

CADGME2016 Targu Mures

Collaborative use of KETCindy with CAS

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KAKENHI 15K01037

CONTENTS

1. What is K_{ET}Cindy?
2. Sample case of K_{ET}Cindy use
3. Collaborative use with Maxima
4. Collaborative use with R
5. Concluding remarks

1. What is K_{ET}Cindy?

Collaboration between dynamically and statically displayed graphics

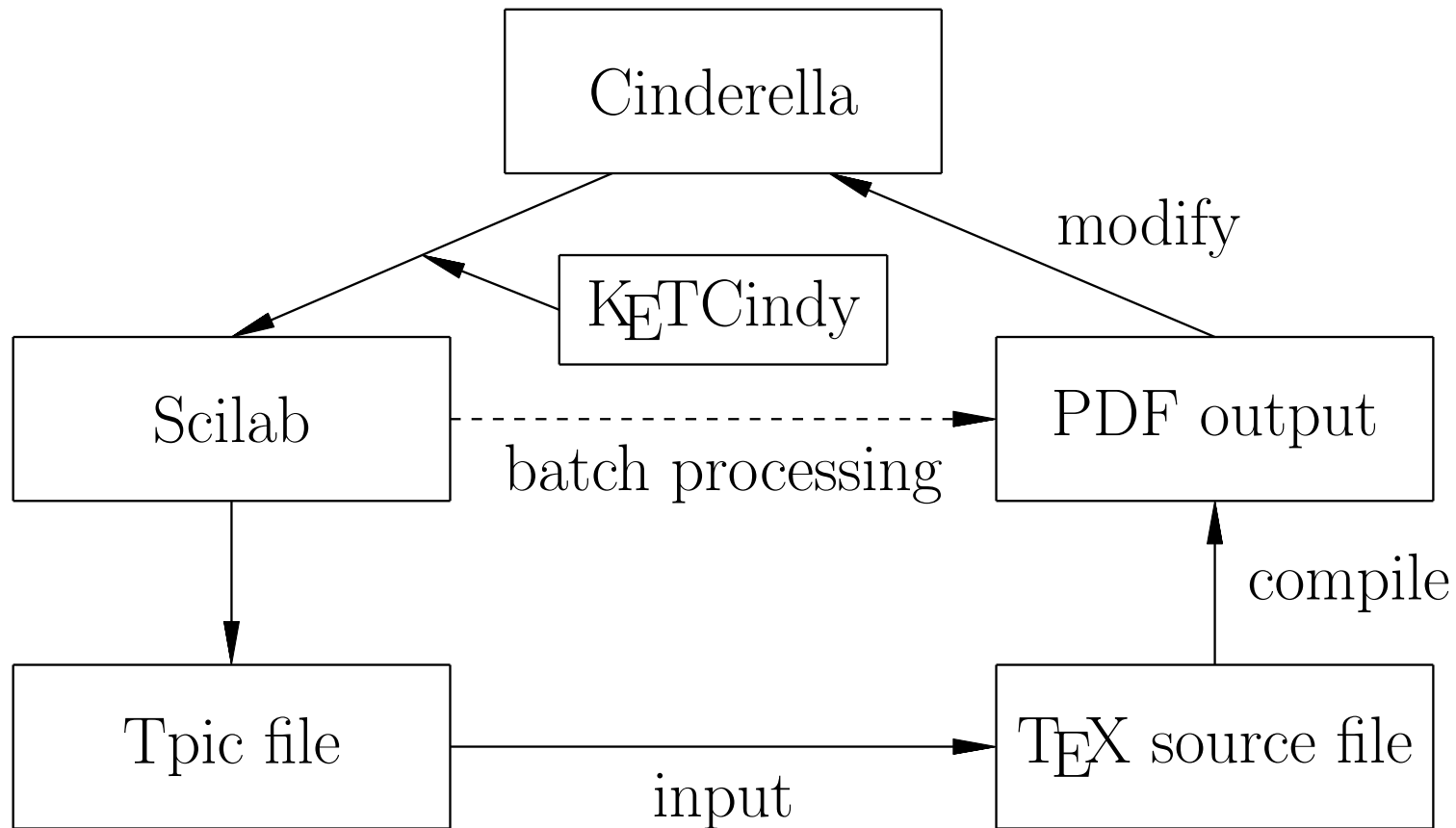
1. Interactive simulation and clarification of mathematical mechanism with the aid of dynamic graphics on Cinderella screen
2. Paper and pencil based deduction and calculation with the aid of the static graphics generated on T_EX documents

1. What is K_ET_Cindy?

Synchronizatoin of mathematical expressions on texts and graphics

1. High quality mathematical expressions on T_EX
2. Mathematical expressions of homogeneous quality on the T_EX graphics generated via K_ET_Cindy
3. Flexibly formatted T_EX graphical output (PDF) via the scripting language of Cinderella (Cindyscript)

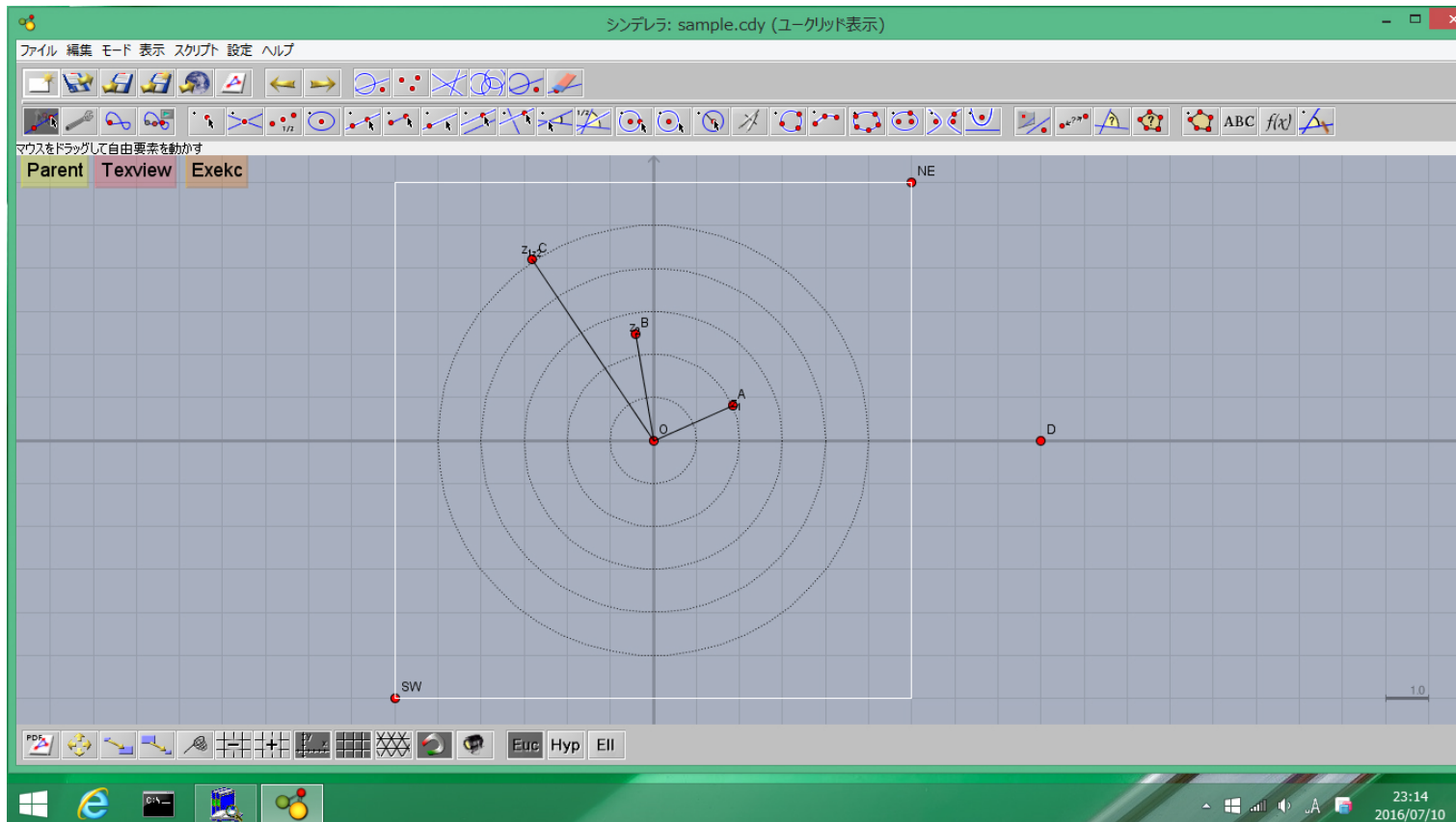
1. What is K_{ET}Cindy?



<http://ketpic.com>

2. Sample case of K_{ET}Cindy use

Dynamic graphics



2. Sample case of K_{ET}Cindy use

Static graphics

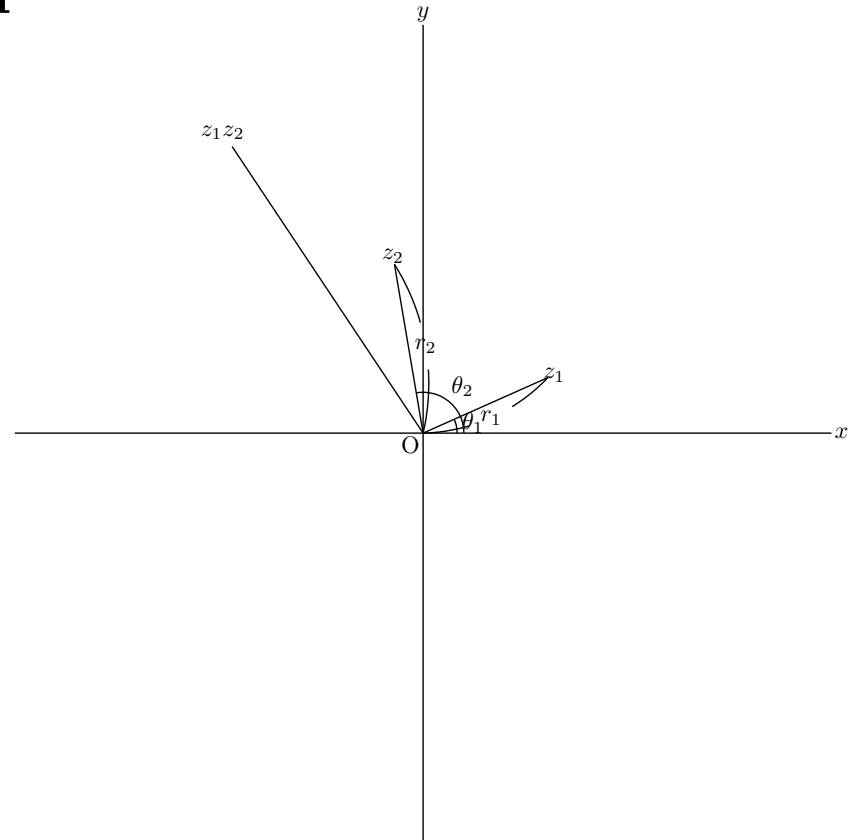
Euler's formula and polar form

When

$$z_1 = r_1 e^{i\theta_1} \quad z_2 = r_2 e^{i\theta_2}$$

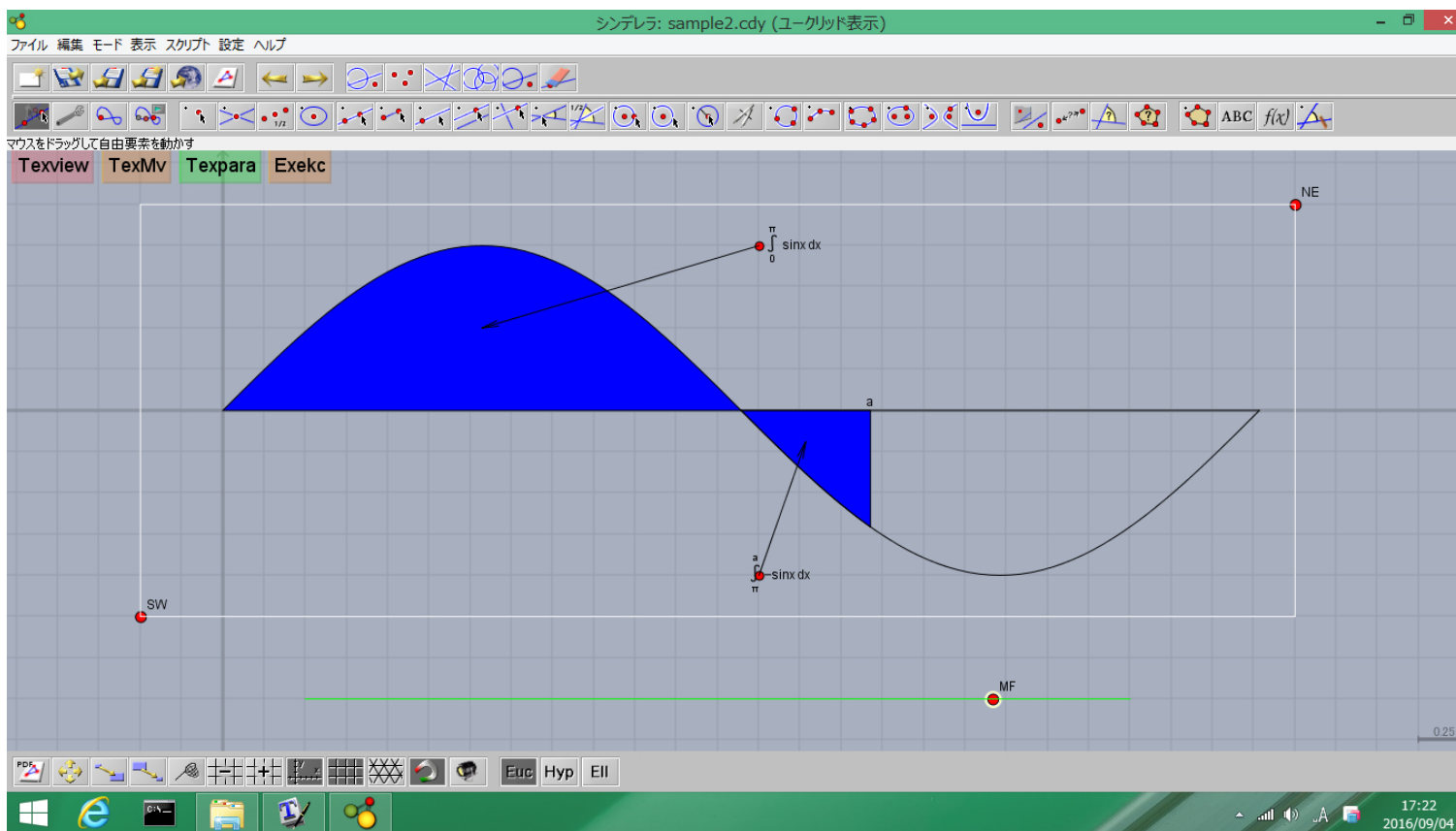
then

$$z_1 z_2 = r_1 r_2 e^{i(\theta_1 + \theta_2)}$$



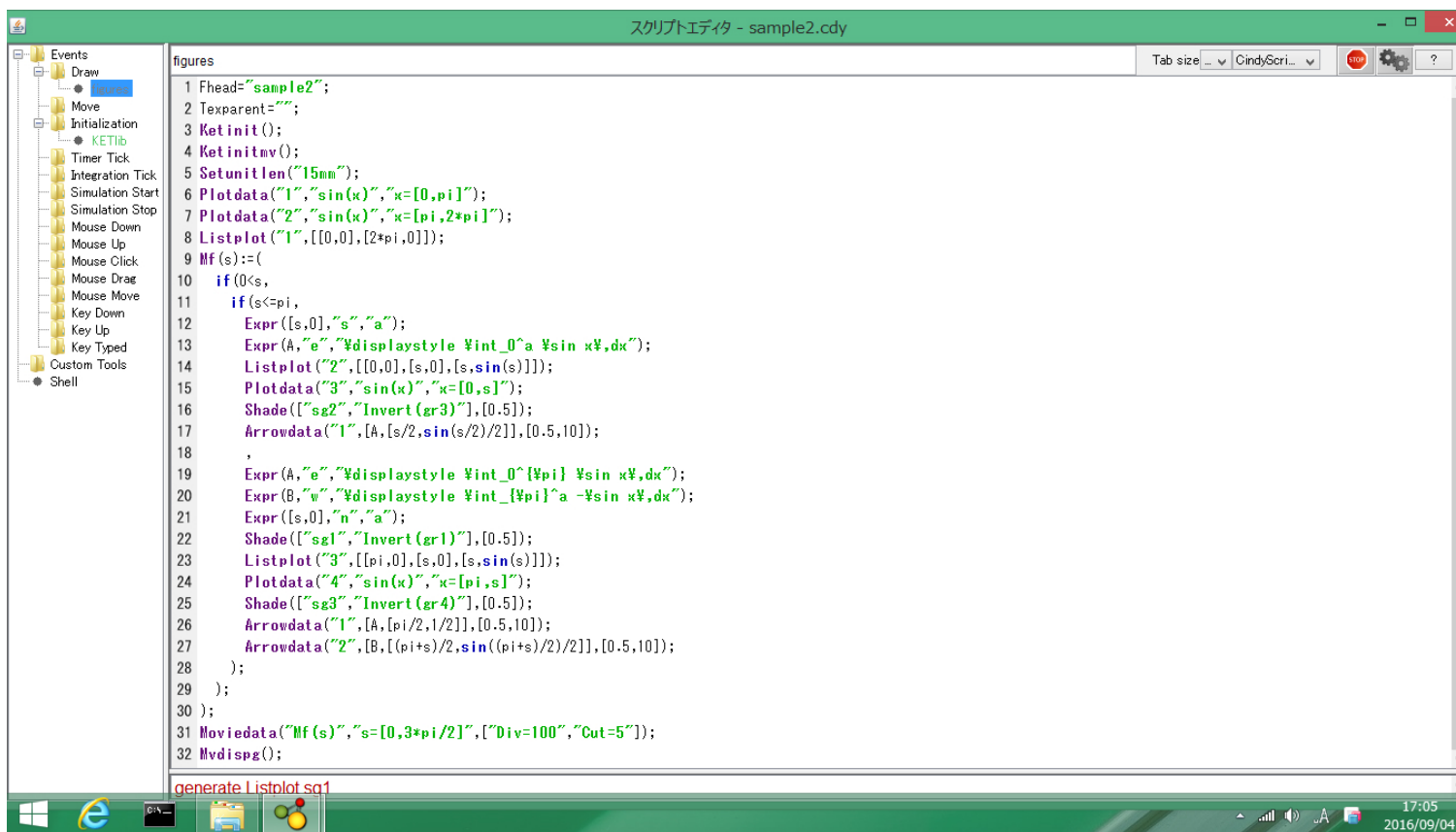
2. Sample case of K_ET Cindy use

Cinderella screen



2. Sample case of K_{ET}Cindy use

Cindyscript screen



The screenshot shows the KET Cindy software interface. The window title is "スクリプトエディタ - sample2.cdy". The interface is divided into three main sections: a left sidebar for "Events", a central script editor, and a right sidebar for "figures".

Events sidebar: Draw, Move, Initialization, KETlib, Timer Tick, Integration Tick, Simulation Start, Simulation Stop, Mouse Down, Mouse Up, Mouse Click, Mouse Drag, Mouse Move, Key Down, Key Up, Key Typed, Custom Tools, Shell.

Script Editor (Cindyscript):

```
1 Fhead="sample2";
2 Texparent="";
3 Ketinit();
4 Ketinitmv();
5 Setunitlen("15mm");
6 Plotdata("1","sin(x)","x=[0,pi]");
7 Plotdata("2","sin(x)","x=[pi,2*pi]");
8 Listplot("1",[[0,0],[2*pi,0]]);
9 Mf(s):=(
10  if(0<s,
11    if(s<=pi,
12      Expr([s,0],"s","a");
13      Expr(A,"e","%displaystyle %int_0^a %sin x% ,dx");
14      Listplot("2",[[0,0],[s,0],[s,sin(s)]]);
15      Plotdata("3","sin(x)","x=[0,s]");
16      Shade(["sg2","Invert(gr3)"],[0.5]);
17      Arrowdata("1",[A,[s/2,sin(s/2)],[0.5,10]]);
18    ,
19    Expr(A,"e","%displaystyle %int_0^{%pi} %sin x% ,dx");
20    Expr(B,"w","%displaystyle %int_{%pi}^a -%sin x% ,dx");
21    Expr([s,0],"n","a");
22    Shade(["sg1","Invert(gr1)"],[0.5]);
23    Listplot("3",[[pi,0],[s,0],[s,sin(s)]]);
24    Plotdata("4","sin(x)","x=[pi,s]");
25    Shade(["sg3","Invert(gr4)"],[0.5]);
26    Arrowdata("1",[A,[pi/2,1/2],[0.5,10]]);
27    Arrowdata("2",[B,[pi+s)/2,sin((pi+s)/2)],[0.5,10]]);
28  );
29 );
30 );
31 Moviedata("Mf(s)","s=[0,3*pi/2]","Div=100","Cut=5");
32 Mvdispz();
```

figures sidebar: generate Listplot sq1

Taskbar: Windows Start button, Internet Explorer, File Explorer, and system tray showing the time 17:05 and date 2016/09/04.

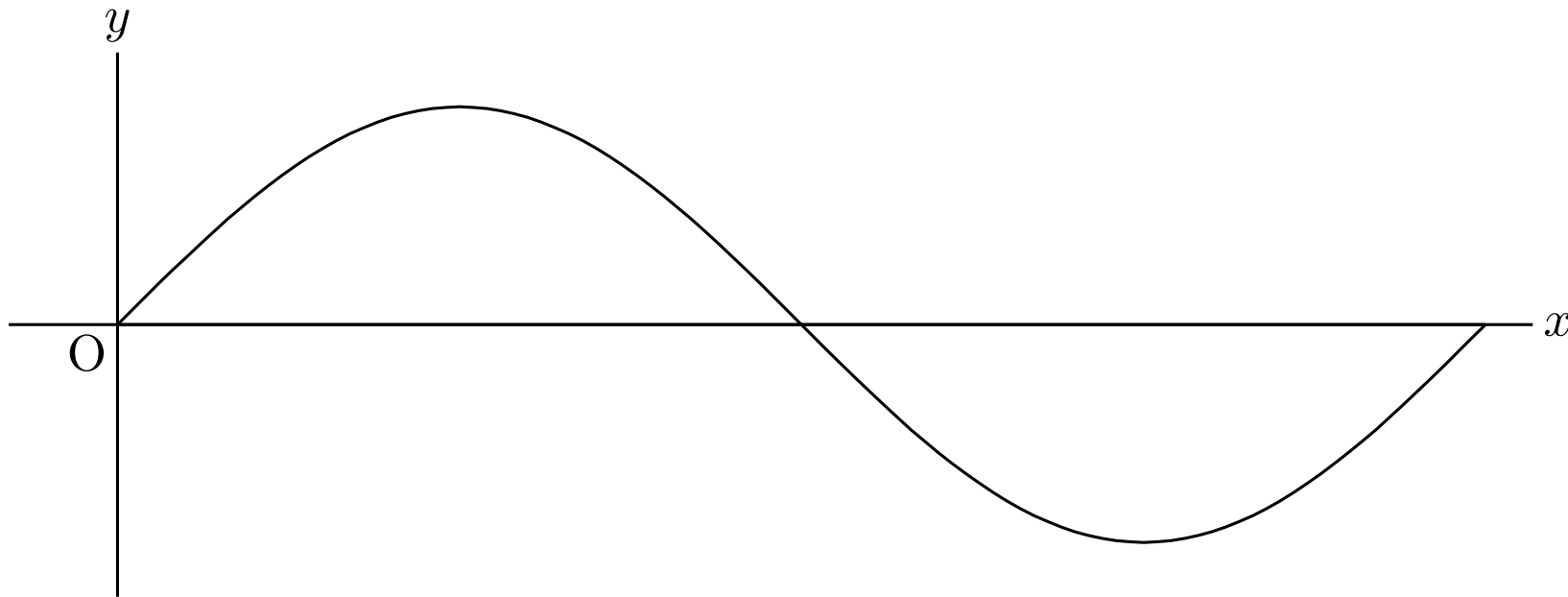
2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output

$$\int_0^a \sin x \, dx = \int_0^\pi \sin x \, dx - \int_\pi^a (-\sin x) \, dx \quad (a > \pi)$$

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



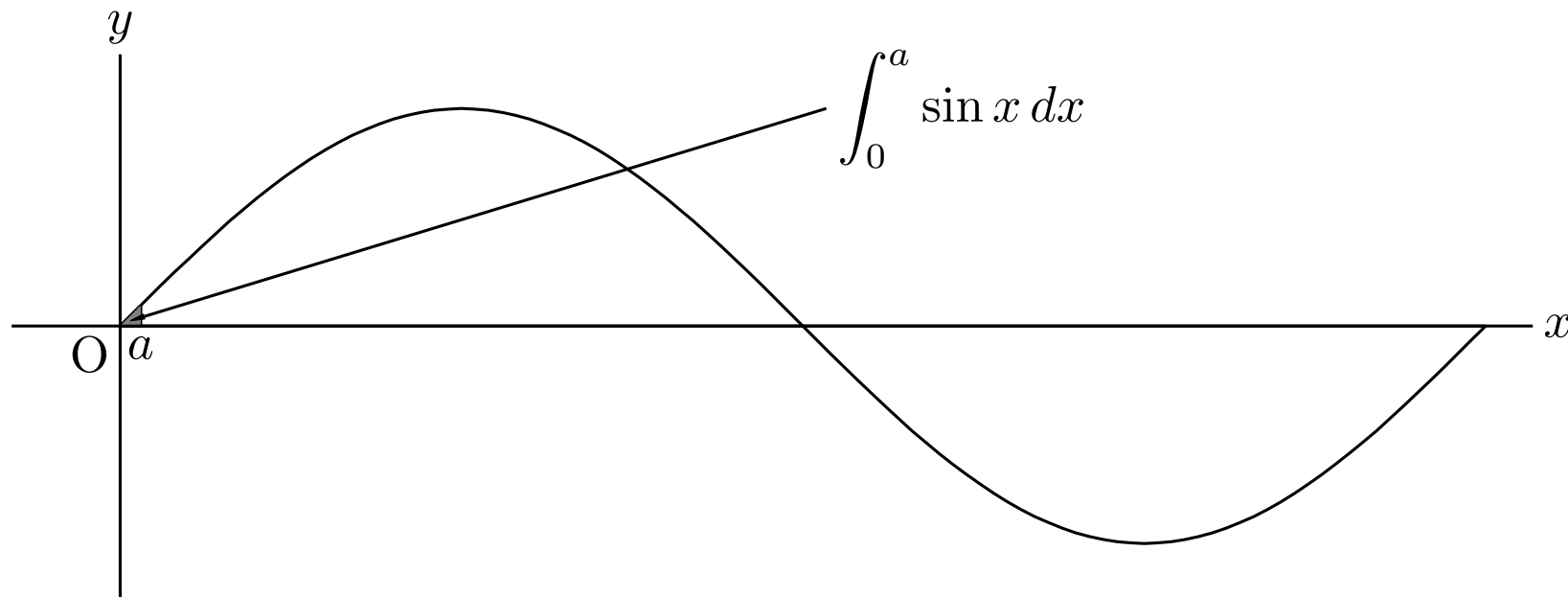
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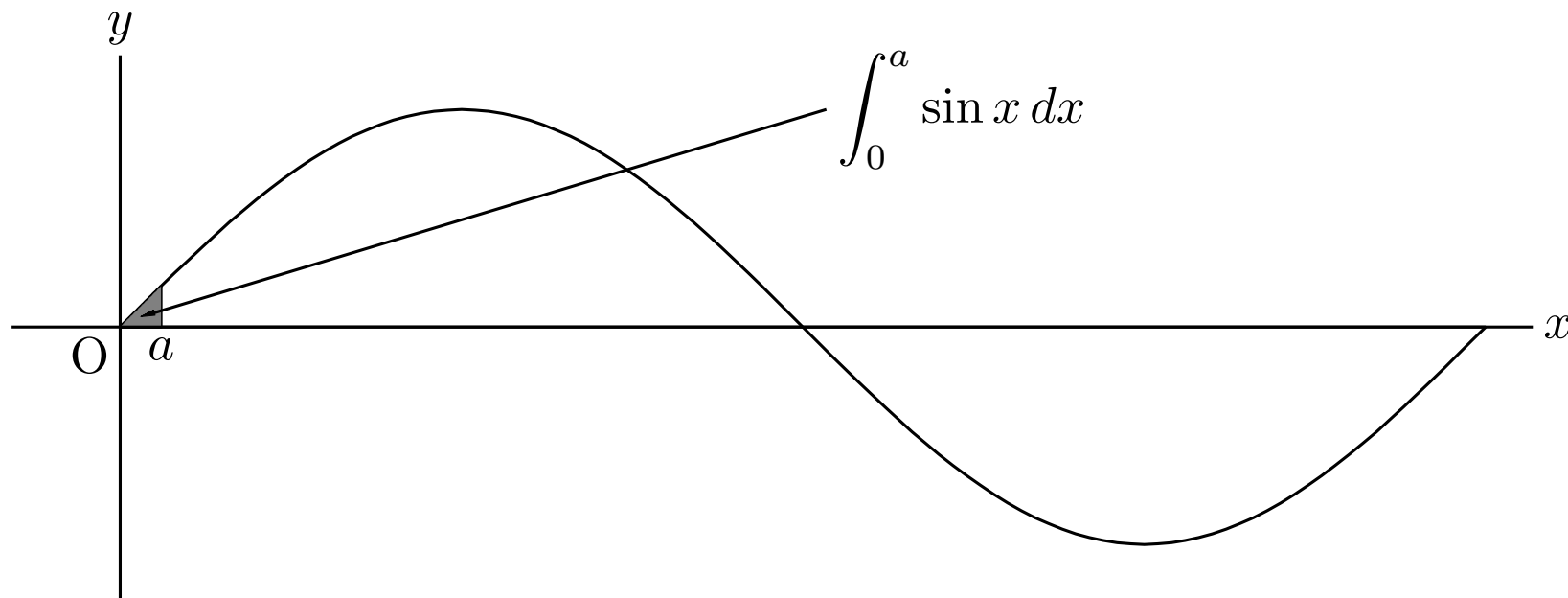
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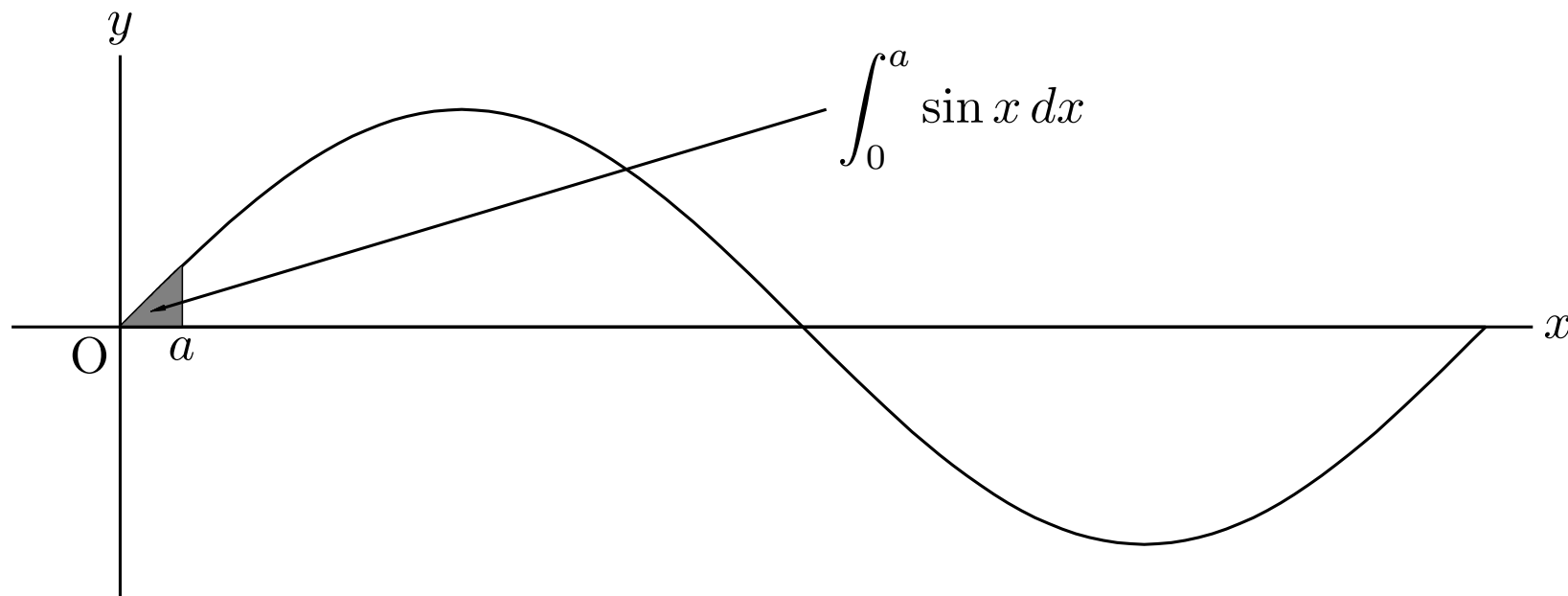
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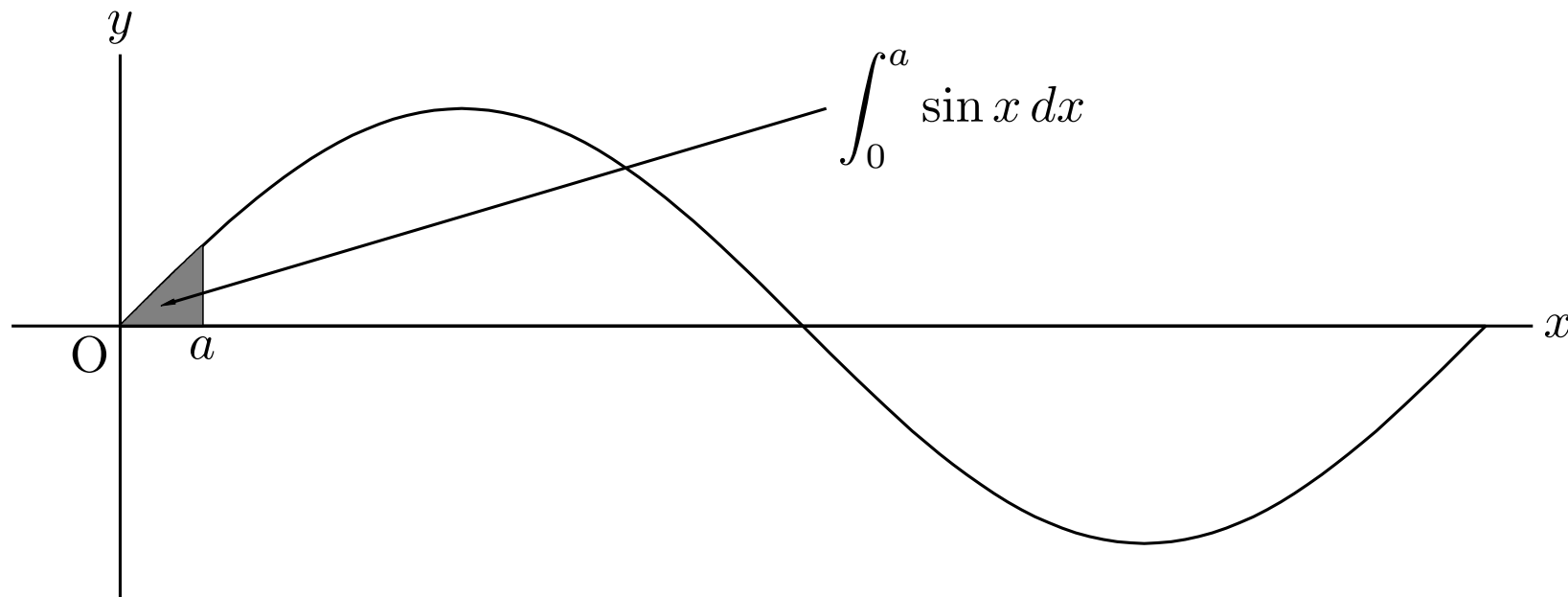
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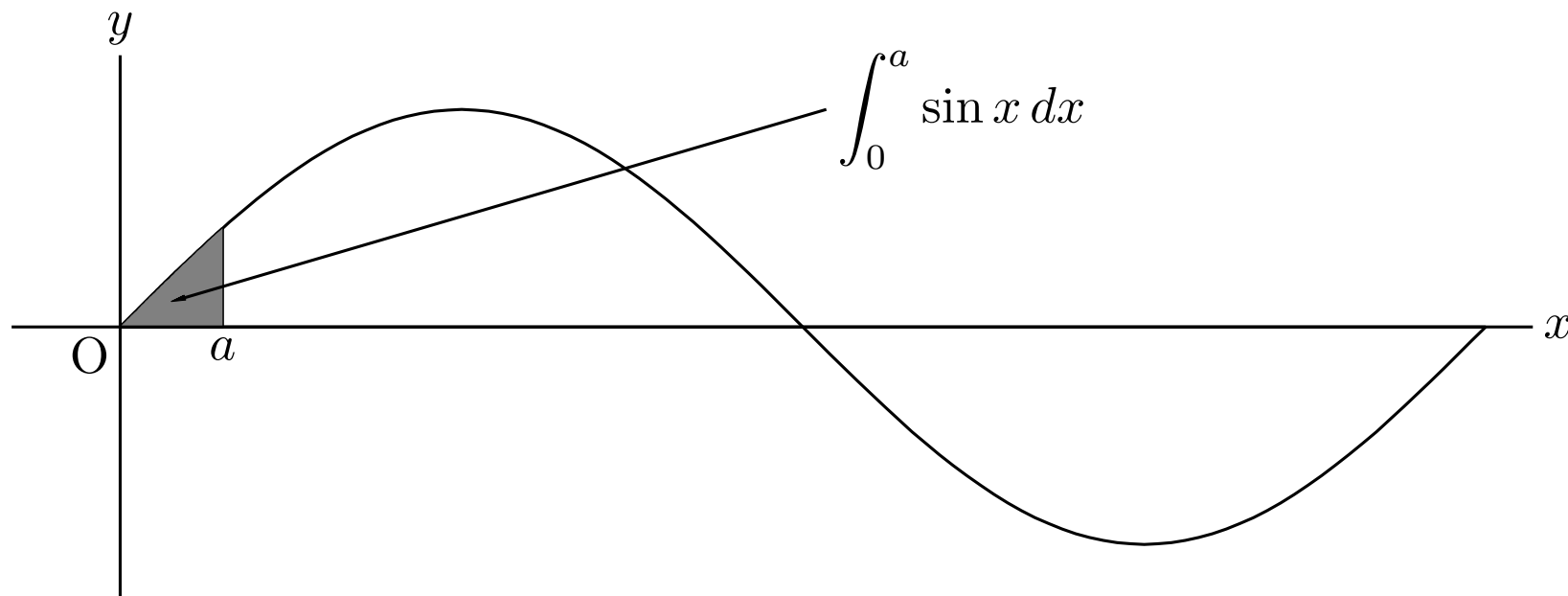
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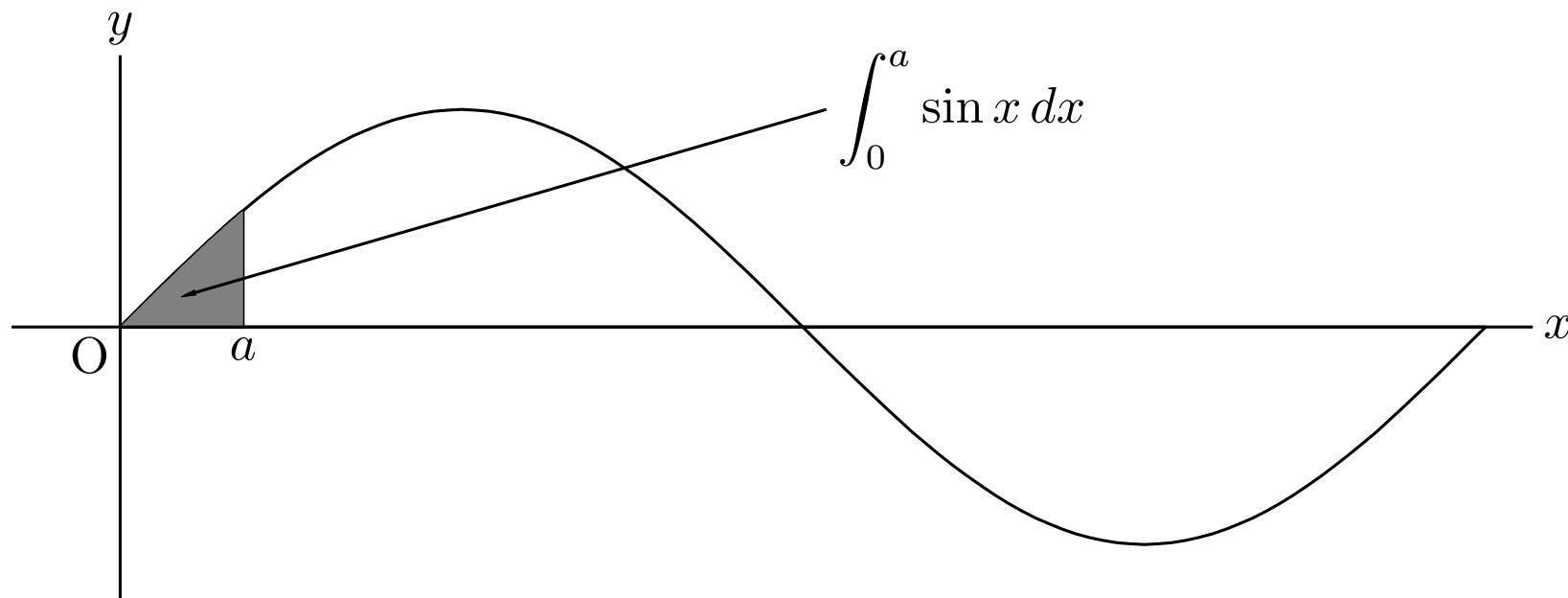
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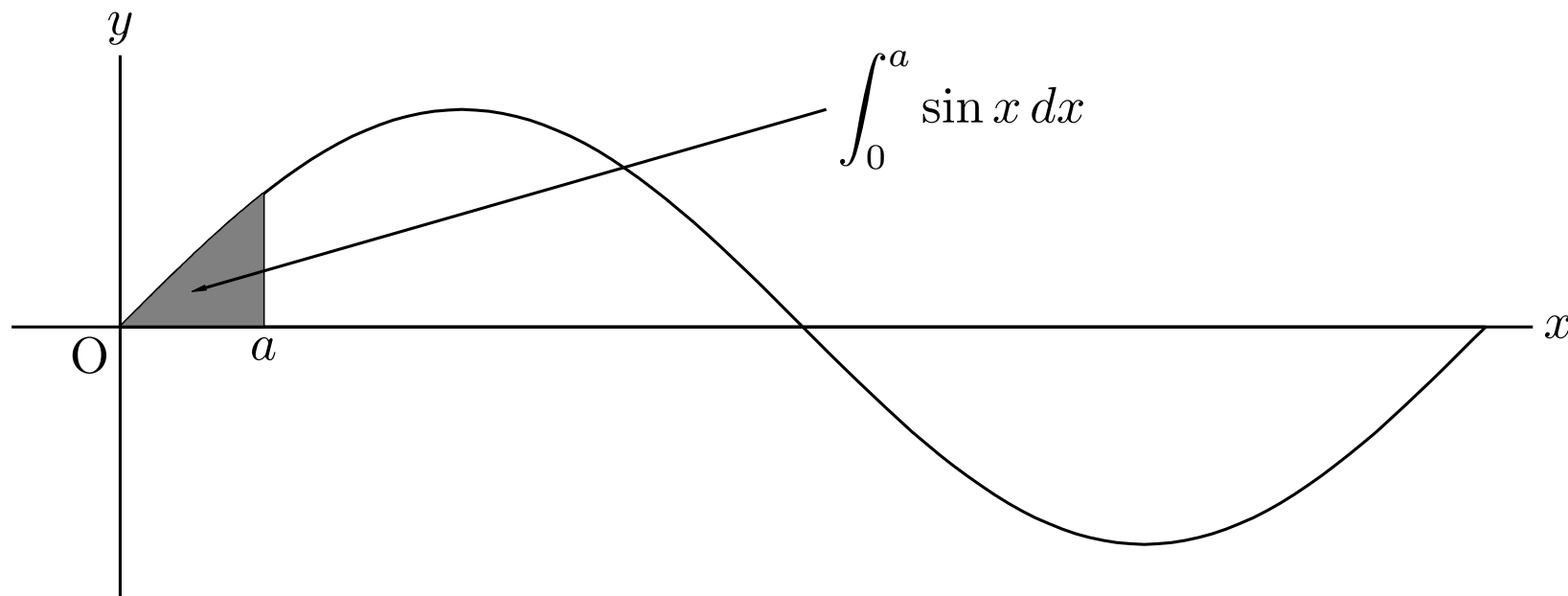
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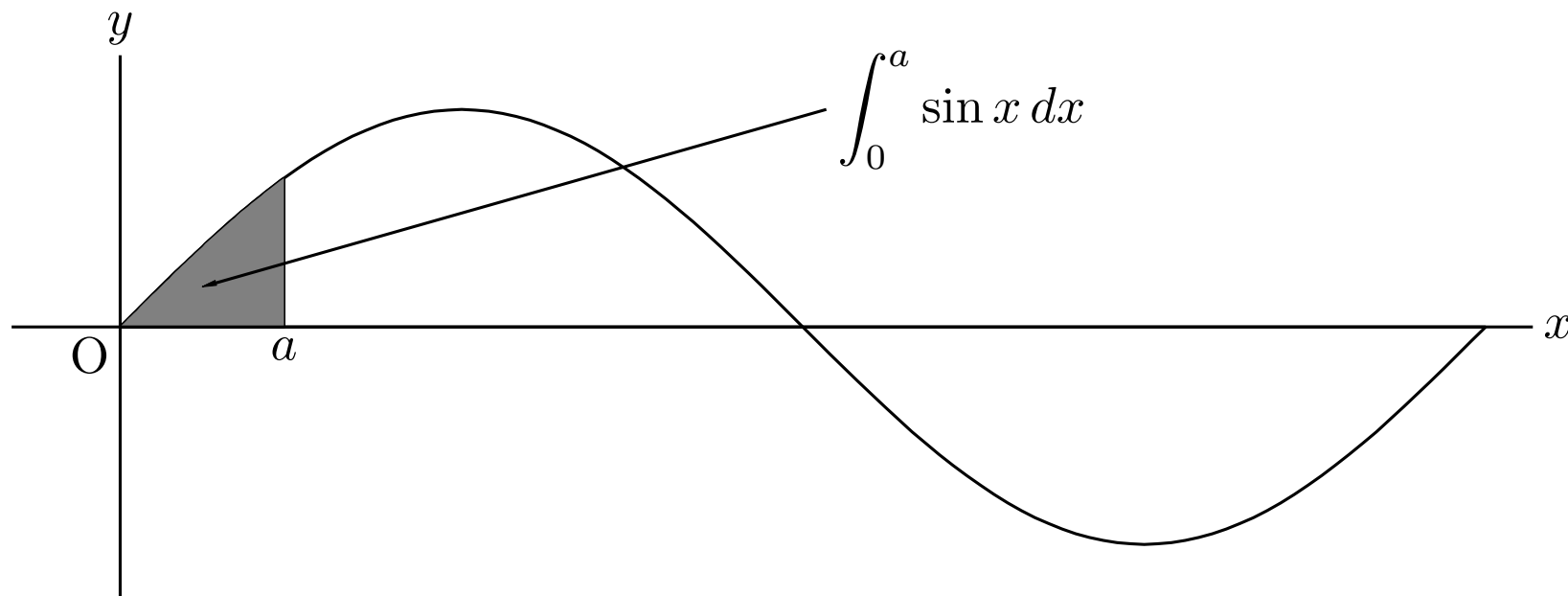
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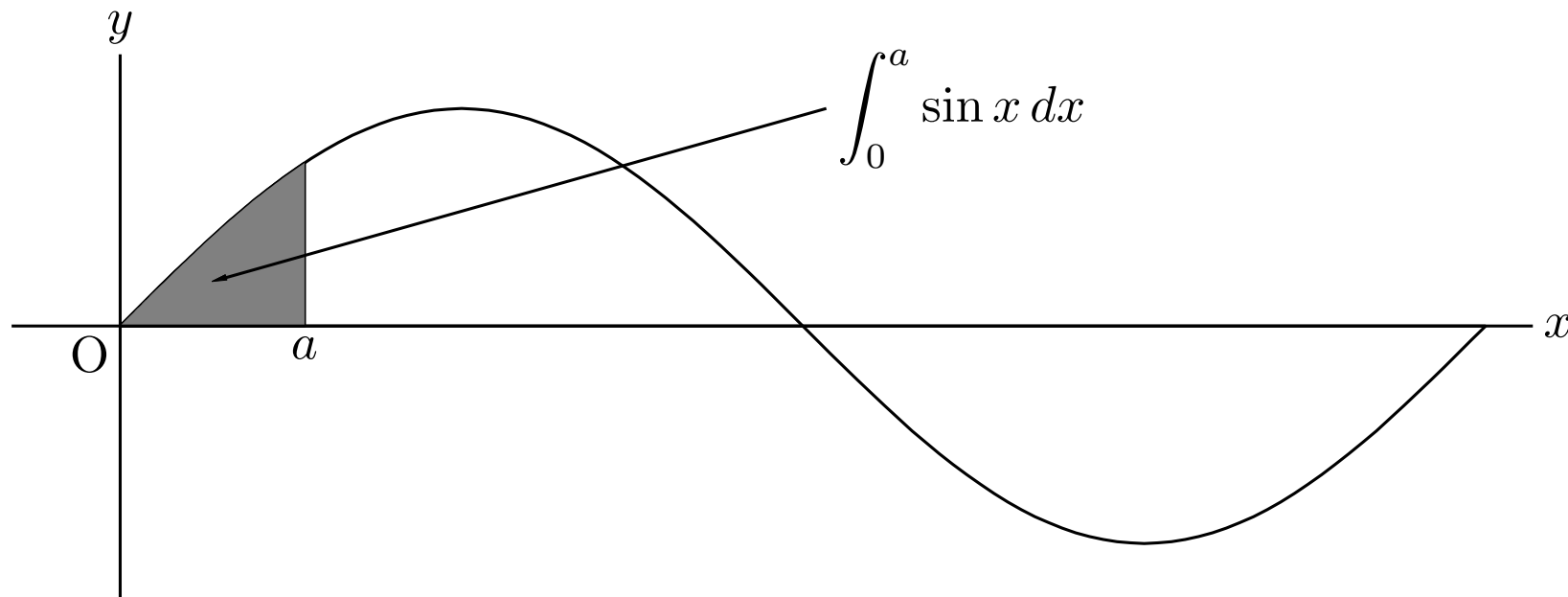
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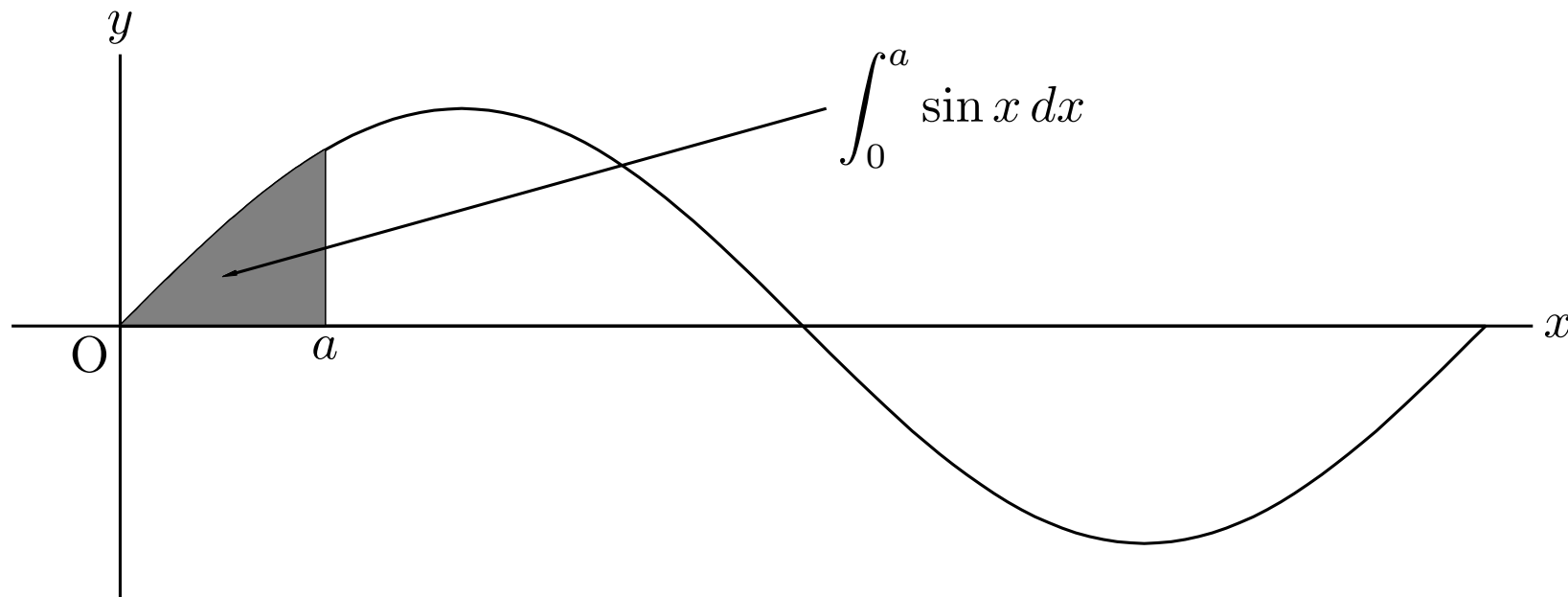
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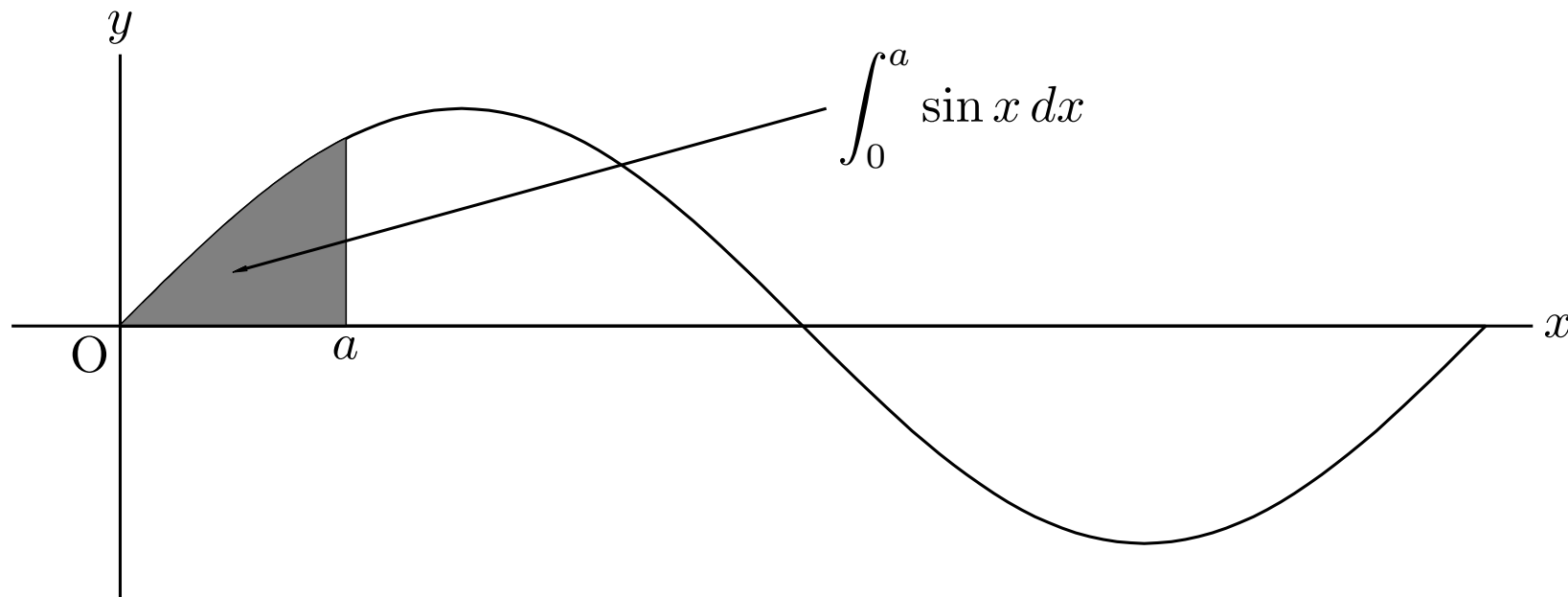
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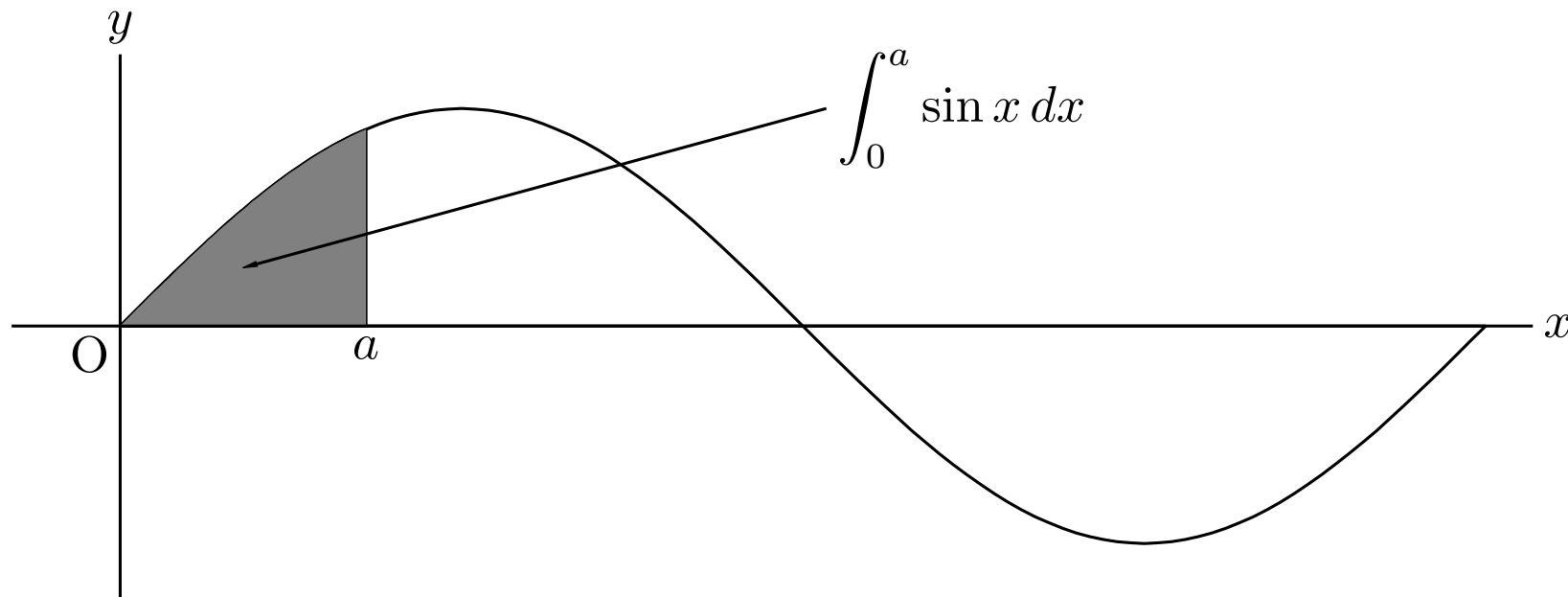
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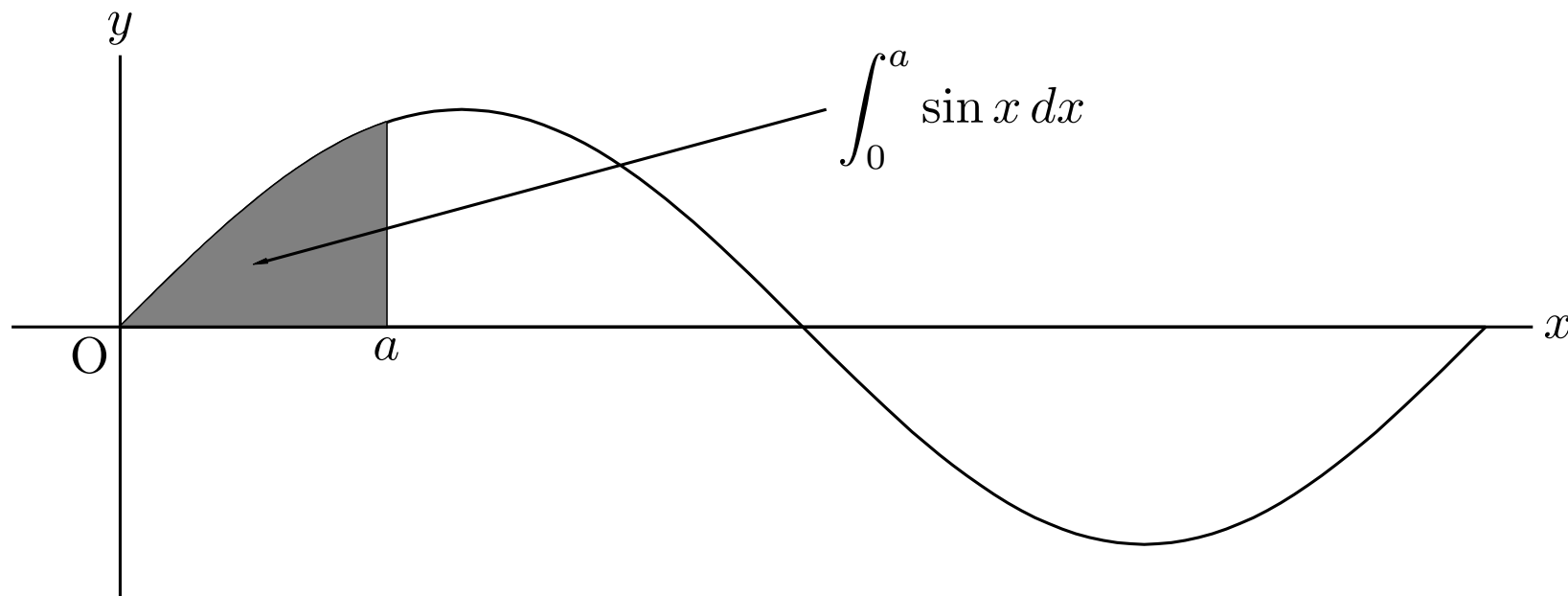
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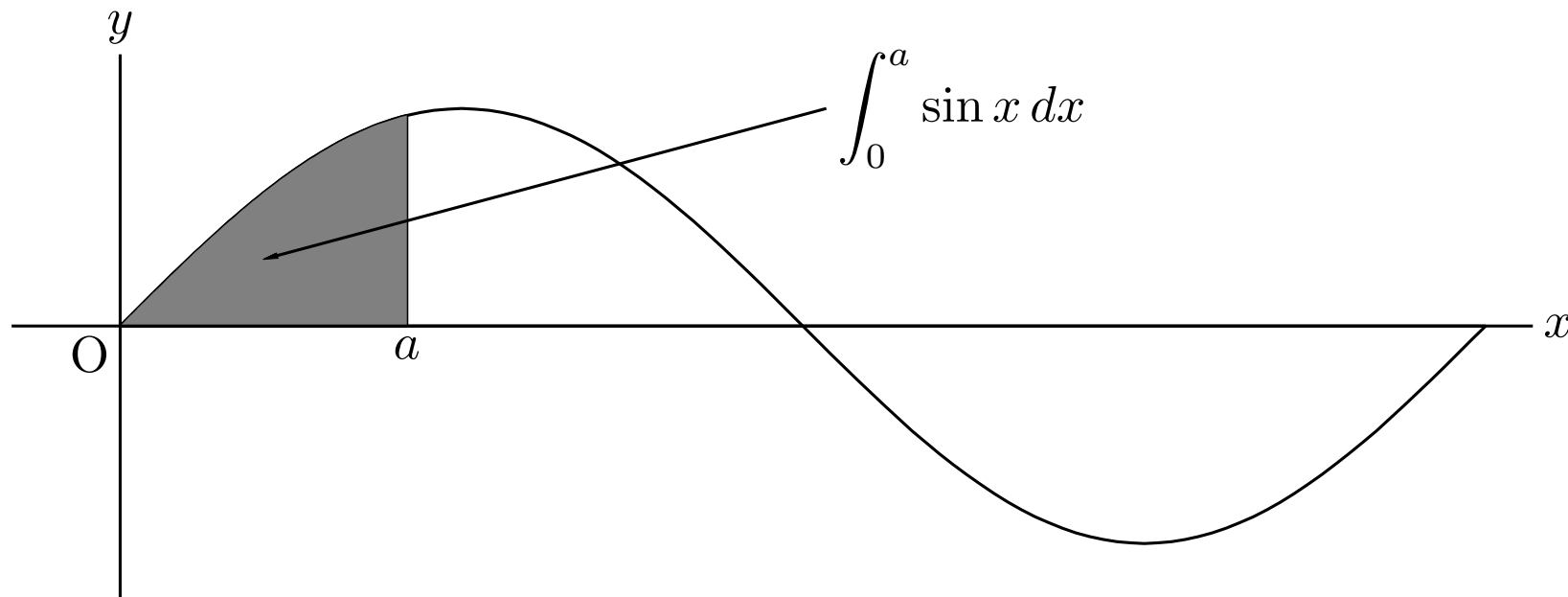
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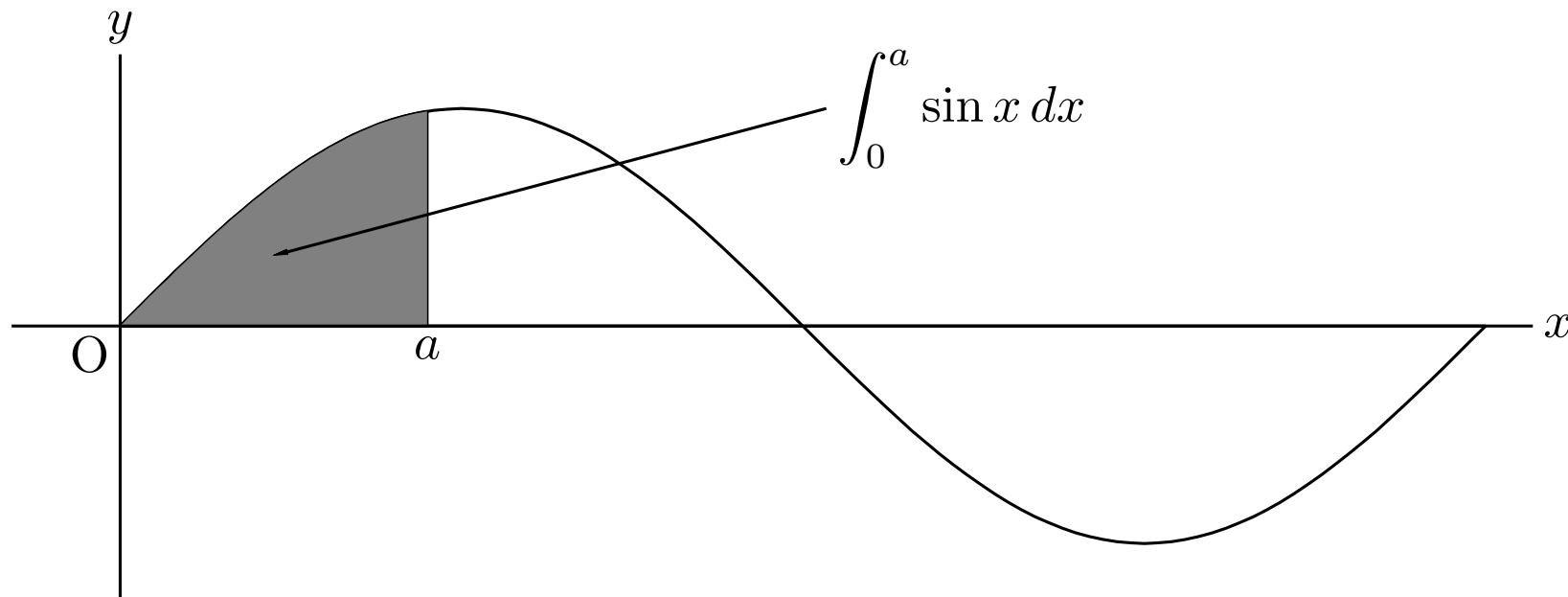
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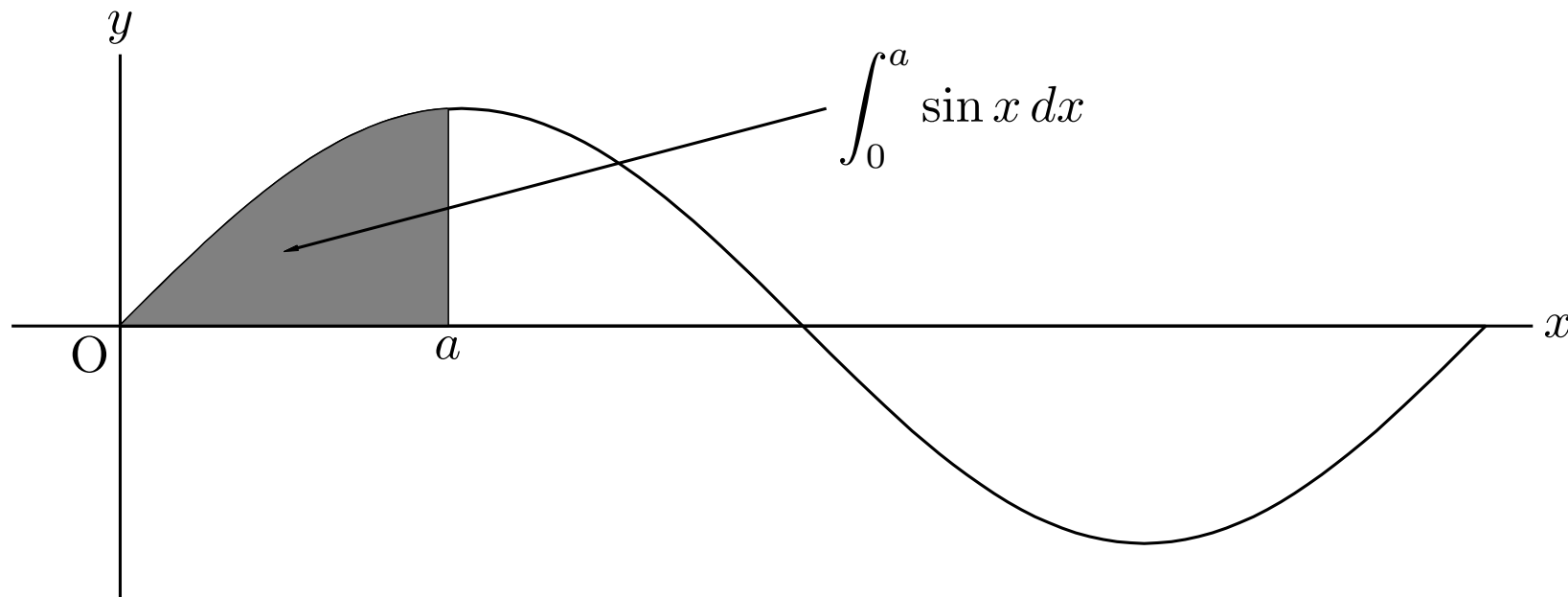
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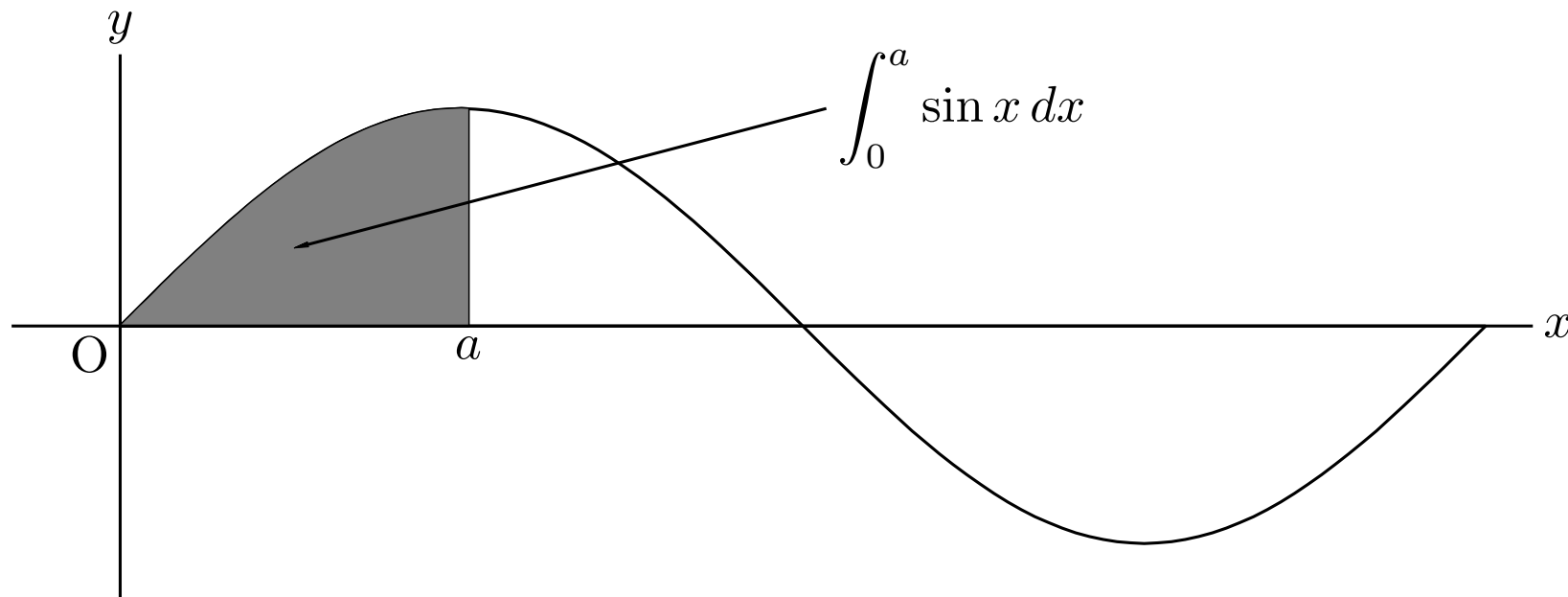
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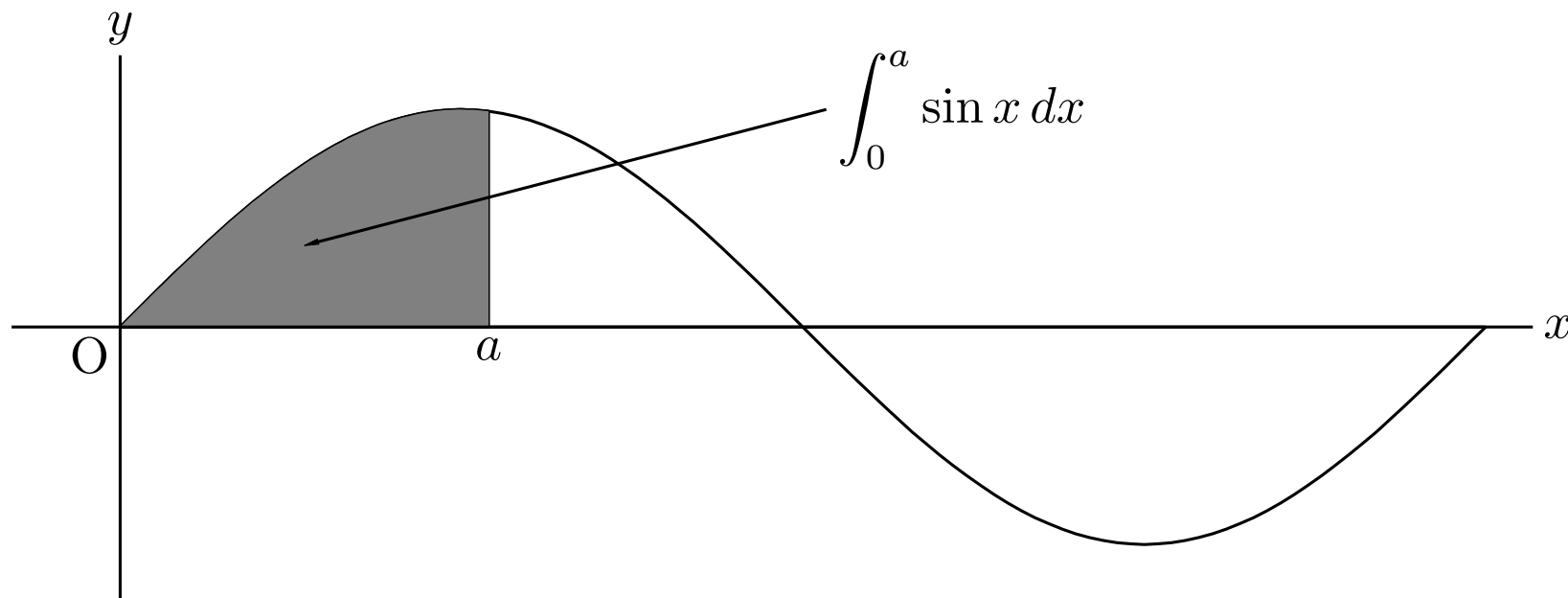
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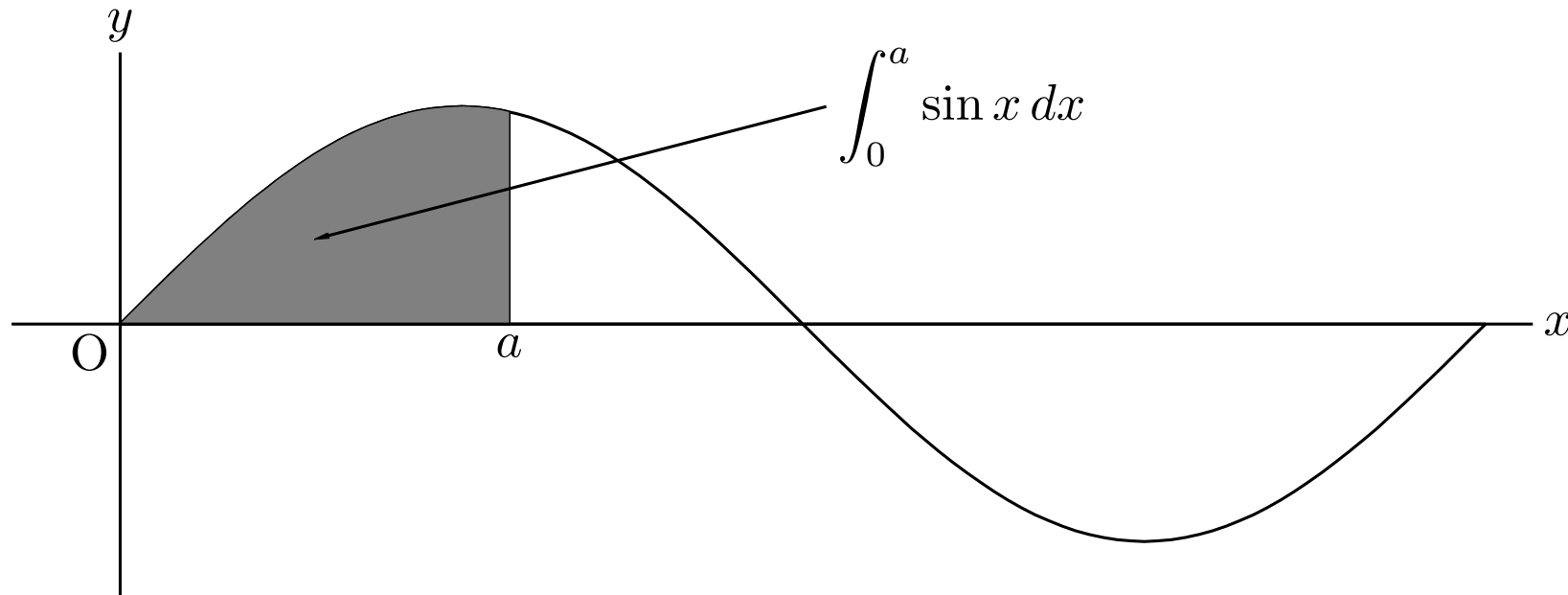
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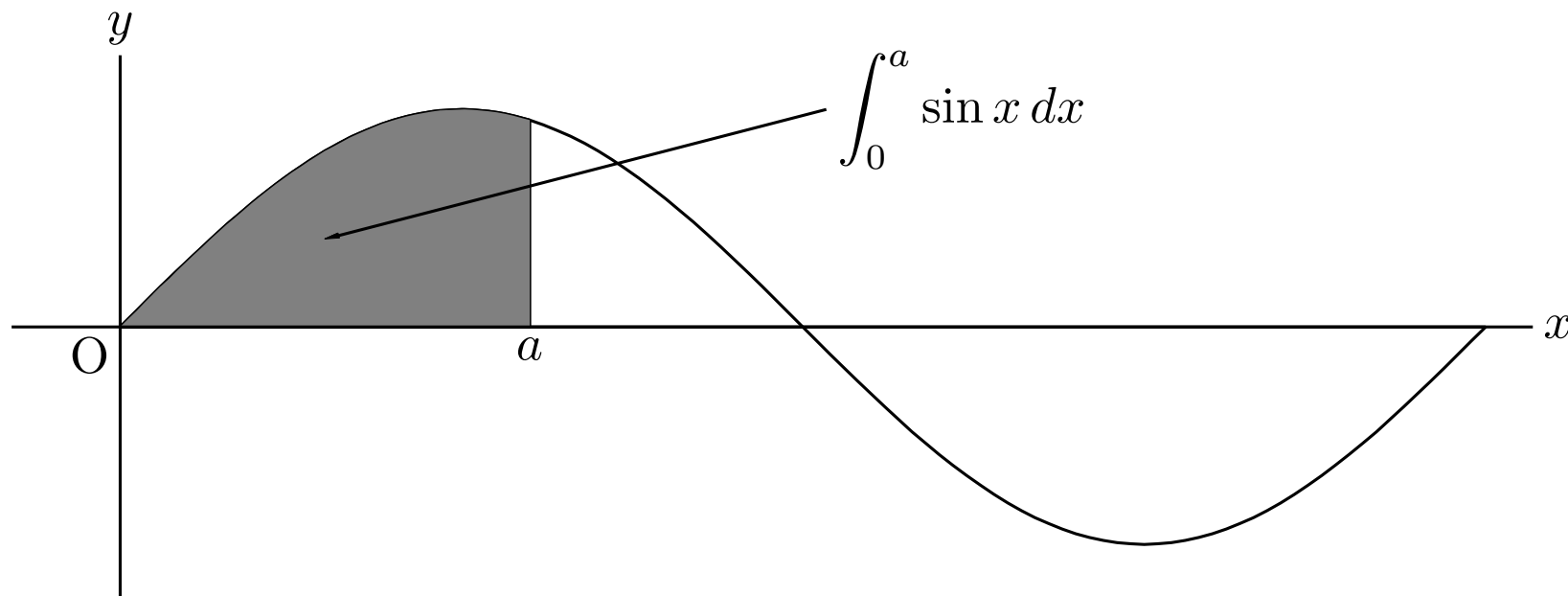
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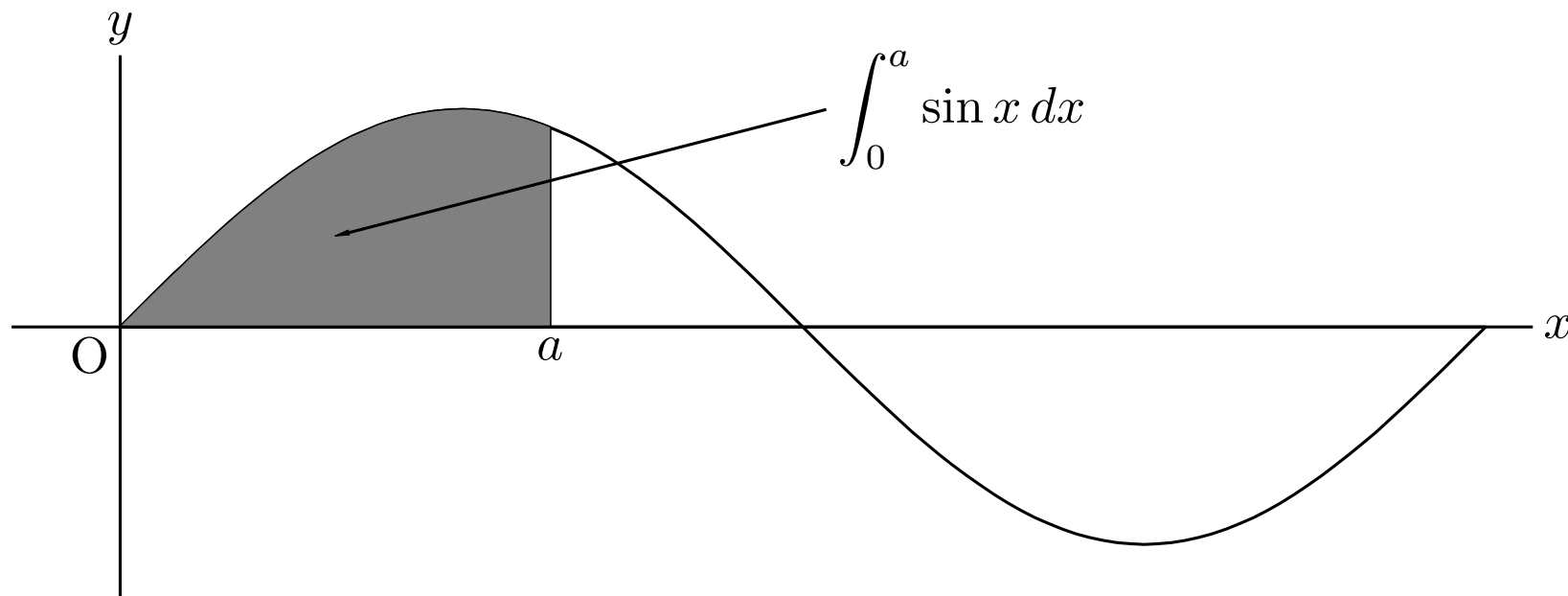
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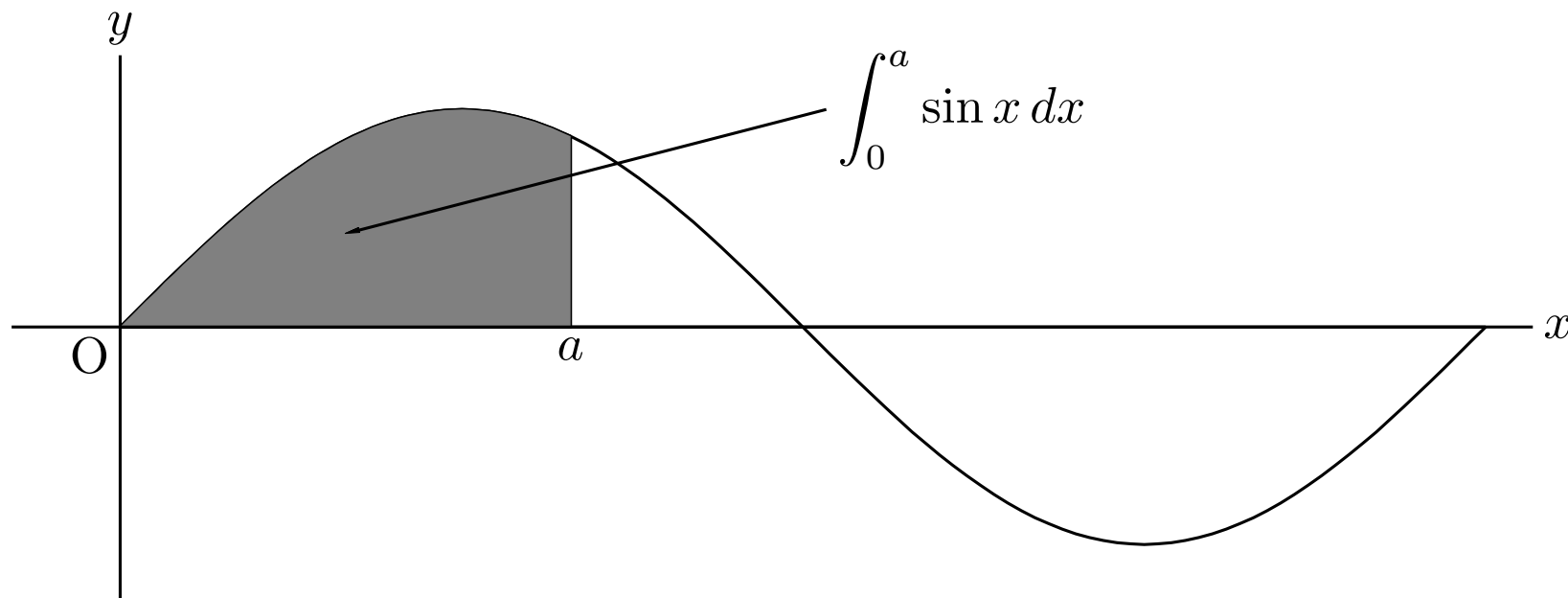
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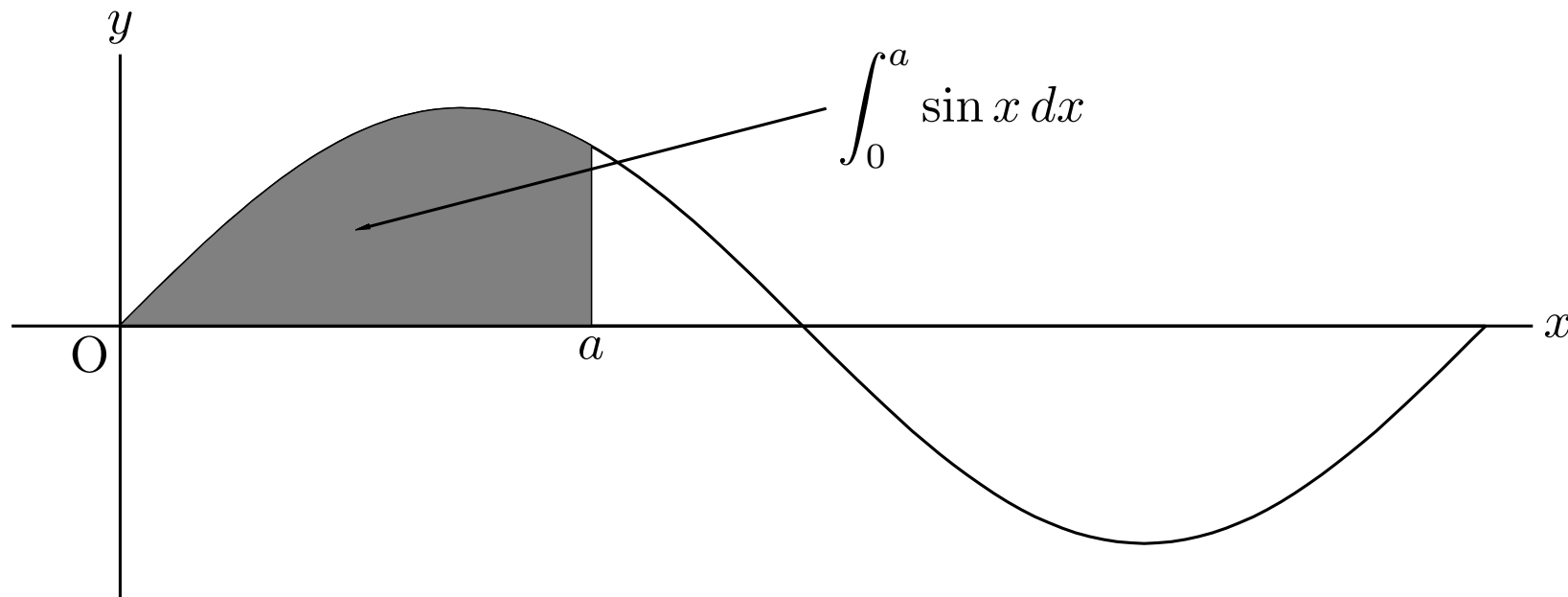
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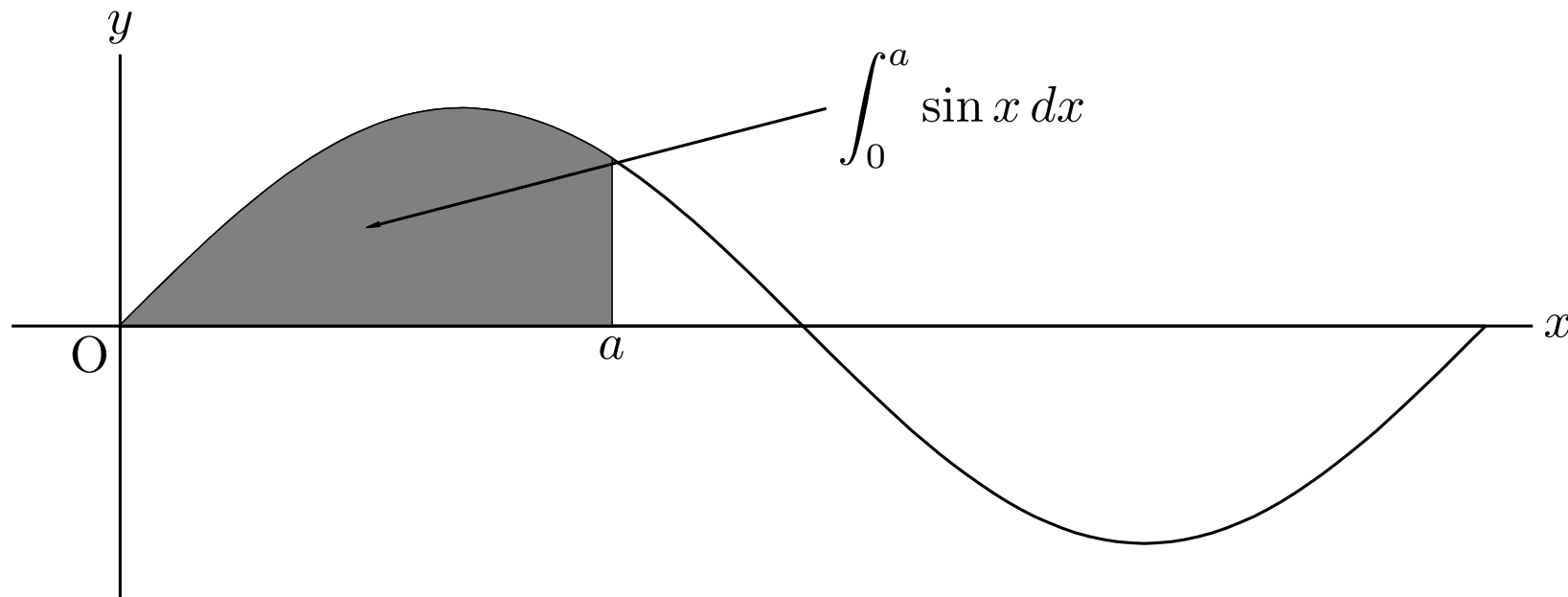
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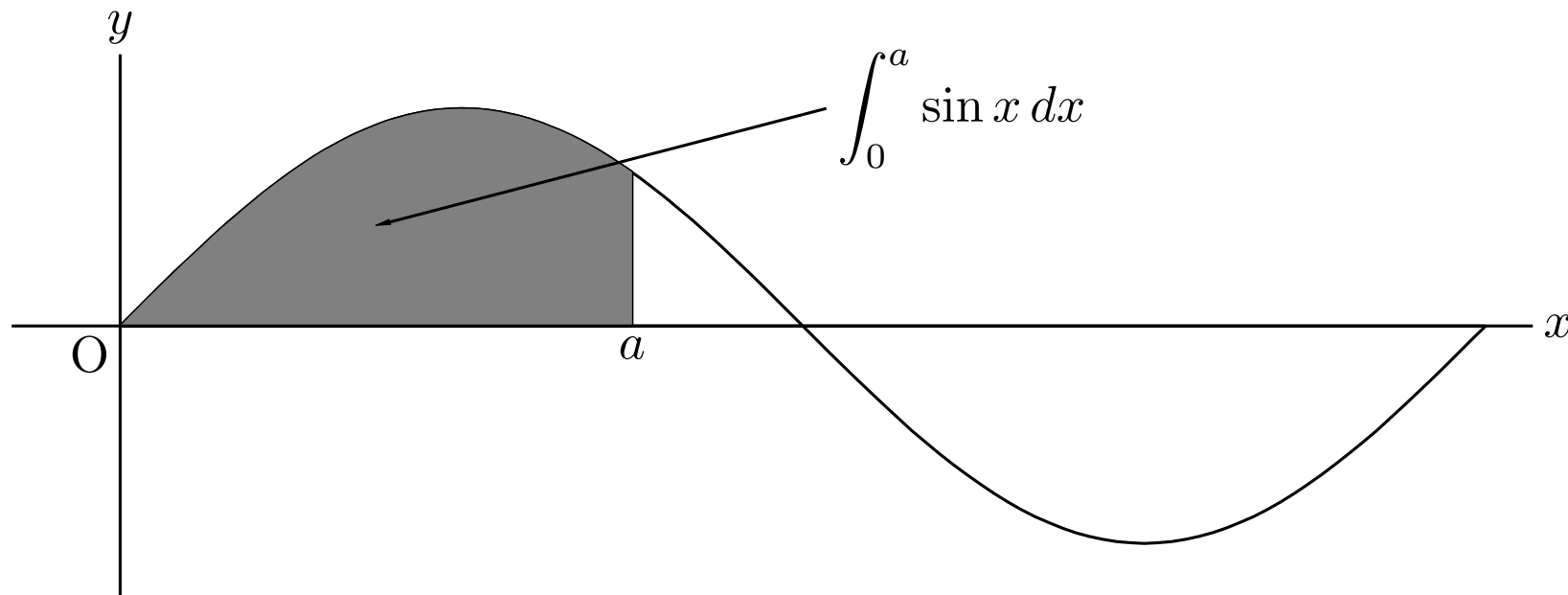
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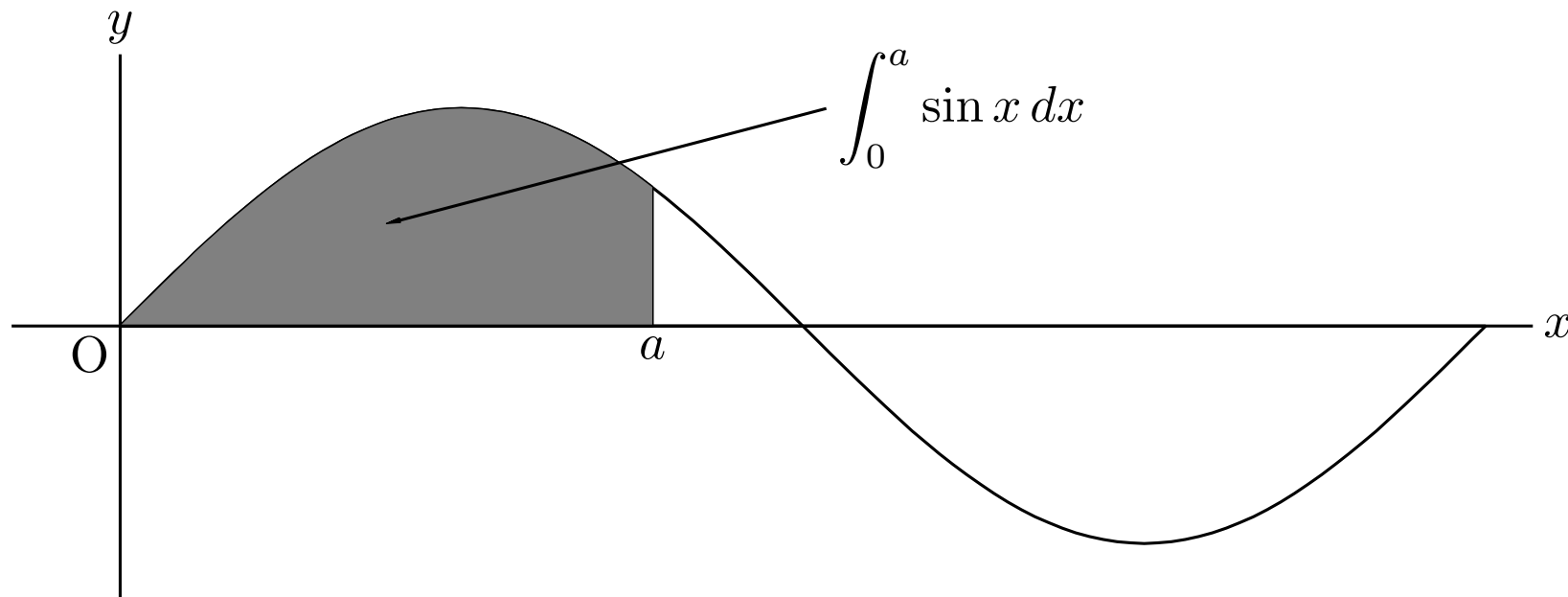
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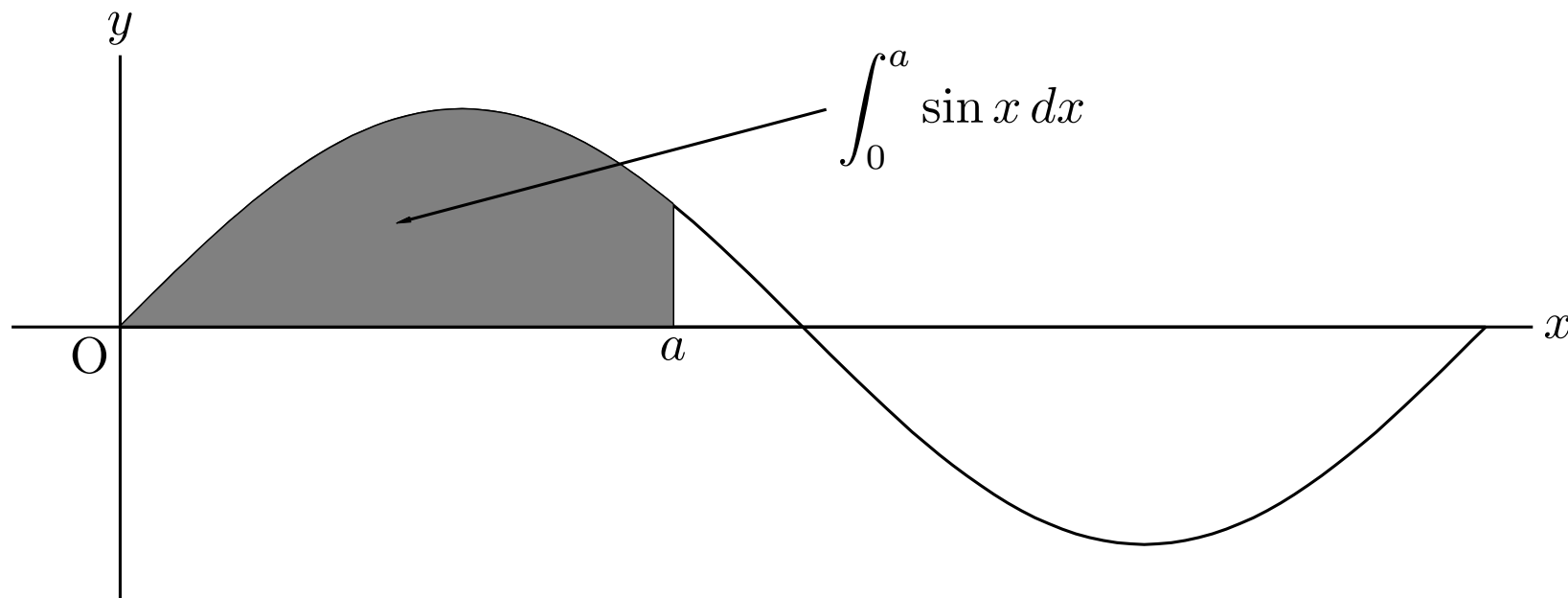
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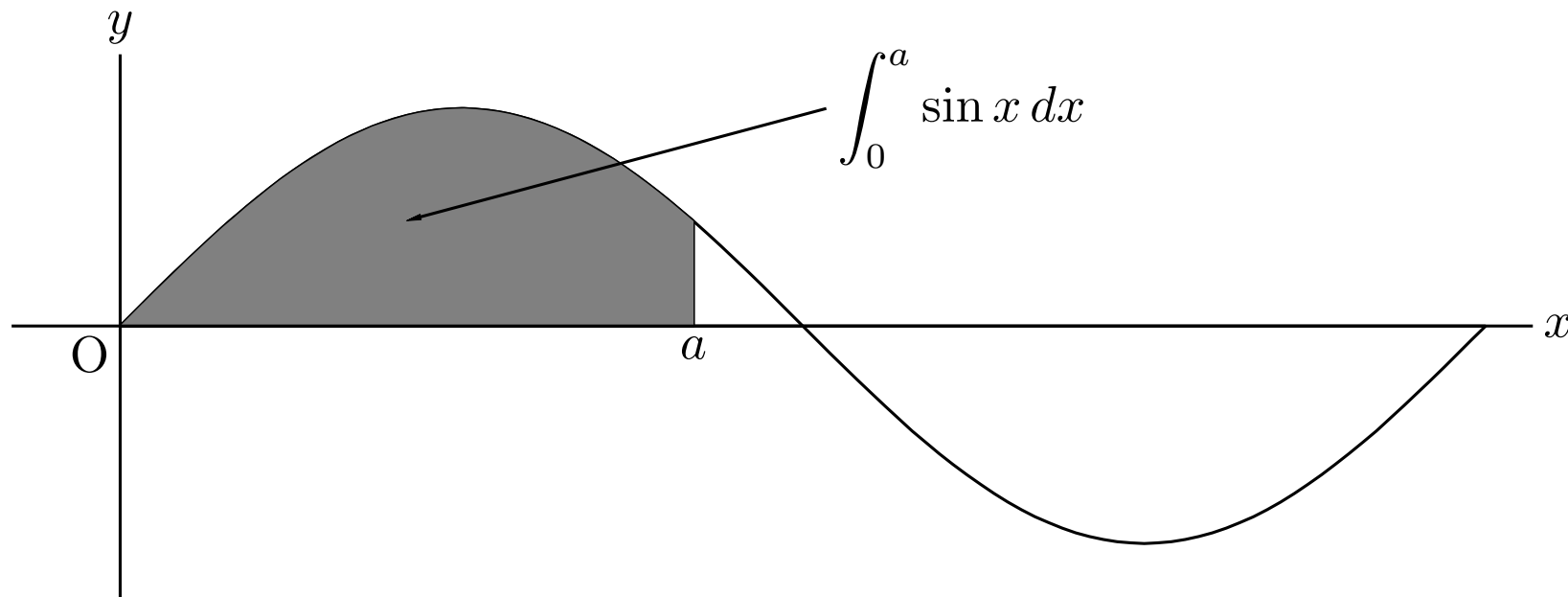
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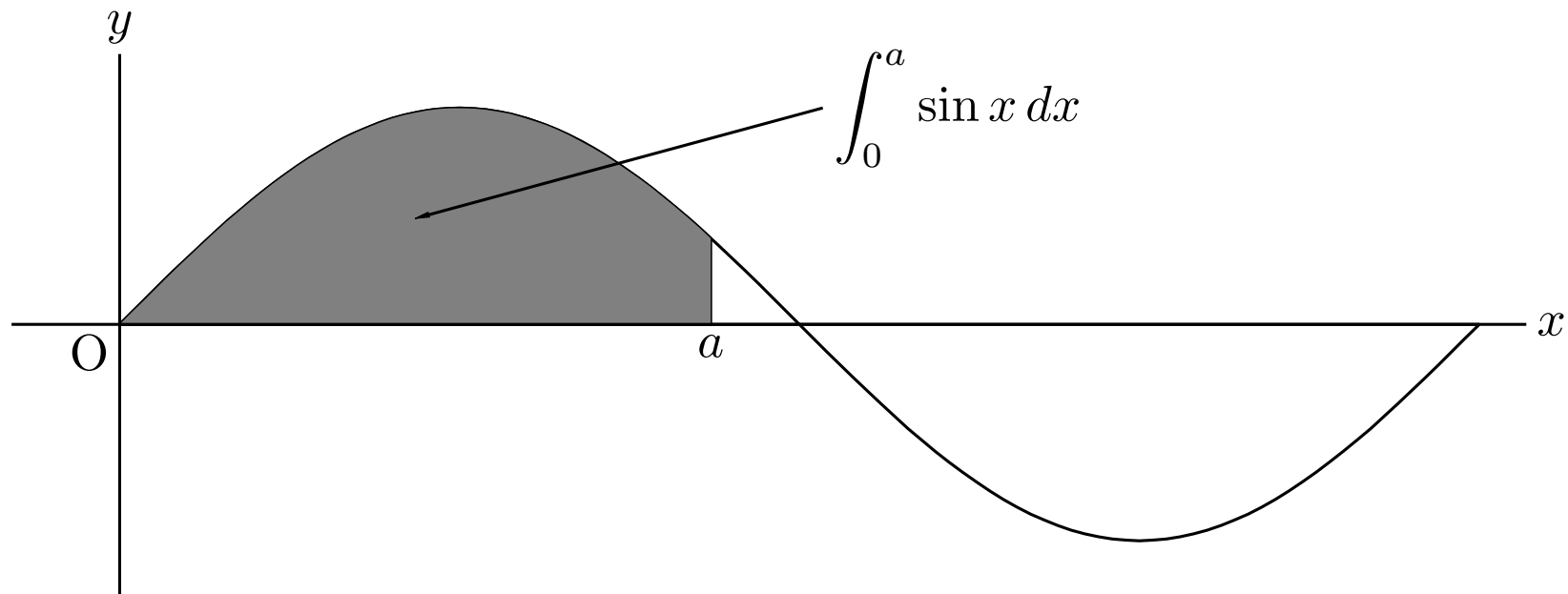
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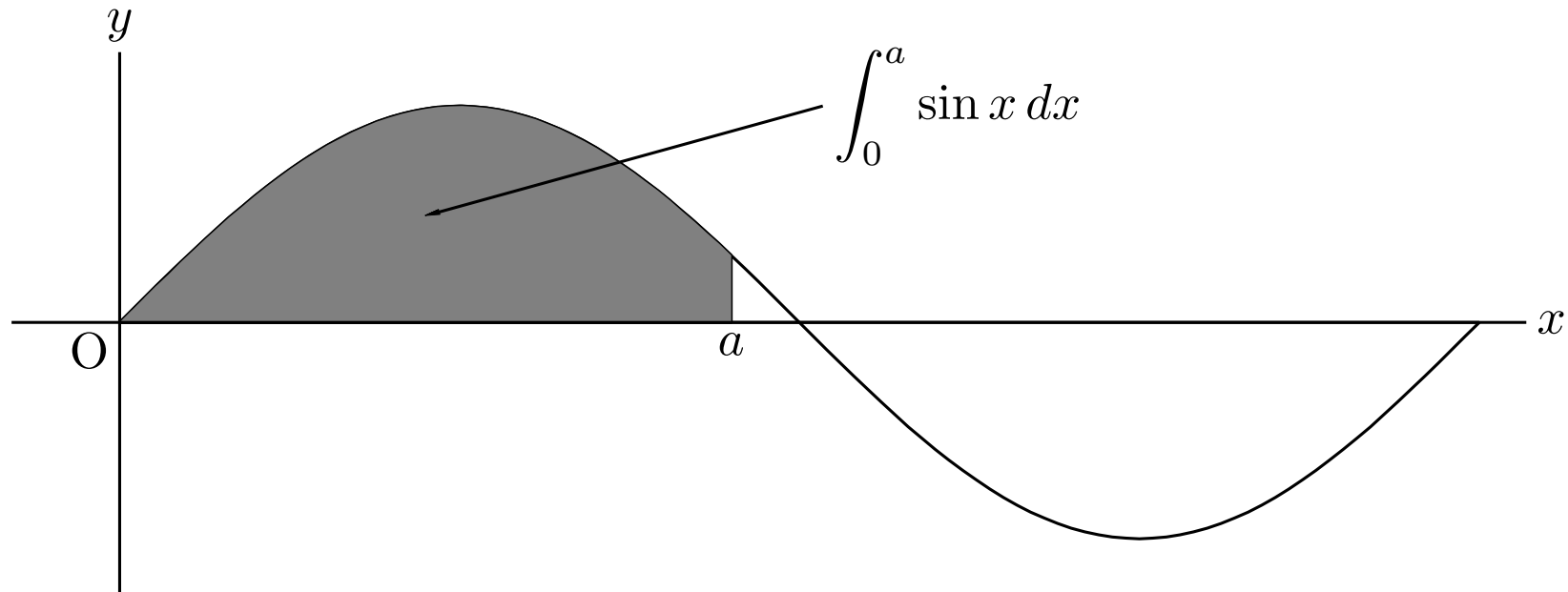
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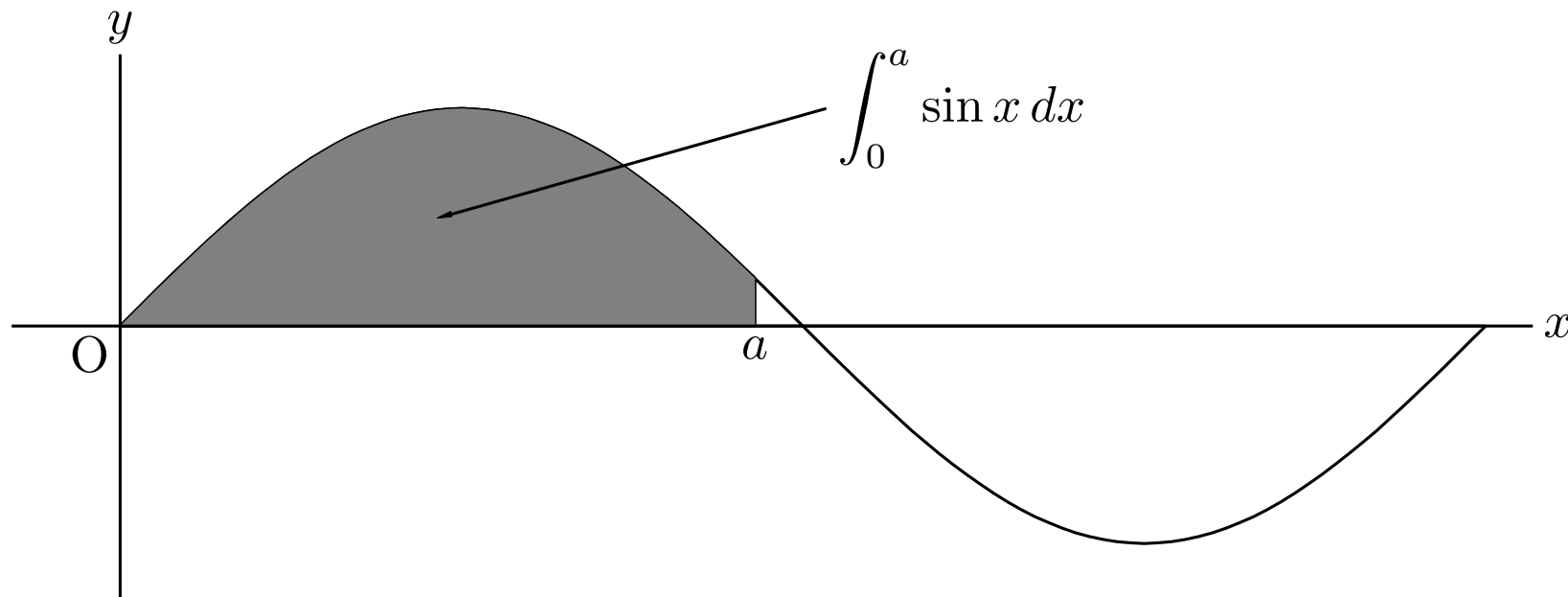
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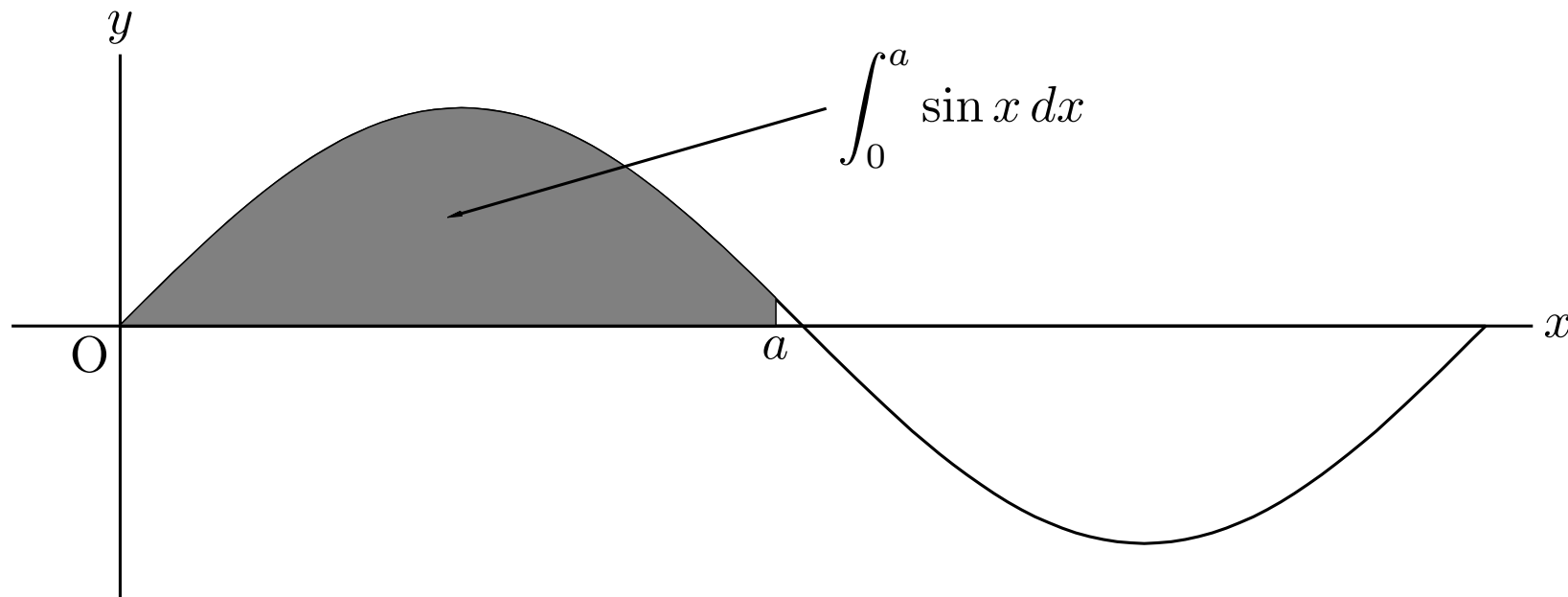
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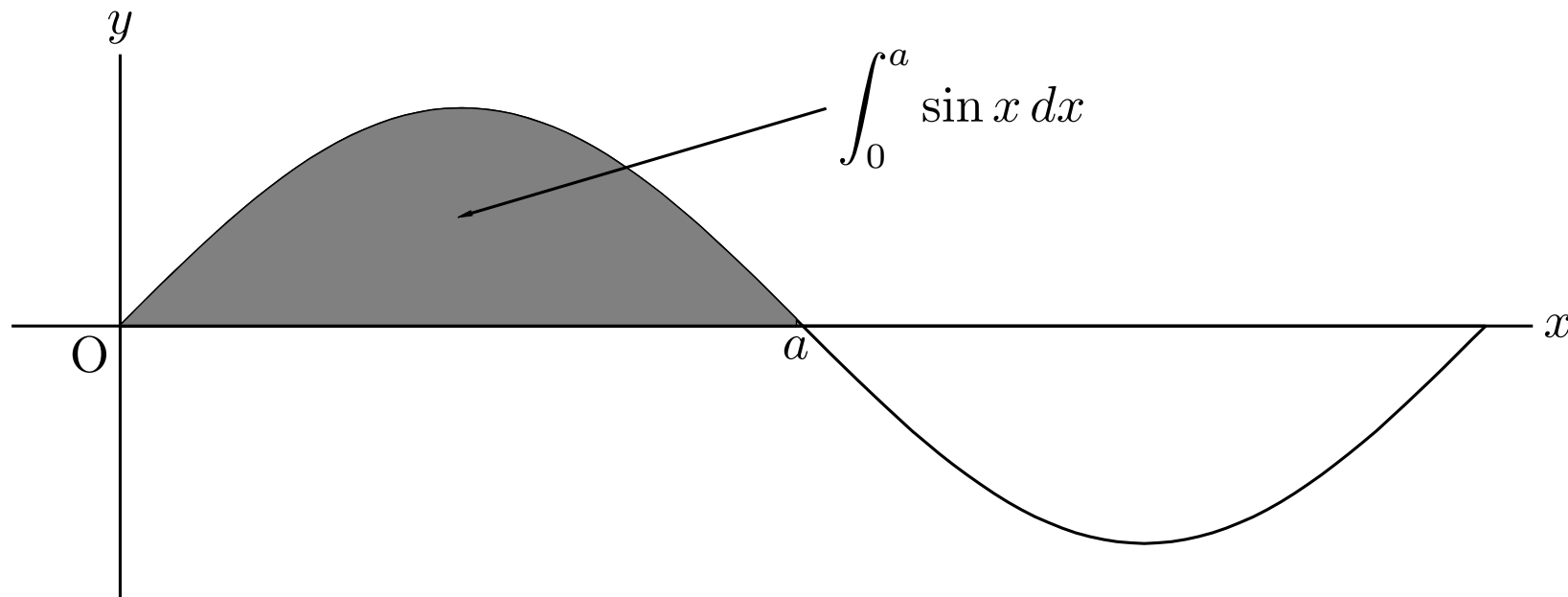
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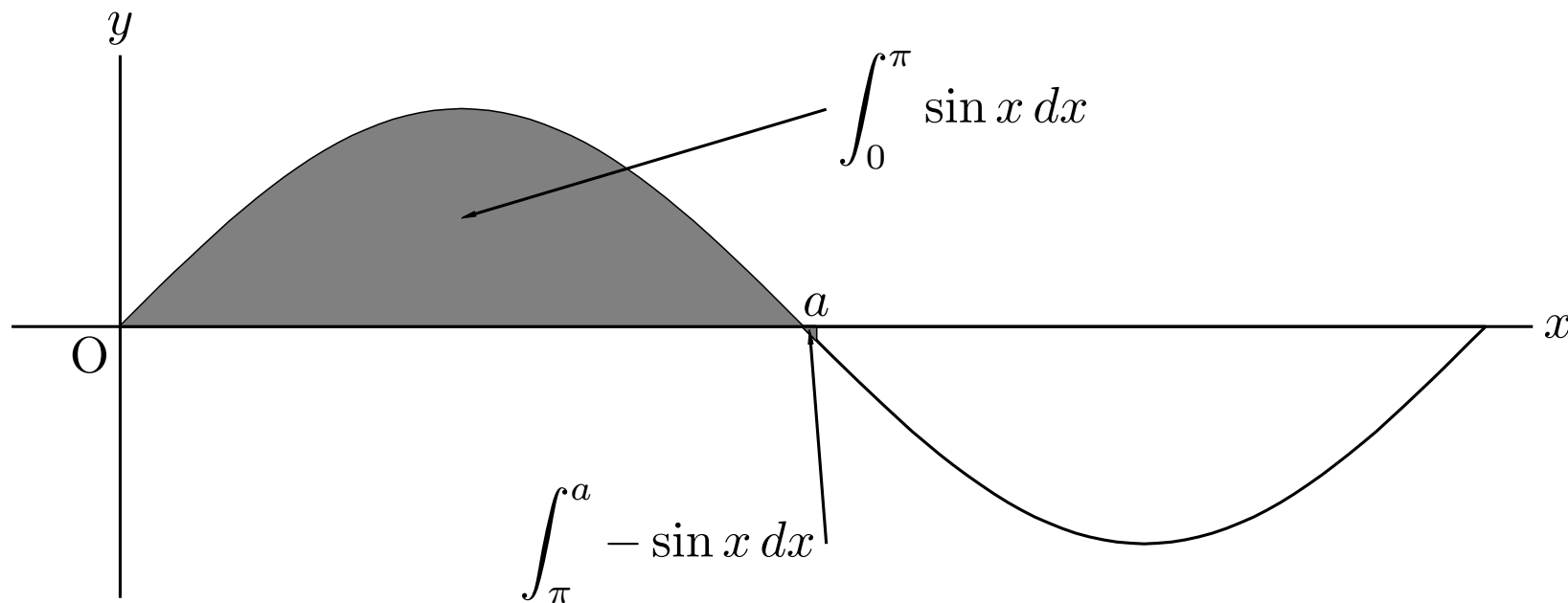
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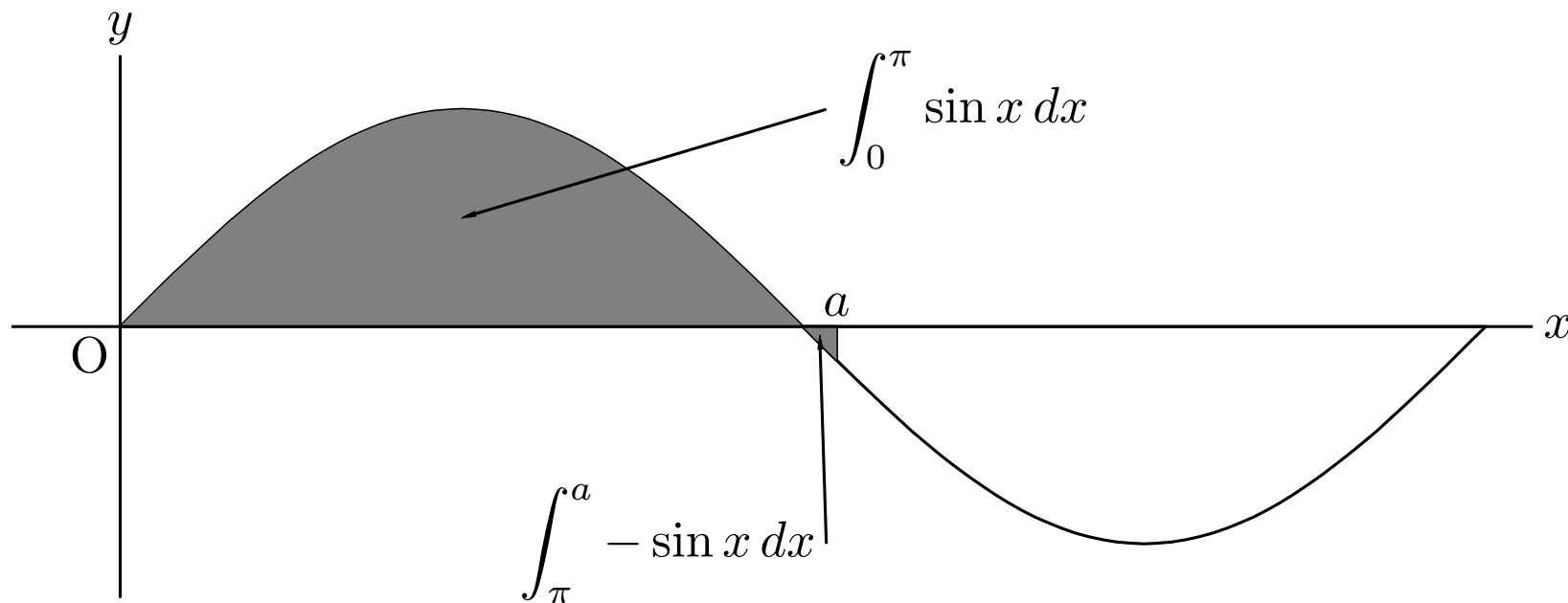
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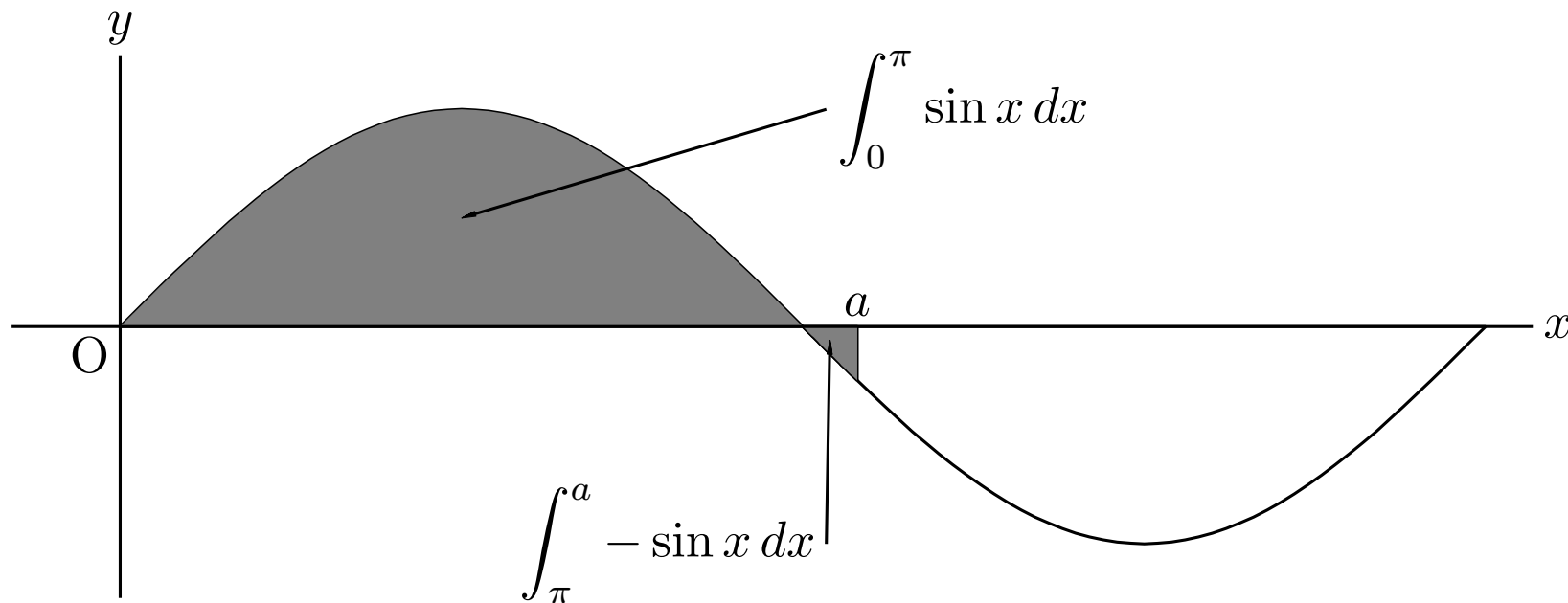
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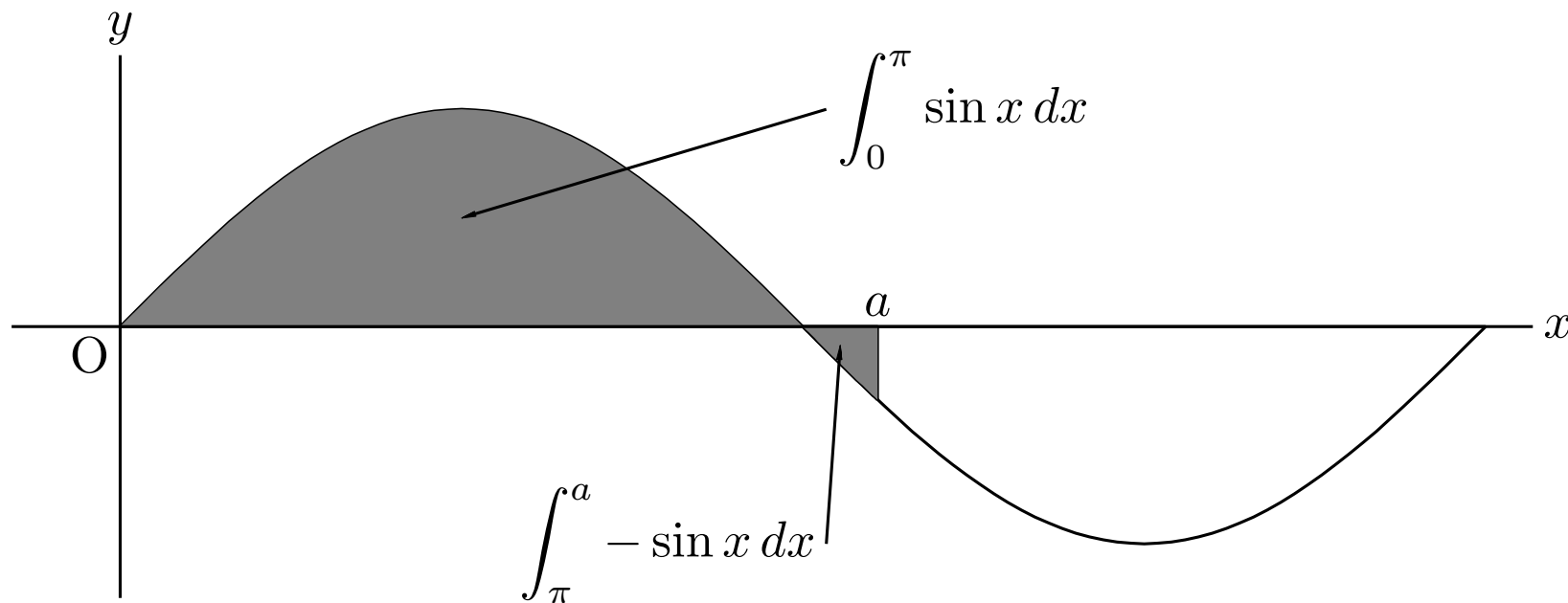
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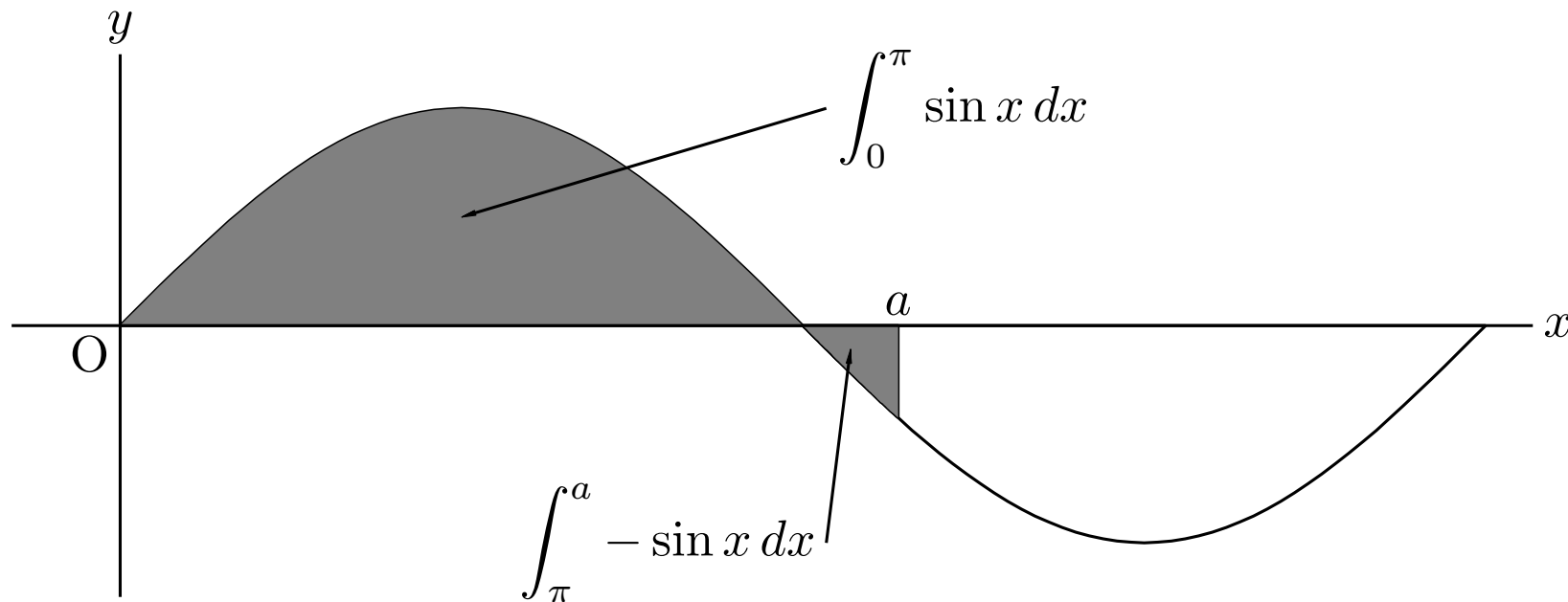
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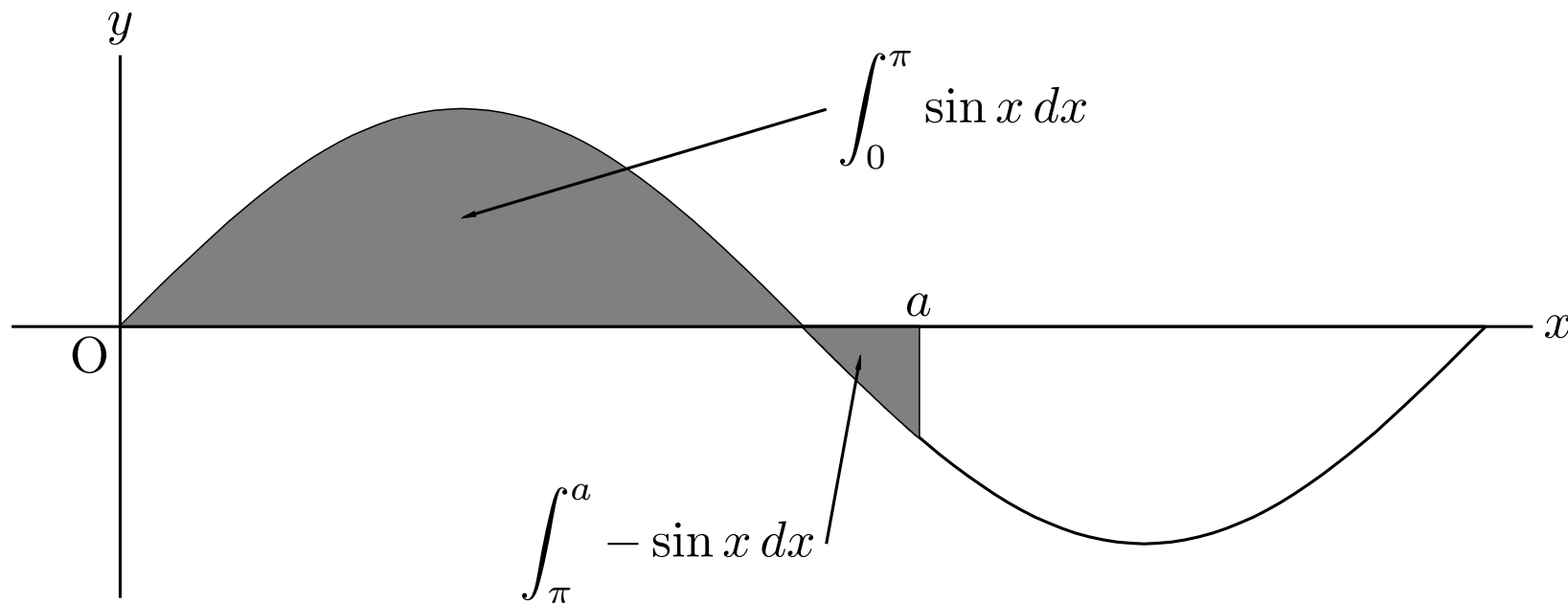
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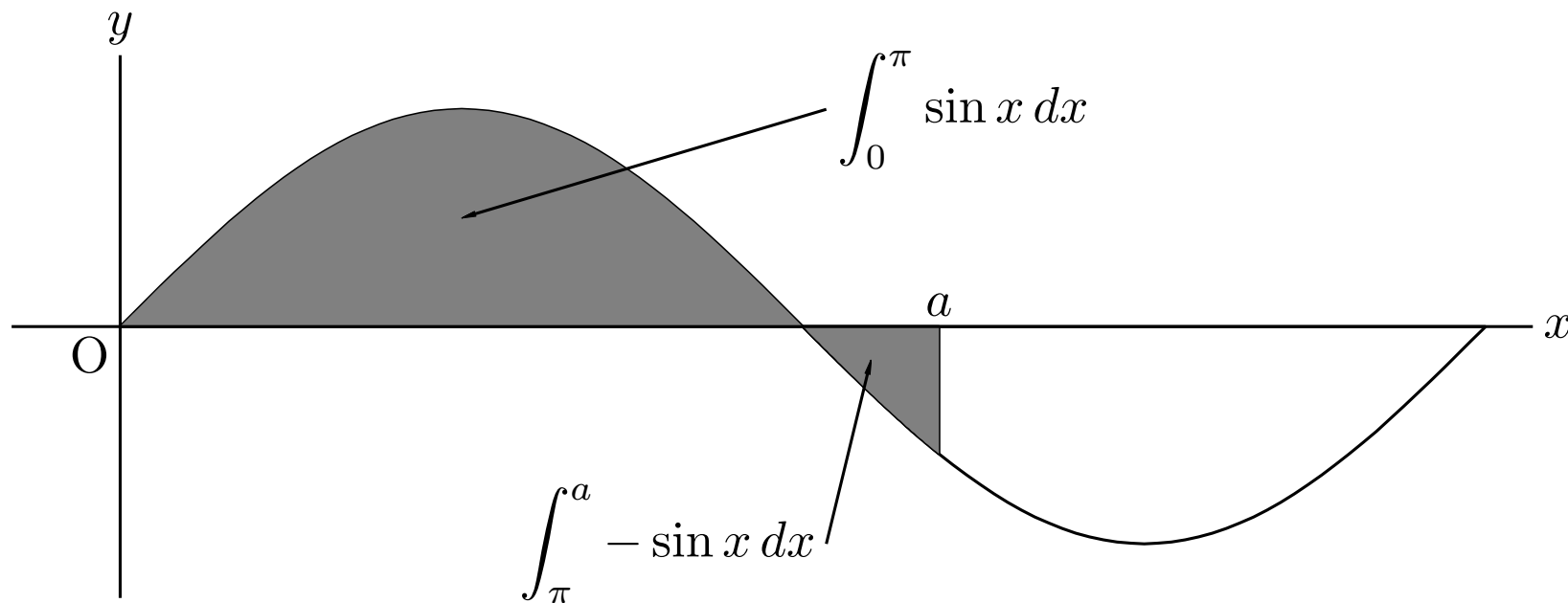
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2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



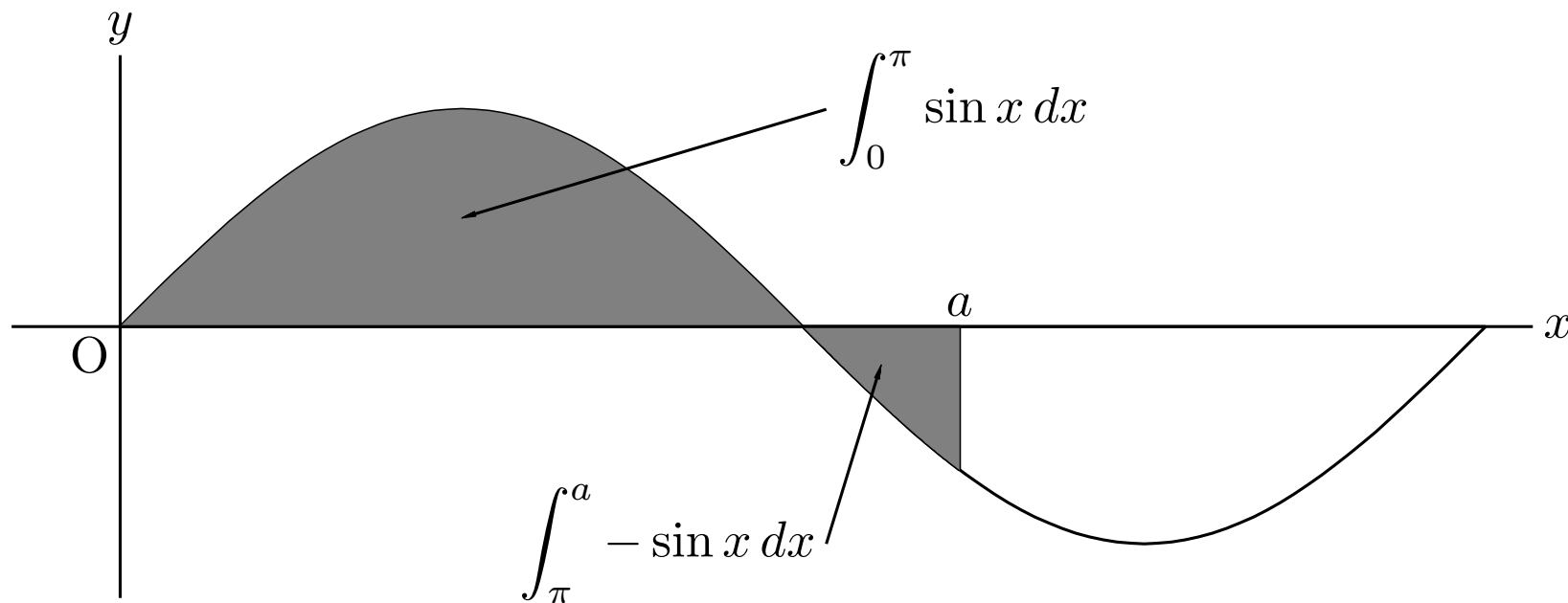
$$\int_0^a \sin x \, dx = \int_0^{\pi} \sin x \, dx - \int_{\pi}^a (-\sin x) \, dx \quad (a > \pi)$$

FIRST

LAST

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



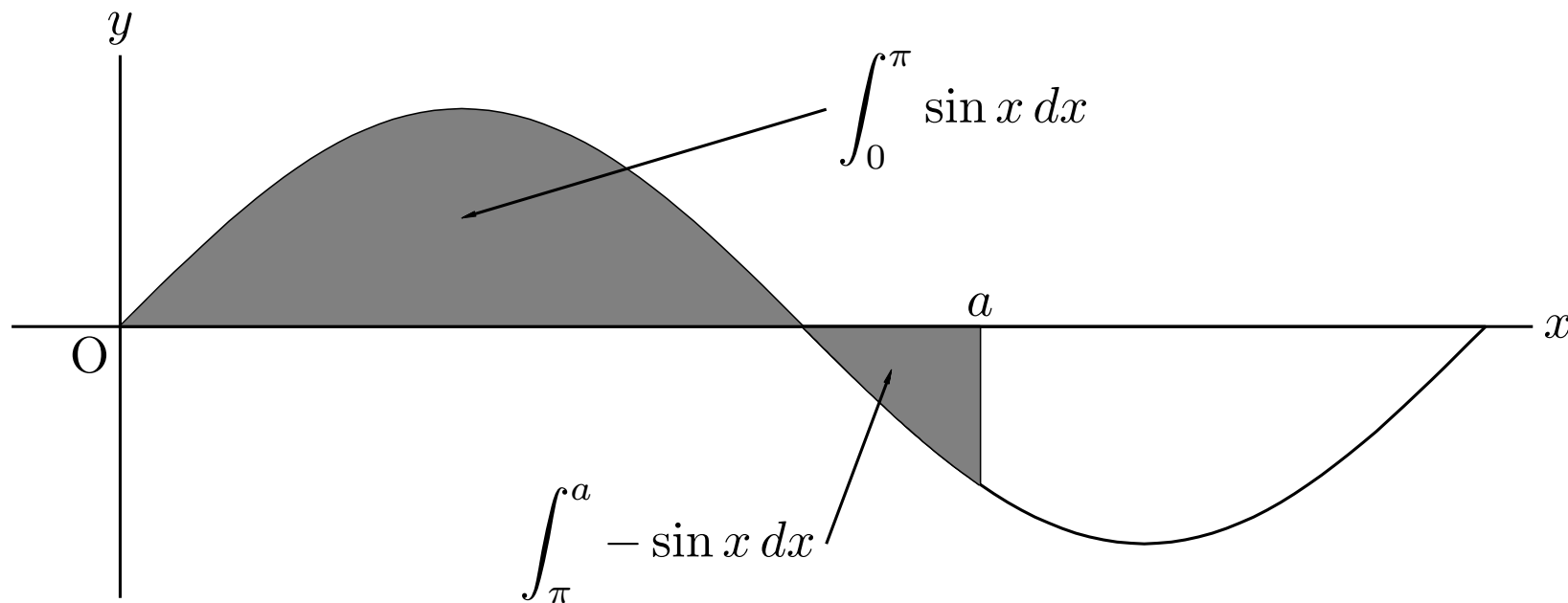
$$\int_0^a \sin x dx = \int_0^\pi \sin x dx - \int_\pi^a (-\sin x) dx \quad (a > \pi)$$

FIRST

LAST

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



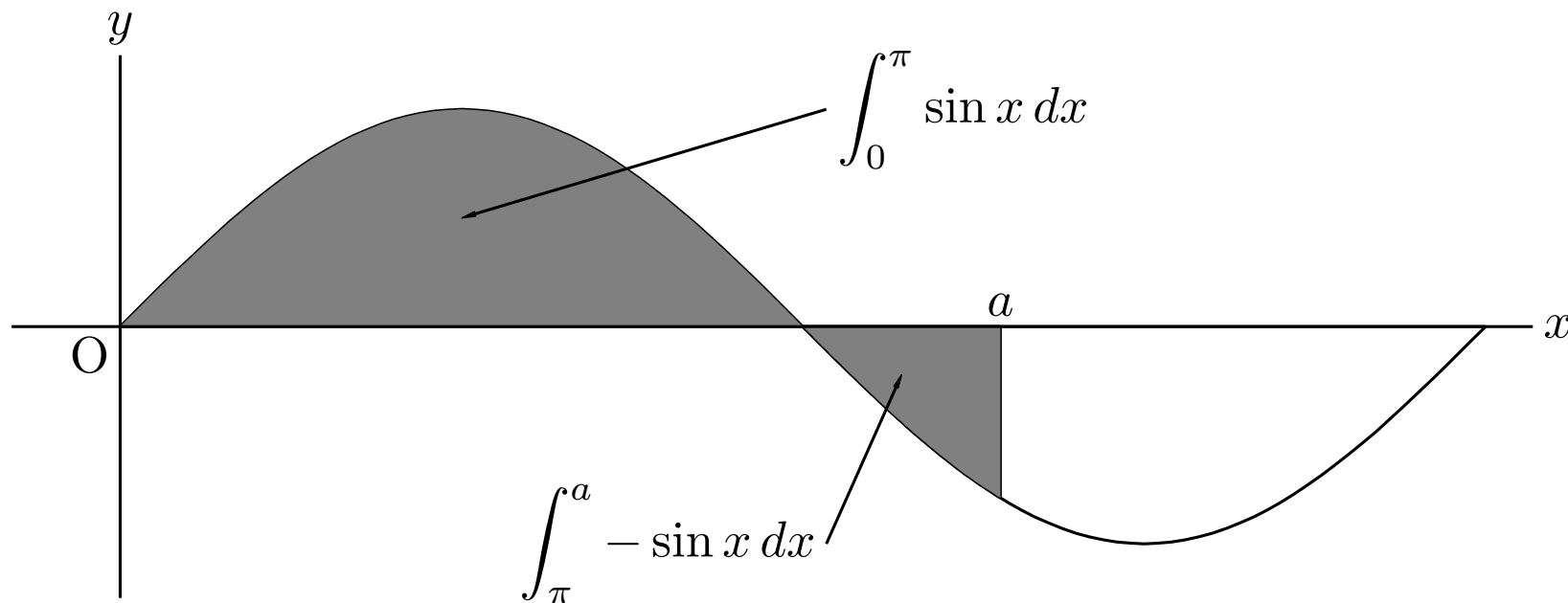
$$\int_0^a \sin x dx = \int_0^\pi \sin x dx - \int_\pi^a (-\sin x) dx \quad (a > \pi)$$

FIRST

LAST

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



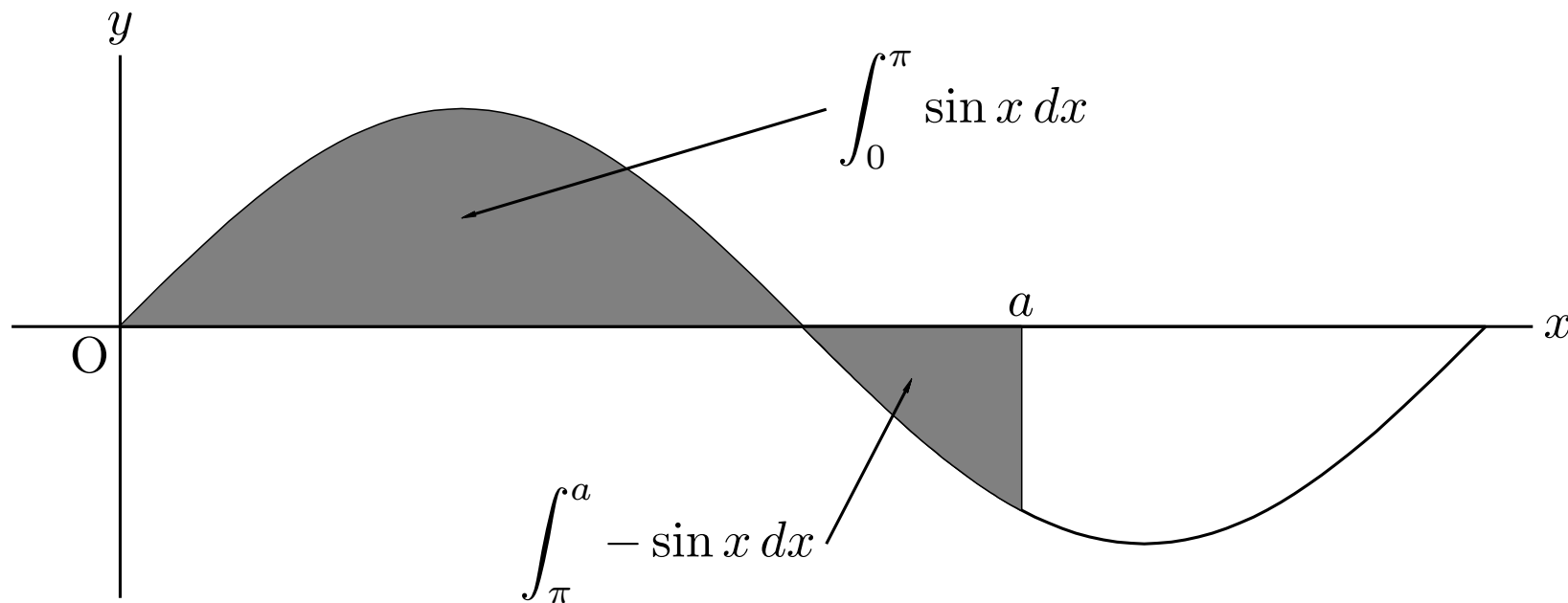
$$\int_0^a \sin x \, dx = \int_0^\pi \sin x \, dx - \int_\pi^a (-\sin x) \, dx \quad (a > \pi)$$

FIRST

LAST

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



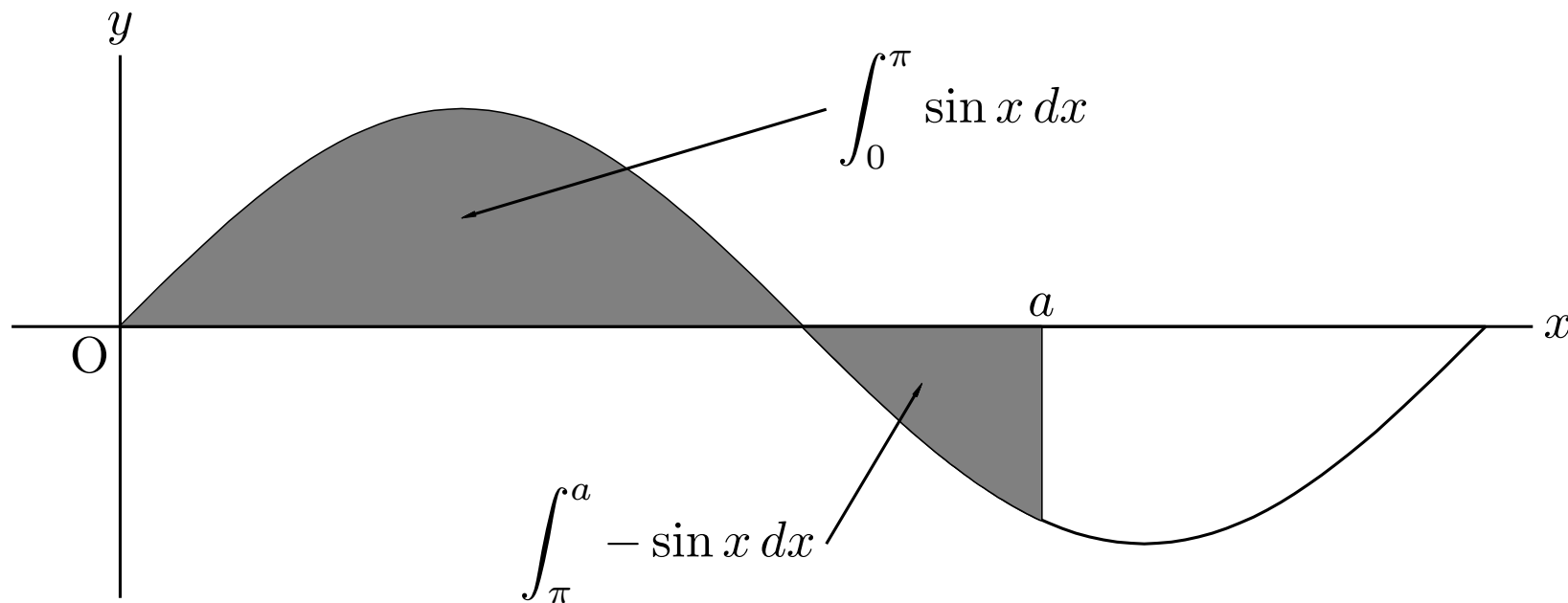
$$\int_0^a \sin x dx = \int_0^\pi \sin x dx - \int_\pi^a (-\sin x) dx \quad (a > \pi)$$

FIRST

LAST

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



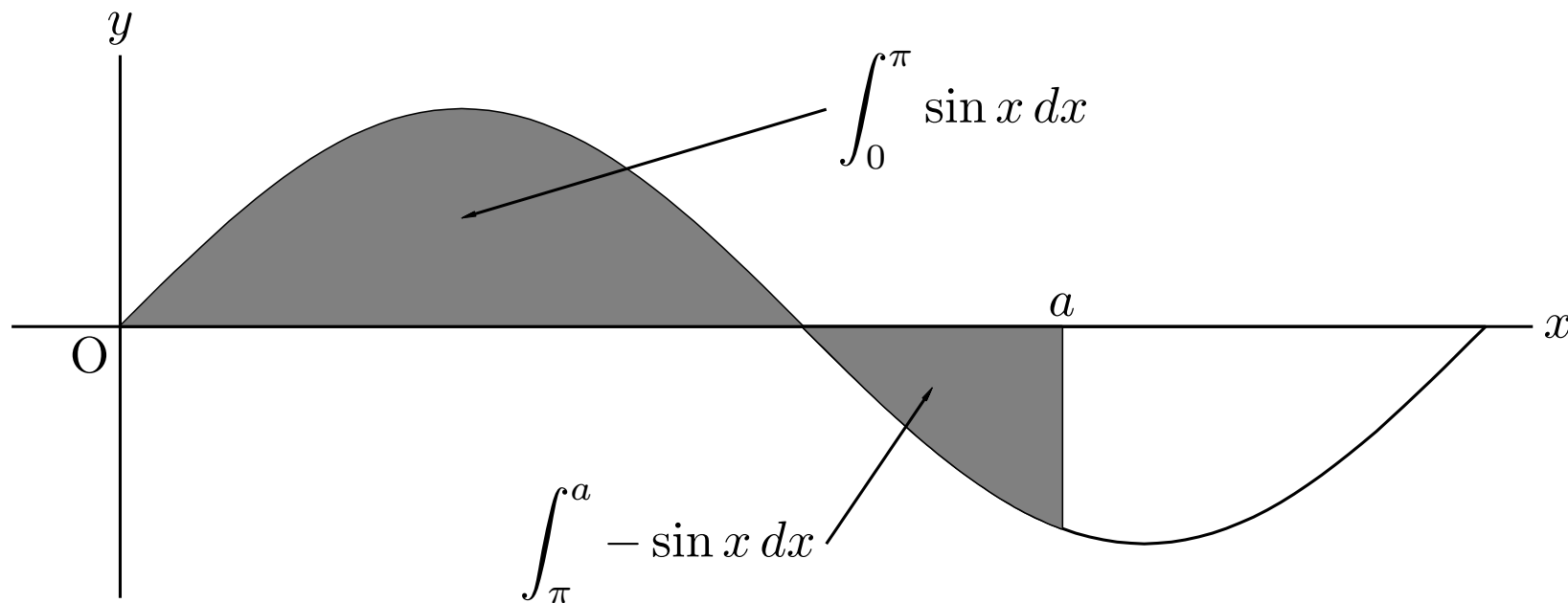
$$\int_0^a \sin x \, dx = \int_0^{\pi} \sin x \, dx - \int_{\pi}^a (-\sin x) \, dx \quad (a > \pi)$$

FIRST

LAST

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



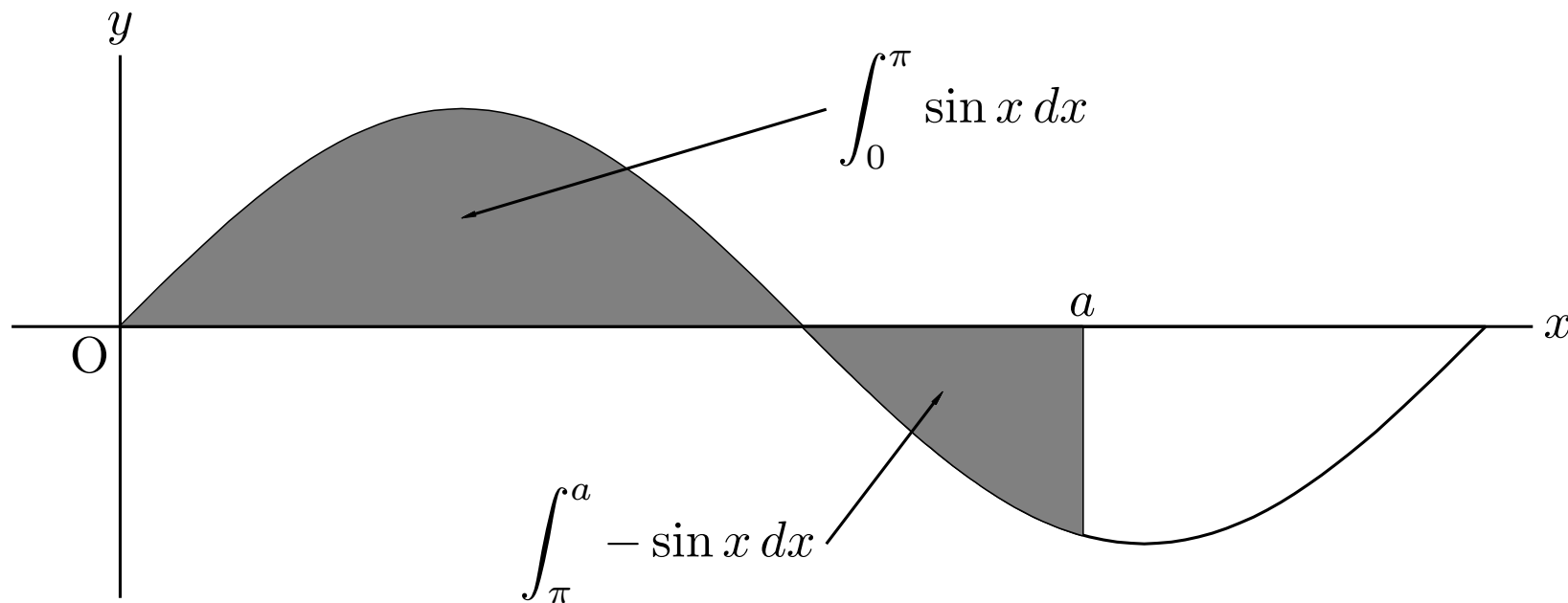
$$\int_0^a \sin x dx = \int_0^\pi \sin x dx - \int_\pi^a (-\sin x) dx \quad (a > \pi)$$

FIRST

LAST

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



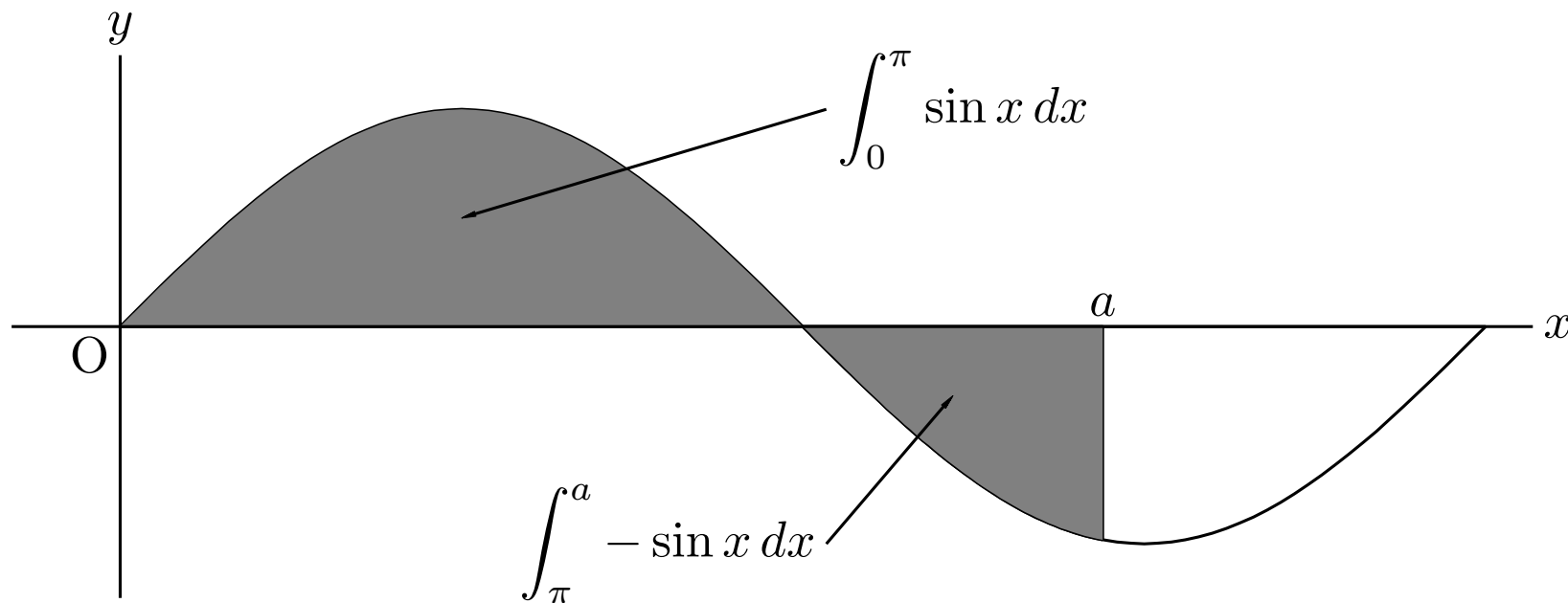
$$\int_0^a \sin x dx = \int_0^\pi \sin x dx - \int_\pi^a (-\sin x) dx \quad (a > \pi)$$

FIRST

LAST

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



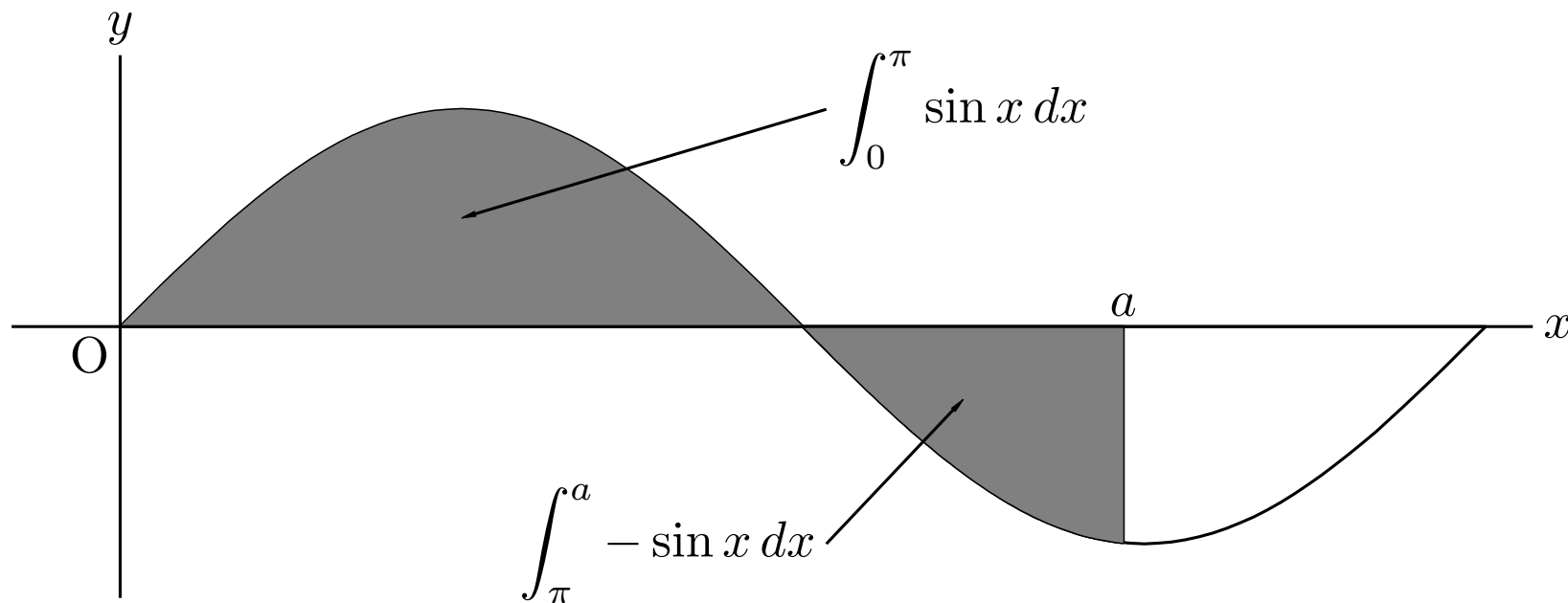
$$\int_0^a \sin x dx = \int_0^\pi \sin x dx - \int_\pi^a (-\sin x) dx \quad (a > \pi)$$

FIRST

LAST

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



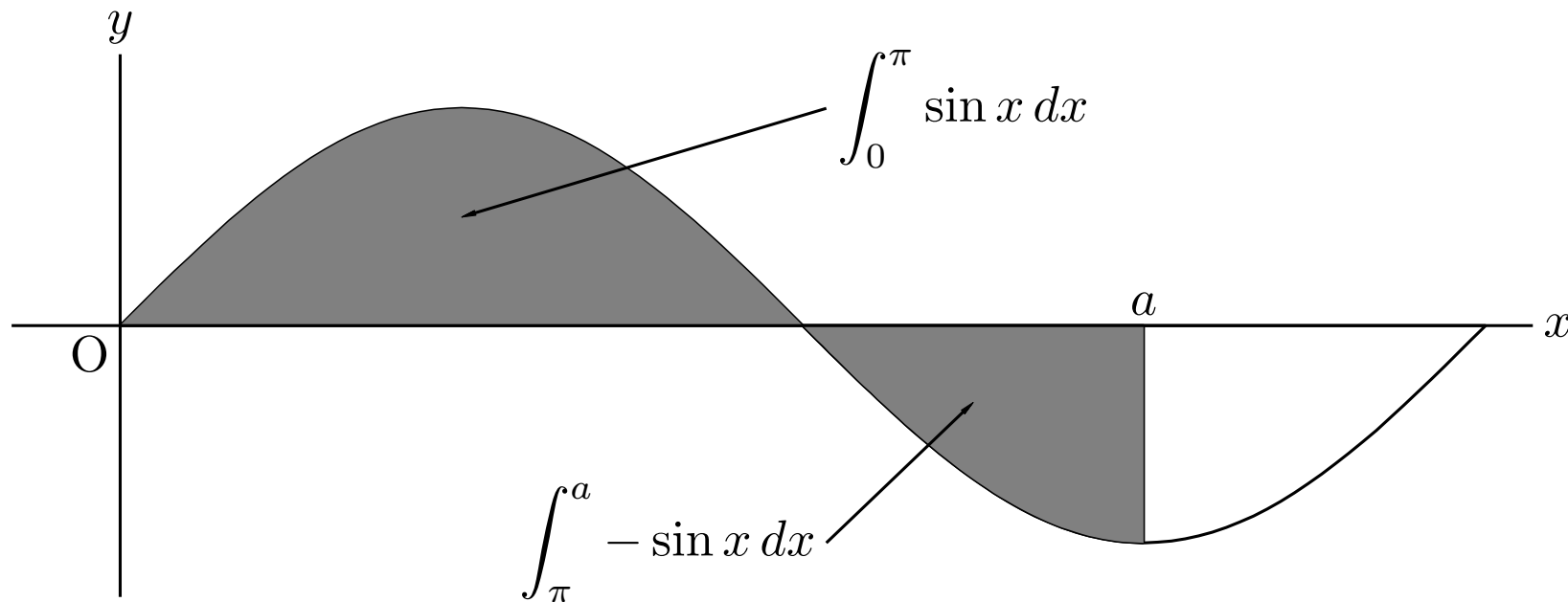
$$\int_0^a \sin x \, dx = \int_0^\pi \sin x \, dx - \int_\pi^a (-\sin x) \, dx \quad (a > \pi)$$

FIRST

LAST

2. Sample case of K_ET Cindy use

Flexibly formatted T_EX output



$$\int_0^a \sin x \, dx = \int_0^\pi \sin x \, dx - \int_\pi^a (-\sin x) \, dx \quad (a > \pi)$$

FIRST

LAST

3. Collaborative use with Maxima

Purpose

Interactive operation onto mathematical objects with high-quality \TeX outputs

3. Collaborative use with Maxima

Purpose

Interactive operation onto mathematical objects with high-quality $\text{T}_{\text{E}}\text{X}$ outputs

+

Symbolically computed results which must be transformed for DGS and $\text{T}_{\text{E}}\text{X}$ use

3. Collaborative use with Maxima

Purpose

Interactive operation onto mathematical objects with high-quality $\text{T}_{\text{E}}\text{X}$ outputs

+

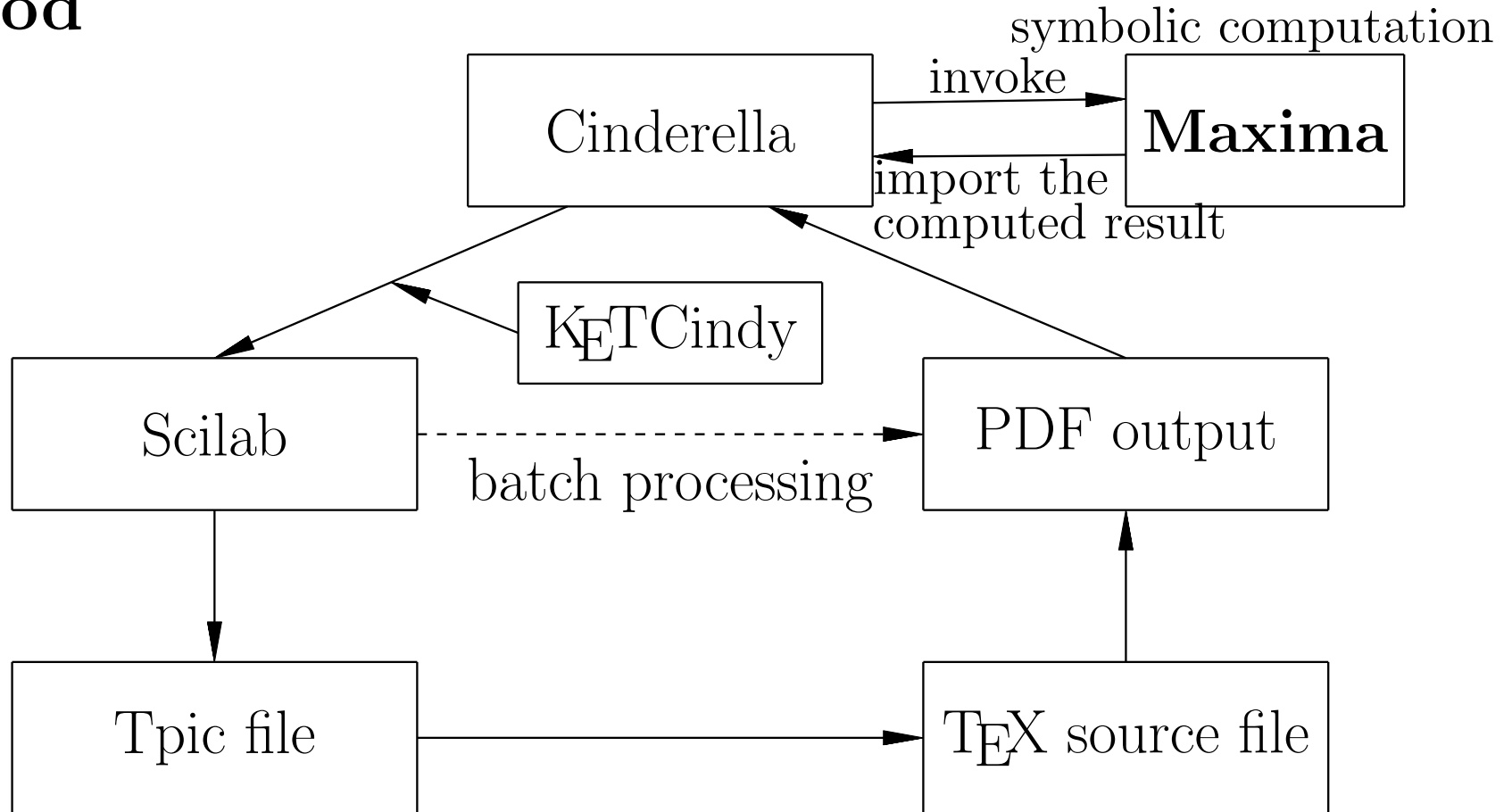


How to synchronize?

Symbolically computed results which must be transformed for DGS and $\text{T}_{\text{E}}\text{X}$ use

3. Collaborative use with Maxima

Method



3. Collaborative use with Maxima

Example

In GeoGebra, points A, B, C, and D are chosen.
Construct a cubic polynomial through those points.
Draw a tangent line in arbitrary point $(x, p(x))$.

3. Collaborative use with Maxima

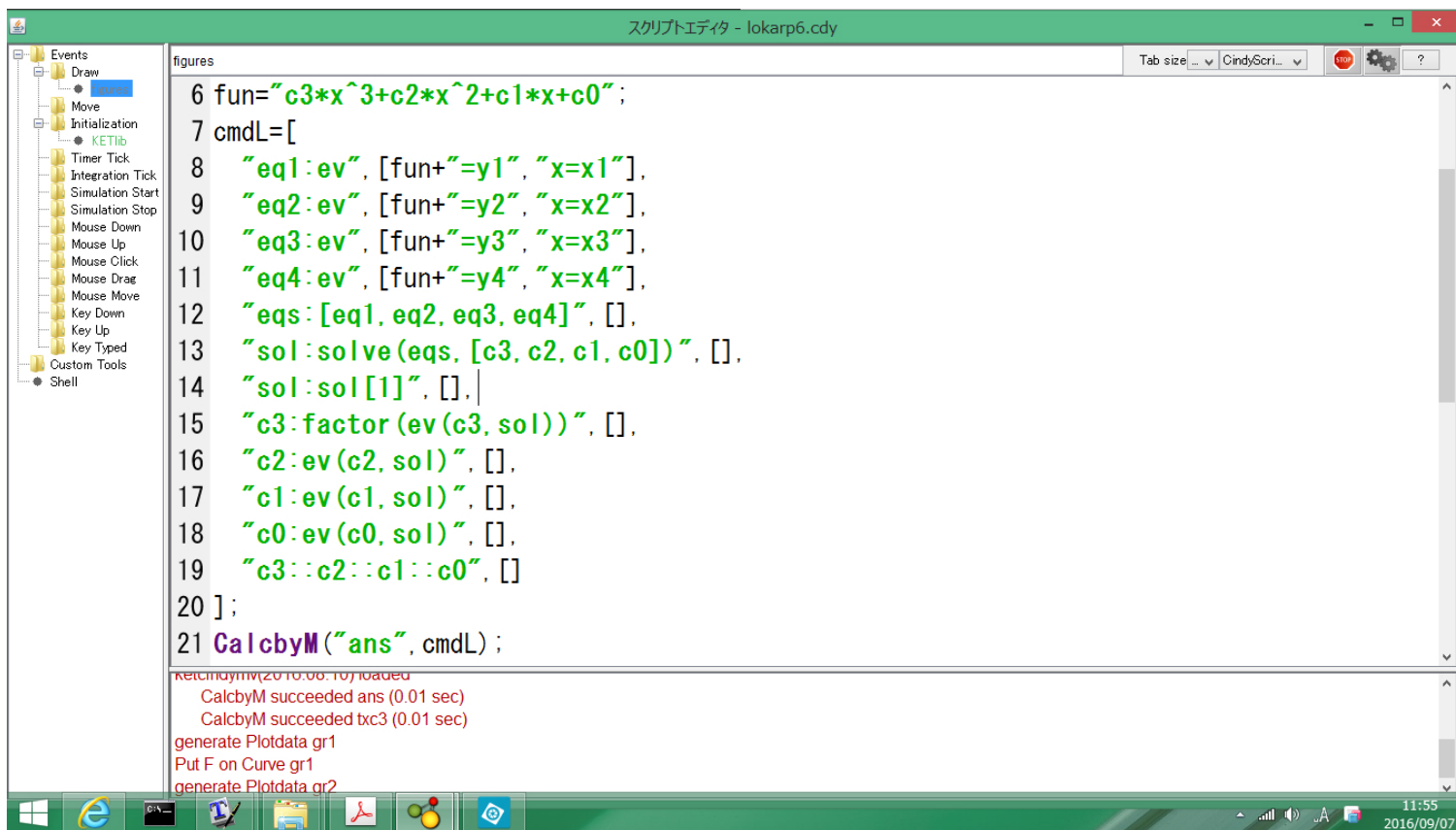
Example

In GeoGebra, points A, B, C, and D are chosen.
Construct a cubic polynomial through those points.
Draw a tangent line in arbitrary point $(x, p(x))$.

- This problem is also solvable by the collaborative use of Cinderella/K_ΕT_Cindy and Maxima
- The K_ΕT_Cindy command “Mxtex” converts the result computed by Maxima into T_ΕX readable form

3. Collaborative use with Maxima

Cindyscript screen (invoking Maxima)



The screenshot shows a window titled "スクリプトエディタ - lokarp6.cdy" with a sidebar on the left containing a tree view of events like Draw, Move, Initialization, etc. The main area contains the following Maxima code:

```
6 fun="c3*x^3+c2*x^2+c1*x+c0";
7 cmdL=[
8   "eq1:ev", [fun+"=y1", "x=x1"],
9   "eq2:ev", [fun+"=y2", "x=x2"],
10  "eq3:ev", [fun+"=y3", "x=x3"],
11  "eq4:ev", [fun+"=y4", "x=x4"],
12  "eqs:[eq1, eq2, eq3, eq4]", [],
13  "sol:solve(eqs, [c3, c2, c1, c0])", [],
14  "sol:sol[1]", [], |
15  "c3:factor(ev(c3, sol))", [],
16  "c2:ev(c2, sol)", [],
17  "c1:ev(c1, sol)", [],
18  "c0:ev(c0, sol)", [],
19  "c3::c2::c1::c0", []
20 ];
21 CalcbyM("ans", cmdL);
```

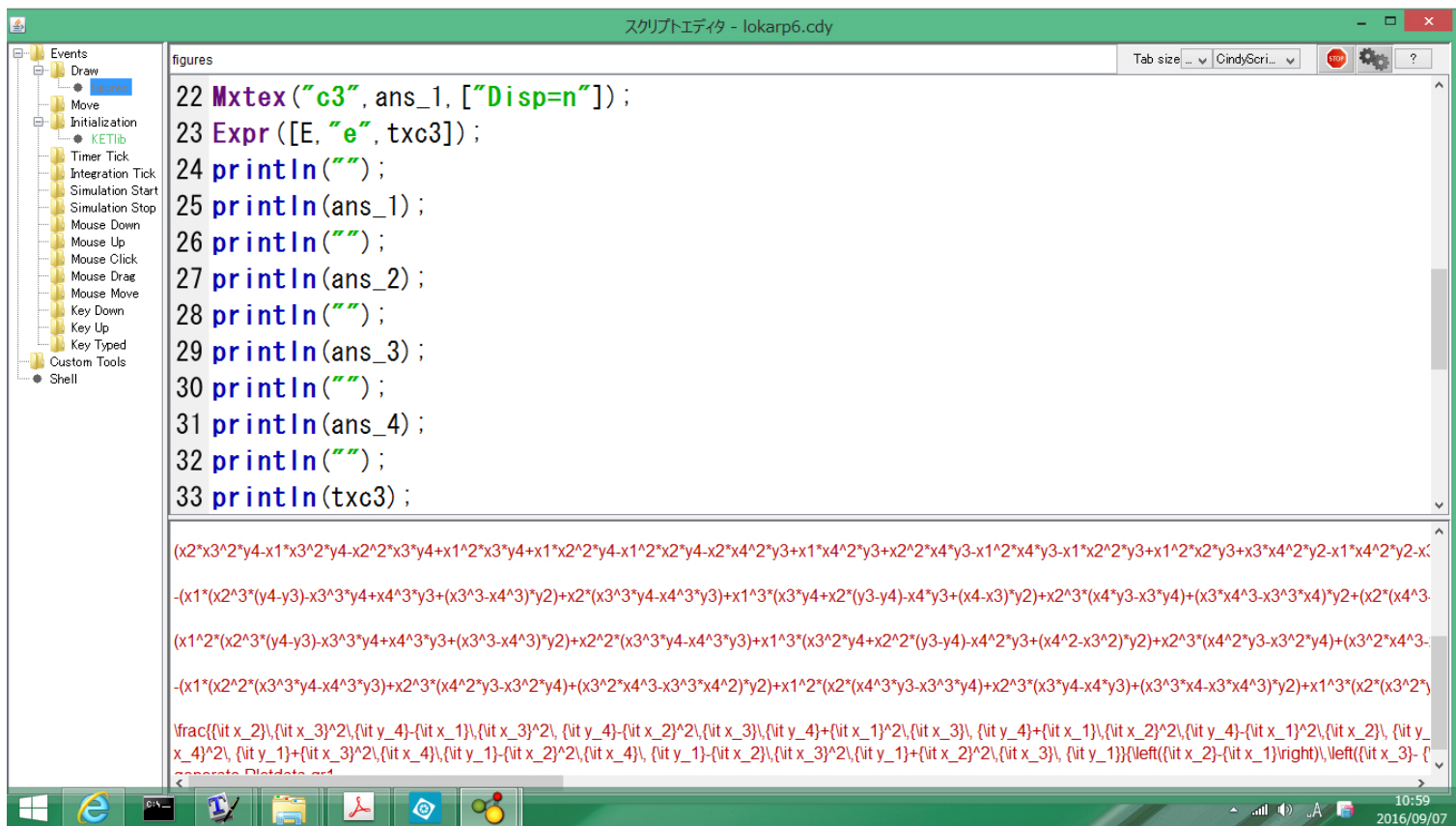
Below the code, the execution output is shown in red text:

```
ketcindy(2016.09.10) loaded
CalcbyM succeeded ans (0.01 sec)
CalcbyM succeeded txc3 (0.01 sec)
generate Plotdata gr1
Put F on Curve gr1
generate Plotdata gr2
```

The Windows taskbar at the bottom shows the date and time as 11:55 on 2016/09/07.

3. Collaborative use with Maxima

Cindyscript screen (Outputs and conversion)



The screenshot shows a window titled "スクリプトエディタ - lokarp6.cdy". On the left is a tree view of events including Draw, Move, Initialization, and Shell. The main area contains the following code:

```
22 Mxtex("c3", ans_1, ["Disp=n"]);
23 Expr([E,"e", txc3]);
24 println("");
25 println(ans_1);
26 println("");
27 println(ans_2);
28 println("");
29 println(ans_3);
30 println("");
31 println(ans_4);
32 println("");
33 println(txc3);
```

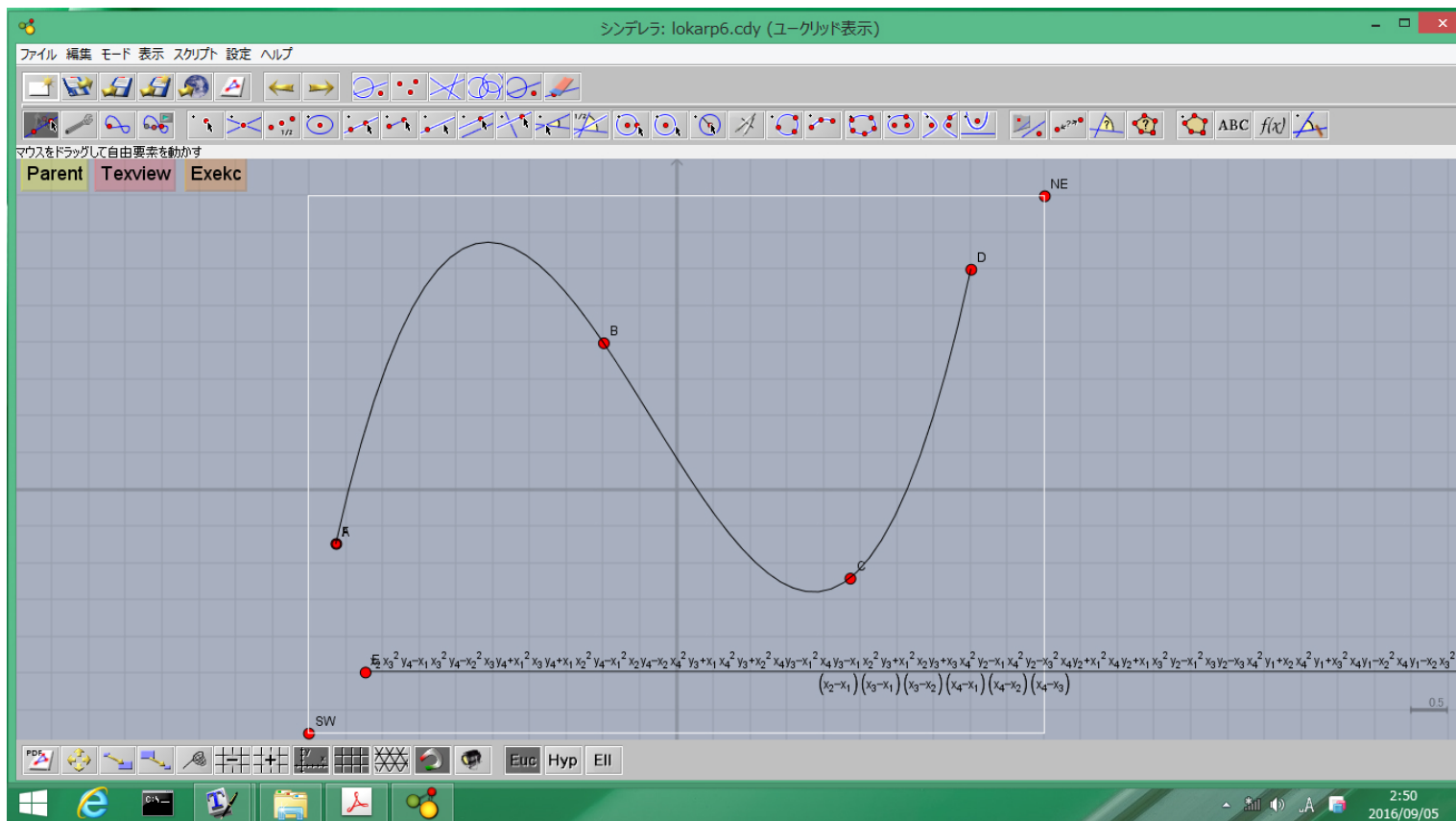
Below the code is a large, complex mathematical expression, which is a partial expansion of the binomial theorem for $(x^2 + x^3)^4$:

$$(x^2 + x^3)^4 = x^8 + 4x^7 + 6x^6 + 4x^5 + x^4$$

The expression is partially visible and ends with a $\frac{1}{2}$ at the bottom.

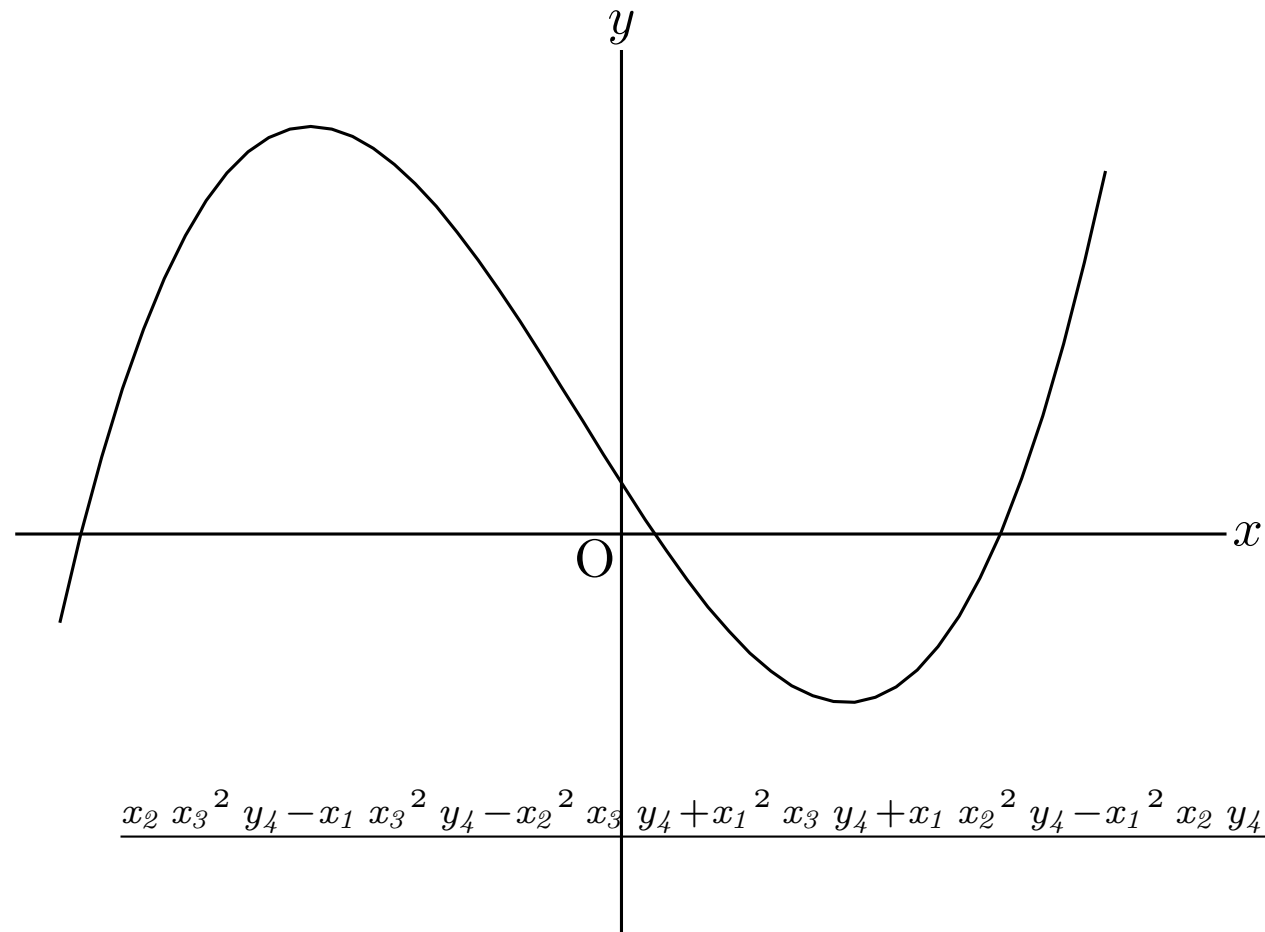
3. Collaborative use with Maxima

Cinderella screen



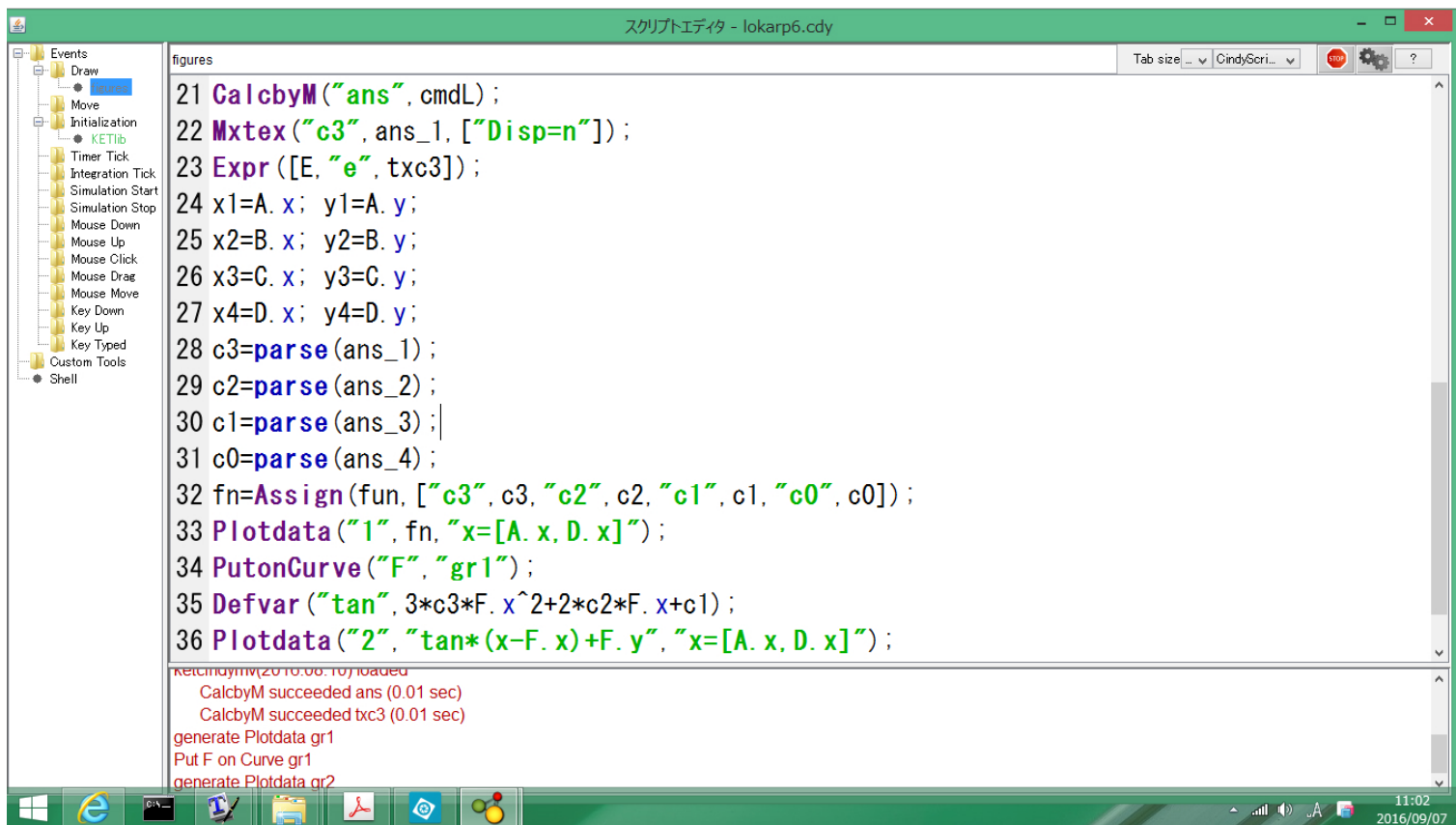
3. Collaborative use with Maxima

TEX output



3. Collaborative use with Maxima

Cindyscript screen (Utilizing output)



The screenshot shows a window titled "スクリプトエディタ - lokarp6.cdy" with a sidebar on the left listing event categories like Draw, Move, Initialization, etc. The main area contains Maxima code lines 21 through 36, followed by a red output log. The code defines variables, parses answers, assigns functions, and plots data. The output log shows successful execution of CalcbyM and generate Plotdata commands.

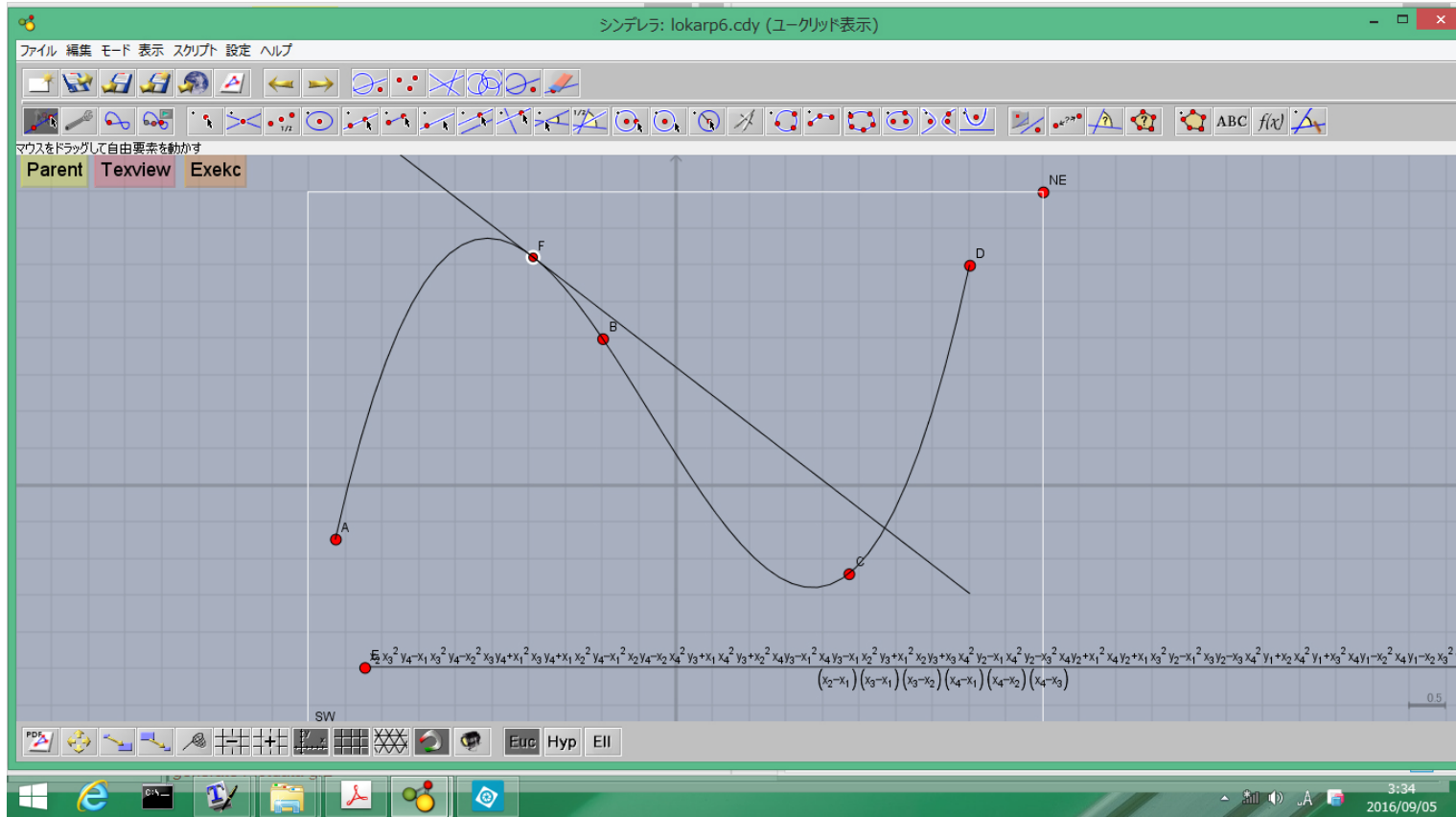
```
21 CalcbyM("ans", cmdL);
22 Mxtex("c3", ans_1, ["Disp=n"]);
23 Expr([E, "e", txc3]);
24 x1=A. x; y1=A. y;
25 x2=B. x; y2=B. y;
26 x3=C. x; y3=C. y;
27 x4=D. x; y4=D. y;
28 c3=parse(ans_1);
29 c2=parse(ans_2);
30 c1=parse(ans_3);
31 c0=parse(ans_4);
32 fn=Assign(fun, ["c3", c3, "c2", c2, "c1", c1, "c0", c0]);
33 Plotdata("1", fn, "x=[A. x, D. x]");
34 PutonCurve("F", "gr1");
35 Defvar("tan", 3*c3*F. x^2+2*c2*F. x+c1);
36 Plotdata("2", "tan*(x-F. x)+F. y", "x=[A. x, D. x]");
```

ketcindyrv(2016.09.10) loaded
CalcbyM succeeded ans (0.01 sec)
CalcbyM succeeded txc3 (0.01 sec)
generate Plotdata gr1
Put F on Curve gr1
generate Plotdata gr2

11:02
2016/09/07

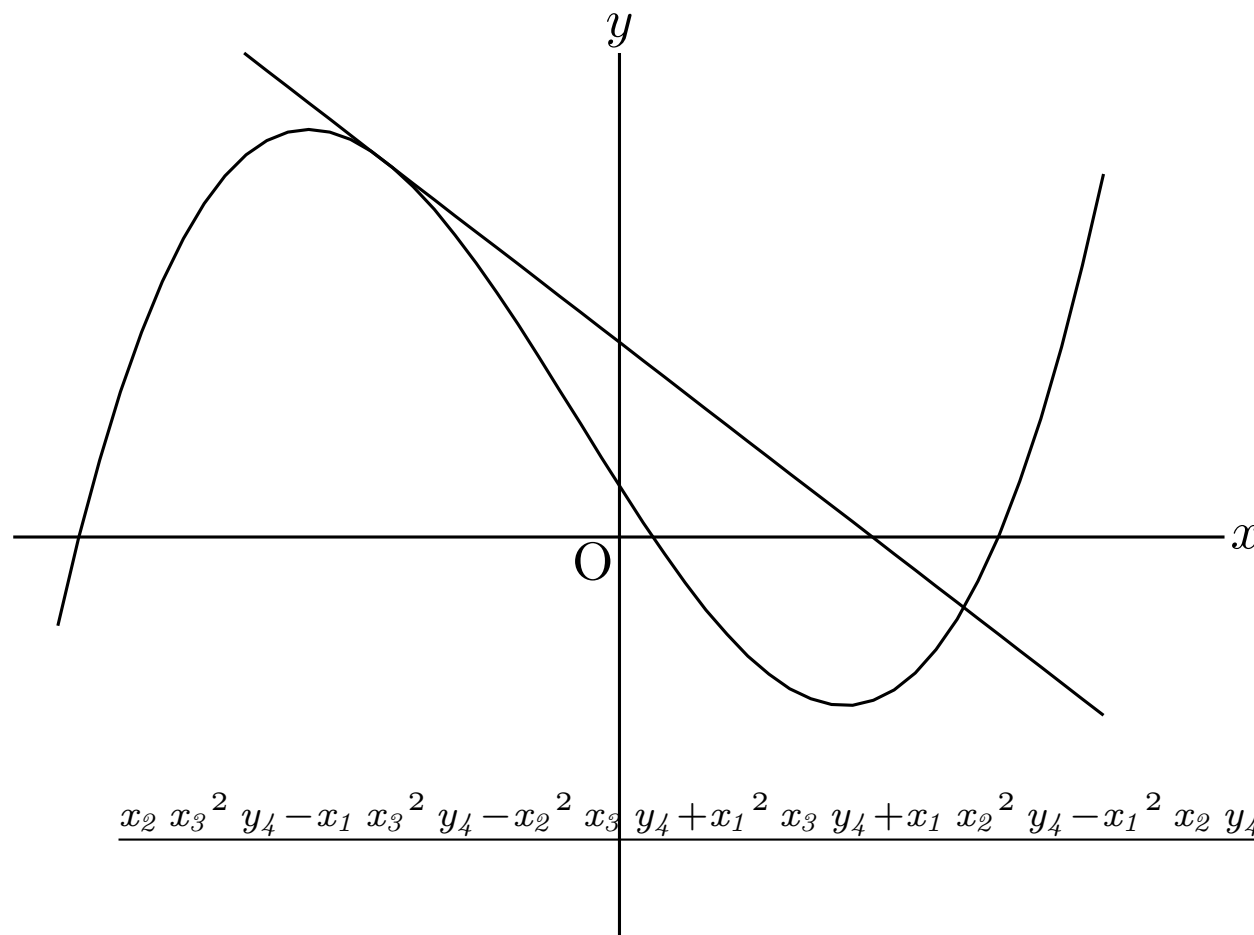
3. Collaborative use with Maxima

Cinderella screen



3. Collaborative use with Maxima

TEX output



4. Collaborative use with R

Purpose

Interactive operation onto mathematical objects with high-quality \TeX outputs

4. Collaborative use with R

Purpose

Interactive operation onto mathematical objects with high-quality $\text{T}_{\text{E}}\text{X}$ outputs

+

Tables in Excel which cannot be copied to DGS and $\text{T}_{\text{E}}\text{X}$ and statistical analysis of it

4. Collaborative use with R

Purpose

Interactive operation onto mathematical objects with high-quality $\text{T}_{\text{E}}\text{X}$ outputs

+

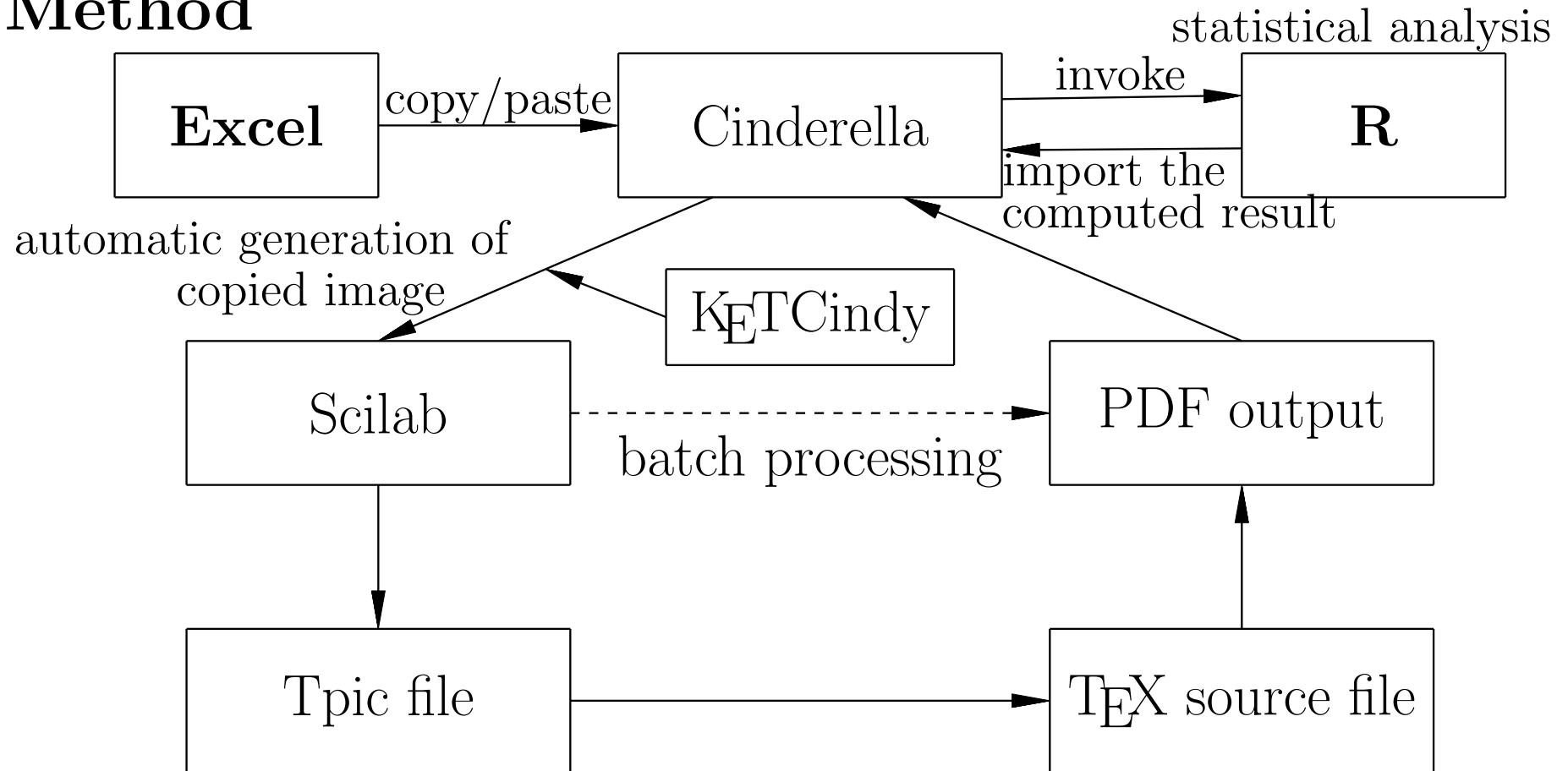


How to synchronize?

Tables in Excel which cannot be copied to DGS and $\text{T}_{\text{E}}\text{X}$ and statistical analysis of it

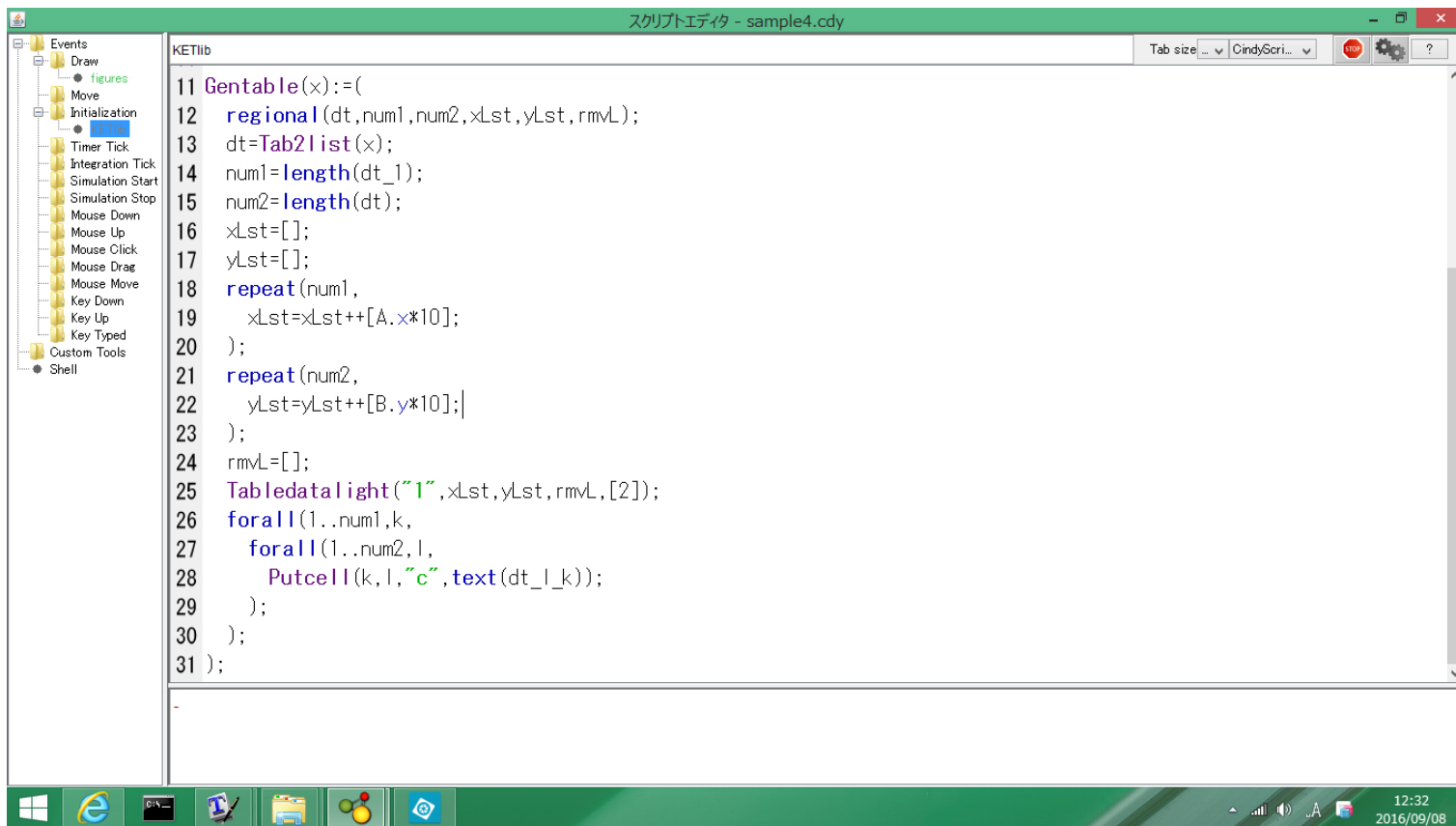
4. Collaborative use with R

Method



4. Collaborative use with R

Cindyscript screen (Definition of “Gentable”)



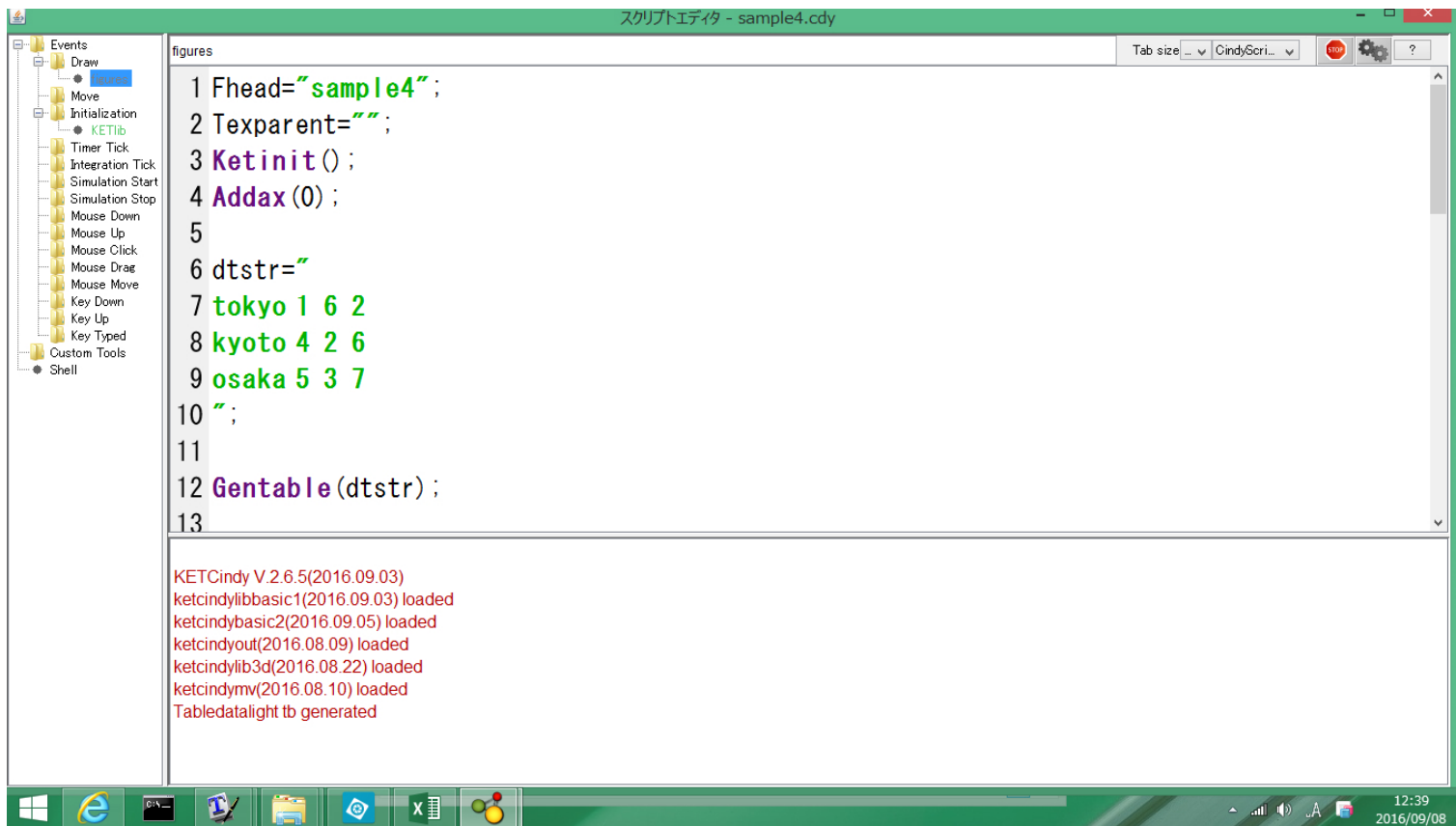
The screenshot shows a software window titled "スクリプトエディタ - sample4.cdy". On the left is a tree view of "Events" including Draw, figures, Move, Initialization, Timer Tick, Integration Tick, Simulation Start, Simulation Stop, Mouse Down, Mouse Up, Mouse Click, Mouse Drag, Mouse Move, Key Down, Key Up, Key Typed, Custom Tools, and Shell. The main area is a code editor with the following Cindyscript code:

```
KETlib
11 Gentable(x):=(
12   regional(dt,num1,num2,xLst,yLst,rmvL);
13   dt=Tab2List(x);
14   num1=length(dt_1);
15   num2=length(dt);
16   xLst=[];
17   yLst=[];
18   repeat(num1,
19     xLst=xLst++[A.x*10];
20   );
21   repeat(num2,
22     yLst=yLst++[B.y*10];|
23   );
24   rmvL=[];
25   Tabledatalight("1",xLst,yLst,rmvL,[2]);
26   forall(1..num1,k,
27     forall(1..num2,l,
28       Putcell(k,l,"c",text(dt_l_k));
29     );
30   );
31 );
```

The Windows taskbar at the bottom shows the time as 12:32 on 2016/09/08.

4. Collaborative use with R

Cindyscript screen (Execution of “copy/paste”)



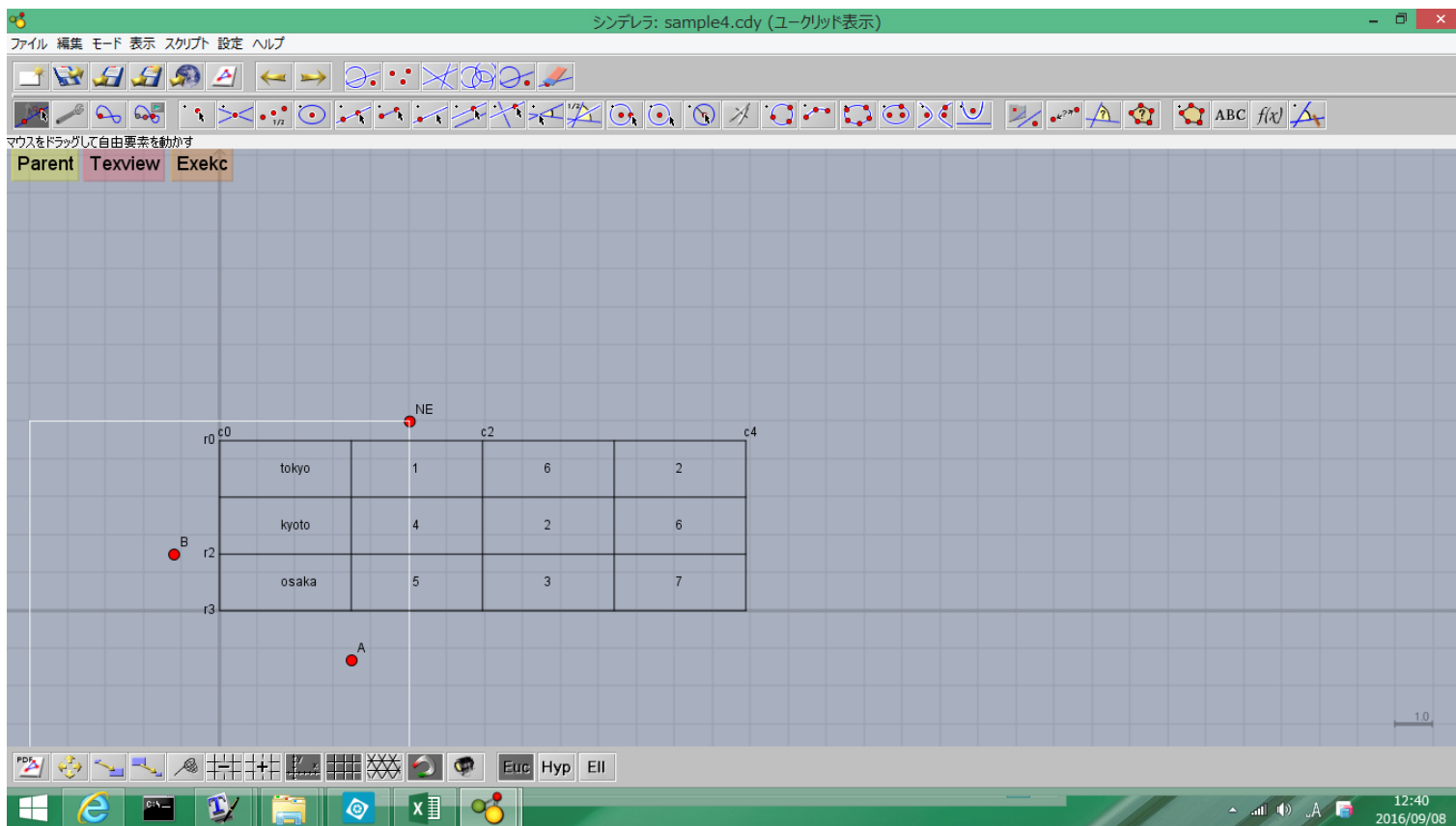
```
スクリプトエディタ - sample4.cdy
Tab size... CindyScri...
Events
  Draw
  Move
  Initialization
  KETlib
  Timer Tick
  Integration Tick
  Simulation Start
  Simulation Stop
  Mouse Down
  Mouse Up
  Mouse Click
  Mouse Drag
  Mouse Move
  Key Down
  Key Up
  Key Typed
  Custom Tools
  Shell
figures
1 Fhead="sample4";
2 Texparent="";
3 Ketinit();
4 Addax(0);
5
6 dtstr=""
7 tokyo 1 6 2
8 kyoto 4 2 6
9 osaka 5 3 7
10 "";
11
12 Gentable(dtstr);
13

KETCindy V.2.6.5(2016.09.03)
ketcindylibbasic1(2016.09.03) loaded
ketcindybasic2(2016.09.05) loaded
ketcindyout(2016.08.09) loaded
ketcindylib3d(2016.08.22) loaded
ketcindymv(2016.08.10) loaded
Tabledatalight tb generated
```

12:39
2016/09/08

4. Collaborative use with R

Cinderella screen (“interactive” table)



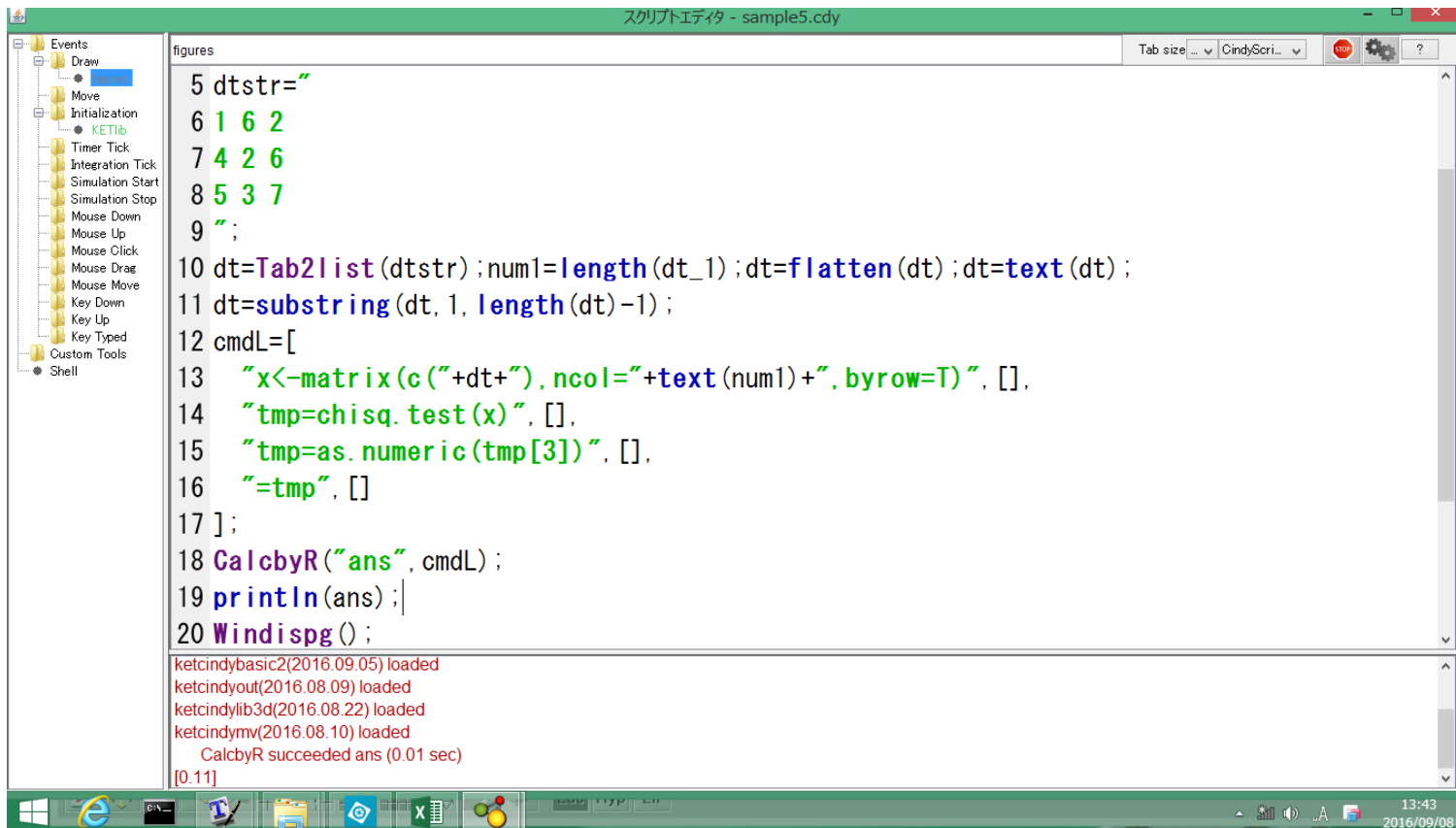
4. Collaborative use with R

TEX output

| | | | |
|-------|---|---|---|
| tokyo | 1 | 6 | 2 |
| kyoto | 4 | 2 | 6 |
| osaka | 5 | 3 | 7 |

4. Collaborative use with R

Cindyscript screen (Execution of χ^2 test)



```
5 dtstr="
6 1 6 2
7 4 2 6
8 5 3 7
9 ";
10 dt=Tab2List(dtstr); num1=length(dt_1); dt=flatten(dt); dt=text(dt);
11 dt=substring(dt, 1, length(dt)-1);
12 cmdL=[
13   "x<-matrix(c("+dt+"), ncol="+text(num1)+", byrow=T)", [],
14   "tmp=chisq.test(x)", [],
15   "tmp=as.numeric(tmp[3])", [],
16   "=tmp", []
17 ];
18 CalcbyR("ans", cmdL);
19 printIn(ans);|
20 WindispG();

ketcindybasic2(2016.09.05) loaded
ketcindyout(2016.08.09) loaded
ketcindylib3d(2016.08.22) loaded
ketcindymv(2016.08.10) loaded
  CalcbyR succeeded ans (0.01 sec)
[0.11]
```

5. Concluding remarks

What is the value of this collaborative system?

5. Concluding remarks

What is the value of this collaborative system?

Collective use of small tools should be effective and indispensable in some situations.

5. Concluding remarks

What is the role of Cinderella?

5. Concluding remarks

What is the role of Cinderella?

It can play as the controller and translator between many small tools via its scripting language (Cindyscript)

Please visit our workshop!!

Sep. 9th 14:00 – 16:00

Room 231

**Thank you very much
for your attentions!!**