

Maple Treasure Hunt

(a) What is the first nonzero digit after the decimal point in $2^{\frac{1}{2010}}$?

```
> evalf(2^(1/2010));
```

```
1.000344909
```

(1)

The answer is 3.

(b) What is the 2010th digit after the decimal point in $\sqrt{2}$?

You need to use 2011 digits, since one is before the decimal point.

```
> evalf(sqrt(2), 2011);
```

```
1.4142135623730950488016887242096980785696718753769480731766797379907324784621\  
07038850387534327641572735013846230912297024924836055850737212644121497099\  
93583141322266592750559275579995050115278206057147010955997160597027453459\  
68620147285174186408891986095523292304843087143214508397626036279952514079\  
89687253396546331808829640620615258352395054745750287759961729835575220337\  
53185701135437460340849884716038689997069900481503054402779031645424782306\  
84929369186215805784631115966687130130156185689872372352885092648612494977\  
15421833420428568606014682472077143585487415565706967765372022648544701585\  
88016207584749226572260020855844665214583988939443709265918003113882464681\  
57082630100594858704003186480342194897278290641045072636881313739855256117\  
32204024509122770022694112757362728049573810896750401836986836845072579936\  
47290607629969413804756548237289971803268024744206292691248590521810044598\  
42150591120249441341728531478105803603371077309182869314710171111683916581\  
72688941975871658215212822951848847208969463386289156288276595263514054226\  
76532396946175112916024087155101351504553812875600526314680171274026539694\  
70240300517495318862925631385188163478001569369176881852378684052287837629\  
38921430065586956868596459515550164472450983689603688732311438941557665104\  
08839142923381132060524336294853170499157717562285497414389991880217624309\  
65206564211827316726257539594717255934637238632261482742622208671155839599\  
92652117625269891754098815934864008345708518147223181420407042650905653233\  
33984364578657967965192672923998753666172159825788602633636178274959942194\  
03777753681426217738799194551397231274066898329989895386728822856378697749\  
66251996658352577619893932284534473569479496295216889148549253890475582883\  
45260965240965428893945386466257449275563819644103169798330618520193793849\  
40057156333720548068540575867999670121372239475821426306585132217408832382\  
94728761739364746783743196000159218880734785761725221186749042497736692920
```

(2)

```
73110963697216089337086611567345853348332952546758516447107578486024636008\
3444911482
```

The answer is 2.

(c) What is the 2010'th prime number?

It may take some digging, but searching for "prime" in Text will eventually find you the proper command: **ithprime**.

```
> ithprime(2010);
                                17477 (3)
```

The answer is 17477.

(d) Find integers a and b such that $(a + b\sqrt{2010})^2 = 73321 - 372\sqrt{2010}$

```
> expand((a+b*sqrt(2010))^2);
                                a^2 + 2 a b sqrt(2010) + 2010 b^2 (4)
```

Evidently we want $a^2 + 2010 b^2 = 73321$ and $2 a b = -372$.

```
> solve({a^2 + 2010*b^2 = 73321, 2*a*b = -372});
{a = 31, b = -6}, {a = -31, b = 6}, {a = -12060 RootOf(2010 _Z^2 - 1, label = _L3), b
= 31 RootOf(2010 _Z^2 - 1, label = _L3)} (5)
```

We could take $a = 31, b = -6$ or $a = -31, b = 6$.

(e) What is the first digit of the 2010'th Bernoulli number?

More digging in the help system will find the **bernoulli** command.

```
> bernoulli(2010);
91576300296802452154457585253950305286651099299894508015245395425404243854071\
26860387995524031313862432217203119773383402192260511205915872428066365259\
38285390723168075629613211367650905223303971973559976180056879757236587734\
32320452350372038904346894473250617929776105675053982898602770333000735299\
33797386003833406465088809061574446401549077550048351164771120191609341478\
17040675941918316060312350689283410349201934718065640487370531957951323425\
86250638544117222087938708589410647599668202543965309965951606575753443571\
28173766151456677126176783379096713351361683627562602680412712212514625492\
77005799638525809909099547845392887170643480057171079639110273166973951570\
27729953107283590211856160138261169065893618141029156834087495460669259434\
65036291301494866204191943373500327709789607940789990384577951874181383859\
89244940733371482859404009262332890853328887961808788487013699598847507302\
25275166719142325614583441702380989658999853840971851840970590341426106016\ (6)
```

20497401200547647204437613990396368129233089734870749634416691957656292029\
65250290841960192765943393297090619776747768978796770863780732452433742422\
11183068165528550581155248534784640053113071487082232020477759143867273871\
66361612800064899063377582950933215634230036937201158051709807494523958611\
70480583874143690738231049972401424693681162015846372455476971921922121796\
33716590733580058998042045745842888076566566045292688247478851984496913885\
45543952518377699383887472958420523750814341768063421959887710452255940509\
70006106711280998425995070364600020689741946576543577079987809707297200247\
68276125198957482708152785295622139867996326199775636977154617457049267651\
14086034199141247948814532564270461150218740448108566065616338538144752168\
29261861340127782908276814819453088135078412852155751800974715466311356986\
50015648964194188563251380954966786521147030021626591753768721187789604565\
92655757990281226571292363188260032349868725418870652518644101229603026618\
15397155410609859656012855476554676382323574629594660090485256579990693144\
56750728270780094684650626064072151632530869391567330610681348087437250897\
85040814319483648361876053146203310187214545247632655061630936867513352771\
81440399532882500386238465975489126044700957493021819225017514364141851342\
72859558301438635027272844157534704000999883044780012733032259017361425029\
96745817593395194475317949023671961560247101344548546935188388167634186362\
89413205905787456963030613208224975392555165693161171242939613222438009428\
26378714296612344050426104796322356379218075860274059043903869142922491556\
50952645787760747907669451848058875143174518138756102574364516152342620145\
63744637103031977589496204561931357382275291829068543577464834521795206586\
07238768725497104642146783889967349765711295983991190362373965346459509533\
60379794829928654530483678061037000804856847137007936652504649417310296484\
38037982134390555060349478010198818137049383477445154742177615072387800346\
51654746224128048703546722143507244445618689784587655509297725150651996274\
71390299951598797582031341857041455984337532549354313922455388614925929110\
78258966489613983011087291159871224902134299086509344832040017596916981770\
19338377097818535825739473274815974833232412911049460889912030200614062232\
52378315723627972969930889441950265920513499366883699803120074098738994851\
53803592705142155668237747452076669556661948369862114686846909388723869538\
19643989939232652702983239030527521156091599440887998498709748796537765921\
12916120417246285571194010680545964111878438595308481122909358747241835258\
41886270690802509051396893807664532389078434259312019593931416116426247385\
86899193281360267686150970904393417658919577259025922162161874466424445057\
46444732583517035486801623563210644870480188361109943197043964314475242590\
80415505253274511089220020366318278100008239146082630168530428441727245711\
74520387521370657189073505615501460072766411877594441880343841092729917627\
89865319837085294512354242942527772366601306902679916724047331169954705139\
11127591027608378363573495974739401409811582483165197765263059128671359001\
20240327727490192739037962072740646872385967865946104470295732204008571459

```
92266918945426820063726185580774433624356460411164329348601002831857540349\  
2771238295960096718993935/28801542
```

It's not an integer: note the /28801542 at the end.

```
> evalf(%);
```

```
3.179562410 104164
```

(7)

The first digit is 3.

(f) Find the limit of $\frac{x^3}{e^x - e^{\sin(x)}}$ as $x \rightarrow 0$. *Hint:* the exponential function in Maple is **exp**.

```
> limit(x^3/(exp(x) - exp(sin(x))), x = 0);
```

```
6
```

(8)

The answer is 6.