

Physics - Key Stage 4

Space

The life cycle of a star

Downloadable resource

Mr C White



Question slides from video



Where do the different types of atom originate?

The most abundant element in the universe is...

- A. hydrogen B. helium
- C. carbon D. oxygen

What is the name given to a large cloud of gas and dust in space?

- A. galaxy B. nebula
- C. asteroid D. cluster

When small nuclei fuse, what is always released?

- A. gravity B. energy in the form of electromagnetic waves
- C. smaller nuclei D. alpha particles



Independent task - birth to main sequence

(a) Order these stages of the star's life cycle from birth to equilibrium.

PROTOSTAR NEBULA MAIN SEQUENCE

(b) State the stage:

(i) where fusion occurs

(ii) where enough matter is pulled together under gravity to form a star

(iii) where matter is far apart and slowly being pulled together under gravity



Independent task - for Sun-like stars

KEYWORDS: white dwarf, main sequence star, nebula, red giant, black dwarf, protostar

Matter is pulled together under gravity in a _____ to make a _____



Fusion reaction starts and self-sustains.



Eventually force from radiation pressure balances gravitational force.



Star is now a _____.



Hydrogen fuel expires; collapse starts as star's surface cools.



Star expands to become a _____ with a large surface area.



Star contracts to become a hot _____



Star cools to become a _____.



Independent task for stars with much greater mass than the Sun.

Matter is pulled together under gravity in a _____ to make a _____



Fusion reaction starts and self-sustains.



Eventually force from radiation pressure balances gravitational force.



Star is now a _____.



Hydrogen fuel expires; collapse starts as star's surface cools.



Star expands to become a _____ with a large surface area.



Star explodes in a _____.



large initial mass = _____ ●

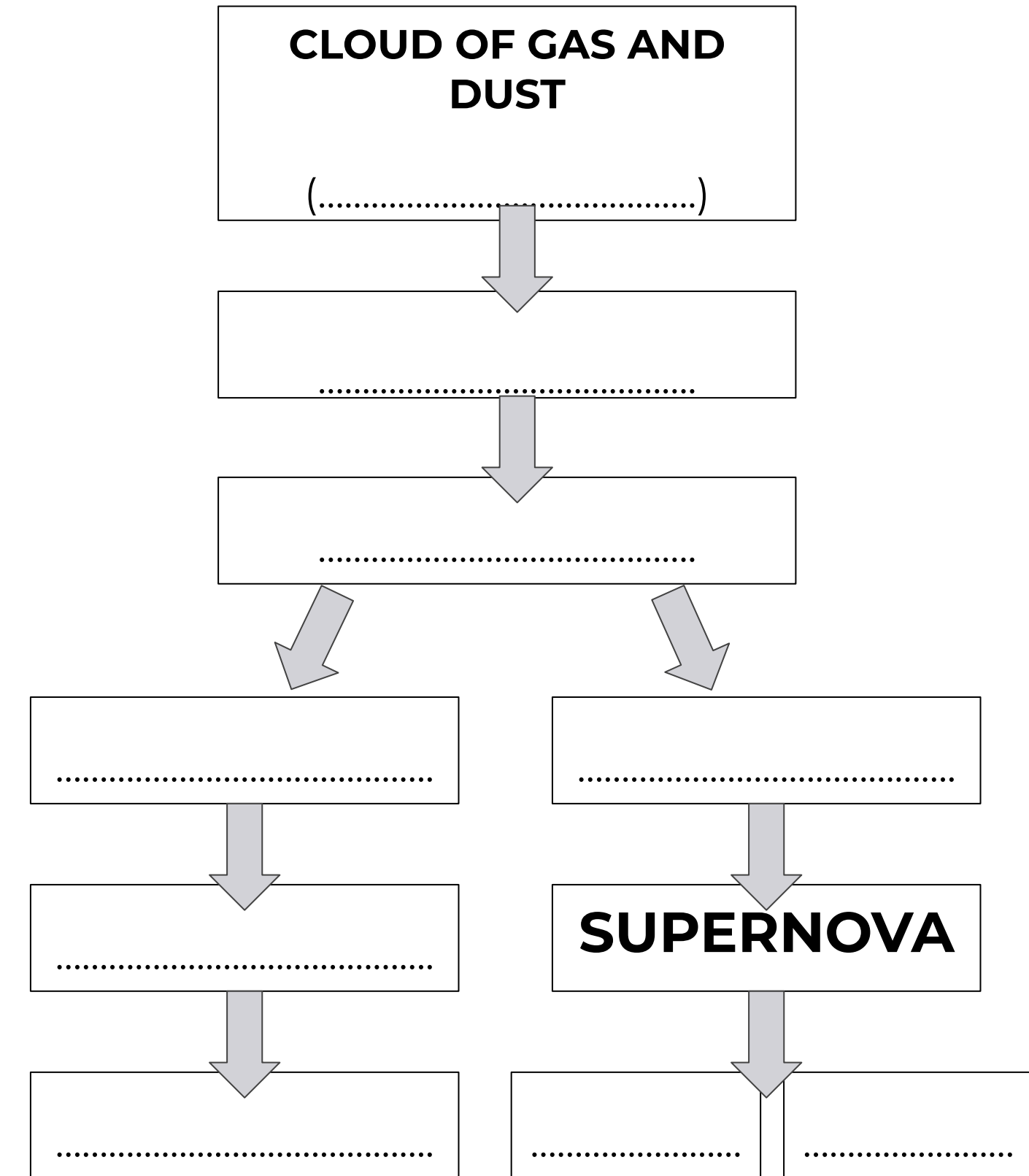


larger initial mass = _____.



Independent Task - life cycles

- (1) Copy and complete the summary diagram on the right for the life cycles of stars. Indicate clearly the route taken for (a) stars of similar mass to our Sun (b) stars with a much higher mass than our Sun.
- (2) Describe the sequence of the life cycle of stars with the greatest initial mass.
- (3) Put these stages in chronological order for a Sun-sized star. BLACK DWARF/PROTOSTAR
RED GIANT/ MAIN SEQUENCE / WHITE DWARF



EXAM STYLE QUESTIONS (PART ONE)

- (a) Rearrange these electromagnetic waves in order of frequency, highest first. (2 marks)

RADIO GAMMA INFRA-RED VISIBLE

- (b) Fusion reactions give off electromagnetic radiation.
Describe what is meant by a fusion reaction. (3 marks)



EXAM STYLE QUESTIONS (PART TWO)

- (c) Explain what conditions are needed for a star to remain a main sequence star for billions of years. (4 marks)

Gravitational waves were detected in 2016 from an instrument called LIGO. These were the result of two colliding neutron stars.

- (d) Describe the life cycle of a star that would conclude in a neutron star, naming the stages appropriately. (6 marks)



Answers



Where do the different types of atom originate?

The most abundant element in the universe is...

- A. hydrogen** B. helium
C. carbon D. oxygen

What is the name given to a large cloud of gas and dust in space?

- A. galaxy **B. nebula**
C. asteroid D. cluster

When small nuclei fuse, what is always released?

- A. gravity **B. energy in the form of electromagnetic waves**
C. smaller nuclei D. alpha particles



Independent task - birth to main sequence - SOLUTIONS

(a) Order these stages of the star's life cycle from birth to equilibrium.

PROTOSTAR **2nd** NEBULA **1st** MAIN SEQUENCE **3rd**

(b) State the stage:

(i) where fusion occurs **MAIN SEQUENCE**

(ii) where enough matter is pulled together under gravity to form a star
PROTOSTAR

(iii) where matter is far apart and slowly being pulled together under gravity **NEBULA**



SOLUTION - for Sun-like stars

Matter is pulled together under gravity in a **NEBULA** to make a **PROTOSTAR**



Fusion reaction starts and self-sustains.



Eventually force from radiation pressure balances gravitational force.



Star is now a **MAIN SEQUENCE STAR**.



Hydrogen fuel expires; collapse starts as star's surface cools.



Star expands to become a **RED GIANT** with a large surface area.



Star contracts to become a hot **WHITE DWARF**.



Star cools to become a **BLACK DWARF**.



SOLUTIONS: life cycle for stars with much greater mass than the Sun:

Matter is pulled together under gravity in a **NEBULA** to make a **PROTOSTAR**



Fusion reaction starts and self-sustains.



Eventually force from radiation pressure balances gravitational force.



Star is now a **MAIN SEQUENCE STAR**.



Hydrogen fuel expires; collapse starts as star's surface cools.



Star expands to become a **RED SUPERGIANT** with a large surface area.



Star explodes in a **SUPERNOVA**.



large initial mass = **NEUTRON STAR** ●

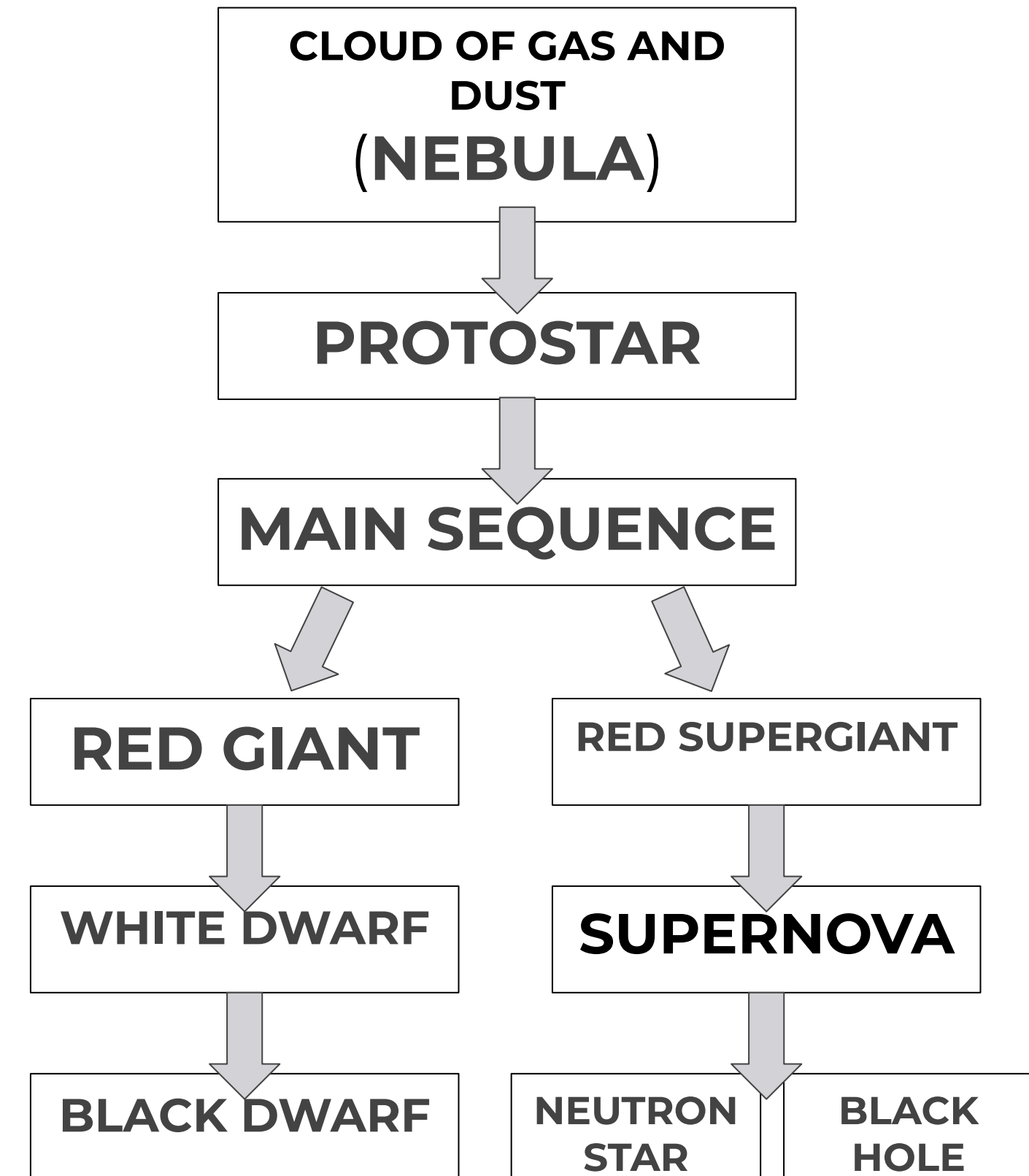
larger initial mass = **BLACK HOLE** .



Independent Task - SOLUTIONS

- (1) See right
- (2) Describe the sequence of the life cycle of stars with the greatest initial mass.

Nebula → protostar → main sequence → red supergiant → supernova → black hole
- (3) Put these stages in chronological order for a Sun-sized star. 1) PROTOSTAR 2) MAIN SEQUENCE, 3) RED GIANT, 4) WHITE DWARF, 5) BLACK DWARF



EXAM STYLE QUESTIONS (PART ONE) - SOLUTIONS

- (a) Rearrange these electromagnetic waves in order of frequency, highest first. (2 marks)

R M I V U X G (lowest frequency first)

RADIO 4th GAMMA 1st INFRA-RED 3rd VISIBLE 2nd

(2 marks for complete correct order, 1 mark for two in incorrect order)

- (b) Fusion reactions give off electromagnetic radiation.

Describe what is meant by a fusion reaction. (3 marks)

Any three from: Light nuclei/hydrogen nuclei (1) join together (1) to form heavier/helium nuclei (1) releasing energy (as EM radiation) (1)



EXAM STYLE QUESTIONS (PART TWO) - SOLUTIONS

c) Explain what conditions are needed for a star to remain a main sequence star for billions of years. (4 marks)

The gravitational force/collapse inwards (1) balances the radiation pressure outwards (1)

(d) Describe the life cycle of a star that would conclude in a neutron star, naming the stages appropriately. (6 marks)

Any 6 in the correct sequence

Gas and dust gather under gravitational force (in a nebula) (1)

To form a protostar (1) Fusion reaction begins/star begins to shine (1)

Star becomes a main sequence star (1) Hydrogen expires/star cools/and star swells to become a red supergiant (1) Explodes in a supernova (1) Collapses to become a neutron star + supporting statement that there is not enough mass to collapse to form a black hole (1)

