

```

1  /*
2  This is part of the Computer Algebra Test Suite (CATS).
3  These files show the results that are computed given the set of integrals
4  listed in
5
6  Spiegel, Murray R.
7  Mathematical Handbook of Formulas and Tables
8  Schaum's Outline Series McGraw-Hill 1968
9
10 Each integral is computed and compared against the published result.
11 Each result is differenced from the published result and reduced to a constant
12 (usually 0).
13
14 source:
15 [0] http://axiom.axiom-developer.org/axiom-website/CATS/index.html
16 [1] http://axiom.axiom-developer.org/axiom-website/CATS/schauml.input.pamphlet
17 */
18
19
20 using math, reduce;
21
22 // Initialization (this requires the REDUCE image file in the current dir).
23 reduce::init "C:/Users/scios/Desktop/pure-lang/pure-reduce/reduce.img" {"-v"};
24
25 // Verbosity level. 0 means no noise at all.
26 reduce::verbosity 0;
27
28 integrate(f,x) = simplify $ intg f x ;
29
30 let D = [] ;
31
32 //1
33 let I = integrate(1/(a*x+b),x);
34 let R = 1/a*log(a*x+b);
35 let D = D+[simplify (I-R)] ;
36 //2
37 let I = integrate(x/(a*x+b),x);
38 let R = x/a-b/a^2*log(a*x+b);
39 let D = D+[simplify (I-R)] ;
40 //3
41 let I = integrate(x^2/(a*x+b),x);
42 let R = (a*x+b)^2/(2*a^3)-(2*b*(a*x+b))/a^3+b^2/a^3*log(a*x+b);
43 let D = D+[simplify (I-R)] ;
44 //4
45 let I = integrate(x^3/(a*x+b),x);
46 let R = (a*x+b)^3/(3*a^4)-(3*b*(a*x+b)^2)/(2*a^4)+(3*b^2*(a*x+b))/
47     a^4-(b^3/a^4)*log(a*x+b);
48 let D = D+[simplify (I-R)] ;
49 //5
50 let I = integrate(1/(x*(a*x+b)),x);
51 let R = 1/b*log(x/(a*x+b));
52 let D = D+[simplify (I-R)] ;
53 //6
54 let I = integrate(1/(x^2*(a*x+b)),x);
55 let R = -1/(b*x)+a/b^2*log((a*x+b)/x);
56 let D = D+[simplify (I-R)] ;
57 //7

```

```

58 let I = integrate(1/(x^3*(a*x+b)),x);
59 let R = (2*a*x-b)/(2*b^2*x^2)+a^2/b^3*log(x/(a*x+b));
60 let D = D+[simplify (I-R)] ;
61 //8
62 let I = integrate(1/(a*x+b)^2,x);
63 let R = -1/(a*(a*x+b));
64 let D = D+[simplify (I-R)] ;
65 //9
66 let I = integrate(x/(a*x+b)^2,x);
67 let R = b/(a^2*(a*x+b))+1/a^2*log(a*x+b);
68 let D = D+[simplify (I-R)] ;
69 //10
70 let I = integrate(x^2/(a*x+b)^2,x);
71 let R = (a*x+b)/a^3-b^2/(a^3*(a*x+b))-((2*b)/a^3)*log(a*x+b);
72 let D = D+[simplify (I-R)] ;
73 //11
74 let I = integrate(x^3/(a*x+b)^2,x);
75 let R = (a*x+b)^2/(2*a^4)-(3*b*(a*x+b))/a^4+b^3/(a^4*(a*x+b))+(3*b^2/
76     a^4)*log(a*x+b);
77 let D = D+[simplify (I-R)] ;
78 //12
79 let I = integrate(1/(x*(a*x+b)^2),x);
80 let R = (1/(b*(a*x+b)))+(1/b^2)*log(x/(a*x+b));
81 let D = D+[simplify (I-R)] ;
82 //13
83 let I = integrate(1/(x^2*(a*x+b)^2),x);
84 let R = (-a/(b^2*(a*x+b)))-(1/(b^2*x))+((2*a)/b^3)*log((a*x+b)/x);
85 let D = D+[simplify (I-R)] ;
86 //14
87 let I = integrate(1/(x^3*(a*x+b)^2),x);
88 let R = -(a*x+b)^2/(2*b^4*x^2)+(3*a*(a*x+b))/(b^4*x)-(a^3*x)/
89     (b^4*(a*x+b))-((3*a^2)/b^4)*log((a*x+b)/x);
90 let D = D+[simplify (I-R)] ;
91 //15
92 let I = integrate(1/(a*x+b)^3,x);
93 let R = -1/(2*(a*x+b)^2);
94 let D = D+[simplify (I/R)] ;
95 //16
96 let I = integrate(x/(a*x+b)^3,x);
97 let R = -1/(a^2*(a*x+b))+b/(2*a^2*(a*x+b)^2);
98 let D = D+[simplify (I-R)] ;
99 //17
100 let I = integrate(x^2/(a*x+b)^3,x);
101 let R = (2*b)/(a^3*(a*x+b))-(b^2)/(2*a^3*(a*x+b)^2)+1/a^3*log(a*x+b);
102 let D = D+[simplify (I-R)] ;
103 //18
104 let I = integrate(x^3/(a*x+b)^3,x);
105 let R = (x/a^3)-(3*b^2)/(a^4*(a*x+b))+b^3/(2*a^4*(a*x+b)^2)-(3*b)/
106     a^4*log(a*x+b);
107 let D = D+[simplify (I-R)] ;
108 //19
109 let I = integrate(1/(x*(a*x+b)^3),x);
110 let R = (a^2*x^2)/(2*b^3*(a*x+b)^2)-(2*a*x)/(b^3*(a*x+b))-
111     (1/b^3)*log((a*x+b)/x);
112 let D = D+[simplify (I-R)] ;
113 //20
114 let I = integrate(1/(x^2*(a*x+b)^3),x);

```

```

115 let R = -a/(2*b^2*(a*x+b)^2)-(2*a)/(b^3*(a*x+b))-1/(b^3*x)+((3*a)/
116     b^4)*log((a*x+b)/x);
117 let D = D+[simplify (I-R)] ;
118 //21
119 let I = integrate(1/(x^3*(a*x+b)^3),x);
120 let R = -1/(2*b*x^2*(a*x+b)^2)+(2*a)/(b^2*x*(a*x+b)^2)+(9*a^2)/(b^3*(a*x+b)^2)
121     +(6*a^3*x)/(b^4*(a*x+b)^2)+(-6*a^2)/b^5*log((a*x+b)/x);
122 let D = D+[simplify (I-R)] ;
123 //22
124 let I = integrate((a*x+b)^n,x);
125 let R = (a*x+b)^(n+1)/((n+1)*a);
126 let D = D+[simplify (I-R)] ;
127 //23
128 let I = integrate(x*(a*x+b)^n,x);
129 let R = ((a*x+b)^(n+2))/((n+2)*a^2)-(b*(a*x+b)^(n+1))/((n+1)*a^2);
130 let D = D+[simplify (I-R)] ;
131 //24
132 let I = integrate(x^2*(a*x+b)^n,x);
133 let R = (a*x+b)^(n+3)/((n+3)*a^3)-(2*b*(a*x+b)^(n+2))/((n+2)*a^3)+
134     (b^2*(a*x+b)^(n+1))/((n+1)*a^3);
135 let D = D+[simplify (I-R)] ;
136 //25
137 let I = integrate(x^m*(a*x+b)^n,x);
138
139
140
141 let Dx = map (\f-> simplify $ df f x) D ;
142
143 // Dx should contain only zeroes.
144
145
146 // some more exmples:
147 let r1 = simplify $ nextprime 1002229999 ;
148 let r2 = simplify $ pf (2/((x+1)^2*(x+2))) x ; // list of partial fraction
149 let r3 = simplify $ solve (log(sin(x+3))^5 == 8) x ;
150 let r4 = simplify $ coeff ((y^2+z)^3/z) y ; // coeffs of polynom w.r.t. var
151 let r5 = simplify $ coeffn ((y^2+z)^3/z) y 6 ; // coeff to y^6 -> 1/z
152 let r6 = simplify $ part (a+b) 2 ; // part 2 of expr -> b
153 let r7 = simplify $ part (a+b) 1 ; // part 1 of expr -> a
154 let r8 = simplify $ part (a+b) 0 ; // part 0 of expr -> (+)
155 let r9 = simplify $ factorize (x^105-1) ;
156
157 reduce::switch "ifactor" 1;
158 let r10 = simplify $ factorize (12*x^2 - 12) ;
159 reduce::switch "ifactor" 0; // should -> {{2,2},{3,1},{X + 1,1},{X - 1,1}}.
160
161 let r11 = simplify $ gcd (x^2+2*x+1) (x^2+3*x+2) ; // -> X+1
162 let r12 = simplify $ gcd (2*x^2-2*y^2) (4*x+4*y) ; // -> 2*X+2*Y
163 let r13 = simplify $ gcd (x^2+y^2) (x-y) ; // -> 1.
164
165 let r14 = simplify $ lcm (x^2+2*x+1) (x^2+3*x+2) ; // -> X^3+4*X^2+5*X+2
166 let r15 = simplify $ lcm (2*x^2-2*y^2) (4*x+4*y) ; // -> 4*(X^2 - Y^2)
167
168 let r16 = simplify $ remainder ((x+y)*(x+2*y)) (x+3*y) ; // -> 2*Y^2
169 let r17 = simplify $ remainder (2*x+y) 2 ; // -> Y.
170
171 let r18 = simplify $ resultant (x/r*u+y) (u*y) u ; // -> Y^2

```

```

172
173 let r19 = simplify $ decompose (x^8-88*x^7+2924*x^6-43912*x^5+263431*x^4-
174      218900*x^3+65690*x^2-7700*x+234) ;
175      // -> {U^2+35*U+234, U=V^2+10*V,V=X^2-22*X}
176
177 let r20 = simplify $ decompose (u^2+v^2+2*u*v+1) ; // -> {W^2 + 1, W=U + V}
178
179 let r21 = simplify $ deg ((a+b)*(c+2*d)^2) d ; //-> 2
180 let r22 = simplify $ deg ((x+b)*(x^6+2*y)^2) x ; //-> 13
181
182 let r23 = simplify $ den (x/y^2) ; //-> Y**2
183
184 let r24 = simplify $ lcof ((a+b)*(c+2*d)^2) a ; // -> C**2+4*C*D+4*D**2
185 let r25 = simplify $ lcof ((a+b)*(c+2*d)^2) d ; // -> 4*(A+B)
186 let r26 = simplify $ lcof ((a+b)*(c+2*d)) (quote e) ; // -> A*C+2*A*D+B*C+2*B*D
187      // !!! e evals to Euler
188
189 let r27 = simplify $ lpower ((a+b)*(c+2*d)^2) a ; // -> A
190 let r28 = simplify $ lpower ((a+b)*(c+2*d)^2) d ; // -> D**2
191 let r29 = simplify $ lpower ((a+b)*(c+2*d)) x ; // -> 1
192
193 let r30 = simplify $ lterm ((a+b)*(c+2*d)^2) a ; // -> A*(C**2+4*C*D+4*D**2)
194 let r31 = simplify $ lterm ((a+b)*(c+2*d)^2) d ; // -> 4*D**2*(A+B)
195 let r32 = simplify $ lterm ((a+b)*(c+2*d)) x ; // -> A*C+2*A*D+B*C+2*B*D
196
197
198 let r33 = simplify $ mainvar ((a+b)*(c+2*d)^2) ; //-> A
199 let r34 = simplify $ mainvar 2 ; //-> 0
200
201 let r35 = simplify $ num (x/y^2) ; // -> X
202 let r36 = simplify $ num (quote (100/6)) ; // -> 50 (quote is necessary!)
203 let r37 = simplify $ num (a/4+b/6) ; // -> 3*A+2*B
204
205 let r38 = simplify $ reduct ((a+b)*(c+2*d)) a ; // -> B*(C + 2*D)
206 let r39 = simplify $ reduct ((a+b)*(c+2*d)) d ; // -> C*(A + B)
207 let r40 = simplify $ reduct ((a+b)*(c+2*d)) x ; // -> 0
208
209 let r41 = simplify $ sub [x==a+y,y==y+1] (x^2+y^2) ; //-> A^2+2*A*Y+2*Y^2+2*Y+1
210
211 let r42 = simplify $ mat [[a,b,c],[d,quote e,f],[g,h,quote i]]; //!!! e,i
212
213 /*
214 reduce::load "odesolve"; // ok
215
216 simplify $ depend x y;
217 simplify $ odesolve ( df y x == x^2 + (quote e)^x ) y x ;
218 //***** Matrix y not set
219 */
220 //simplify $ factor x;
221 reduce::switch "rat" 0;
222 let r43 = simplify (2*X^2*Y*A*(Y + 2) + X*(Y^2 + Z))/(2*A) ;
223 reduce::switch "rat" 1;
224 reduce::switch "div" 1;
225 let r44 = simplify (2*X^2*Y*A*(Y + 2) + X*(Y^2 + Z))/(2*A) ;
226
227
228 // set <==> assignment in REDUCE (:=),however, both sides are evaluated

```

```
229 let r45 = simplify $ set P (a*x^n + b* x^m + c) ; // P:=a*x^n + b* x^m + c;
230 let r46 = simplify P ; // return P (from Reduce)
231 let r47 = simplify $ df P x; // diff P x
232 let r48 = simplify $ set Q (intg P x) ; // integrate P x, store in Q
233
234 // df(F,x1,2,x2,x3,2)
235 let r49 = simplify $ set F (x1^2*a*x2*b*x3^3) ;
236 let r50 = simplify $ df F x1 2 x2 x3 2 ; // -> 12*a*b*x3
237
238 // df(G,x1,2,x2,2,x3)
239 let G = x1^N*x2^M*x3^J ;
240 let r51 = simplify $ set F G ;
241 let r52 = simplify $ df F x1 2 x2 2 x3 ;
242 let r53 = simplify $ df G x1 2 x2 2 x3 ;
243 let r54 = simplify (r53-r52) ; // -> 0
244
245 /* print the results
246 using system;
247 let R = [val ("r"+str i) | i=1..54];
248 map puts $ map str $ map eval R;
249 */
```