\[-2u \cos u + 2 \sin u + C = 2(\sin \sqrt{x} - \sqrt{x} \cos \sqrt{x}) + C.\]

61. Use integration by parts with

\[u = \arcsin x \quad \text{and} \quad dv = \frac{1}{x^2} \, dx.\]

Then apply Formula 60 of the endpapers, or use the trigonometric substitution \(x = \sin u\).

62. Let \(x = 3 \sec u\) to transform the integral into

\[9 \int \sec u \tan^2 u \, du = 9 \int (\sec^3 u - \sec u) \, du.\]

Apply Formulas 14 and 28 of the endpapers to obtain

\[
\frac{9}{2} (\sec u \tan u - \ln|\sec u + \tan u|) + C_1
\]

\[
= \frac{9}{2} \left( \frac{1}{9} x(x^2 - 9)^{1/2} - \ln\frac{x}{3} + \frac{1}{3} (x^2 - 9)^{1/2} \right) + C_1
\]

\[
= \frac{1}{2} x(x^2 - 9)^{1/2} - \frac{9}{2} \ln|x + (x^2 - 9)^{1/2}| + C.
\]

63. Let \(x = \sin u\) to transform the integrand into

\[
\frac{1}{4} (2 \sin u \cos u)^2 = \frac{1}{4} \sin^2(2u) = \frac{1}{8} (1 - \cos 4u).
\]

64. Because \(2x - x^2 = 1 - (x - 1)^2\), let \(x = 1 + \sin u\). Then

\[
\int x(2x - x^2)^{1/2} \, dx = \int (1 + \sin u)(\cos^2 u) \, du
\]

\[
= \int \left( \frac{1}{2} + \frac{\cos 2u}{2} + \cos^2 u \sin u \right) \, du
\]

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\[
= \frac{1}{2} u + \frac{1}{2} \sin u \cos u - \frac{1}{3} \cos^3 u + C
\]
\[
= \frac{1}{2} \sin^{-1}(x - 1) + \frac{1}{2} (x - 1)(2x - x^2)^{1/2} - \frac{1}{3} (2x - x^2)^{3/2} + C.
\]

The answer can be further simplified to
\[
\frac{1}{2} \sin^{-1}(x - 1) + \frac{1}{6} (2x - x^2)^{1/2}(2x^2 - x - 3) + C.
\]

65. Write
\[
\frac{x - 2}{(2x + 1)^2} = \frac{2x + 1}{2(2x + 1)^2} - \frac{5}{2(2x + 1)^2}.
\]

66. Because
\[
\frac{2x^2 - 5x - 1}{x^3 - 2x^2 - x + 2} = \frac{1}{x + 1} + \frac{2}{x - 1} - \frac{1}{x - 2},
\]

the required antiderivative can be written as
\[
\ln \left| \frac{(x + 1)(x - 1)^2}{x - 2} \right| + C.
\]

68. Let \( u = \sin x \). Then \( du = \cos x \, dx \), and we obtain
\[
\int \frac{1}{u^2 - 3u + 2} \, du = \int \frac{1}{(u - 1)(u - 2)} \, du
\]
\[
= \int \left( -\frac{1}{u - 1} + \frac{1}{u - 2} \right) \, du
\]
\[
= \ln \left| \frac{u - 2}{u - 1} \right| + C = \ln \left( \frac{2 - \sin x}{1 - \sin x} \right) + C.
\]

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69. The partial fractions decomposition of the integrand is
\[
\frac{2}{x+1} - \frac{3}{(x+1)^2} + \frac{5}{(x+1)^4}.
\]

70. The substitution \( u = \tan x \) yields
\[
\int \frac{1}{u^2 + 2u + 2} \, du = \int \frac{1}{1 + (u + 1)^2} \, du
\]
\[
= \tan^{-1}(u + 1) + C = \tan^{-1}(1 + \tan x) + C.
\]

71. The partial fractions decomposition of the integrand is
\[
\frac{x + 1}{x^2 + 1} + \frac{x}{(x^2 + 1)^2}.
\]

72. The substitution \( u = \tan \frac{x}{2} \) transforms the integral into
\[
\int \frac{8 + 4u^2}{(3u^2 + 1)(u^2 + 1)} \, du.
\]

The partial fractions decomposition of the integrand is
\[
\frac{10}{3u^2 + 1} - \frac{2}{u^2 + 1},
\]
and this leads to the antiderivative
\[
\frac{10}{3} \sqrt{3} \tan^{-1}(u\sqrt{3}) - 2 \tan^{-1} u + C
\]
\[
= \frac{10}{3} \sqrt{3} \tan^{-1}(\sqrt{3} \tan \frac{x}{2}) - \xi + C.
\]

73. Let \( u = x^3 - 1 \); the rest is routine.
74. Let \( u = \tan \frac{\theta}{2} \). Then the integral becomes

\[
\int \frac{1}{u + 2} \, du = \ln |u + 2| + C
\]

\[
= \ln |2 + \tan \frac{\theta}{2}| + C
\]

\[
= \ln \left| \frac{2 + 2 \cos \frac{\theta}{2} \sin \frac{\theta}{2}}{1 + \cos \frac{\theta}{2}} \right| + C.
\]

76. Let \( x = \tan z \). The integral becomes

\[
\int \frac{3 \tan^2 z \sec^2 z}{\sec^2 z \tan^2 z} \, dz = 3z + C = 3 \tan^{-1}(x^{1/3}) + C.
\]

77. Use the identity \( \sin 2x = 2 \sin x \cos x \).

78. Because \( \frac{1}{2}(1 + \cos t) = \cos^2 \left( \frac{t}{2} \right) \),

\[
\int (1 + \cos t)^{1/2} \, dt = \sqrt{2} \int \left( \frac{1 + \cos t}{2} \right)^{1/2} \, dt
\]

\[
= \sqrt{2} \int \cos \left( \frac{t}{2} \right) \, dt = 2\sqrt{2} \sin \left( \frac{t}{2} \right) + C,
\]

which may also be written in the form \( 2\sqrt{1 - \cos t} + C \).

Note: We took the positive square root in the computations above. If this problem had been a definite integral, we'd need to see whether the values of \( t \) made \( \cos(t/2) \) positive or negative to know which sign to take.

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79. Multiply numerator and denominator of the integrand by
\[ \sqrt{1 - \sin t}. \]

80. Let \( u = \tan t \). Then the integral becomes
\[
\int \frac{1}{1 - u^2} \, du = \frac{1}{2} \int \left( \frac{1}{1 - u} + \frac{1}{1 + u} \right) \, du
\]
\[
= \frac{1}{2} \ln \left| \frac{1 + u}{1 - u} \right| + C = \frac{1}{2} \ln \left| \frac{1 + \tan t}{1 - \tan t} \right| + C.
\]

81. Use integration by parts with \( u = \ln(x^2 + x + 1) \) and -- if you wish -- \( v = x + \frac{1}{2} \) (this will save some trouble later).

82. Let \( u = e^x \). The integral becomes
\[
I = \int \sin^{-1} u \, du.
\]

Now do an integration by parts with \( p = \sin^{-1} u, \, dq = du \):
\[
I = u \sin^{-1} u - \int u(1 - u^2)^{-1/2} \, du
\]
\[
= u \sin^{-1} u + (1 - u^2)^{1/2} + C
\]
\[
= e^x \sin^{-1}(e^x) + (1 - e^{2x})^{1/2} + C.
\]

83. Integration by parts, with \( u = \arctan x, \, dv = x^{-2} \, dx \). The new integrand has the partial fractions decomposition
\[
\frac{1}{x} = \frac{x}{x^2 + 1}.
\]

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