In [1]:

```
import pandas as pd
import matplotlib.pyplot as plt
```

In [2]:

```
df = pd.read_table("processed_log1.md", sep=" ")
df.head()
```

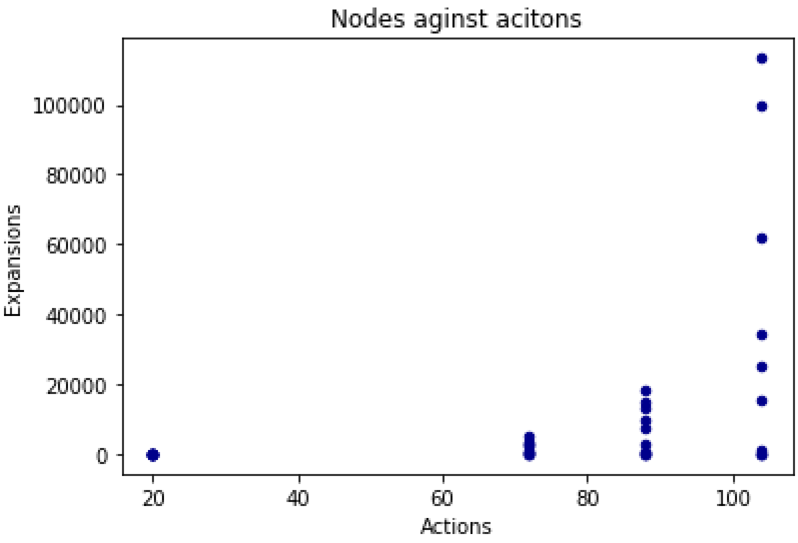
Out[2]:

	Problem	Search	Actions	Expa
0	AirCargoProblem1	breadth_first_search	20	43
1	AirCargoProblem1	depth_first_graph_search	20	21
2	AirCargoProblem1	uniform_cost_search	20	60
3	AirCargoProblem1	greedy_best_first_graph_searchwithh_unmet_goals	20	7
4	AirCargoProblem1	greedy_best_first_graph_searchwithh_pg_levelsum	20	6

1.Use a table or chart to analyze the number of nodes expanded against number of actions in the domain

In [9]:

```
df.plot.scatter(x="Actions", y="Expansions", c='DarkBlue', title='Nodes aginst acitons')
plt.show()
```

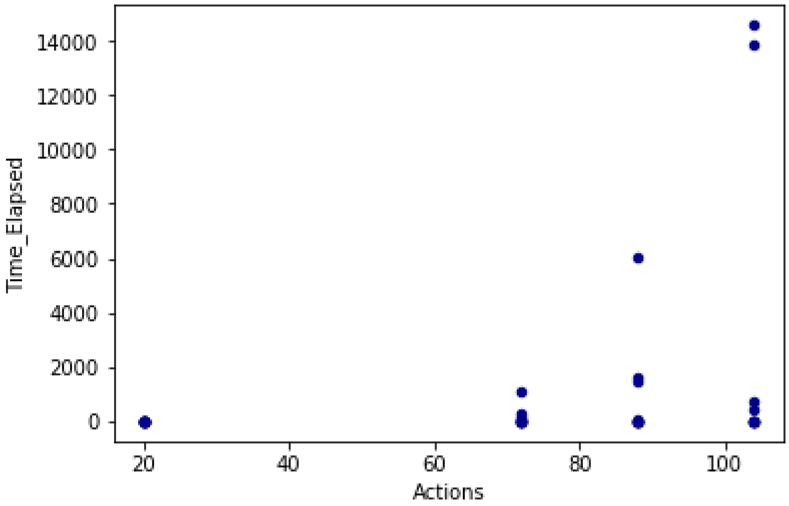


Answer: There is a positive correlation between the two factors. As the problem size increases, the average number of nodes expanded increases too, and the expansions variance of different algorithms also increases.

2.Use a table or chart to analyze the search time against the number of actions in the domain

In [12]:

```
df.plot.scatter(x="Actions", y="Time_Elapsed", c='DarkBlue')
plt.show()
```



Answer: There is a positive correlation between the two factors. As the problem size increases, the average Time_Elapsed increases too, and the Time_Elapsed variance of different algorithms also increases.

3.Use a table or chart to analyze the length of the plans returned by each algorithm on all search problems

In [40]:

```
df.pivot(index="Search", columns="Problem", values="Plan_Length")
```

Out[40]:

Problem	AirCargoProblem1	AirCargoProb
Search		
astar_searchwithh_pg_levelsum	6.0	9.0
astar_searchwithh_pg_maxlevel	6.0	9.0
astar_searchwithh_pg_setlevel	6.0	9.0
astar_searchwithh_unmet_goals	6.0	9.0
breadth_first_search	6.0	9.0
depth_first_graph_search	20.0	619.0
greedy_best_first_graph_searchwithh_pg_levelsum	6.0	9.0
greedy_best_first_graph_searchwithh_pg_maxlevel	6.0	9.0
greedy_best_first_graph_searchwithh_pg_setlevel	6.0	10.0
greedy_best_first_graph_searchwithh_unmet_goals	6.0	9.0
uniform_cost_search	6.0	9.0

Answer: The depth_first_graph_search generate longest plan length and then is the greedy_best_first_graph_search.

4.Which algorithm or algorithms would be most appropriate for planning in a very restricted domain (i.e., one that has only a few actions) and needs to operate in real time?

In [13]:

```
df.groupby(["Problem"]).min()["Actions"]
```

Out[13]:

```
Problem
AirCargoProblem1     20
AirCargoProblem2     72
AirCargoProblem3     88
AirCargoProblem4    104
Name: Actions, dtype: int64
```

In [53]:

```
df.loc[df.Problem == "AirCargoProblem1",["Problem", "Search", "Time_Elapsed"]].sort_values(by="Time_Elapsed")
```

Out[53]:

	Problem	Search	Time_Elapsed
3	AirCargoProblem1	greedy_best_first_graph_searchwithh_unmet_goals	0.001875
1	AirCargoProblem1	depth_first_graph_search	0.006557
7	AirCargoProblem1	astar_searchwithh_unmet_goals	0.013105
2	AirCargoProblem1	uniform_cost_search	0.016912
0	AirCargoProblem1	breadth_first_search	0.020445
5	AirCargoProblem1	greedy_best_first_graph_searchwithh_pg_maxlevel	0.234453
9	AirCargoProblem1	astar_searchwithh_pg_maxlevel	0.322859
8	AirCargoProblem1	astar_searchwithh_pg_levelsum	0.360759
4	AirCargoProblem1	greedy_best_first_graph_searchwithh_pg_levelsum	0.666980
10	AirCargoProblem1	astar_searchwithh_pg_setlevel	1.031665
6	AirCargoProblem1	greedy_best_first_graph_searchwithh_pg_setlevel	1.148178

Answer: greedy_best_first_graph_searchwithh_unmet_goals or depth_first_graph_search

5.Which algorithm or algorithms would be most appropriate for planning in very large domains (e.g., planning delivery routes for all UPS drivers in the U.S. on a given day)

In [54]:

```
df.loc[df.Problem == "AirCargoProblem4",["Problem", "Search", "Time_Elapsed"]].sort_values(by="T
ime_Elapsed")
```

Out[54]:

	Problem	Search	Time_Elapsed
36	AirCargoProblem4	greedy_best_first_graph_searchwithh_unmet_goals	0.024215
40	AirCargoProblem4	astar_searchwithh_unmet_goals	4.126687
33	AirCargoProblem4	breadth_first_search	5.505404
37	AirCargoProblem4	greedy_best_first_graph_searchwithh_pg_levelsum	6.883281
35	AirCargoProblem4	uniform_cost_search	8.394633
38	AirCargoProblem4	greedy_best_first_graph_searchwithh_pg_maxlevel	14.741153
41	AirCargoProblem4	astar_searchwithh_pg_levelsum	437.795106
34	AirCargoProblem4	depth_first_graph_search	767.090839
39	AirCargoProblem4	greedy_best_first_graph_searchwithh_pg_setlevel	13833.821295
42	AirCargoProblem4	astar_searchwithh_pg_maxlevel	14585.299921

Answer: greedy_best_first_graph_searchwithh_unmet_goals.

6.Which algorithm or algorithms would be most appropriate for planning problems where it is important to find only optimal plans?

Answer: astar_searchwithh_unmet_goals, breadth_first_search, uniform_cost_search