

Lab 10

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210123075

Q1 (a)

x	f(x)	f'(x) forward difference
0.5000000000000000	0.4794000000000000	0.8520000000000000
0.6000000000000000	0.5646000000000000	0.7960000000000000
0.7000000000000000	0.6442000000000000	-

x	f(x)	f'(x) backward difference
0.5000000000000000	0.4794000000000000	-
0.6000000000000000	0.5696000000000000	0.9020000000000000
0.7000000000000000	0.6442000000000000	0.7460000000000000

(b)

x	f(x)	f'(x) forward difference
1	1	1.3125000000000000
1.2000000000000000	1.2625000000000000	1.9850000000000000
1.4000000000000000	1.6595000000000000	-

x	f(x)	f'(x) backward difference
1	1	-
1.2000000000000000	1.2625000000000000	1.3125000000000000
1.4000000000000000	1.6595000000000000	1.9850000000000000

Q2 (a)

x	f(x)	$f'(x)$ forward difference	$f'(x)$ exact	error
0.5000000000000000	0.4794000000000000	0.8520000000000000	0.877582561890373	0.0255825618903727
0.6000000000000000	0.5646000000000000	0.7960000000000000	0.825335614909678	0.0293356149096783
0.7000000000000000	0.6442000000000000	-	0.764842187284488	-

x	f(x)	$f'(x)$ backward difference	$f'(x)$ exact	error
0.5000000000000000	0.4794000000000000	-	0.877582561890373	-
0.6000000000000000	0.5646000000000000	0.8520000000000000	0.825335614909678	0.0266643850903217
0.7000000000000000	0.6442000000000000	0.7960000000000000	0.764842187284488	0.0311578127155116

(b)

x	f(x)	$f'(x)$ forward difference	$f'(x)$ exact	error
1	1	1.3125000000000000	1	0.3125000000000000
1.2000000000000000	1.2625000000000000	1.9850000000000000	1.63757173630549	0.347428263694509
1.4000000000000000	1.6595000000000000	-	2.34212226253940	-

x	f(x)	$f'(x)$ backward difference	$f'(x)$ exact	error
1	1	-	1	-
1.2000000000000000	1.2625000000000000	1.3125000000000000	1.63757173630549	0.325071736305491
1.4000000000000000	1.6595000000000000	1.9850000000000000	2.34212226253940	0.357122262539396

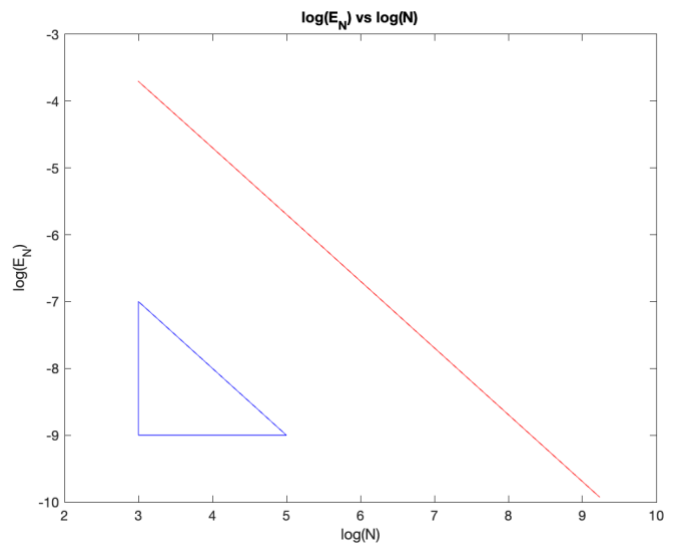
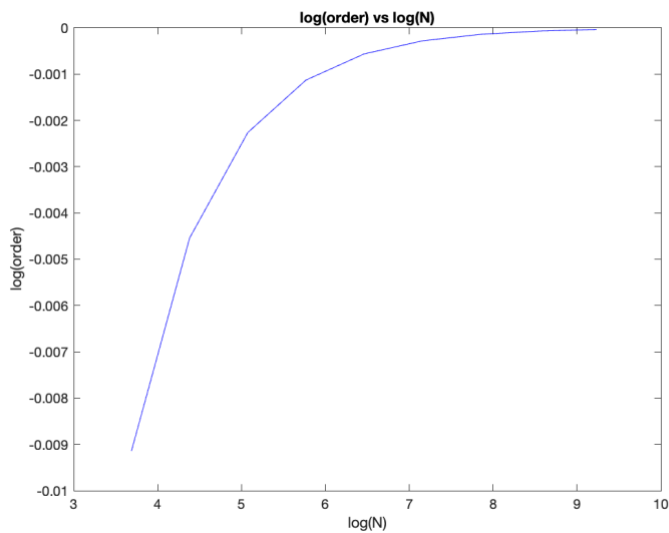
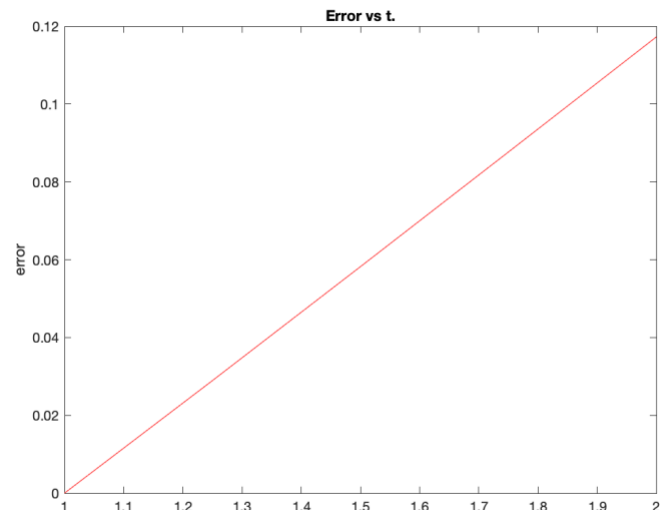
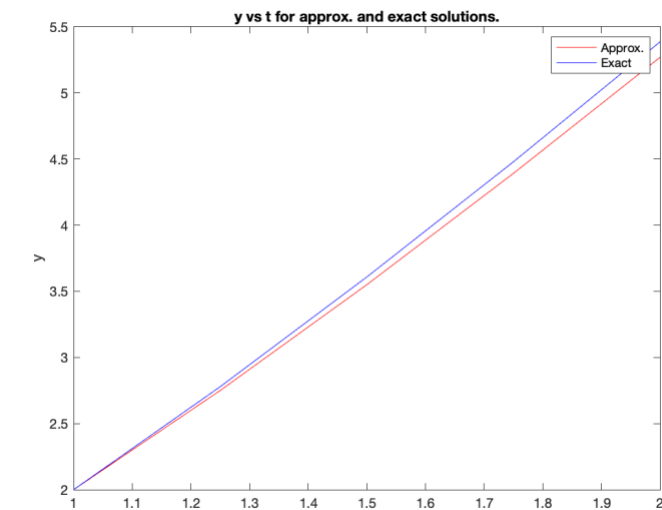
Q3 Voltage at time 1.00, 1.01, 1.02 and 1.03 were calculated using forward difference while voltage at time 1.04 was calculated using backward difference.

Time	1.00	1.01	1.02	1.03	1.04
Current	3.10	3.12	3.14	3.18	3.24
Voltage	2.4002	2.40304	4.36588	6.33156	6.34008

Q4 (a)

t_i	Approx.	Exact	Error
1	2	2	0
1.2500000000000000	2.7500000000000000	2.77892943914276	0.0289294391427622
1.5000000000000000	3.5500000000000000	3.60819766216225	0.0581976621622466
1.7500000000000000	4.391666666666667	4.47932762888699	0.0876609622203230
2	5.26904761904762	5.38629436111989	0.117246742072272

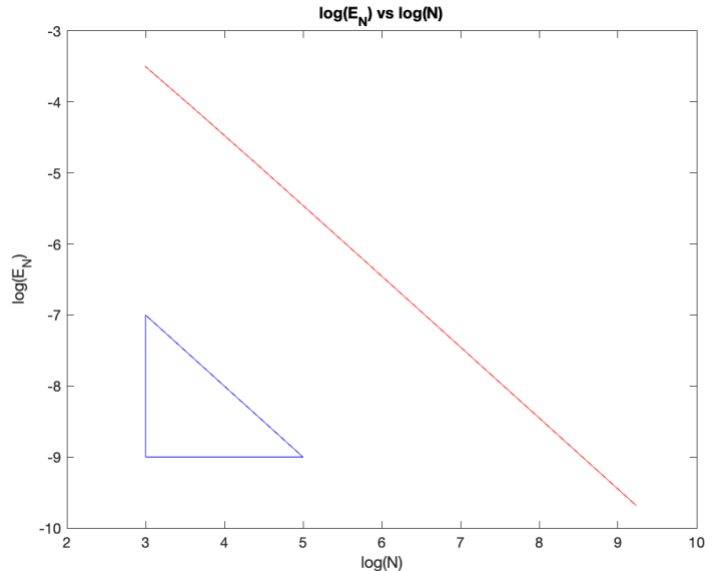
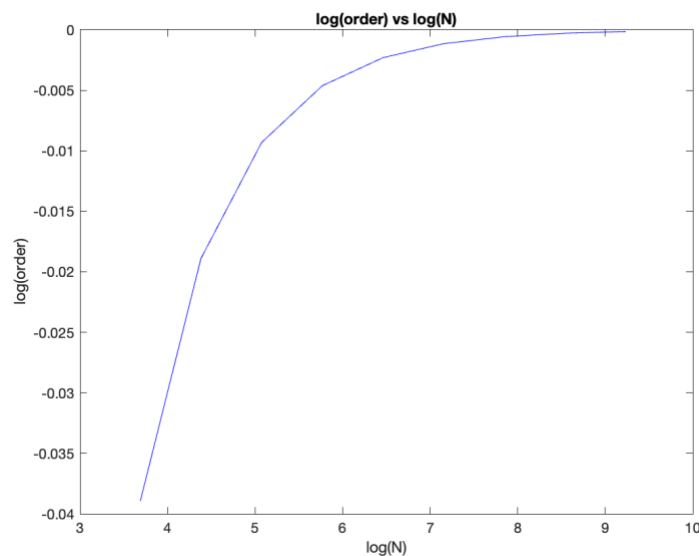
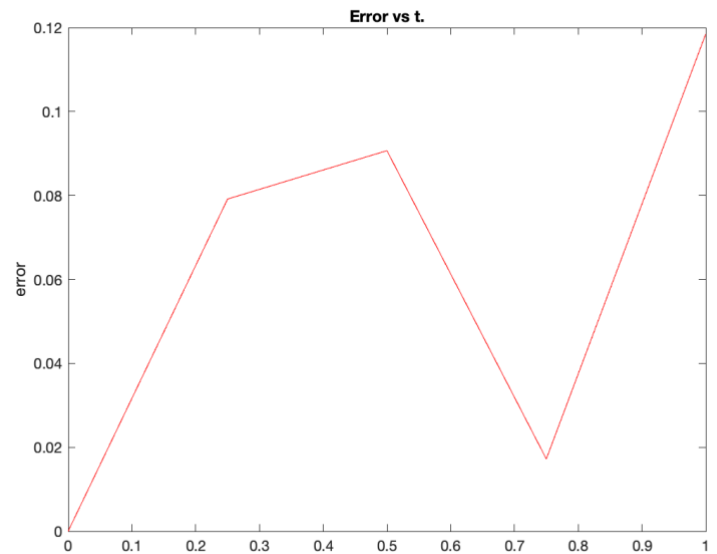
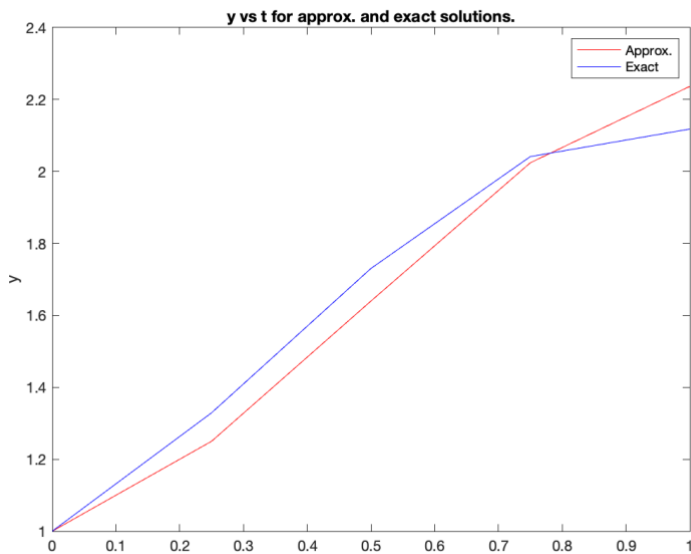
N	E_N	Order
20	0.0246875975345018	0
40	0.0124218811016100	0.990902783980146
80	0.00623046913144148	0.995470961844761
160	0.00312011721134358	0.997740570117573
320	0.00156127929837062	0.998871581708242
640	0.000780944824306397	0.999436118062299
1280	0.000390548706050533	0.999718141225330
2560	0.000195293426513745	0.999859091155473
5120	9.76514816269278e-05	0.999929550768890
10240	4.88269329046906e-05	0.999964776712492



(b)

t_i	Approx.	Exact	Error
0	1	1	0
0.2500000000000000	1.2500000000000000	1.32914981301083	0.0791498130108279
0.5000000000000000	1.63980533047843	1.73048975851471	0.0906844280362872
0.7500000000000000	2.02425465359648	2.04147203420961	0.0172173806131313
1	2.23645725323538	2.11797954561299	0.118477707622392

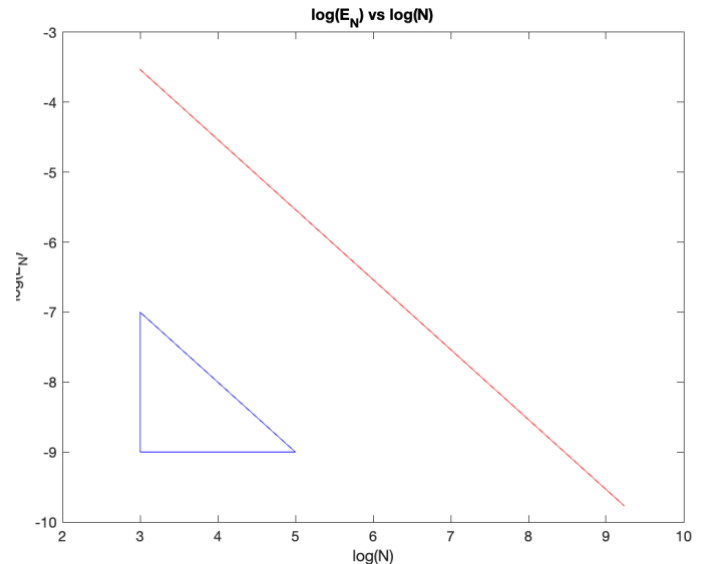
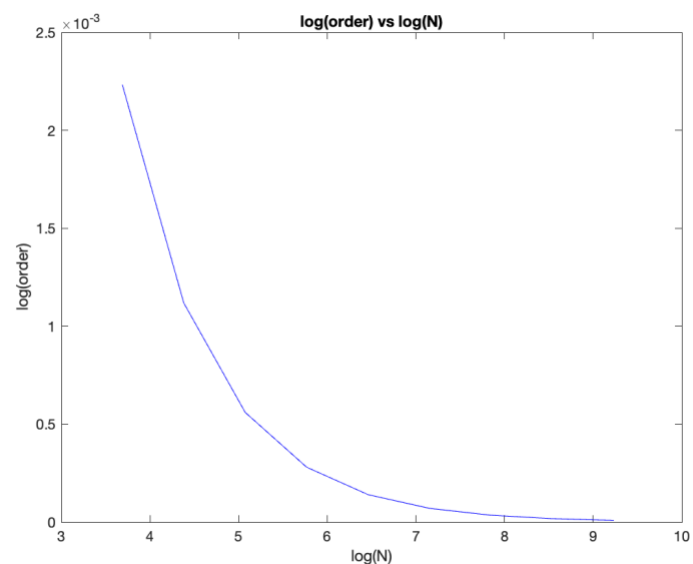
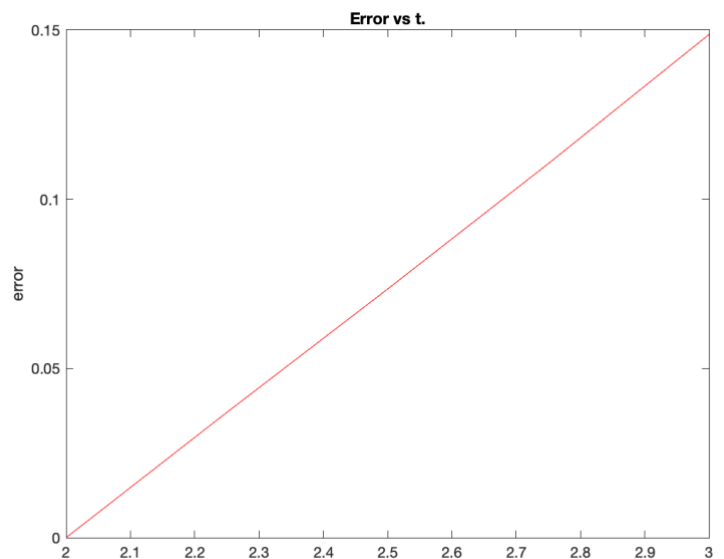
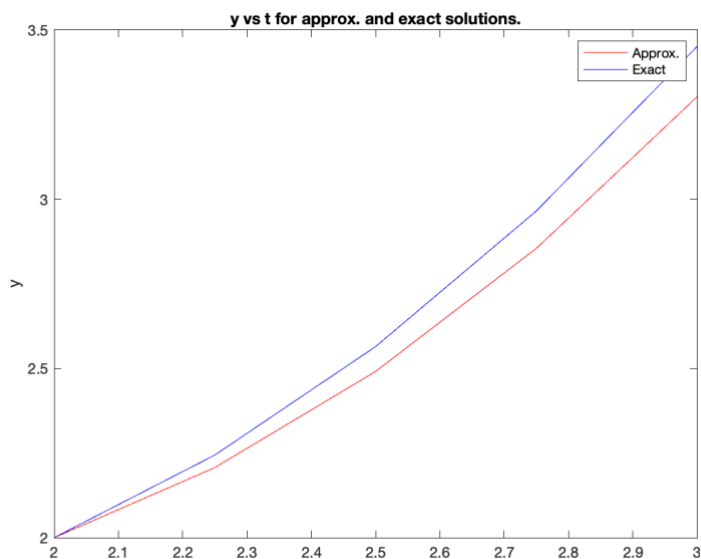
N	E_N	Order
20	0.0302525216587776	0
40	0.0155321474455123	0.961798093509036
80	0.00786750190703618	0.981279779482825
160	0.00395910528414163	0.990731189882954
320	0.00198589105503118	0.995387953817399
640	0.000994530120146120	0.997699509508973
1280	0.000497661207574840	0.998851130812271
2560	0.000248929640618912	0.999425908560802
5120	0.000124489579514009	0.999713039964197
10240	6.22509795575436e-05	0.999856541397379



(c)

t_i	Approx.	Exact	Error
2	2	2	$1.73717097497377e-16$
2.2500000000000000	2.20710678118655	2.24412111033650	0.0370143291499539
2.5000000000000000	2.49099890784320	2.56445194923163	0.0734530413884301
2.7500000000000000	2.85468034846393	2.96519383449175	0.110513486027825
3	3.30259646497368	3.45128665226430	0.148690187290614

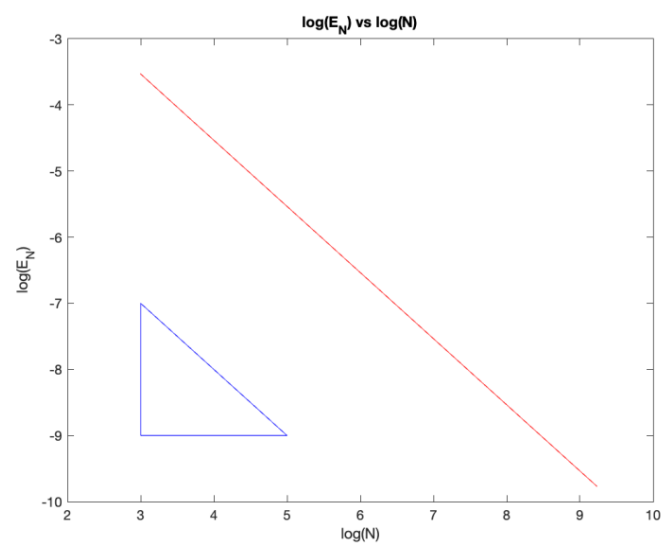
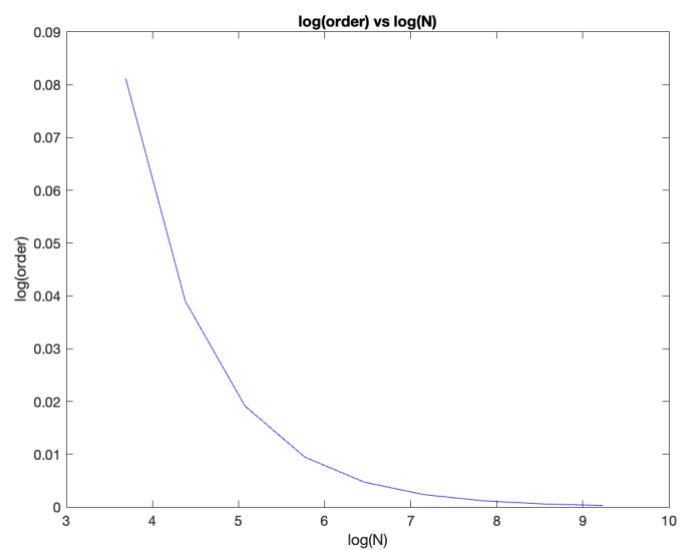
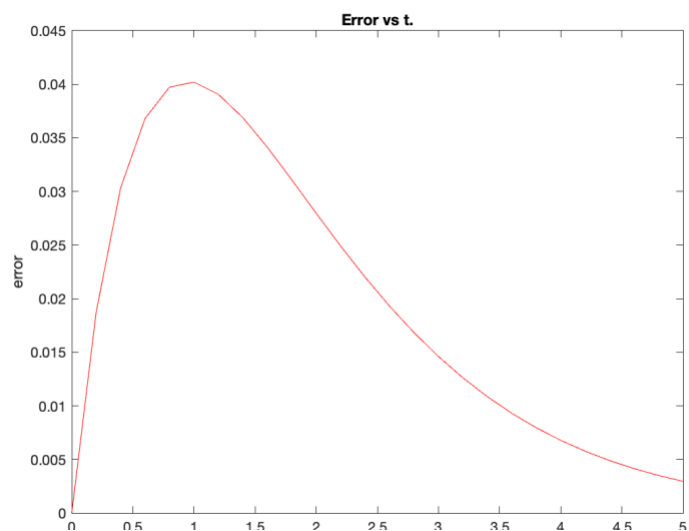
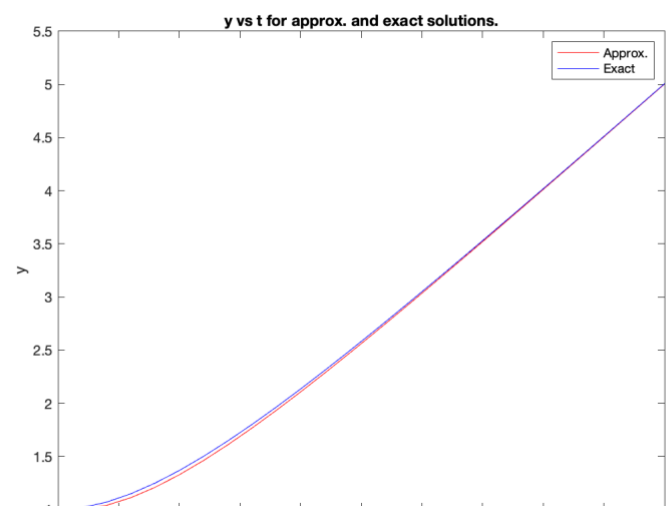
N	E_N	Order
20	0.0293741926896646	0
40	0.0146643641245847	1.00223468730022
80	0.00732649805701841	1.00111883014914
160	0.00366182788295050	1.00055979744662
320	0.00183055863551313	1.00027999562492
640	0.000915190488729848	1.00014002219100
1280	0.000457573036782569	1.00007001721891
2560	0.000228780966460010	1.00003501010881
5120	0.000114389095260573	1.00001750520418
10240	$5.71942006148440e-05$	1.00000875326404



Q5 (a) $h = 0.2$

t_i	Approx.	Exact	Error
0	1	1	0
0.2000000000000000	1	1.01873075307798	0.0187307530779819
0.4000000000000000	1.0400000000000000	1.07032004603564	0.0303200460356393
0.6000000000000000	1.1120000000000000	1.14881163609403	0.0368116360940264
0.8000000000000000	1.2096000000000000	1.24932896411722	0.0397289641172216
1	1.3276800000000000	1.36787944117144	0.0401994411714423
1.2000000000000000	1.4621440000000000	1.50119421191220	0.0390502119122021
1.4000000000000000	1.6097152000000000	1.64659696394161	0.0368817639416066
1.6000000000000000	1.7677721600000000	1.80189651799466	0.0341243579946554
1.8000000000000000	1.9342177280000000	1.96529888822159	0.0310811602215864
2	2.1073741824000000	2.13533528323661	0.0279611008366126
2.2000000000000000	2.2858993459200000	2.31080315836233	0.0249038124423340
2.4000000000000000	2.4687194767360000	2.49071795328941	0.0219984765534124
2.6000000000000000	2.6549755813888000	2.67427357821433	0.0192979968255338
2.8000000000000000	2.8439804651110400	2.86081006262522	0.0168295975141779
3	3.0351843720888300	3.04978706836786	0.0146026962790321
3.2000000000000000	3.2281474976710700	3.24076220397837	0.0126147063073006
3.4000000000000000	3.4225179981368500	3.43337326996033	0.0108552718234738
3.6000000000000000	3.6180143985094800	3.62732372244729	0.00930932393781064
3.8000000000000000	3.8144115188075900	3.82237077185617	0.00795925304858004
4	4.0115292150460700	4.01831563888873	0.00678642384266577
4.2000000000000000	4.2092233720368500	4.21499557682048	0.00577220478362334
4.4000000000000000	4.4073786976294800	4.41227733990307	0.00489864227358491
4.6000000000000000	4.6059029581035900	4.61005183574463	0.00414887764104651
4.8000000000000000	4.8047223664828700	4.80822974704902	0.00350738056615026
5	5.0037778931863000	5.00673794699909	0.00296005381278951

N	E_N	Order
20	0.0514731911714423	0
40	0.0242705253656257	1.08461588999484
80	0.0118053107196494	1.03976932347781
160	0.00582415191512585	1.01931612238385
320	0.00289291692753489	1.00952309107684
640	0.00144172524940388	1.00472864033676
1280	0.000719686279906805	1.00235619516160
2560	0.000359549916906664	1.00117607879252
5120	0.000179701760172556	1.00058753623067
10240	8.98325939280174e-05	1.00029364247408

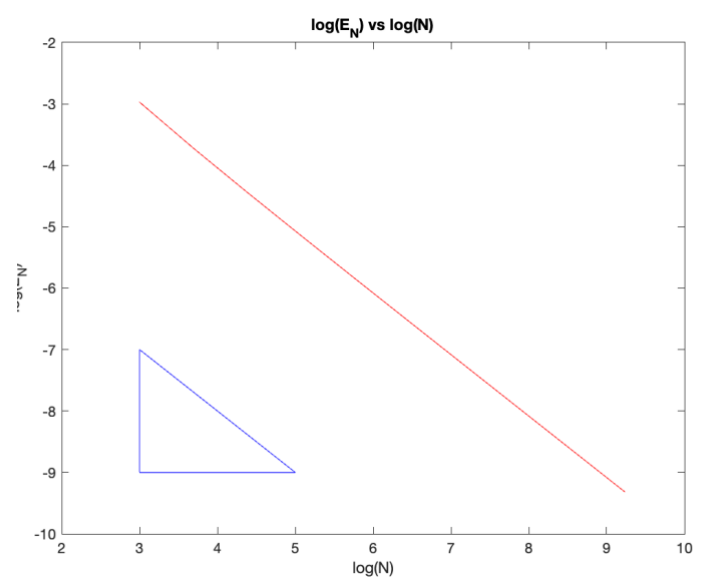
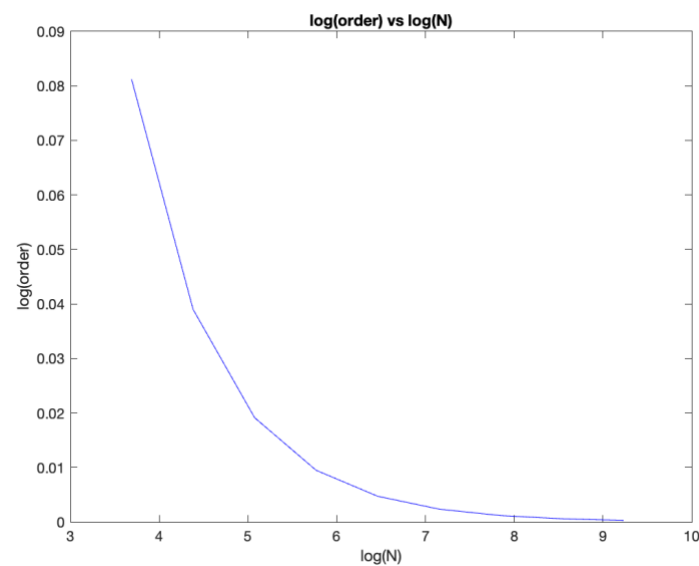
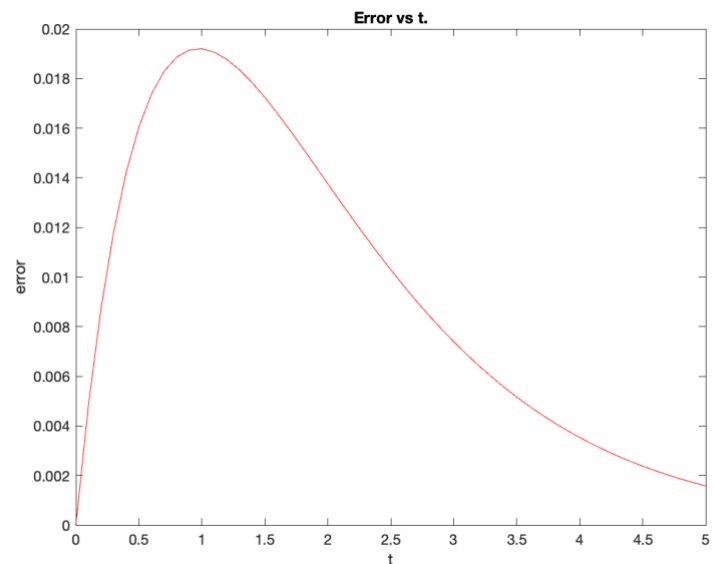
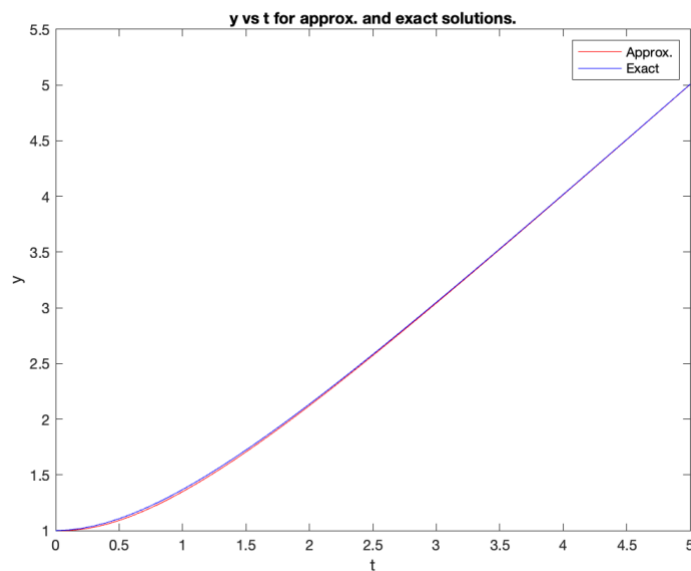


(b) $h = 0.1$

t_i	Approx.	Exact	Error
0	1	1	0
0.1000000000000000	1	1.00483741803596	0.00483741803595957
0.2000000000000000	1.0100000000000000	1.01873075307798	0.00873075307798186
0.3000000000000000	1.0290000000000000	1.04081822068172	0.0118182206817179
0.4000000000000000	1.0561000000000000	1.07032004603564	0.0142200460356393
0.5000000000000000	1.0904900000000000	1.10653065971263	0.0160406597126337
0.6000000000000000	1.1314410000000000	1.14881163609403	0.0173706360940267
0.7000000000000000	1.1782969000000000	1.19658530379141	0.0182884037914099
0.8000000000000000	1.2304672100000000	1.24932896411722	0.0188617541172220
0.9000000000000000	1.2874204890000000	1.30656965974060	0.0191491707405995
1	1.34867844010000	1.36787944117144	0.0192010010714427
1.1000000000000000	1.41381059609000	1.43287108369808	0.0190604876080800
1.2000000000000000	1.48242953648100	1.50119421191220	0.0187646754312025
1.3000000000000000	1.55418658283290	1.57253179303401	0.0183452102011128
1.4000000000000000	1.62876792454961	1.64659696394161	0.0178290393919966
1.5000000000000000	1.70589113209465	1.72313016014843	0.0172390280537810
1.6000000000000000	1.78530201888518	1.80189651799466	0.0165944991094714
1.7000000000000000	1.86677181699667	1.88268352405273	0.0159117070560690
1.8000000000000000	1.95009463529700	1.96529888822159	0.0152042529245875
1.9000000000000000	2.03508517176730	2.04956861922264	0.0144834474553360
2	2.12157665459057	2.13533528323661	0.0137586286460437
2.1000000000000000	2.20941898913151	2.22245642825298	0.0130374391214698
2.2000000000000000	2.29847709021836	2.31080315836233	0.0123260681439730
2.3000000000000000	2.38862938119653	2.40025884372280	0.0116294625262788
2.4000000000000000	2.47976644307687	2.49071795328941	0.0109515102125398
2.5000000000000000	2.57178979876919	2.58208499862390	0.0102951998547135
2.6000000000000000	2.66461081889227	2.67427357821433	0.00966275932206730
2.7000000000000000	2.75814973700304	2.76720551273975	0.00905577573670987
2.8000000000000000	2.85233476330274	2.86081006262522	0.00847529932248191
2.9000000000000000	2.94710128697246	2.95502322005641	0.00792193308394458
3	3.04239115827522	3.04978706836786	0.00739591009264761
3.1000000000000000	3.13815204244769	3.14504920239356	0.00689715994586328
3.2000000000000000	3.23433683820293	3.24076220397837	0.00642536577544105
3.3000000000000000	3.33090315438263	3.33688316740124	0.00598001301860738
3.4000000000000000	3.42781283894437	3.43337326996033	0.00556043101595669
3.5000000000000000	3.52503155504993	3.53019738342232	0.00516582837238602
3.6000000000000000	3.62252839954494	3.62732372244729	0.00479532290235324
3.7000000000000000	3.72027555959045	3.72472352647034	0.00444796687989386
3.8000000000000000	3.81824800363140	3.82237077185617	0.00412276822476455
3.9000000000000000	3.91642320326826	3.92024191144580	0.00381870817754351
4	4.01478088294144	4.01831563888873	0.00353475594729953
4.1000000000000000	4.11330279464729	4.11657267540176	0.00326988075447015
4.2000000000000000	4.21197251518256	4.21499557682048	0.00302306163791593
4.3000000000000000	4.31077526366431	4.31356855901220	0.00279329534789496
4.4000000000000000	4.40969773729788	4.41227733990307	0.00257960260519282
4.5000000000000000	4.50872796356809	4.51110899653824	0.00238103297015439

4.600000000000000	4.60785516721128	4.61005183574463	0.00219666853335428
4.700000000000000	4.70706965049015	4.70909527710170	0.00202562661154457
4.800000000000000	4.80636268544114	4.80822974704902	0.00186706160788416
4.900000000000000	4.90572641689702	4.90744658307092	0.00172016617390207
5	5.00515377520732	5.00673794699909	0.00158417179176495

N	E_N	Order
20	0.0514731911714423	0
40	0.0242705253656257	1.08461588999484
80	0.0118053107196494	1.03976932347781
160	0.00582415191512585	1.01931612238385
320	0.00289291692753489	1.00952309107684
640	0.00144172524940388	1.00472864033676
1280	0.000719686279906805	1.00235619516160
2560	0.000359549916906664	1.00117607879252
5120	0.000179701760172556	1.00058753623067
10240	8.98325939280174e-05	1.00029364247408



(c) $h = 0.05$

t_i	Approx.	Exact	Error
0	1	1	0
0.0500000000000000	1	1.00122942450071	0.00122942450071401
0.1000000000000000	1.00250000000000	1.00483741803596	0.00233741803595957
0.1500000000000000	1.00737500000000	1.01070797642506	0.00333297642505781
0.2000000000000000	1.01450625000000	1.01873075307798	0.00422450307798192
0.2500000000000000	1.02378093750000	1.02880078307140	0.00501984557140488
0.3000000000000000	1.03509189062500	1.04081822068172	0.00572633005671791
0.3500000000000000	1.04833729609375	1.05468808971871	0.00635079362496340
0.4000000000000000	1.06342043128906	1.07032004603564	0.00689961474657681
0.4500000000000000	1.08024940972461	1.08762815162177	0.00737874189716393
0.5000000000000000	1.09873693923838	1.10653065971263	0.00779372047425464
0.5500000000000000	1.11880009227646	1.12694981038049	0.00814971810402687
0.6000000000000000	1.14036008766264	1.14881163609403	0.00845154843138969
0.6500000000000000	1.16334208327951	1.17204577676102	0.00870369348151110
0.7000000000000000	1.18767497911553	1.19658530379141	0.00891032467587986
0.7500000000000000	1.21329123015975	1.22236655274101	0.00907532258126155
0.8000000000000000	1.24012666865177	1.24932896411722	0.00920229546545602
0.8500000000000000	1.26812033521918	1.27741493194873	0.00929459672954945
0.9000000000000000	1.29721431845822	1.30656965974060	0.00935534128238078
0.9500000000000000	1.32735360253531	1.33674102345450	0.00938742091919378
1	1.35848592240854	1.36787944117144	0.00939351876290017
1.0500000000000000	1.39056162628812	1.39993774911116	0.00937612282304027
1.1000000000000000	1.42353354497371	1.43287108369808	0.00933753872437012
1.1500000000000000	1.45735686772502	1.46663676937905	0.00927990165402929
1.2000000000000000	1.49198902433877	1.50119421191220	0.00920518757342931
1.2500000000000000	1.52738957312183	1.53650479686019	0.00911522373835600
1.3000000000000000	1.56352009446574	1.57253179303401	0.00901169856827024
1.3500000000000000	1.60034408974246	1.60924026064589	0.00889617090343627
1.4000000000000000	1.63782688525533	1.64659696394161	0.00877007868627410
1.4500000000000000	1.67593554099257	1.68457028809380	0.00863474710123184
1.5000000000000000	1.71463876394294	1.72313016014843	0.00849139620549237
1.5500000000000000	1.75390682574579	1.76224797382674	0.00834114808095246
1.6000000000000000	1.79371148445850	1.80189651799466	0.00818503353615426
1.6500000000000000	1.83402591023558	1.84204990862075	0.00802399838517807
1.7000000000000000	1.87482461472380	1.88268352405273	0.00785890932893741
1.7500000000000000	1.91608338398761	1.92377394345045	0.00769055946283766
1.8000000000000000	1.95777921478823	1.96529888822159	0.00751967343335940
1.8500000000000000	1.99989025404882	2.00723716631363	0.00734691226481191
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1280	0.000719686279906805	1.00235619516160
2560	0.000359549916906664	1.00117607879252
5120	0.000179701760172556	1.00058753623067
10240	8.98325939280174e-05	1.00029364247408

