Pekan Solmu-kirjoitus

19.4.2016, *H.A.*

```
> restart;
```

```
> f := sqrt(1 - cos(n*x))
```

$$f := \sqrt{1 - \cos(n\,x)} \tag{1}$$

```
> int(f, x = -Pi..Pi)
```

Warning, unable to determine if 2*Pi*_Z2/n is between -Pi and Pi; try to use assumptions or use the AllSolutions option
Warning, unable to determine if 2*Pi*_Z5/n is between -Pi and Pi; try to use assumptions or use the AllSolutions option

$$\int_{-\pi}^{\pi} \sqrt{1 - \cos(n\,x)}\ \mathrm{d}x \tag{2}$$

```
> infolevel[int] := 3; # Pyydetään infoa integroinnin vaiheista.
```

$$infolevel_{int} := 3 \tag{3}$$

```
> int(f, x = -Pi..Pi,'AllSolutions')
```

Definite Integration: Integrating expression on x=-Pi..Pi
Definite Integration: Using the integrators [distribution, piecewise, series, o, polynomial, ln, lookup, cook, ratpoly, elliptic, ellipticctrig, meijergspecial, improper, asymptotic, ftoc, ftocms, meijerg, contour]
LookUp Integrator: unable to find the specified integral in the table
int/elliptic: trying elliptic integration
int/elliptic: trying elliptic integration
int/definite/contour: contour integration
Definite Integration: Returning integral unevaluated.
Warning, unable to determine if 4*Pi*_Z11/n is between -Pi and Pi; try to use assumptions or use the AllSolutions option
Warning, unable to determine if 2*Pi*_Z12/n is between -Pi and Pi; try to use assumptions or use the AllSolutions option
Warning, unable to determine if 2*Pi*_Z9/n is between -Pi and Pi; try to use assumptions or use the AllSolutions option

$$int\left(\sqrt{1 - \cos(n\,x)}, x = -\pi..\pi, AllSolutions\right) \tag{4}$$

```
> assume(n, integer);
```

```
> res := int(f, x = -Pi..Pi)
```

Definite Integration: Integrating expression on x=-Pi..Pi
Definite Integration: Using the integrators [distribution, piecewise, series, o, polynomial, ln, lookup, cook, ratpoly, elliptic, ellipticctrig, meijergspecial, improper, asymptotic, ftoc, ftocms, meijerg, contour]
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int/elliptic: trying elliptic integration
int/elliptic: trying elliptic integration
int/indef1: first-stage indefinite integration
int/indef2: second-stage indefinite integration
int/trigon: case of integrand containing trigs
int/definite/contour: contour integration
Definite Integration: Returning integral unevaluated.
Warning, unable to determine if 2*Pi*_Z17/n is between -Pi and

Pi: try to use assumptions or use the AllSolutions option
Warning, unable to determine if 2*Pi*_Z24/n is between -Pi and
Pi: try to use assumptions or use the AllSolutions option

$$res := \int_{-\pi}^{\pi} \sqrt{1-\cos(n\sim x)}\, dx \tag{5}$$

```
> additionally(n > 0)
> res := int(f, x=-Pi..Pi)
```

```
Definite Integration:  Integrating expression on x=-Pi..Pi
Definite Integration:  Using the integrators [distribution,
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int/trigon: case of integrand containing trigs
Definite Integration:  Method ftoc succeeded.
Definite Integration:  Finished sucessfully.
```

$$res := \frac{1}{\sin\left(\frac{1}{2}\pi n\sim\right)\sqrt{-2\cos\left(\frac{1}{2}\pi n\sim\right)^2+2}\; n\sim}\left(4\left(\sqrt{2}\sin\left(\frac{1}{2}\pi n\sim\right)\sqrt{-2\cos\left(\frac{1}{2}\pi n\sim\right)^2+2}\; n\sim+2\cos\left(\frac{1}{2}\pi n\sim\right)^3-2\cos\left(\frac{1}{2}\pi n\sim\right)\right)\right) \tag{6}$$

```
> res := simplify(res);   # Ei tee mitään
```

$$res := \frac{1}{\sin\left(\frac{1}{2}\pi n\sim\right)\sqrt{-2\cos\left(\frac{1}{2}\pi n\sim\right)^2+2}\; n\sim}\left(4\left(\sqrt{2}\sin\left(\frac{1}{2}\pi n\sim\right)\sqrt{-2\cos\left(\frac{1}{2}\pi n\sim\right)^2+2}\; n\sim+2\cos\left(\frac{1}{2}\pi n\sim\right)^3-2\cos\left(\frac{1}{2}\pi n\sim\right)\right)\right) \tag{7}$$

```
> seq(eval(res, n=k), k=1..11, 2); # Parittomat indeksit ok.
```

$$4\sqrt{2}, 4\sqrt{2}, 4\sqrt{2}, 4\sqrt{2}, 4\sqrt{2}, 4\sqrt{2} \tag{8}$$

```
> seq(eval(res, n=k), k=2..6, 2);
      # Parillisilla n tulee 0:lla jako, kuten lausekkesta näkyy.
```

```
Error, numeric exception: division by zero
```

```
> infolevel[int] := 0;                    # Poistetaan integrointihöpinät.
```

$$infolevel_{int} := 0 \tag{9}$$

```
> seq(int(f, x=-Pi..Pi), n=100..120)
      # Lasketaan integraali numeerisilla n:n arvoilla (edelleen symbolisesti)
```

```
>
```

$$4\sqrt{2}, 4\sqrt{2} \quad \textbf{(10)}$$

```
> infolevel[int] := 3;
```

$$infolevel_{int} := 3 \quad \textbf{(11)}$$

```
> n := 10; int(f, x = -Pi..Pi)
      # Katsotaan vielä integrointiloki konkreettisella n:n arvolla, valitaan parillinen
      "ongelma-arvo", n=10)
```

$$n := 10$$

```
Definite Integration:  Integrating expression on x=-Pi..Pi
Definite Integration:  Using the integrators [distribution,
piecewise, series, o, polynomial, ln, lookup, cook, ratpoly,
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```

$$4\sqrt{2} \quad \textbf{(12)}$$

```
>
```