

AQA GCSE PHYSICS (HIGHER) • 8463

PHYSICS



EXAM QUESTION PACK

4.8.1 SOLAR SYSTEM, STABILITY OF ORBITAL MOTIONS AND SATELLITES (PACK 2)

SCORE

/39

PERCENTAGE

%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

Studying stars gives scientists evidence about the evolution of the Universe.

- (a) (i) In astronomy, what is meant by a black hole?

(2)

- (ii) How is it possible to detect a black hole?

(2)

- (b) The changes which happen in stars result in new elements being formed.

Nuclei of the heaviest elements are found in the Sun.

Describe how these nuclei are formed.

(2)

(Total 6 marks)

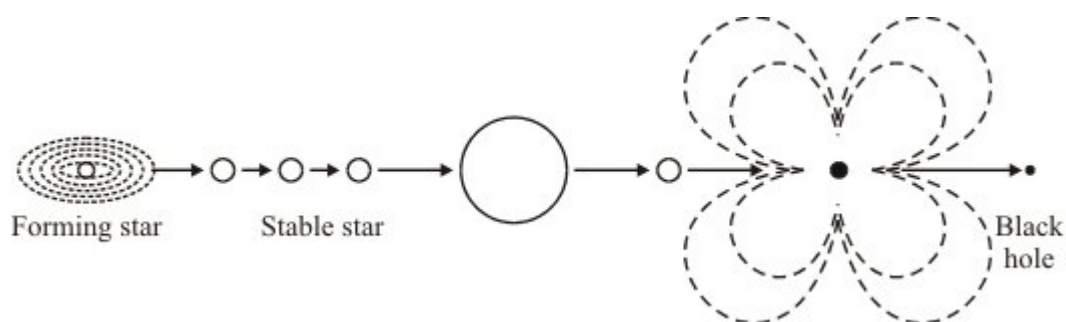
Q2.

One theory of the origin of the Universe was that billions of years ago all matter was in one place, then it exploded ('big bang').

Describe, in as much detail as you can, how our star (the Sun) formed from the time when there was just dust and gas (mostly hydrogen) up to now when it is in its main stable period.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

- (b) Stars form from gas (mostly hydrogen) and dust.



Describe, in as much detail as you can, what forces allow a stable star to exist and how the star may eventually form a black hole.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

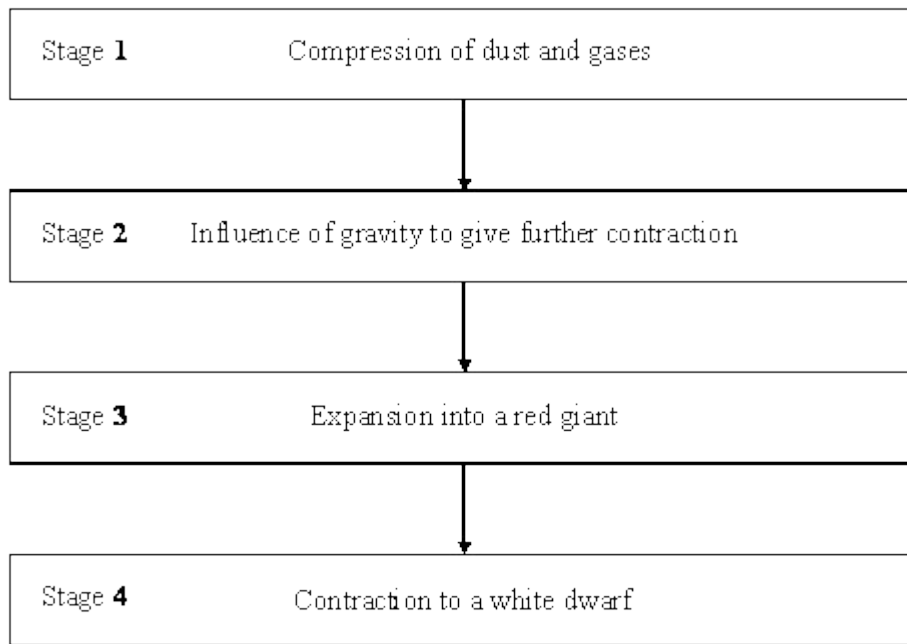
This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(6)

(Total 7 marks)

Q4.

The flowchart shows four stages thought to occur in the evolution of a star such as our Sun.



At a particular time a star might have reached one of these stages or be between stages or be at a further stage. What period in its evolution has our star, the Sun, reached?

(Total 1 mark)

Q5.

At the very high temperatures in the sun, hydrogen is converted into helium. It takes four hydrogen nuclei to produce one helium nucleus.

The table shows the relative masses of hydrogen and helium nuclei.

		Nucleus	Relative Mass
Hydrogen nucleus	Helium nucleus	hydrogen	1.007825
		helium	4.0037

- (a) Use these figures to calculate what happens to the mass of the sun as hydrogen is converted to helium.

(3)

- (b) Use your answer to part (a) to explain how the sun has been able to radiate huge amounts of energy for billions of years.

(2)
(Total 5 marks)

Q6.

The energy radiated by a **main sequence** star like the Sun is released by a nuclear fusion reaction in its core.

Read the following information about this reaction then use it to answer the questions below.

- The net result of the nuclear fusion reaction is that four hydrogen nuclei produce one helium nucleus. There is a loss of mass of 0.7%.
- For nuclear fusion to occur nuclei must collide at very high speeds.
- The energy released during the reaction can be calculated as shown:

$$\text{energy released [J]} = \text{loss of mass [kg]} \times (\text{speed of light [m/s}^2\text{)})$$

(The speed of light is 3×10^8 m/s)

- (a) Calculate the energy released when 1g of hydrogen fuses to form helium.

(Show your working.)

(4)

- (b) The table shows the lifetimes and surface temperatures of main sequence stars with different masses.

MASS OF STAR [SUN = 1]	LIFETIME ON MAIN SEQUENCE [MILLION OF YEARS]	SURFACE TEMPERATURE * [KELVIN]
0.5	200 000	4000
1	10 000	6000

Mark schemes

Q1.

- (a) (i) any **two** from
- (matter from) exploded star / supernova
- matter so dense / gravity so strong
- that electromagnetic radiation / light cannot escape from it
- 2
- (ii) X-rays emitted
- 1
- when gases or matter released from nearby stars spiral into it
- 1
- (b) fusion (of nuclei)
- 1
- of lighter elements / hydrogen helium
- 1
- [6]**

Q2.

Quality of written communication: One mark for using correct scientific sequence :
gravity → fusion → balance

1

any **four** from

- (dust and gas) pulled together by gravity
- (star formed when) it is hot enough
accept (as mass is pulled together) it gets very hot
- hydrogen (and helium) nuclei fuse
- (these nuclear fusion reactions) release the energy / heat / light
(which is radiated by stars)
- energy causes expansion
- gravitational pull is balanced by the expansion (force)

4

[5]

Q3.

- (a) materials produced when earlier stars
exploded
- accept the Sun is a second generation star*
accept formed from nebulae

1

(b) **Quality of written communication:**

1 mark for correct sequencing balanced forces → expansion → contraction / explosion

1

any **five** from

gravity pulling matter together

accept idea that a star is very massive so its force of gravity is very strong

high temperatures that create expansion forces

nuclear fusion releases energy that causes the very high temperatures

these forces balance

star expands greatly

since expansion is greater than gravity

accept fuel runs out

forms a red giant

give no further marks if red giant → white dwarf, red dwarf etc

collapses inwards and explodes outwards

called a supernova

neutron star may form

leaves a small, dense object (a black hole)

accept nothing can escape from it

5

[7]

Q4.

any **one** of

- * between (stage) 2 and (stage) 3
- * (in) the main sequence
- * (in) the main stable period
- * (it is a) yellow dwarf

[1]

Q5.

- (a) *evidence of conclusion* 4×1.007825 **or** 4.0313
each gain 1 mark

*based on use of data that there is a (very small) loss of mass
or 0.0276 but a loss of mass of 0.0276 for every helium atom or 0.69%/0.7%
gains 3 marks*

3

- (b) *idea that* loss of mass results in release of energy
gains 1 mark

but small loss of mass results in huge energy release
gains 2 marks

2

[5]

Q6.

- (a) it use $E = mc^2$

mass in kg i.e. $0.001 \times \frac{0.7}{100}$

each gains 1 mark

but 000007

gains 2 marks

2.1×10^3

gains 3 marks

evidence of 0.000007

mass in kg (i.e. 0.0007 **or** $0.7/100000$)

each gains 1 mark

squaring the speed of light

but 6.3×10^{11} (*credit alternative ways of stating this*)

gains 3 marks

units J/joule

for 1 further mark

(N.B credit kJ, MJ, GJ but check power of 10 for full credit)

4

- (b) (i) *idea that* the bigger the mass the shorter the life
gains 1 mark

but *idea that* decrease in life is much more than
 proportional to increase in mass
or more than proportional to mass²

gains 2 marks

2

- (ii) *ideas that:*

greater mass means greater **core** temperature/pressure
 greater core temperature/pressure means greater rate of fusion
 increase in mass produces a proportionally much greater
 increase in the rate of fusion

each for 1 mark

3

Q7.

ideas that

- formed from dust/gases
- pulled together by gravity
- massive so very large gravitational forces (pulling inwards)
- hydrogen → helium / fusion releases energy [not fission or just 'nuclear']
- high temperature creates high pressure (pushing outwards)
- long period when forces balance
- then expands → red giant / red star
- then contracts to (dense) white dwarf / white star

[credit if massive enough / more massive than sun, red giant → supernova → (very dense) neutron star but do not accept w.r.t. Sun itself]

[The whole of the (non bracketed part of) each idea must be present in some appropriate form of words for each mark to be credited. To gain more than a single mark ideas must also be in correct sequence and/or appropriately related.]

any six 1 mark each