

**Question 16****(9 marks)**

Use the Standard Model in the Formulae and Data Booklet provided to answer the following questions.

- (a) Identify the elementary particle responsible for mediating each of the following phenomena and complete each sentence. (3 marks)

The elementary particle responsible for the weak force is the \_\_\_\_\_.

The elementary particle responsible for the strong force is the \_\_\_\_\_.

The elementary particle responsible for the electrostatic force is the \_\_\_\_\_.

A table of the characteristics of the four forces can be drawn as shown.

Force	Relative strength	Range (m)
Strong	1	$10^{-15}$
Weak	$10^{-6}$	$10^{-18}$
Electromagnetic	$10^{-2}$	infinite
Gravitational		infinite

- (b) (i) The relative strength of the gravitational force would **best** be described as (1 mark)

- A  $10^{12}$ .
- B  $10^{-4}$ .
- C  $10^{-12}$ .
- D  $10^{-38}$ .

Your answer \_\_\_\_\_

- (ii) Give an appropriate reason for your choice. (2 marks)

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(c) The order of evolution of forces directly after the big bang is best thought of as (1 mark)

- A gravitational first, then strong and weak last.
- B weak first, then strong and gravitational last.
- C strong first, then weak and gravitational last.
- D simultaneous, i.e. all forces were created at the same moment.

Your answer \_\_\_\_\_

(d) A graviton is the proposed particle that mediates gravity but is as yet undiscovered.  
Suggest a characteristic for the graviton and give a reason why. (2 marks)

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