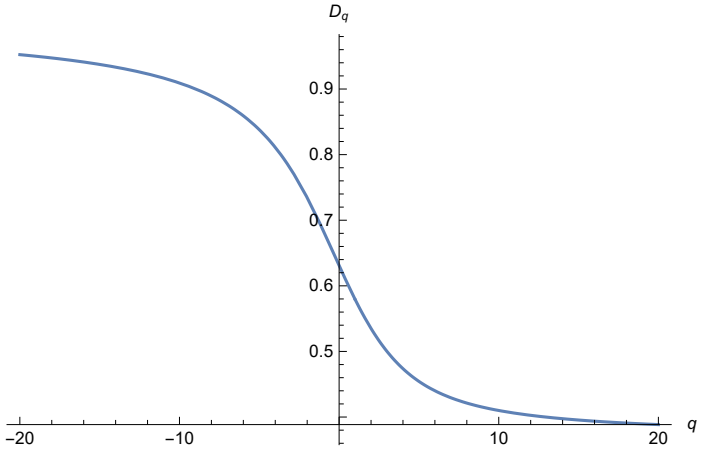
```
p = 1/3;
sum = Sum[Binomial[n, k] * ((p^k) * (1 - p)^(n - k))^q, {k, 0, n}];

limit = 1/(1 - q) * Limit[Log[sum]/Log[3^n], {n → Infinity}];
```

Out[•]=

$$\frac{-q \operatorname{Log}\left[\frac{3}{2}\right] + \operatorname{Log}\left[1 + 2^{-q}\right]}{(1 - q)\ \operatorname{Log}[3]} \quad \text{if} \quad q \operatorname{Log}\left[\frac{3}{2}\right] > \operatorname{Log}\left[1 + 2^{-q}\right]$$

In[1]:=
```
limitWithoutCondition[q0_] = (-q Log[3/2] + Log[1 + 2^-q])/(1 - q) Log[3] /. q → q0;
Plot[limitWithoutCondition[q], {q, -20, 20}, AxesLabel → {q, D_q}]
```

Out[2]=



In[•]:=
```
Limit[limitWithoutCondition[q], q → 1]
limitWithoutCondition[q] /. q → 2
FullSimplify[Limit[limitWithoutCondition[q], q → -Infinity]]
Limit[limitWithoutCondition[q], q → Infinity]
```

Out[•]=
$$\frac{\operatorname{Log}\left[\frac{27}{4}\right]}{\operatorname{Log}[27]}$$

Out[•]=
$$-\frac{\operatorname{Log}\left[\frac{5}{4}\right] - 2 \operatorname{Log}\left[\frac{3}{2}\right]}{\operatorname{Log}[3]}$$

Out[•]= 1

Out[•]=
$$\frac{\operatorname{Log}\left[\frac{3}{2}\right]}{\operatorname{Log}[3]}$$

Out[•]= 0.36907