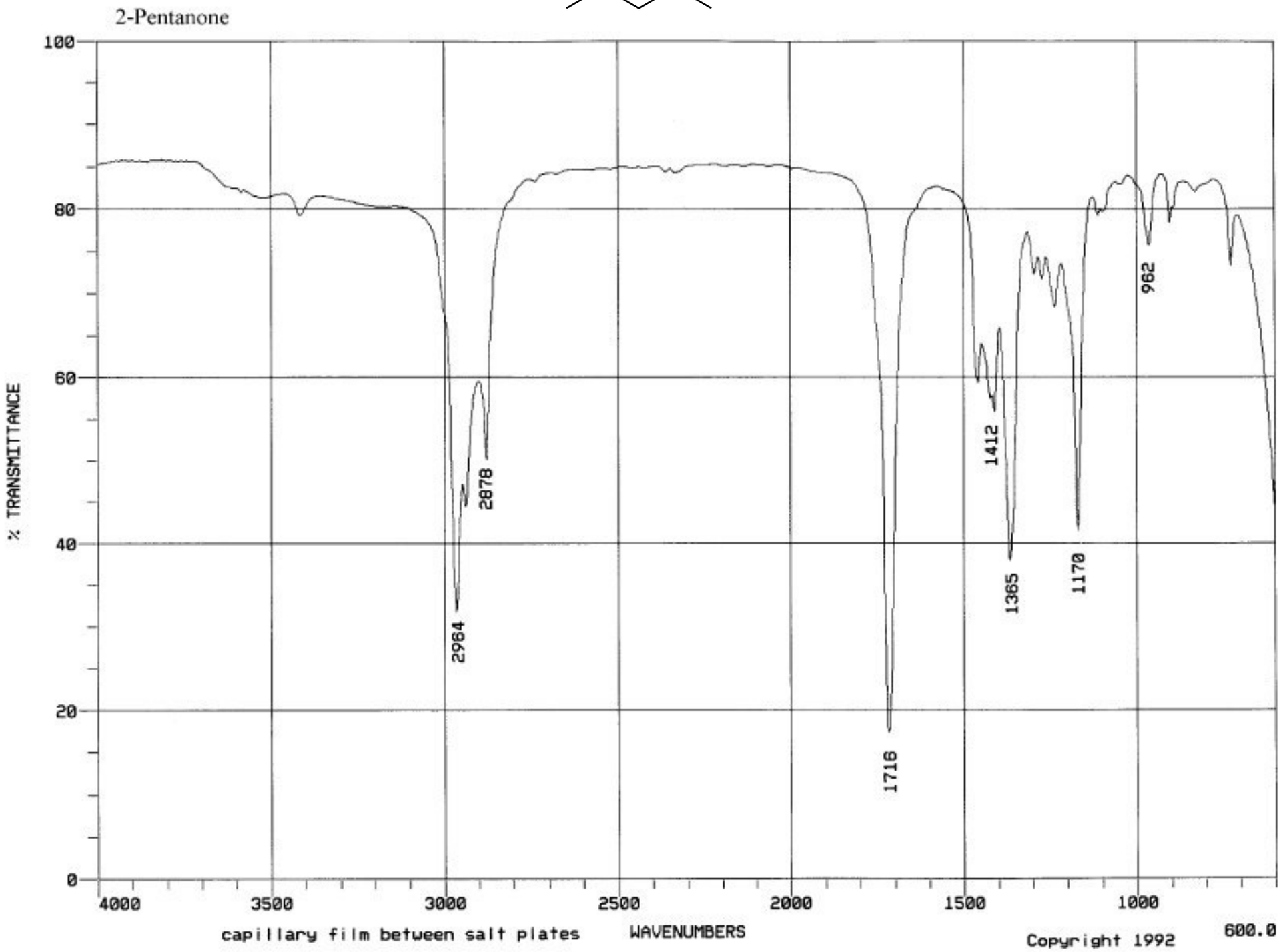
Ketones and Aldehydes

Strong C=O stretch between 1700-1800 cm^{-1}.
Aldehydic C-H stretch doublet at 2750 and 2850 cm^{-1}.

2-pentanone




2-Pentanone
100
80
60
40
20
0
% TRANSMITTANCE
2964
2878
1716
1412
1365
1170
962
4000
3500
3000
2500
2000
1500
1000
600.0
capillary film between salt plates
WAVENUMBERS
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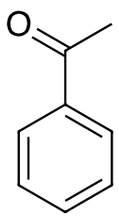
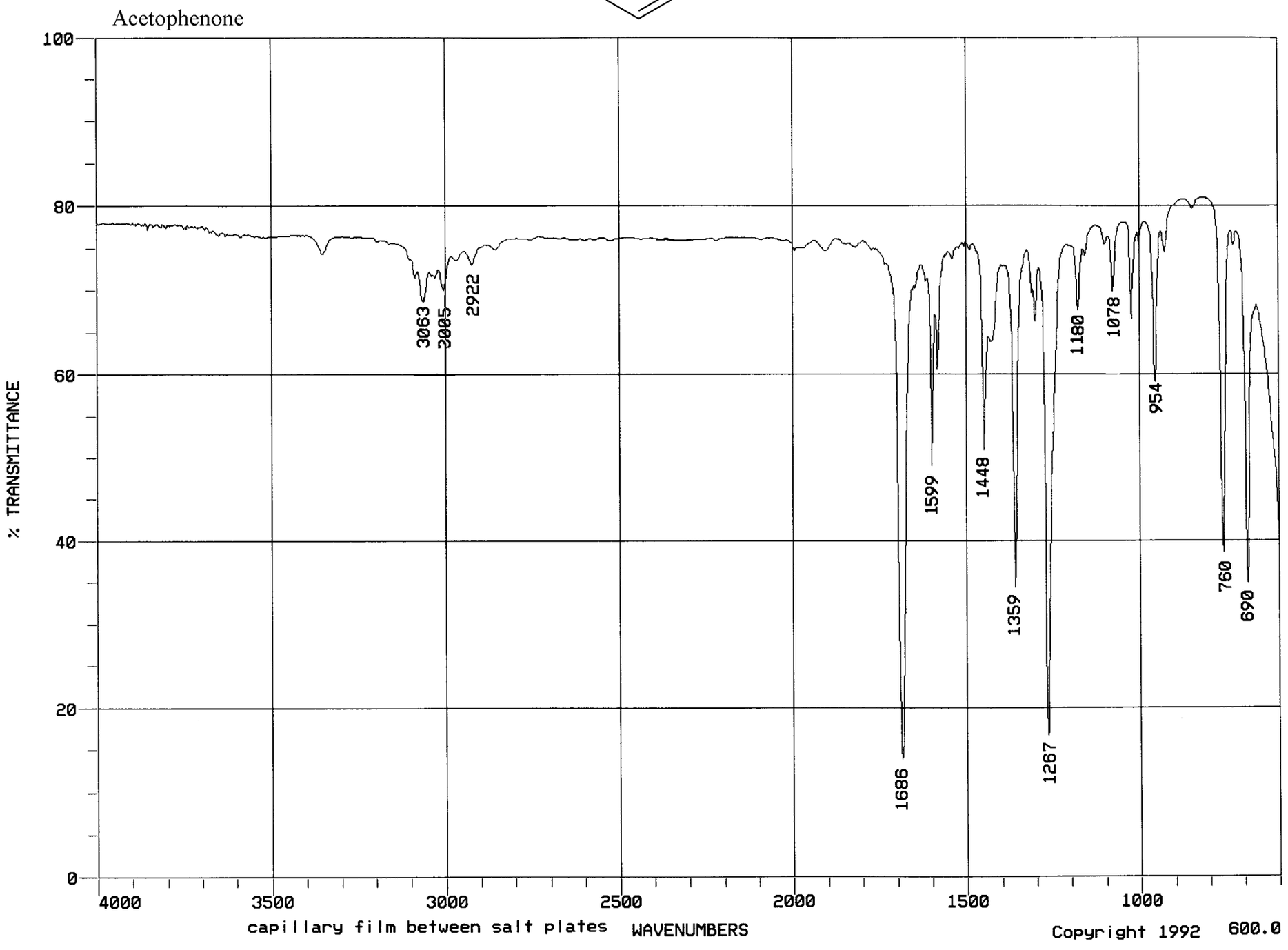
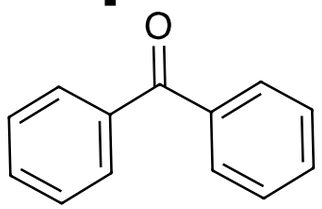
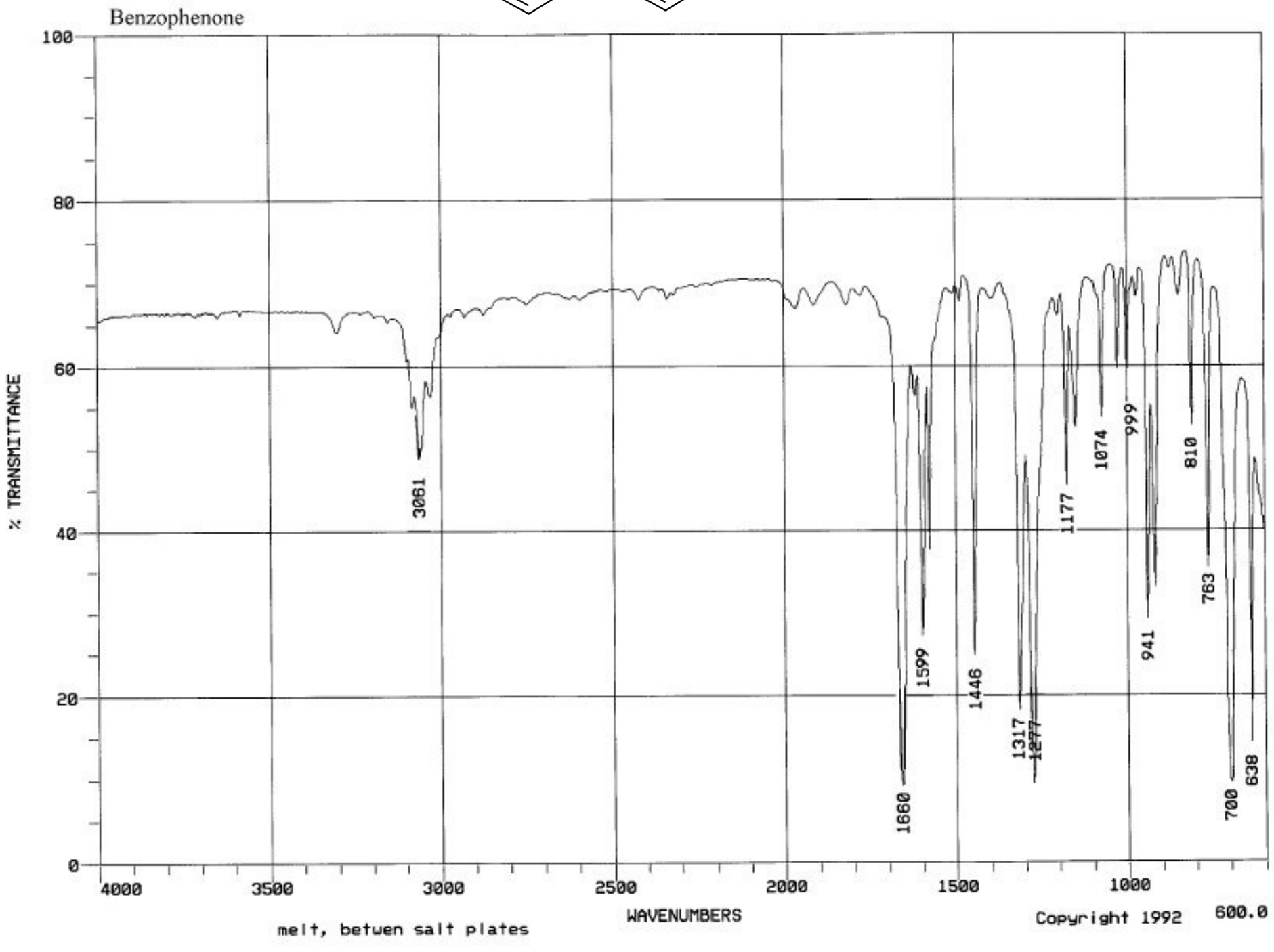
acetophenone



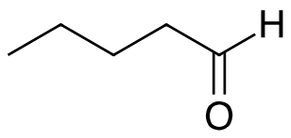


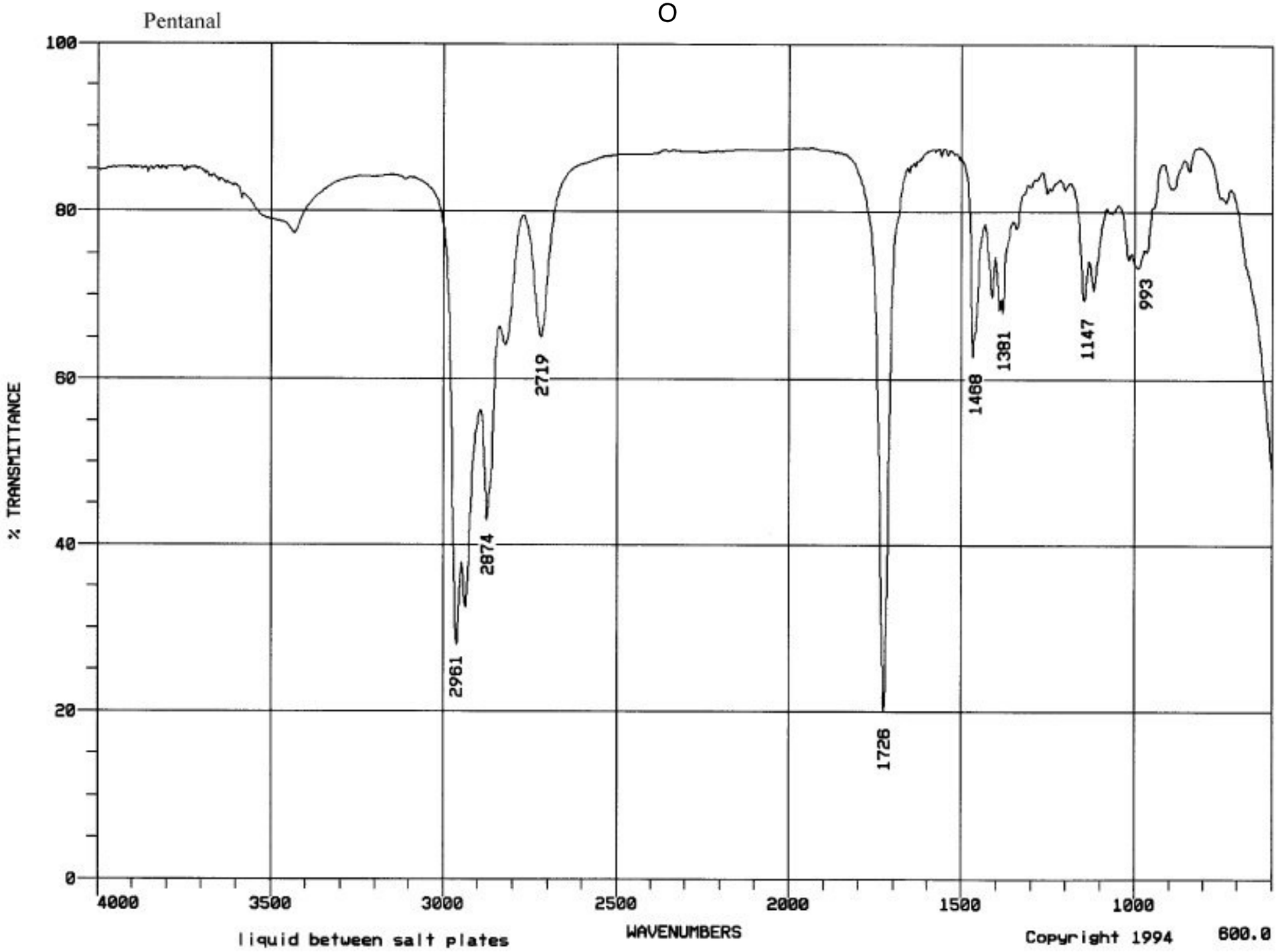
benzophenone



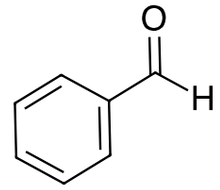


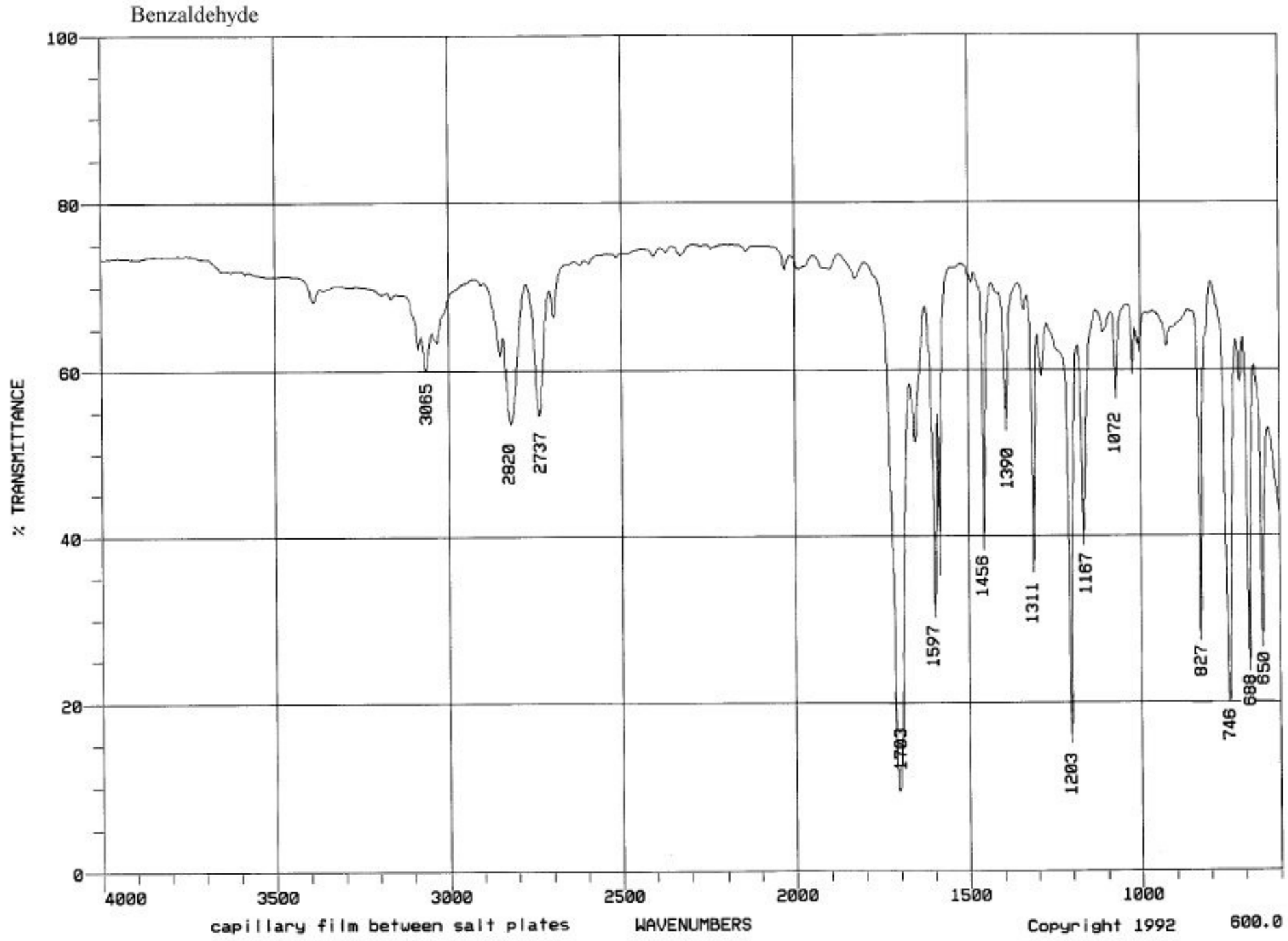
pentanal


H
O


Pentanal
100
80
60
40
20
0
% TRANSMITTANCE
2719
2961
2874
1468
1381
1726
1147
993
4000
3500
3000
2500
2000
1500
1000
WAVENUMBERS
liquid between salt plates
Copyright 1994
600.0

benzaldehyde

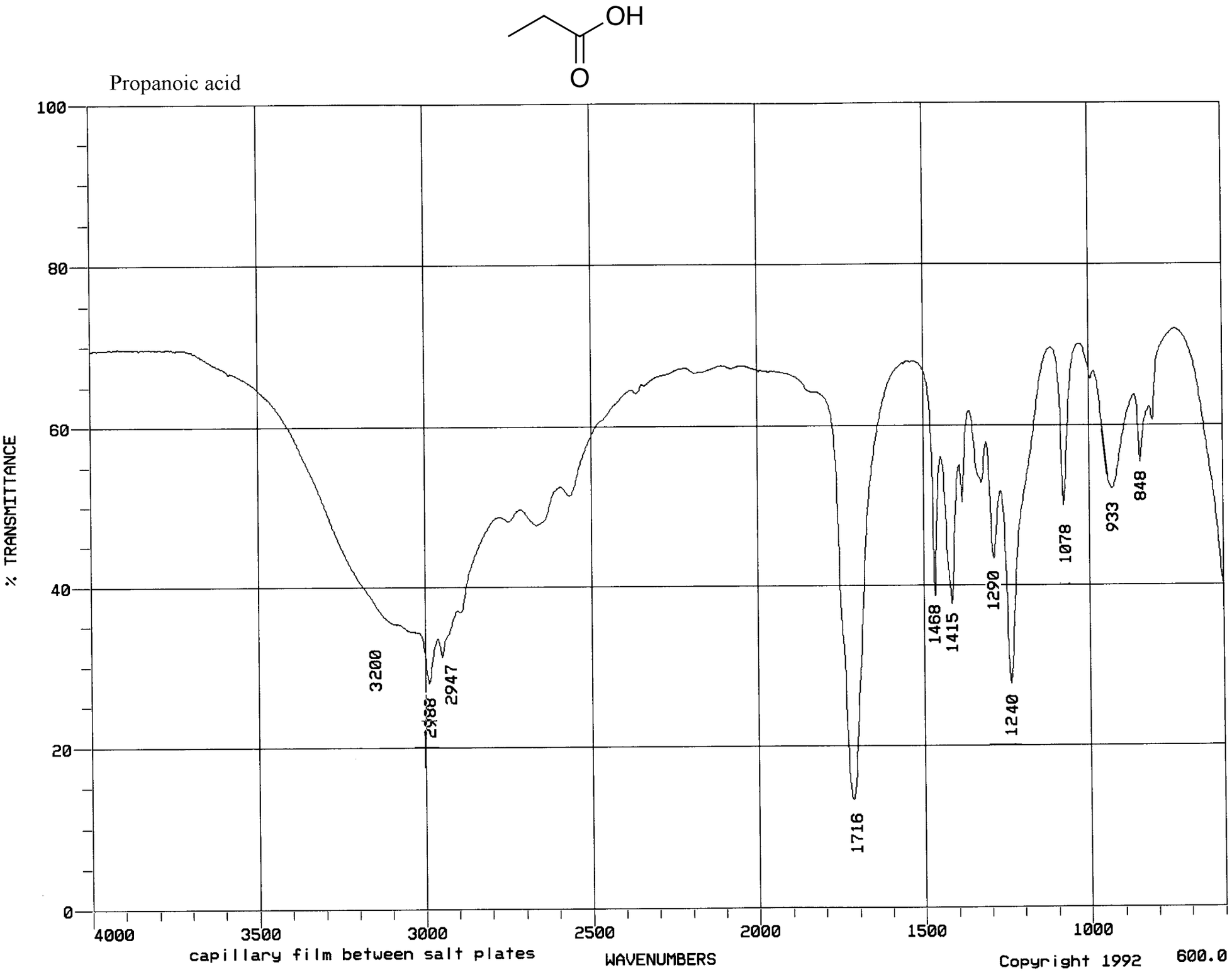




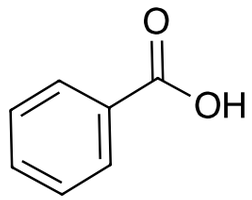
Carboxylic Acids

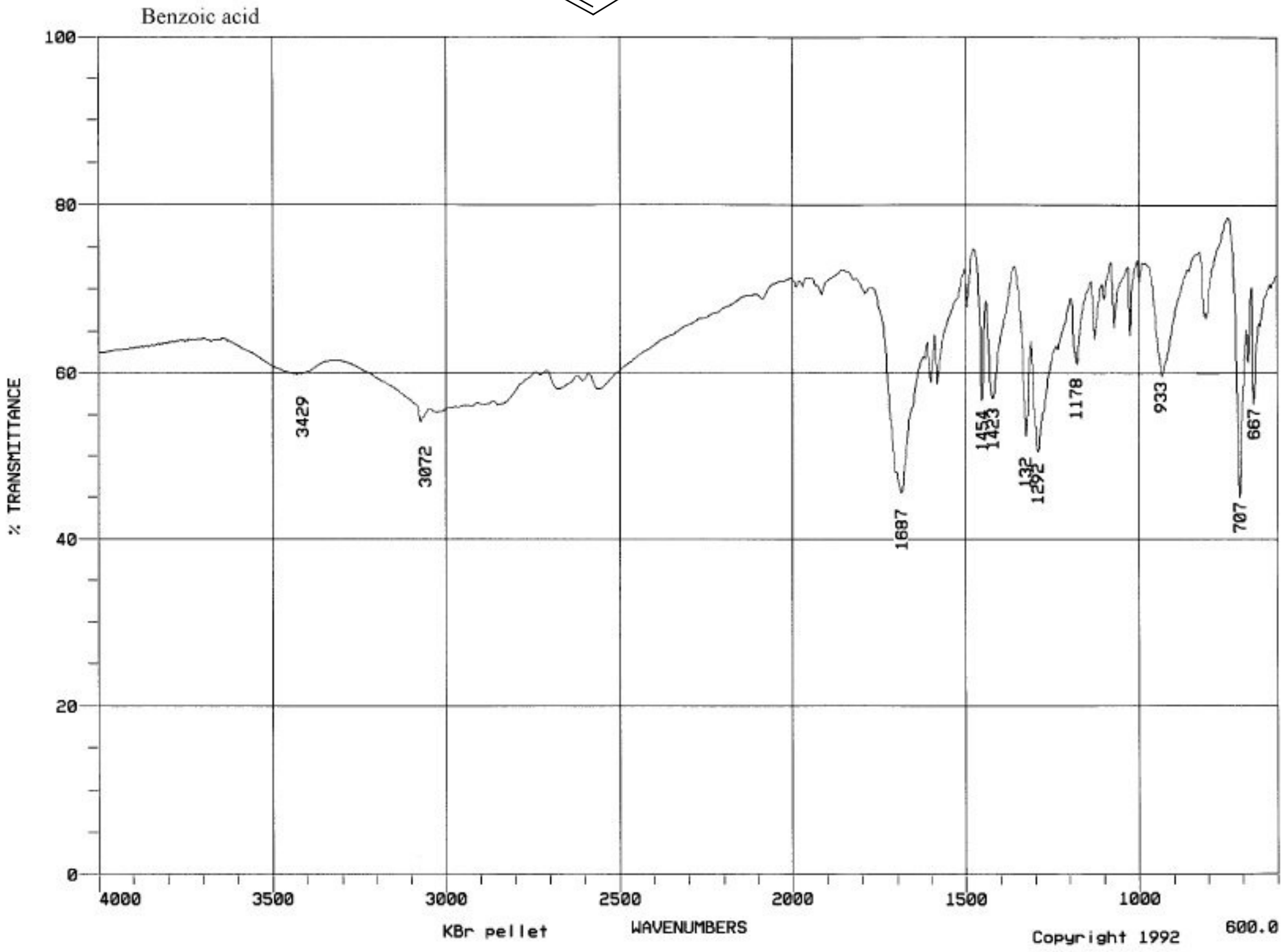
Both a strong C=O stretch between 1700 and 1800 cm^{-1} and an O-H stretch around 3400 cm^{-1}.

propanoic acid



benzoic acid

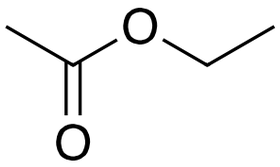


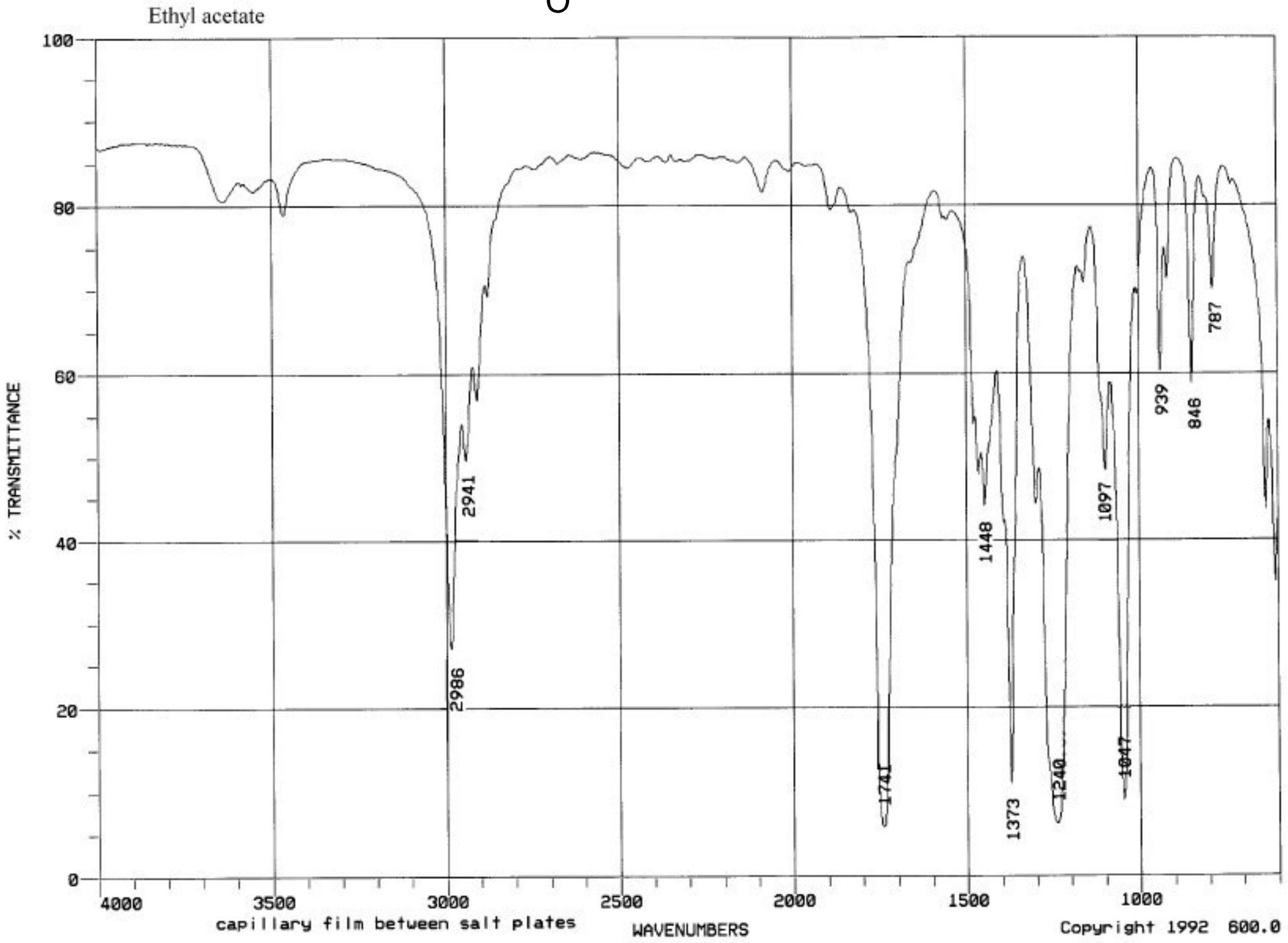


Esters and Amides

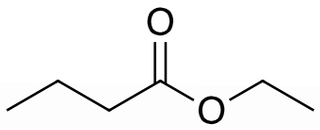
C=O stretch between 1700 and 1750 cm^{-1}. Amides may also have a(n) N-H stretch(s) around 3400 cm^{-1}.

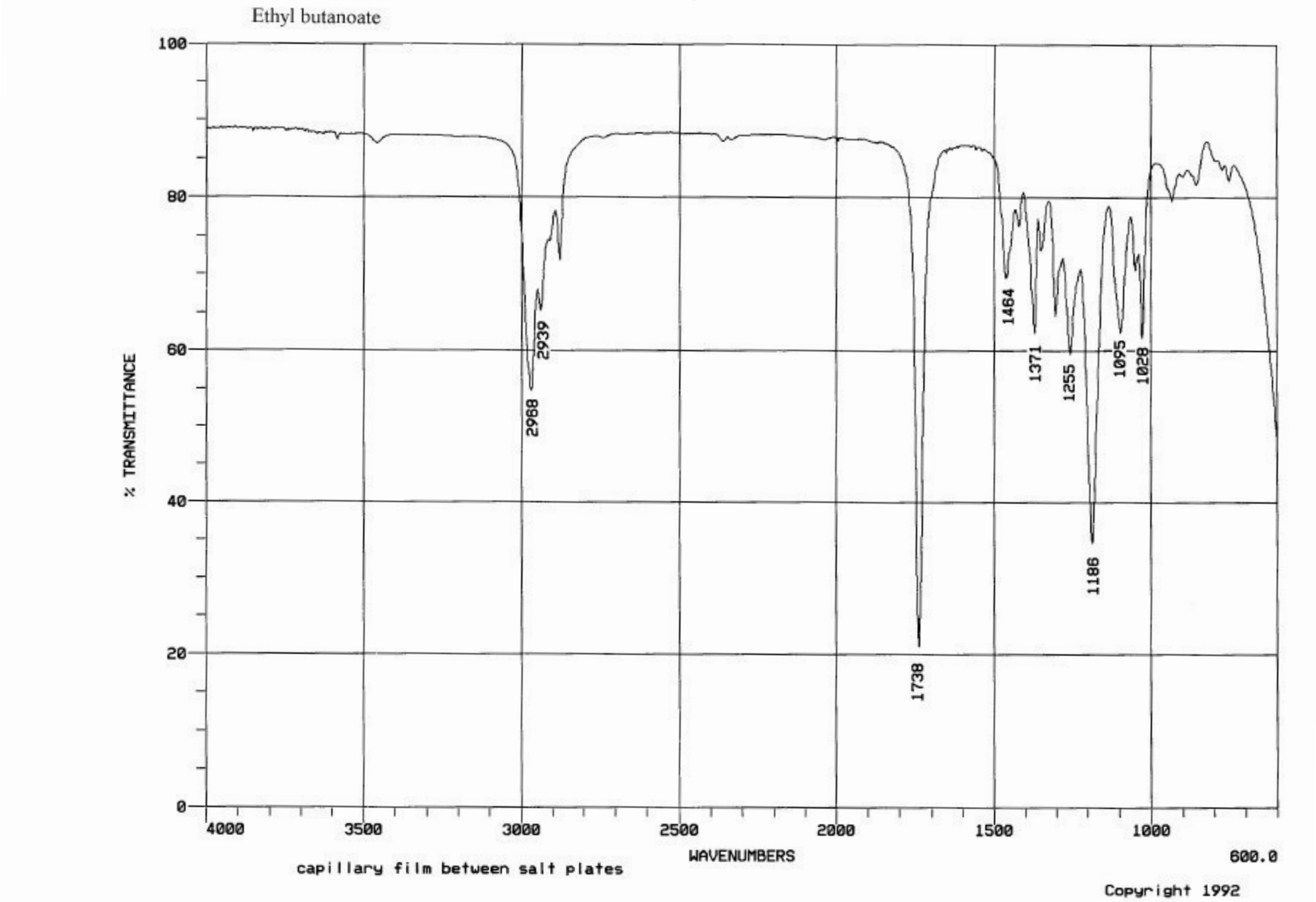
ethyl acetate



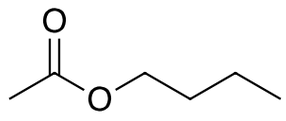


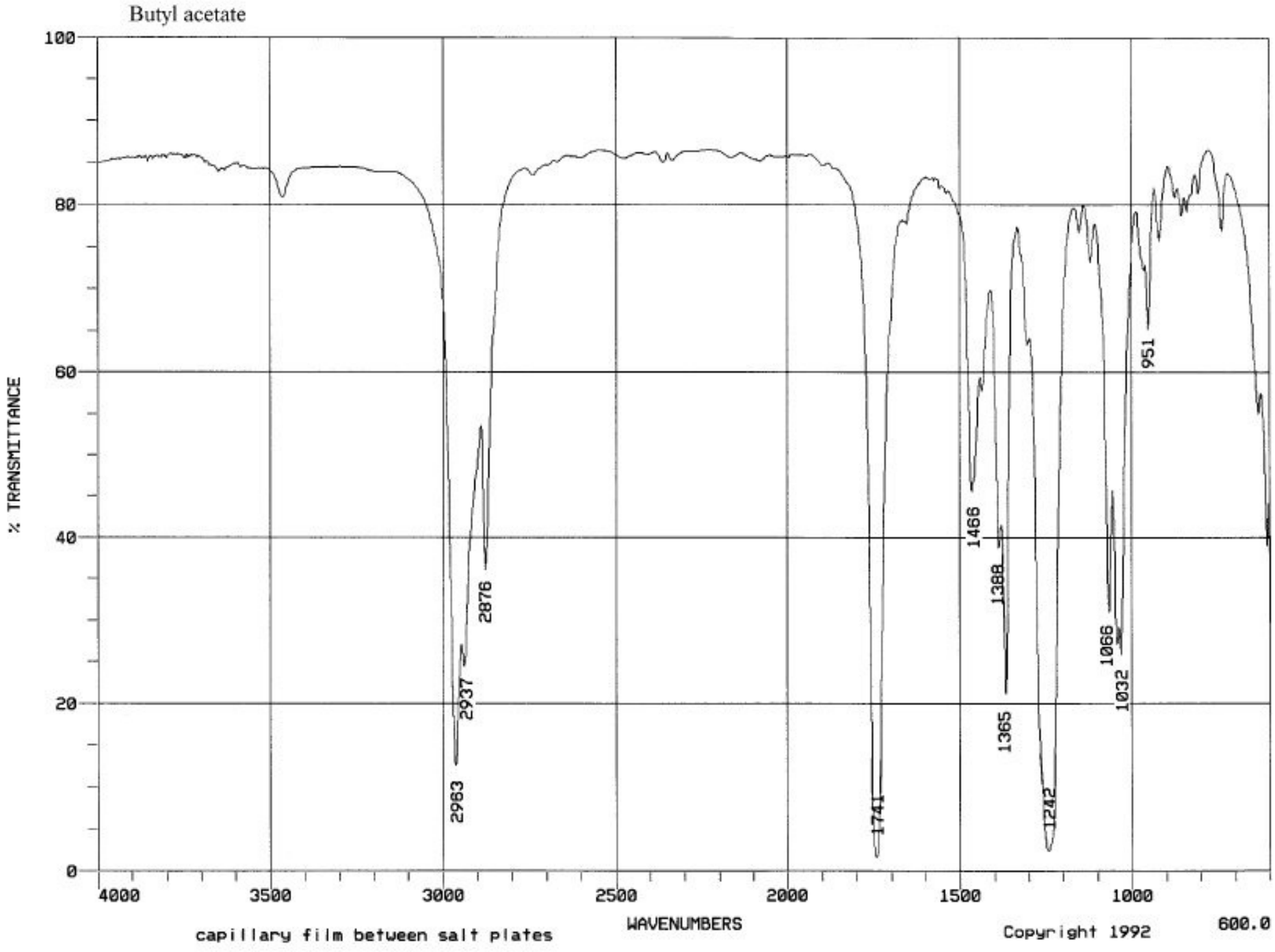
ethyl butanoate



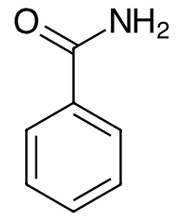


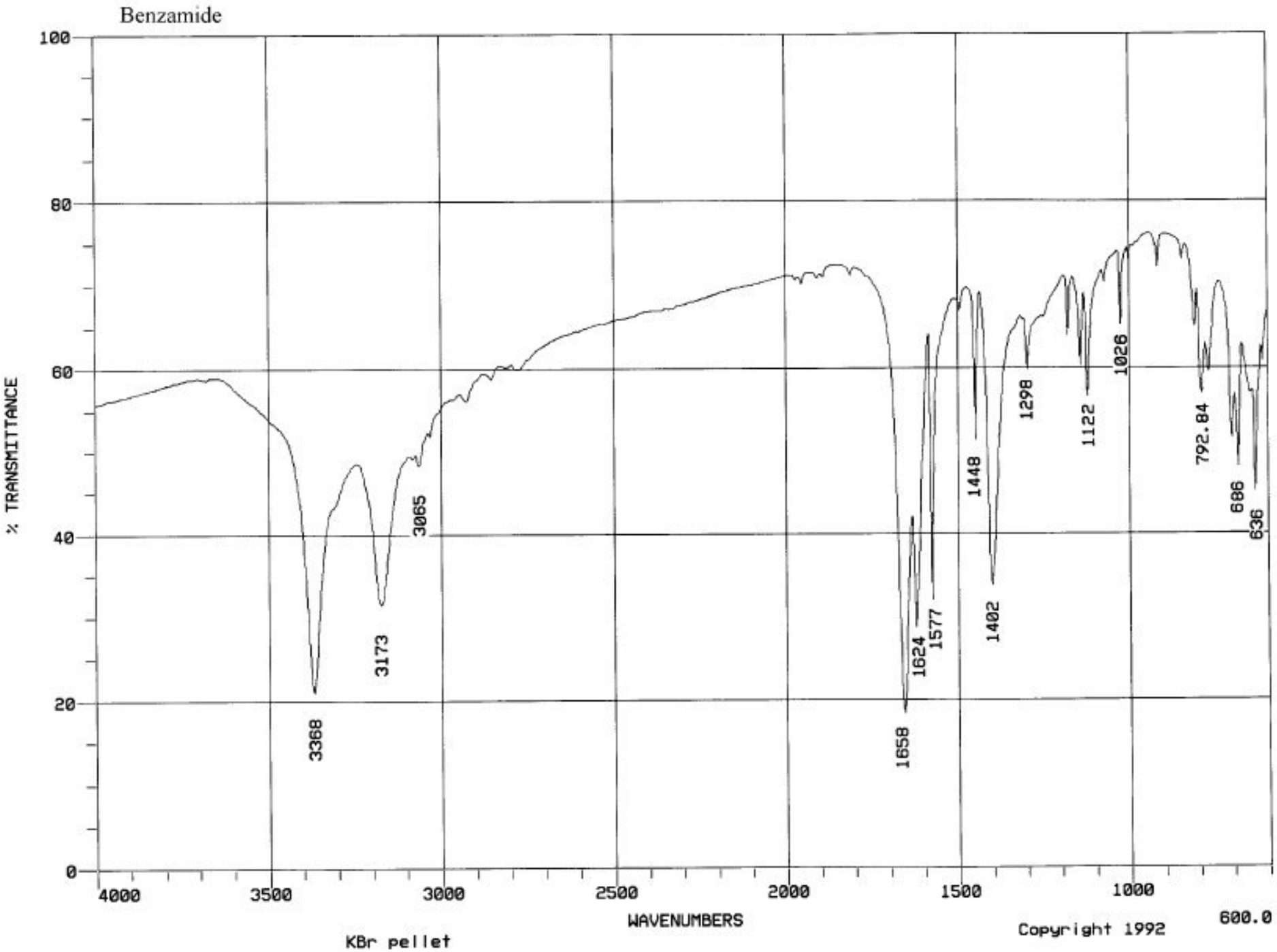
butyl acetate





benzamide


O
NH2


Benzamide
100
80
60
40
20
0
% TRANSMITTANCE
4000
3500
3000
2500
2000
1500
1000
600.0
WAVENUMBERS
3368
3173
3065
1658
1624
1577
1448
1402
1298
1122
1026
792.84
686
636
KBr pellet
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