

1. (4 points) According to the standard model, which if the following is *not* an elementary particle?

(a) **antineutron**

(b) neutrino

(c) antiquark

(d) photon

(e) electron

2. (4 points) Give the fundamental force each one of the following particles mediates:

- $\gamma$  (photon): electromagnetism
- $g$  (gluon) : strong nuclear force
- $W^\pm$  and  $Z^0$ : weak nuclear force

3. (3 points) What, for a black hole, is equal to the speed of light?

(a) temperature

(b) **escape velocity**

(c) Hawking radiation

(d) the strength of gravity

(e) speed of collapse

4. (4 points) Approximately how many exoplanets have we discovered so far?

(a)  $3 \times 10^{-6}$

(b)  $3 \times 10^{-3}$

(c) 3

(d)  $3 \times 10^3$

(e)  $3 \times 10^6$

5. (4 points) Neil DeGrasse Tyson closes his book with reflections on a “cosmic perspective.” How does learning more about how the universe works change your perspective? (I’m not looking for a correct answer, but some intelligent reflection.)

**Answer:** Answers will differ. You might be convinced by Tyson, or not—but you should have an argument backing up your position in either case.