**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)

Forces (strong. Weak, EM) in the standard model are mediated by gauge bosons. ✓

An example of a gauge boson is a photon. ✓

It can mediate the electromagnetic force of repulsion between two positively charged protons. ✓

Or other acceptable examples (gluons – strong nuclear interaction between hadrons, W/Z weak nuclear interaction between quarks and leptons)

1. 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/ sut 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

The electromagnetic force is mediated by photons. 1

(no 1/2 marks)

4. By equating Baryon, Lepton and Charge numbers, 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 an 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)*