

1 (a) State what is meant by work done.

.....
..... [1]

(b) Use the answer to (a) to determine the SI base units of power.

SI base units [2]

(c) The maximum useful output power P of a car travelling on a horizontal road is given by

$$P = v^3 b$$

where v is the maximum speed of the car and b is a constant.

For the car,

$P = 84 \text{ kW} \pm 5\%$
and $b = 0.56 \pm 7\%$ in SI units.

(i) Calculate the value of v .

$v = \dots\dots\dots \text{ms}^{-1}$ [2]

(ii) Determine the absolute uncertainty in the value of v .

absolute uncertainty = ms^{-1} [2]

[Total: 7]

7 (a) Describe the structure of an atom of uranium-238, ${}^{238}_{92}\text{U}$.

.....
.....
..... [2]

(b) The decay of uranium-238 is shown by the equation



For nucleus X, calculate the ratio, in C kg^{-1} , of

$$\frac{\text{charge}}{\text{mass}}$$

ratio = C kg^{-1} [3]

(c) Two particles P and Q each consist of three quarks. These quarks are up (u) or down (d) quarks.

Particle P has no overall charge.

Particle Q has an overall charge of $+2e$, where e is the elementary charge.

State the quark composition of:

(i) particle P

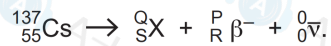
..... [1]

(ii) particle Q.

..... [1]

[Total: 7]

- 7 (a) A nucleus of caesium-137 ($^{137}_{55}\text{Cs}$) decays by emitting a β^- particle to produce a nucleus of an element X and an antineutrino. The decay is represented by



- (i) State the number represented by each of the following letters.

P

Q

R

S

[2]

- (ii) State the name of the class (group) of particles that includes the β^- particle and the antineutrino.

..... [1]

- (b) A particle Y has a quark composition of ddd where d represents a down quark.

A particle Z has a quark composition of $\bar{u}d$ where \bar{u} represents an up antiquark.

- (i) Show that the charges of particles Y and Z are equal.

[2]

- (ii) State and explain which particle is a meson and which particle is a baryon.

meson:

.....

baryon:

..... [2]

[Total: 7]

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