**SKILLS TEST 9 (The Standard Model) NAME:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

*(21 Marks, 21 Minutes)*

1. Explain the role that gauge bosons play in the standard model and give an example of a gauge boson and how it can interact with other particles.

[3 marks]

2. Use the table below to assist with your answers to the following questions.

|  |  |  |  |
| --- | --- | --- | --- |
| **Quark** | **Relative Electric Charge** | **Strangeness** | **Bottomness** |
| Up | +2/3 | 0 | 0 |
| Down | -1/3 | 0 | 0 |
| Top | +2/3 | 0 | 0 |
| Bottom | -1/3 | 0 | -1 |
| Charm | +2/3 | 0 | 0 |
| Strange | -1/3 | -1 | 0 |

Note that antiquarks have equal but opposite sign for electric charge, strangeness and bottomness

* 1. Give the quark composition of a baryon that has a +1 electric charge, -1 strangeness and 0 bottomness. [2 mark]

uus / tts/ ccs any one for 2 marks

May also describe in words

Gives an incorrect 3 quark combination; 1 mark

* 1. Give the quark composition of an antibaryon that has a +1 electric charge, 0 strangeness and +2 bottomness. [2 mark]

2

May also describe in words

Gives an incorrect 3 antiquark combination; 1 mark

* 1. Give the quark composition of electrically neutral meson that has a +1 strangeness and 0 bottomness. [2 mark]

2

May also describe in words

Gives an incorrect quark-antiquark combination; 1 mark

3. An atomic nucleus is a delicate balance between forces that hold it together and forces that try to blow it apart. Name these forces. [2 marks]

The strong nuclear force is mediated by gluons. 1

(no 1/2 marks)

4. By equating Baryon, Lepton and Charge numbers only, decide whether the following equations are possible:

|  |  |  |
| --- | --- | --- |
|  |  | |
| Charge | -1 | -1 |
| Baryon | 0 | 0 |
| Lepton | 0 | 0 |

Possible

|  |  |  |
| --- | --- | --- |
|  |  | |
| Charge | -1 | +1 |
| Baryon | -1 | 1 |
| Lepton | 0 | 0 |

Not possible

|  |  |  |
| --- | --- | --- |
|  |  | |
| Charge | 2 | 2 |
| Baryon | 1 | 1 |
| Lepton | 0 | -1 |

Not possible

*1 mark for completed table, 1 mark for answer – no table, no marks (6 Marks)*

5. When an electron and a positron collide they can annihilate each other and release their mass energy as two photons. Assuming these two photons are identical,

a)What will each of their energies be?

*9.11 x 10-31(3x108)2 ✓*

*= 8.199 x 10-14 J ✓*

*(2 marks)*

b) What wavelength will they have?

⇒

⇒ *✓*

⇒ λ = 2.42 m *✓*

*(2 marks)*