Questions

Q1.

(a) Which force is responsible for keeping satellites in orbit?

(1)

☒ **A** electrostatic

☒ **B** gravitational

☒ **C** magnetic

☒ **D** nuclear

(b) Which of these is the largest?

(1)

☒ **A** galaxy

☒ **B** planet

☒ **C** star

☒ **D** universe

(c) Which of these represents the brightness of stars at a standard distance?

(1)

☒ **A** absolute magnitude

☒ **B** colour

☒ **C** diameter

☒ **D** temperature

(Total for question = 3 marks)

Q2.

(a) Which of these objects orbits a planet?

(1)

☒ **A** comet

☒ **B** dwarf star

☒ **C** galaxy

☒ **D** moon

(b) What is the correct name for our galaxy?

(1)

☒ **A** Crab Nebula

☒ **B** Milky Way

☒ **C** Solar System

☒ **D** Universe

(c) Which of these objects has the largest mass?

(1)

☒ **A** artificial satellite

☒ **B** comet

☒ **C** Earth

☒ **D** Sun

(d) Which of these stars is the coolest?

(1)

☒ **A** blue star

☒ **B** orange star

☒ **C** red star

☒ **D** yellow star

(Total for question = 4 marks)

Q3.

The International Space Station (ISS) is a satellite that orbits the Earth at a height of 409 km above the surface of the Earth.

The ISS has an orbital speed of 7.66 km/s and a period of 92.7 minutes.

(a) (i) Calculate the orbital radius of the ISS.

Give your answer to 3 significant figures.

(4)

orbital radius = ... km

(ii) Calculate the radius of the Earth using your value for the orbital radius.

(1)

Earth radius = ... km

(Total for question = 5 marks)

Q4.

A toy produces continuous waves when floating on the surface of a pool of water.

The waves spread out as circular wavefronts.

Diagram 1 shows the wavefronts produced when the toy is not moving, as viewed from above.

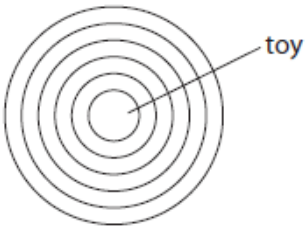

Diagram 1

Diagram 2 shows the wavefronts produced when the toy is moving across the surface of the pool of water.

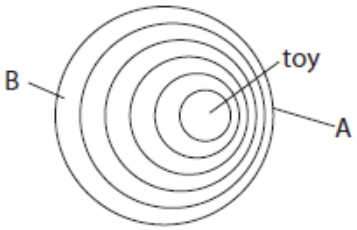

Diagram 2

(a) Draw an arrow on diagram 2 to show the direction the toy is moving.

(1)

(b) Explain how the frequency of the waves at point A is different to the frequency of the waves at point B.

(4)

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(Total for question = 5 marks)

Q5.

The Sun is a main sequence star.

In the Sun, hydrogen nuclei are changed into helium nuclei, releasing energy.

(a) Name the process that changes hydrogen into helium.

(1)

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(b) Describe the evolution of the Sun when it leaves the main sequence.

(2)

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(c) The Sun's core has a mass of approximately 7×10^{29} kg.

Approximately 75% of the mass of the core is hydrogen.

(i) Calculate the approximate mass of hydrogen in the Sun's core.

(1)

mass of hydrogen = ... kg

(ii) When most of the hydrogen nuclei in the Sun's core have been changed into

helium nuclei the Sun will leave the main sequence.

The Sun's core loses approximately 9×10^{19} kg of hydrogen each year.

Estimate the time until the Sun leaves the main sequence.

Give your answer to one significant figure.

(2)

time = ... years

(Total for question = 6 marks)

Q6.

(a) Give two pieces of evidence for the Big Bang theory.

(2)

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(b) Explain how this evidence supports the Big Bang theory.

(4)

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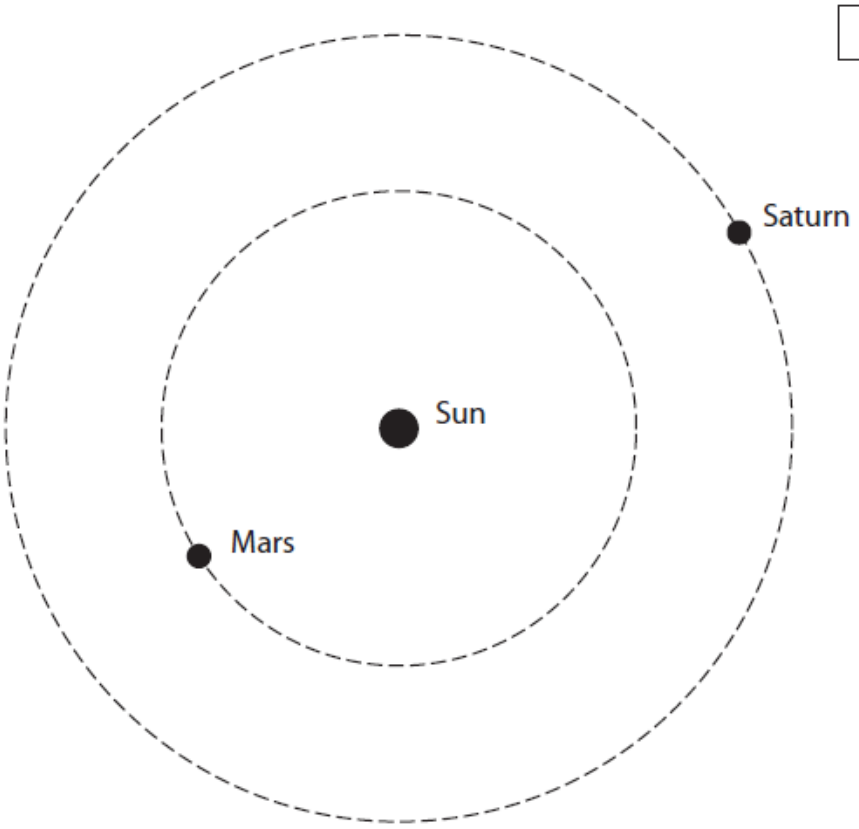
(Total for question = 6 marks)

Q7.

The planets Mars and Saturn orbit around the same star, the Sun.

(a) The diagram shows the orbital paths of Mars and Saturn.



Draw an orbital path of a comet on the diagram.

(2)

(b) The table gives some information about the orbits of Mars and Saturn.

	Mars	Saturn
Orbital radius in km	2.28×10^8	1.43×10^9
Orbital speed in km/s	24.1	9.70

Mars completes a number of orbits in the time it takes for Saturn to complete one orbit.

Calculate the number of orbits that Mars completes in the time it takes for Saturn to complete one orbit.

(5)

number of orbits = ...

(Total for question = 7 marks)

Q8.

Main sequence stars can vary in brightness, colour and mass.

Describe the evolution of both low mass stars and high mass stars after they join the main sequence.

(6)

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(Total for question = 6 marks)

Q9.

This question is about stars.

(a) Astronomers measure the absolute magnitude of stars.

State what is meant by the term **absolute magnitude**.

(2)

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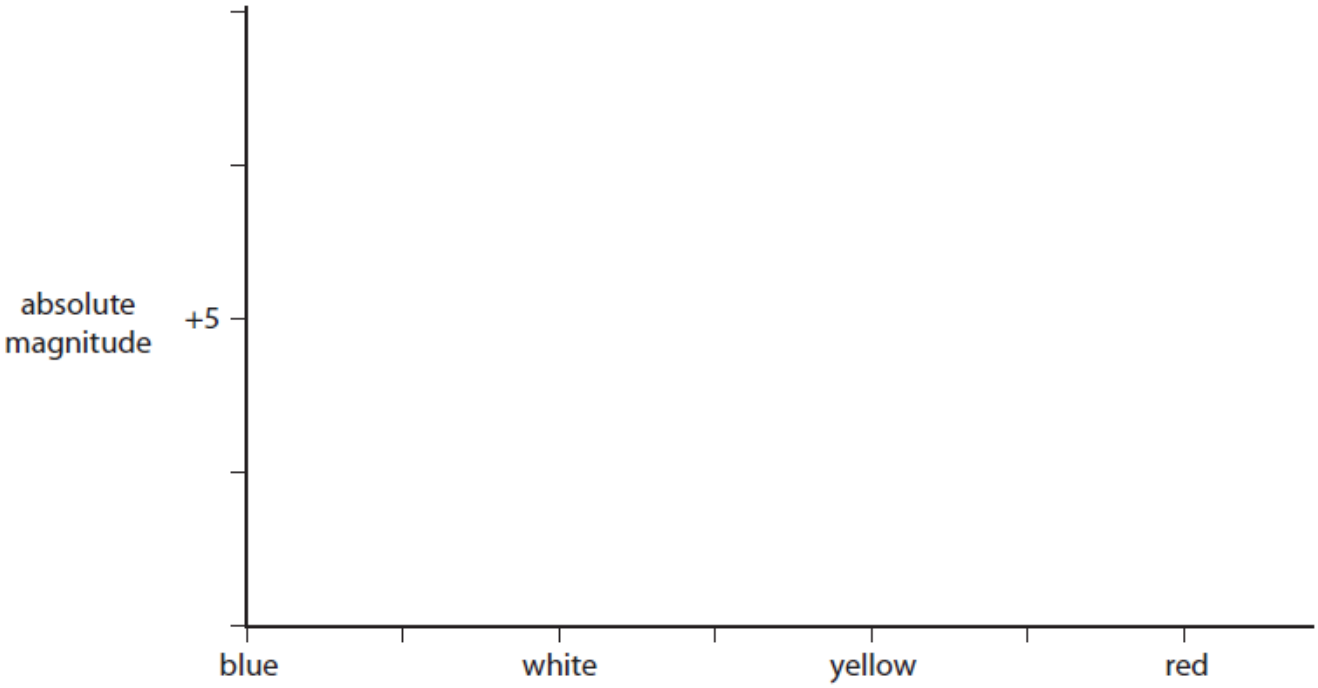
(b) The evolution of stars can be shown on a Hertzsprung-Russell diagram (HR diagram).

Complete the HR diagram by

- labelling the x-axis
- completing the absolute magnitude scale
- drawing the main sequence, red giant and white dwarf regions

(5)



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(Total for question = 7 marks)

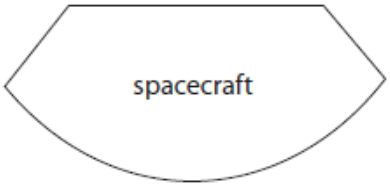
Q10.

Schiaparelli is a spacecraft that was sent to Mars in 2016.

(a) Schiaparelli slowed down as it fell vertically through the atmosphere of Mars.

(i) Draw labelled arrows on the diagram to show the forces acting on Schiaparelli as it fell.

(3)



(ii) Schiaparelli then opened a parachute to slow down.

Explain how the spacecraft reached a low terminal velocity after opening its parachute.

Use ideas about forces in your answer.

(4)

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(b) The parachute was disconnected when Schiaparelli was at a height of 2.0 m from the surface of Mars and travelling at a speed of 0.45 m/s.

Calculate the speed of the spacecraft just before it hits the surface of Mars.
[acceleration of free-fall on Mars = 3.4 m/s^2]

(4)

speed = ... m/s

(c) Suggest why Mars has a lower gravitational field strength than Earth.

(1)

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(Total for question = 12 marks)

Q11.

(a) (i) A student investigates how current varies with voltage for a metal filament lamp.

Draw a diagram of the circuit that a student could use for this investigation.

(4)

(ii) Describe a method the student could use for their investigation.

(4)

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(b) The student extends the investigation by recording additional data for the lamp.

This is her method.

For each voltage

- switch the current on for 45 seconds
- record the current and colour of the lamp
- calculate the power and the energy transferred by the lamp

The table shows the student's results.

Voltage in V	Current	Power in W	Energy in J	Colour of lamp
0.0	0.00	0.0	0.0	off
2.0	0.40	0.8	36	red
4.0	0.90	3.6		orange
6.0	1.60	9.6	430	yellow
8.0	2.80	22.4	1000	white

(i) State the unit for current.

(1)

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(ii) Calculate the missing value of energy for the voltage of 4.0 V.

Give your answer to 2 significant figures.

(2)

energy = ... J

(iii) The colour of a star is related to its surface temperature.

The Sun is yellow.

Use the student's results to identify a colour for a star that is cooler than the Sun.

(1)

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(Total for question = 12 marks)

Q12.

This question is about astrophysics.

(a) (i) What is a star formed from?

(1)

☒ **A** a black dwarf

☒ **B** a nebula

☒ **C** a planet

☒ **D** a white dwarf

(ii) Which of these indicates that the Universe is expanding?

(1)

☒ **A** galaxies are moving further away from each other

☒ **B** galaxies rotate

☒ **C** it takes millions of light years for light to reach us from some stars

☒ **D** some stars in the Milky Way are accelerating towards our Sun

(iii) Which of these provides evidence for the Big Bang theory?

(1)

☒ **A** cosmic microwave background radiation

☒ **B** nebulae

☒ **C** neutron stars

☒ **D** ultrasound radiation

(iv) Which of these does red-shift provide evidence for?

(1)

☒ **A** galaxies are moving away from each other

☒ **B** nebulae contract to form stars

☒ **C** red giants shrink to red dwarfs

☒ **D** white dwarfs expand into red giants

(b) The spectra of stars and galaxies show lines at specific wavelengths that correspond to the spectra of hydrogen, helium and carbon.

Give reasons why lines corresponding to these elements are found in spectra from typical galaxies.

(2)

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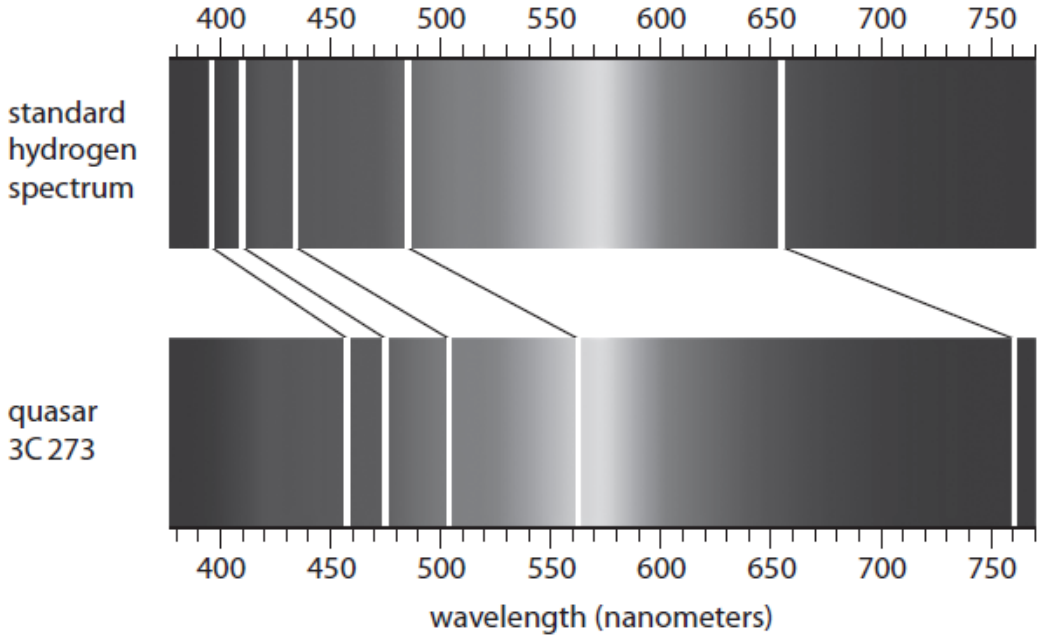
(c) The spectrum of light from an astronomical object called a quasar can be compared to the spectrum of hydrogen on Earth.



(i) Calculate the change in wavelength, $\Delta\lambda$, for the line at the red end of the spectrum.

(2)

$\Delta\lambda$ = ... nm

(ii) Calculate a value for the recessional velocity of the quasar using your value for $\Delta\lambda$.

speed of light in free space, $c = 3.0 \times 10^5$ km/s

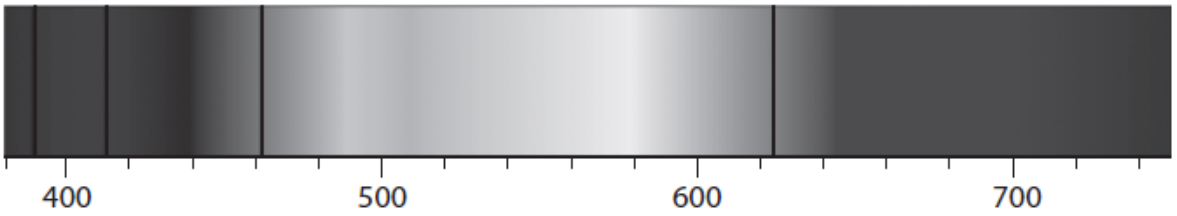
(3)

recessional velocity = ... km/s

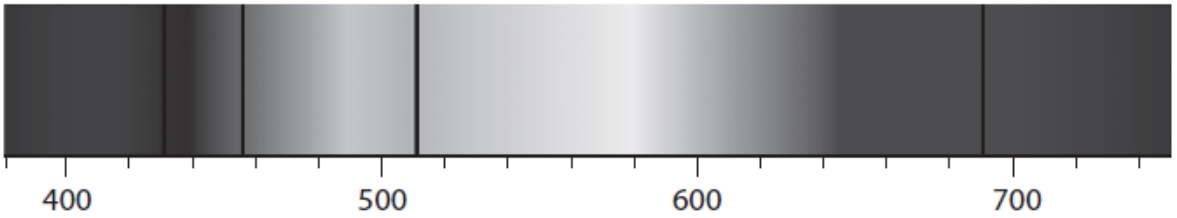
(d) An astronomer observes the light from a nearby galaxy.

She notices that the spectra for hydrogen from the right side and left side of the galaxy are different.

left side of the galaxy

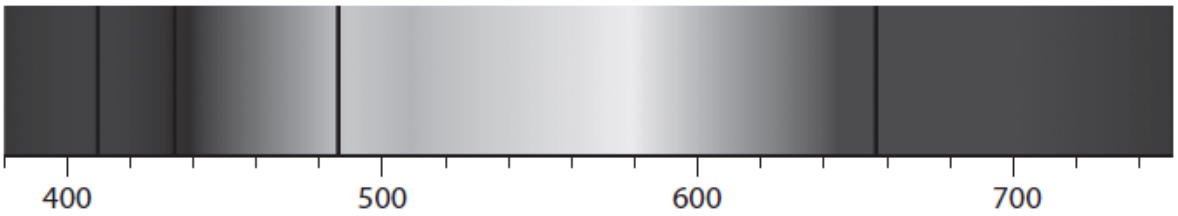


right side of the galaxy



She compares them to the spectrum for hydrogen from the centre of the galaxy.

centre of the galaxy



Explain what information the two spectra give about the movement of the galaxy.

(3)

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(Total for question = 14 marks)