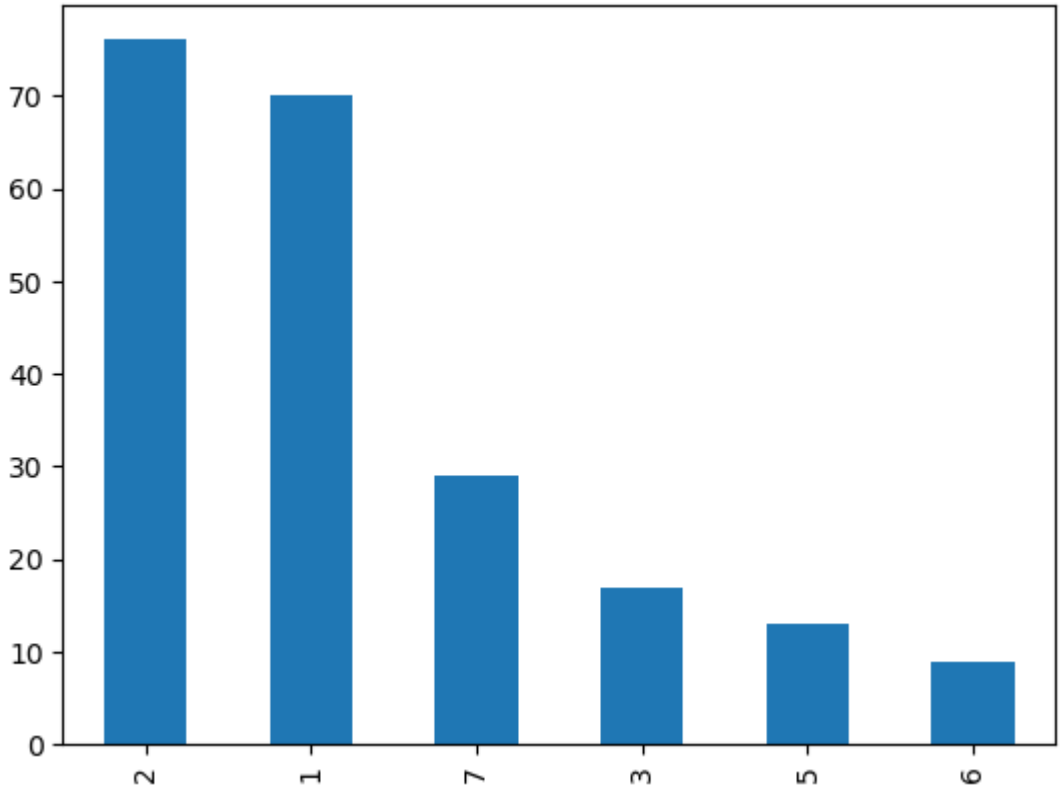
In [3]:
```
#1.Learn to use Cross validation to pick the best models.
import pandas as pd
import matplotlib.pyplot as plot
%matplotlib inline
import numpy as np
import os
os.chdir('F:\\Gurudatt\\gg\\Topmentor\\Batch64 Day31\\Batch64 Day31\\CS 44 Ans - M
os.getcwd()
data = pd.read_csv("glass.csv")
print(data)
data.info()
data["Type"].values
types = data["Type"].values
print(np.unique(types))
fig, ax = plot.subplots()
data['Type'].value_counts().plot(ax=ax, kind='bar')
```

```
          RI     Na    Mg    Al     Si     K    Ca    Ba   Fe  Type
0    1.52101  13.64  4.49  1.10  71.78  0.06  8.75  0.00  0.0     1
1    1.51761  13.89  3.60  1.36  72.73  0.48  7.83  0.00  0.0     1
2    1.51618  13.53  3.55  1.54  72.99  0.39  7.78  0.00  0.0     1
3    1.51766  13.21  3.69  1.29  72.61  0.57  8.22  0.00  0.0     1
4    1.51742  13.27  3.62  1.24  73.08  0.55  8.07  0.00  0.0     1
..       ...    ...   ...   ...    ...   ...   ...   ...  ...   ...
209  1.51623  14.14  0.00  2.88  72.61  0.08  9.18  1.06  0.0     7
210  1.51685  14.92  0.00  1.99  73.06  0.00  8.40  1.59  0.0     7
211  1.52065  14.36  0.00  2.02  73.42  0.00  8.44  1.64  0.0     7
212  1.51651  14.38  0.00  1.94  73.61  0.00  8.48  1.57  0.0     7
213  1.51711  14.23  0.00  2.08  73.36  0.00  8.62  1.67  0.0     7

[214 rows x 10 columns]
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 214 entries, 0 to 213
Data columns (total 10 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   RI      214 non-null    float64
 1   Na      214 non-null    float64
 2   Mg      214 non-null    float64
 3   Al      214 non-null    float64
 4   Si      214 non-null    float64
 5   K       214 non-null    float64
 6   Ca      214 non-null    float64
 7   Ba      214 non-null    float64
 8   Fe      214 non-null    float64
 9   Type    214 non-null    int64
dtypes: float64(9), int64(1)
memory usage: 16.8 KB
[1 2 3 5 6 7]
```

Out[3]:
```
<AxesSubplot:>
```



In [4]:
```
#2.     Make a train_test split and fit a single decision tree classifier.
X, y = data.iloc[:, :-1].values, data.iloc[:, -1].values
print (X)
```

```
[[ 1.52101 13.64     4.49    ...  8.75     0.       0.     ]
 [ 1.51761 13.89     3.6     ...  7.83     0.       0.     ]
 [ 1.51618 13.53     3.55    ...  7.78     0.       0.     ]
 ...
 [ 1.52065 14.36     0.      ...  8.44     1.64     0.     ]
 [ 1.51651 14.38     0.      ...  8.48     1.57     0.     ]
 [ 1.51711 14.23     0.      ...  8.62     1.67     0.     ]]
```

In [5]:
```
print (y)
```

```
[1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3
 3 3 3 3 3 3 3 3 3 3 3 3 3 3 5 5 5 5 5 5 5 5 5 5 5 5 6 6 6 6 6 6 6 6
 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7]
```

In [6]:
```
from sklearn.preprocessing import LabelEncoder
gender_encoder = LabelEncoder()
y = gender_encoder.fit_transform(y)
print (y)
```

```
[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2
 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4 4 4
 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5]
```

In [7]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_st
print(X_train.shape)
```

```
(171, 9)
```

In [8]:
```
from sklearn.tree import DecisionTreeClassifier
clf = DecisionTreeClassifier()
clf.fit(X_train,y_train)
```

Out[8]:
```
DecisionTreeClassifier()
```

In [9]:
```
y_predict = clf.predict(X_test)
```

In [10]:
```
from sklearn.metrics import accuracy_score
from sklearn.metrics import  confusion_matrix
accuracy = accuracy_score(y_predict,y_test)
print(accuracy)
print(confusion_matrix(y_predict,y_test))
```

```
0.6976744186046512
[[14  2  1  0  0  0]
 [ 4  7  2  0  0  0]
 [ 1  0  3  0  0  0]
 [ 0  1  0  1  0  0]
 [ 0  1  0  0  1  0]
 [ 0  1  0  0  0  4]]
```

In [12]:
```
"""3.Make a k-fold split with 3 splits and measure the accuracy score with each sp
[Hint: Refer to KFold module under sklearn's model selection.]"""
from sklearn.model_selection import KFold
from sklearn.metrics import  confusion_matrix
k_fold = KFold(3)
print(X_train.shape,y_train.shape)
```

```
(171, 9) (171,)
```

In [13]:
```
models =[]
for k in enumerate(k_fold.split(X_train, y_train)):
    clf.fit(X_train,y_train)
    print(clf.score(X_test,y_test))
    models.append(clf)
```

```
0.7209302325581395
0.7441860465116279
0.6976744186046512
```

In [14]:
```
y_predict = clf.predict(X_test)
print ( accuracy_score(y_predict,y_test))
print(confusion_matrix(y_predict,y_test))
```

```
0.6976744186046512
[[14  2  1  0  0  0]
 [ 3  7  2  0  0  0]
 [ 1  0  3  0  0  0]
 [ 0  1  0  1  0  0]
 [ 0  1  0  0  1  0]
 [ 1  1  0  0  0  4]]
```

In [15]:
```
"""4.Use gridSearchCV from sklearn for finding out a suitable number of estimators
along with a 10-fold cross validation.[Hint: Define a range of estimators and feed
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV
n_estimators_range = [1,2,4,8,16,32]
grid_cv= GridSearchCV(RandomForestClassifier(),param_grid=dict(n_estimators=n_esti
grid_cv.fit(X_train,y_train)
```

Out[15]:
```
GridSearchCV(cv=KFold(n_splits=10, random_state=None, shuffle=False),
             estimator=RandomForestClassifier(),
             param_grid={'n_estimators': [1, 2, 4, 8, 16, 32]})
```

In [16]:
```
grid_cv.best_score_
```

Out[16]:
```
0.7601307189542483
```

In [17]:
```
grid_cv.best_estimator_
```

Out[17]:
```
RandomForestClassifier(n_estimators=16)
```

In [18]:
```
y_predict = grid_cv.predict(X_test)
print ( accuracy_score(y_predict,y_test))
conf_mat = confusion_matrix(y_predict,y_test)
print(conf_mat)
```

```
0.7441860465116279
[[14  1  2  0  0  0]
 [ 2 10  2  0  0  0]
 [ 3  0  2  0  0  0]
 [ 0  0  0  1  0  0]
 [ 0  0  0  0  1  0]
 [ 0  1  0  0  0  4]]
```

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