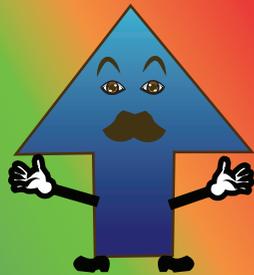


## Up Quark

Electric Charge:  $+2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

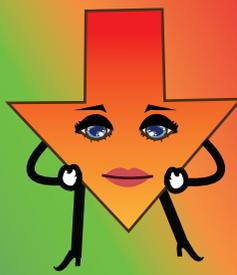
Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Down Quark

Electric Charge:  $-1/3$   
Spin:  $1/2$   
Mass: 4.8 MeV  
Half Life: Stable

Colour Charge: Yes  
Baryon Number:  $1/3$   
1st generation (1 point)



## Strange Quark

Electric Charge:  $-1/3$   
Spin:  $1/2$   
Mass: 95 MeV  
Half Life: 0.1 nanoseconds

Colour Charge: Yes  
Baryon Number:  $1/3$   
2nd generation (2 points)



## Photon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

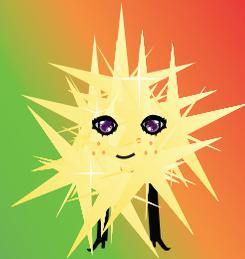
Colour Charge: No  
Exchange boson (1 point)  
Note: the photon is its own antiparticle.



## Charm Quark

Electric Charge:  $+2/3$   
Spin:  $1/2$   
Mass: 1.29 GeV  
Half Life: 1.1 picoseconds

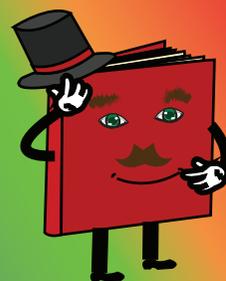
Colour Charge: Yes  
Baryon Number:  $1/3$   
2nd generation (2 points)



## Top Quark

Electric Charge:  $+2/3$   
Spin:  $1/2$   
Mass: 173.07 GeV  
Half Life:  $4.2 \times 10^{-25}$ s

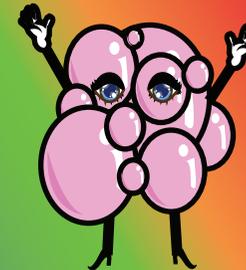
Colour Charge: Yes  
Baryon Number:  $1/3$   
3rd generation (3 points)



## Bottom Quark

Electric Charge:  $-1/3$   
Spin:  $1/2$   
Mass: 4.18 GeV  
Half Life: 1.3 picoseconds

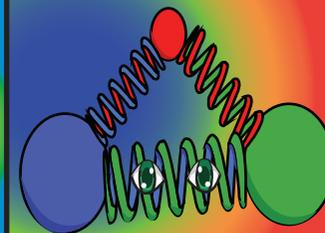
Colour Charge: Yes  
Baryon Number:  $1/3$   
3rd generation (3 points)



## Gluon

Electric Charge: 0  
Spin: 1  
Mass: 0.0 eV  
Half Life: Stable

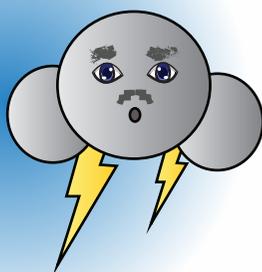
Colour Charge: Yes  
Exchange boson (1 point)



## Electron

Electric Charge: -1  
Spin:  $1/2$   
Mass: 0.511 MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number (e): 1  
1st generation (1 point)



## Muon

Electric Charge: -1  
Spin:  $1/2$   
Mass: 105.7 MeV  
Half Life: 2.2  $\mu$ s

Colour Charge: No  
Lepton Number ( $\mu$ ): 1  
2nd generation (2 points)



## Tau

Electric Charge: -1  
Spin:  $1/2$   
Mass: 1.777 GeV  
Half Life: 0.3 picoseconds

Colour Charge: No  
Lepton Number ( $\tau$ ): 1  
3rd generation (3 points)



## Z Boson

Electric Charge: 0  
Spin: 1  
Mass: 91.2 GeV  
Half Life:  $3 \times 10^{-25}$ s

Colour Charge: No  
Exchange boson (1 points)  
Note: the Z boson is its own antiparticle.



## Electron Neutrino

Electric Charge: 0  
Spin:  $1/2$   
Mass:  $<2.2$  eV  
Half Life: Stable

Colour Charge: No  
Lepton Number (e): 1  
1st generation (0 points)



## Muon Neutrino

Electric Charge: 0  
Spin:  $1/2$   
Mass:  $<0.17$  MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number ( $\mu$ ): 1  
2nd generation (0 points)



## Tau Neutrino

Electric Charge: 0  
Spin:  $1/2$   
Mass:  $<15.5$  MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number ( $\tau$ ): 1  
3rd generation (0 points)



## W+ Boson

Electric Charge: +1  
Spin: 1  
Mass: 80.4 GeV  
Half Life:  $3 \times 10^{-25}$ s

Colour Charge: No  
Exchange boson (1 points)



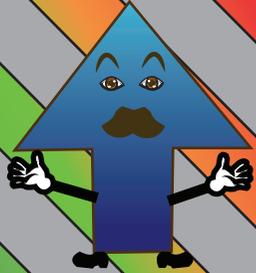
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Fundamental Particle Card

## Anti-Up Quark

Electric Charge:  $-2/3$   
Spin:  $1/2$   
Mass: 2.3 MeV  
Half Life: Stable

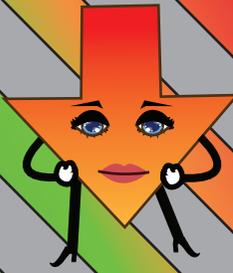
Colour Charge: Yes  
Baryon Number:  $-1/3$   
1st generation (1 point)



## Anti-Down Quark

Electric Charge:  $+1/3$   
Spin:  $1/2$   
Mass: 4.8 MeV  
Half Life: Stable

Colour Charge: Yes  
Baryon Number:  $-1/3$   
1st generation (1 point)



## Anti-Strange Quark

Electric Charge:  $+1/3$   
Spin:  $1/2$   
Mass: 95 MeV  
Half Life: 0.1 nanoseconds

Colour Charge: Yes  
Baryon Number:  $-1/3$   
2nd generation (2 points)



## Higgs Boson

Electric Charge: 0  
Spin: 0  
Mass: 126 GeV  
Half Life:  $\sim 10^{-22}$ s

Colour Charge: No  
(5 points)  
The Higgs Boson is an excitation of the Higgs field which gives particles their mass.



## Anti-Charm Quark

Electric Charge:  $-2/3$   
Spin:  $1/2$   
Mass: 1.29 GeV  
Half Life: 1.1 picoseconds

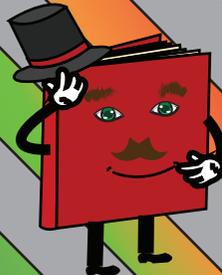
Colour Charge: Yes  
Baryon Number:  $-1/3$   
2nd generation (2 points)



## Anti-Top Quark

Electric Charge:  $-2/3$   
Spin:  $1/2$   
Mass: 173.07 GeV  
Half Life:  $4.2 \times 10^{-25}$ s

Colour Charge: Yes  
Baryon Number:  $-1/3$   
3rd generation (3 points)



## Anti-Bottom Quark

Electric Charge:  $+1/3$   
Spin:  $1/2$   
Mass: 4.18 GeV  
Half Life: 1.3 picoseconds

Colour Charge: Yes  
Baryon Number:  $-1/3$   
3rd generation (3 points)



## W<sup>-</sup> Boson

Electric Charge: -1  
Spin: 1  
Mass: 80.4 GeV  
Half Life:  $3 \times 10^{-25}$ s

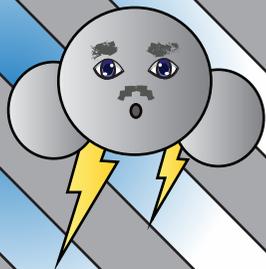
Colour Charge: No  
Exchange boson  
(2 points)



## Positron (Anti-Electron)

Electric Charge: +1  
Spin:  $1/2$   
Mass: 0.511 MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number (e): -1  
1st generation (1 point)



## Anti-Muon

Electric Charge: +1  
Spin:  $1/2$   
Mass: 105.7 MeV  
Half Life: 2.2  $\mu$ s

Colour Charge: No  
Lepton Number ( $\mu$ ): -1  
2nd generation (2 points)



## Anti-Tau

Electric Charge: +1  
Spin:  $1/2$   
Mass: 1.777 GeV  
Half Life: 0.3 picoseconds

Colour Charge: No  
Lepton Number ( $\tau$ ): -1  
3rd generation (3 points)



## W<sup>+</sup> Boson

Electric Charge: +1  
Spin: 1  
Mass: 80.4 GeV  
Half Life:  $3 \times 10^{-25}$ s

Colour Charge: No  
Exchange boson  
(1 points)



## Anti-Electron Neutrino

Electric Charge: 0  
Spin:  $1/2$   
Mass:  $< 2.2$  eV  
Half Life: Stable

Colour Charge: No  
Lepton Number (e): -1  
1st generation (0 points)



## Anti-Muon Neutrino

Electric Charge: 0  
Spin:  $1/2$   
Mass:  $< 0.17$  MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number ( $\mu$ ): -1  
2nd generation (0 points)



## Anti-Tau Neutrino

Electric Charge: 0  
Spin:  $1/2$   
Mass:  $< 15.5$  MeV  
Half Life: Stable

Colour Charge: No  
Lepton Number ( $\tau$ ): -1  
3rd generation (0 points)



## W<sup>-</sup> Boson

Electric Charge: -1  
Spin: 1  
Mass: 80.4 GeV  
Half Life:  $3 \times 10^{-25}$ s

Colour Charge: No  
Exchange boson  
(1 point)



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