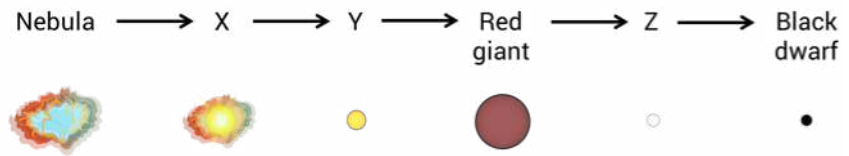| 0	1

The life cycle of a star depends on its mass. The life cycle of a star which is around the same mass as our Sun is as shown in the below diagram.

Nebula ⟶ X ⟶ Y ⟶ Red giant ⟶ Z ⟶ Black dwarf

0	1	.	1

Write down the names of the parts of the life cycle of a star which are labelled X, Y and Z in the above diagram.

X Protostar

Y Main sequence star

Z White dwarf

0	1	.	2

What is a nebula?

A cloud of gas (mainly hydrogen) and dust in space [1].

0	1	.	3

Explain how a star is formed from a nebula.

Gravity causes a nebula collapses in on itself / a nebula collapses under its self-gravity / every particle in the nebula will be attracted towards its centre of gravity [1].

This leads to the release of large amounts of thermal energy / causes the temperature of the nebula to increase / causes gravitational potential energy to be converted to thermal energy / cause work to be done on the gas by the gravitational force [1].
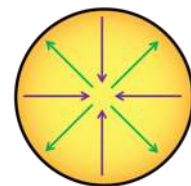
When the temperature of this collapsing nebula / protostar becomes high enough, (nuclear) fusion processes release huge amounts of (nuclear) energy / hydrogen nuclei will fuse to form helium [1]. A star is born!

0	1	.	4

The majority of stars spend most of their lives at stage Y. The Sun is currently at this stage in its life cycle. We say therefore that stars such are our Sun are **stable**. Explain the cause of the stability of such stars.

Inside a main sequence star, the gravitational forces which are acting inwards are balanced [1] by the forces due to (gas and radiation) pressure which are acting outwards [1].

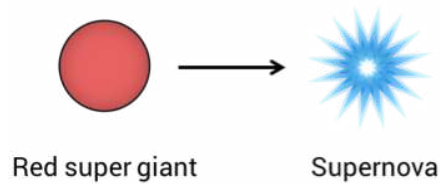The resultant force (acting on particles within the star) is therefore zero, and so the star is stable.

Force due to gravity
Force due to pressure

0	2

Stars which are much more massive than our Sun become red super giants rather than red giants. These stars will eventually enter the supernova phase of their life cycle.

Red super giant → Supernova

0	2	.	1

Explain why a large-mass red super giant undergoes supernova.

Fusion processes within a red super giant slow down / stop / the red super giant runs out of (fusion) fuel [1].

As a result, the outwards forces due to (gas and radiation) pressure within the star no longer balance the inwards forces due to gravity, and the star begins to collapse [1].

As it does so, its temperature increases massively / work is done on the collapsing star by gravity / gravitational potential energy is converted to thermal (heat) energy [1].

This triggers a massive explosion called a *supernova*.

As you might have guessed, supernovae are a little more complicated than this, and tend to take place across a number of pulsating collapse-growth-collapse cycles. As interesting and important as all of that is, you don't need to know about any of it for your exam, and could be well on the way to a shiny Grade 9 if you can remember and understand the above answer.

0	2	.	2

It is thought that all of the nuclei on Earth (and in the entire Universe) which are heavier than iron were formed in past supernovae. Explain why heavy elements are only thought to be formed in supernovae.

Because the very high temperatures (and densities) required to fuse together (certain lighter) nuclei to form heavier nuclei are only thought to be found inside exploding high-mass stars / during supernovae [1].

Accept: very high temperature required for fusion.

0	2	.	3

Describe the possible final stages in the life cycle of a large-mass star after it has undergone supernova.

After it has exploded / undergone supernova, a high-mass star may turn into a *neutron star* [1].

If the (original) mass of the star is very high, after it has undergone supernova, it may turn into a *black hole* [1].