OCR
RECOGNISING ACHIEVEMENT

GCSE

PHYSICS A

F **A333/01**

Physics A Unit 3 Ideas in Context plus P7

Specimen Paper

1 hour

Candidates answer on the question paper:

Additional materials: ruler (cm/mm), calculator

Candidate Name	

Centre Number						Candidate Number				

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers on the dotted lines unless the question says otherwise.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- There is a space after most questions. Use it to do your working. In many questions marks will be given for a correct method even if the answer is incorrect.
- Do not write in the bar code. Do not write in the grey area between the pages.
- DO NOT WRITE IN THE AREA OUTSIDE THE BOX BORDERING EACH PAGE. ANY WRITING IN THIS AREA WILL NOT BE MARKED.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **55.**

This specimen paper consists of 24 printed pages.

 Registered Charity Number: 1066969

Useful relationships

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

momentum = mass × velocity

change in momentum = resultant force × time for which it acts

work done by force = force × distance moved by force

change in energy = work done

change in GPE = weight × vertical height difference

kinetic energy = ½ × mass × [velocity]^2

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage in primary coil}}{\text{voltage in secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

power = potential difference × current

energy transferred = power × time

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}}$$

wave speed = frequency × wavelength

Answer all questions.

1. This question is about the discovery of X-rays.

X-Rays – seeing the 'invisible'

Discovery of X-rays

In the late 19th Century many scientists were investigating the way an electric current was carried through a gas in a glass tube.
The gas inside the tube glowed when an electric current passed through.
Wilhelm Röntgen was a German scientist. In November 1895 he was investigating the glowing gas when he made an unexpected observation.
Some fluorescent material, the other side of the room, was glowing. The gas tube was covered with a dark cloth, so it was not the light from the glowing gas which made the fluorescent material shine.
Over the following seven weeks Röntgen investigated what was causing the fluorescence. He discovered that the rays that were coming from the end of the glass tube penetrated wood, a thick book and metal sheets.

JEAN-LOUP CHARMET / SCIENCE PHOTO LIBRARY

Strangest of all he saw the bones of his hand on the fluorescent screen.
During these investigations Röntgen had his meals served in the laboratory and even moved his bed there so he could work undisturbed. Only once did he mention his work to colleagues, he said "I have discovered something quite interesting but I do not know whether my observations are correct".
On 1st January 1896 Röntgen sent his first report and some examples of X-ray photographs to scientific colleagues in several countries. These new rays became known as X-rays.
During 1896 other scientists investigated X-rays and found similar results. Many scientists gave lectures, with members of the audience paying a fee to have their hands or purses X-rayed.

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The first X-ray photograph of a human being shows the hand of Röntgen's wife, who was wearing a ring.

Dangers from X-rays

In the first few years after the discovery of X-rays there was no awareness of the risks of working with this new radiation.
The first known death from X-ray exposure was in 1904. At this time many radiologists suffered radiation burns as they used self-exposure experiments to determine exposure times for patients.
It was not until 1921 that the first recommendations were made to limit exposure to X-rays in hospitals. Commercial and industrial applications of X-rays were not controlled until much later.
Up until the late 1950s buying new shoes for children included the chance to see images of your feet inside the shoes to check the fit.
Governments now provide strict guidelines about the amount of exposure to ionising radiation – both for workers and for the public.

(a) X-rays are part of the electromagnetic spectrum.

Fill in the gaps in this diagram of the electromagnetic spectrum.

Choose words from this list:

Sound

Radio

Transverse

X-ray

	microwave	infrared	visible light	ultraviolet		Gamma rays

[3]

(b) X-rays are an **ionising** radiation.

Write down the names of two other types of ionising radiation.

1 .....

2 .....[3]

(c) Röntgen showed that the fluorescent material was not shining because of the visible light from the glowing gas.

How did he do this?

.....

.....[2]

(d) Röntgen observed that the X-rays penetrated many materials.

Write down the names of **two** materials that X-rays passed through in Röntgen's experiments.

1. .....

2. .....[2]

(e) The article describes the discovery of X-rays and how they became accepted as a new kind of radiation.

The list describes how a scientific discovery is made and accepted by other scientists.

They are in the wrong order.

A A scientist makes an unexpected observation.

B The scientist tells other scientists about the results of the experiments.

C The new ideas are accepted as being correct.

D The other scientists repeat the experiments.

E The scientist carries out further experiments.

Fill in the boxes to show the right order. The first one has been done for you.

A				

[3]

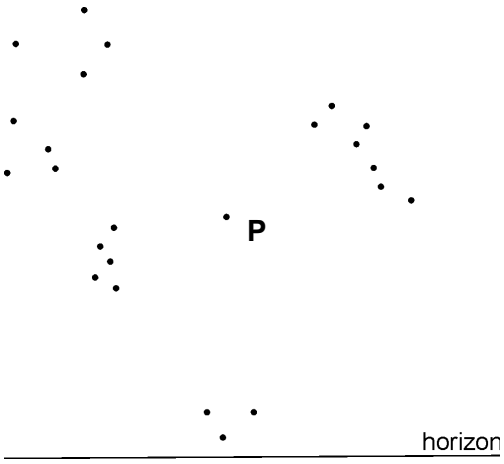
(f) Suggest why it was not until 25 years after the discovery of X-rays that there were regulations to limit exposure to X-rays.

.....

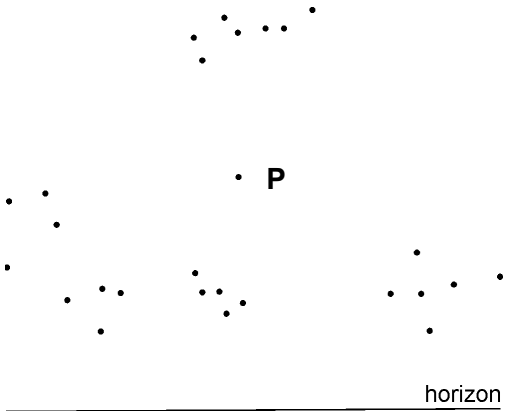
.....[2]

[Total: 15]

1. **(a)** The two diagrams show the brightest stars in the **northern** night sky on the same night at two different times. The Pole Star is labelled P in each diagram.



Northern view at 8pm



Northern view at midnight

Choose from this list of words to complete the sentences below.

anticlockwise **clockwise** **Equator** **North pole** **stationary** **turning**

The stars appear to have rotated .....

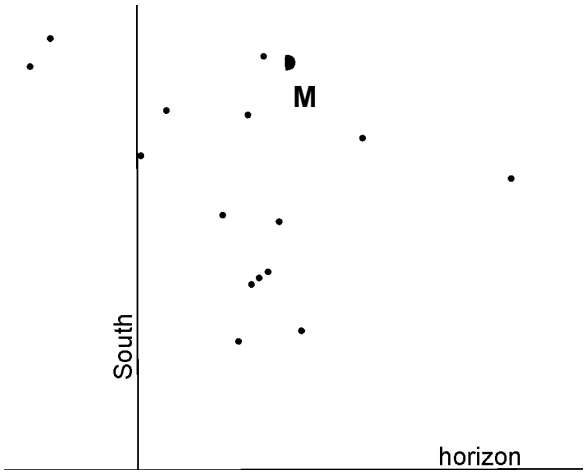
This is because the Earth is .....

The star P (the Pole Star) does not seem to move. This is because it is immediately above the.....

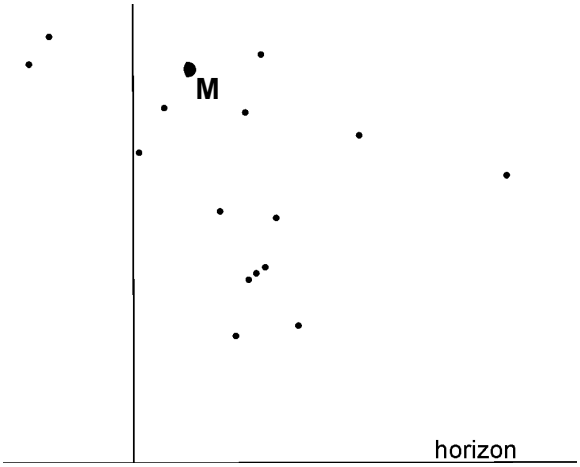
[3]

(b) The two sky maps below show the brightest stars in the **southern** night sky at the same time on two different days, 17th and 18th February 2005.

The moon (M) can also be seen on these maps.



View at 9pm on 17th February 2005



View at 9pm on 18th February 2005

(i) The Moon appears further East at 9 p.m. on 18th February than it was at exactly the same time on the previous day.

Explain why.

.....

.....[1]

(ii) More of the Moon is visible at 9 p.m. on 18th February than it was at exactly the same time on the previous day.

Explain why.

.....

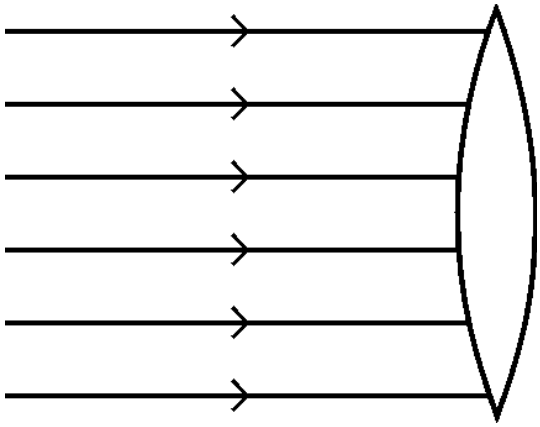
.....

.....[2]

[Total: 6]

2. This question is about lenses and telescopes.

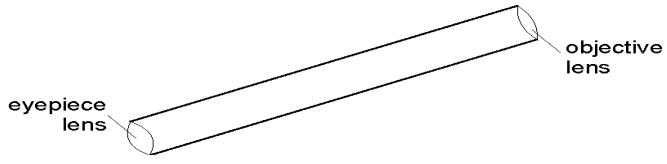
(a) Complete and label the following diagram to show how a lens refracts parallel light



[2]

(b) The table below lists lenses, all made from the same type of glass, which may be used in making a telescope.

Lens	Focal length (mm)	Diameter of lens (mm)
A	500	80
B	250	120
C	25	60
D	50	100



(i) Which of these lenses is the most powerful?

Lens.....[1]

(ii) Which of these lenses would have the least curved surfaces?

Lens.....[1]

(iii) Which of these lenses, if used as the objective lens, would give the brightest image?

Lens.....[1]

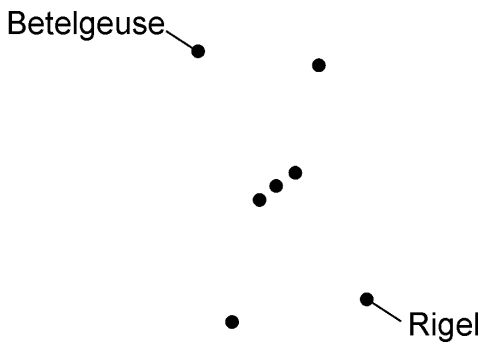
(iv) Calculate the magnification given by a telescope using lenses A and C.

Magnification .....[2]

[Total: 7]

3. This question is about the light given off by stars.

(a) The constellation Orion contains the bright stars Betelgeuse and Rigel.



(i) Choose the best words from this list below to complete the sentences below.

cooler **denser** **dimmer** **hotter**

Betelgeuse is red, while Rigel is blue-white.

This shows that Betelgeuse is ..... than Rigel.

Although both stars are the same size, Rigel gives out much more light than

Betelgeuse. This is because Rigel is .....than Betelgeuse.

[2]

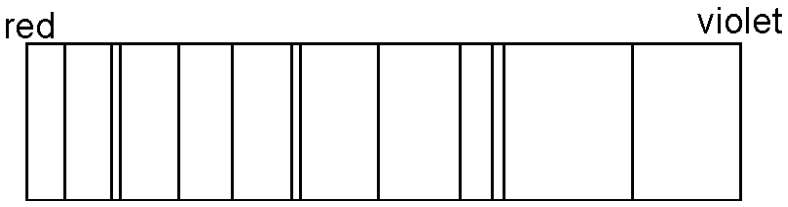
(ii) Rigel gives off much more light than Betelgeuse, but from Earth Betelgeuse looks brighter than Rigel.

Explain why Betelgeuse looks so bright.

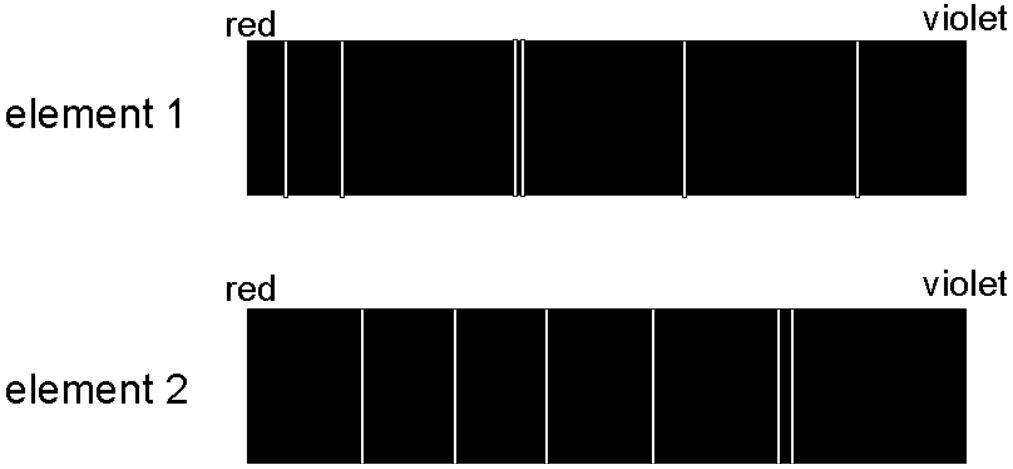
.....

.....[1]

(b) The diagram shows the visible light spectrum of a star. The black lines show wavelengths that have been absorbed by the outer layers of the star.



The diagrams below show the bright line spectrum from two different elements.



Explain clearly how this shows that the star contains element 1 but **not** element 2.

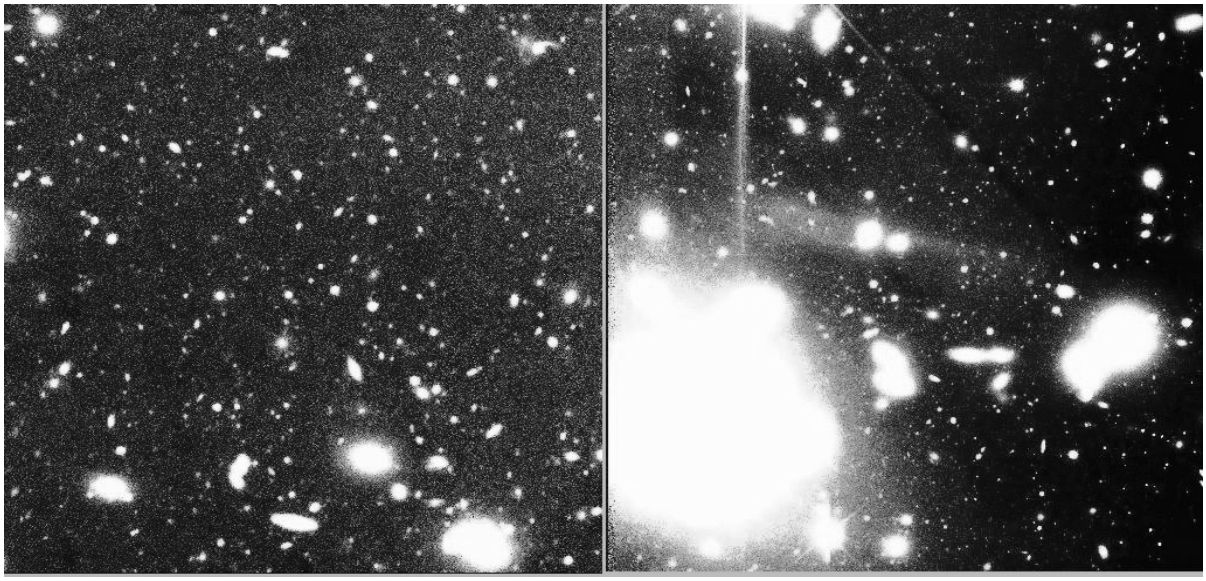
.....

.....

.....[1]

[Total: 4]

4. This question is about determining distances to distant galaxies.



CANADA-FRANCE-HAWAII TELESCOPE

Astronomers have made observations on the Coma cluster of galaxies to determine their distances from us. It is thought that all galaxies in this cluster are very close together and have similar speeds away from us.

The table below contains measurements made on some of these galaxies.

Galaxy	Speed (km/s)
Coma 1	6690
Coma 2	6760
Coma 3	6750
Coma 4	6830
Coma 5	6720
Coma 6	7800

(a) Explain why the reading for Coma 6 should be ignored to make a best estimate of the velocity of the Coma cluster.

.....

.....[1]

(b) Use the values for the first five galaxies to find the mean speed of the Coma cluster.

Speed = ... km/s [2]

(c) The distance to the Coma cluster is believed to be about 97 megaparsecs (Mpc).

Use the equation

Speed of recession = Hubble constant × distance

to show that the results in the table are consistent with a Hubble constant of about 70km/s/Mpc.

[2]

[Total: 5]

5. The Canada-France-Hawaii Telescope is an international astronomy project in Hawaii.

JEAN-CHARLES CUILLANDRE / CANADA-FRANCE-HAWAII TELESCOPE

(a) Name one other major astronomical observatory.

.....[1]

(b) This telescope is on top of the tallest mountain in the Pacific.

The nearest town is 26 miles away, on the coast.

Explain why it is useful that this telescope is computer-controlled.

One mark is for using correct spelling.

.....

.....

.....

..... [2+1]

(c) This telescope was planned and built in Hawaii because the skies there are very clear and unpolluted.

Describe and explain two other factors which needed to be considered in planning this project.

.....

.....[2]

[Total: 8]

6. This question is about gases.

(a) Lizzie buys a helium balloon on a cold day. She takes it into a hot room.

She notices that the balloon skin is now tighter.

Join each statement below with the correct explanation. One has been done for you.

Statement	Explanation
The balloon skin was quite tight to start with.	Faster molecules will hit the side of the balloon harder.
The balloon skin became tighter in the hot room.	Moving molecules inside the balloon are bouncing off the balloon skin and pushing it out.
The temperature of the helium inside the balloon increased when it was taken into the hot room.	Molecules in a hot gas move faster than molecules in a cold gas.
Increasing the temperature of the helium makes the pressure go up.	The pressure of the helium in the balloon increased when it got hot.

[2]

(b) Lizzie wonders how many so many balloons can be blown up by such a small cylinder of gas. The cylinder is only four times as big as the balloon.

Katy says that the pressure of the helium in the cylinder is much greater than the pressure of the helium in the balloon.

Use your ideas about molecular motion to explain how the small cylinder can supply enough gas for so many balloons.

.....

.....

.....

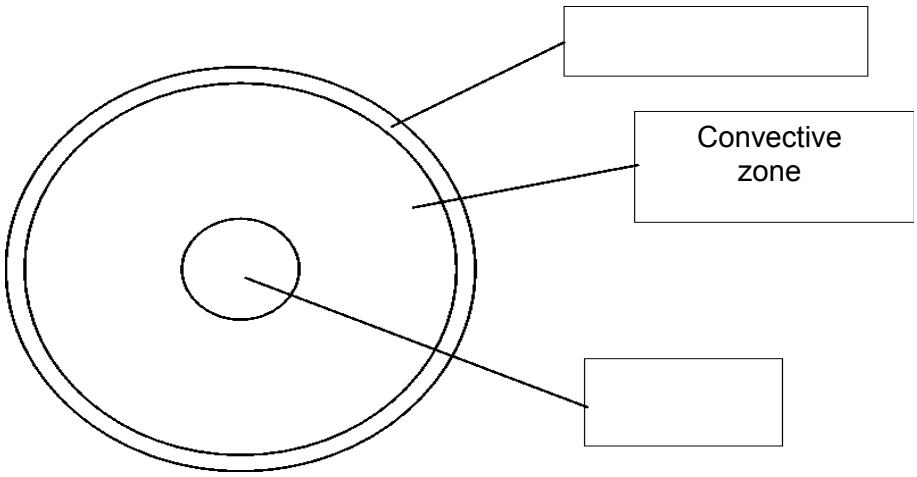
.....[3]

[Total: 5]

7. This question is about the Sun.

The diagram shows a section through the Sun.

(a) In the boxes on the diagram label the three regions of the Sun. One has been done for you.



[2]

(b) In which part of the Sun is hydrogen converted into helium?

.....[1]

(c) When the Sun runs out of hydrogen fuel, it will change.

Complete this flow diagram to show the different stages in the life of a star like our Sun.

[2]

[Total: 5]

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PHYSICS A

F **A333/01**

Physics A Unit 3 Ideas in Context plus P7

Specimen Mark Scheme

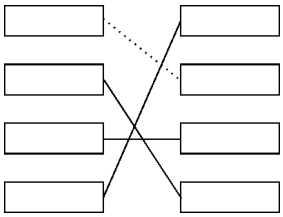
1 hour

Maximum mark for this paper is [55]

This specimen mark scheme consists of 4 printed pages.

Registered Charity Number: 1066969

Question Number	Answer	Max Mark
1(a)	radio; X-ray	**[3]**
1(b)	ultraviolet; gamma; alpha; beta **Any two**	**[3]**
1(c)	covered the glass tube; no light reached the fluorescent paper;	**[2]**
1(d)	wood, book/paper, metal, hand, glass **Any two**	**[2]**
1(e)	(A) E B D C	**[3]**
1(f)	took some time for damage to show; information was not collected together	**[2]**
	Total marks	**[15]**
2(a)	Anticlockwise✓ turning✓ North pole	**[3]**
2(b)i	Any mention of Moon orbiting / moving relative to Earth ✓	**[1]**
2(b)ii	Moon more lit up / nearer to Full Moon / owtte✓ Recognising Moon needs to be more nearly opposite Sun in sky to be lit up more✓ **Any two valid points**	**[2]**
	Total marks	**[6]**
3(a)	Lines cross at labelled (principal) focus✓ Diagram symmetrical about horizontal line✓ **Ignore any refraction within lens**	**[2]**
3(b)i	C ✓	**[1]**
3(b)ii	A ✓	**[1]**
3(b)iii	B ✓	**[1]**
3(b)iv	ratio of focal lengths = 500/25 = 20 ✓m✓e	**[2]**
	Total marks	**[7]**
4(a)i	cooler ✓ hotter ✓	**[2]**
4(a)ii	Closer to us owtte ✓	**[1]**
4(b)	(all the) lines of element 1 are in the star spectrum but (all the) lines of element 2 are missing ✓	**[1]**
	Total marks	**[4]**

5(a)	It is an outlier owtte ✓	**[1]**
5(b)	Mean = 6750 km/s ✓m✓e	**[2]**
5(c)	70 × 97 = 6790✓ 6790 comparable with data in table ✓ **Ora from data in table ecf for second mark**	**[2]**
	Total marks	**[5]**
6(a)	Any named observatory e.g. Paranal or Cero Tololo or Las Campanas or La Silla or Cerro Pachon (Gemini S) in Chile, Kitt Peak or VLA in US, Jodrell Bank, RGO in Canary Islands, any named space telescope ✓ **Location is enough**	**[1]**
6(b)	Not easily accessible ✓ Staying at telescope restricts other activities ✓ computer control improves accuracy and precision ✓ and reduces human error ✓ **Any two points. One mark for correct spelling**	**[2+1]**
6(c)	Name any method, e.g. false colour, noise reduction, improving contrast ✓ Stating what the name means (not how it is done) ✓	**[2]**
6(d)	cost of importing materials; cost of construction; communication difficulties to remote site; availability of technically trained workforce; accommodation for construction workers / astronomers / support staff; **Any two; not two cost points; not two accommodation points**	**[2]**
	Total marks	**[8]**
7(a)	 **One correct for ✓, three correct for ✓✓**	**[2]**
7(b)	In a gas molecules very spread out; as pressure increases molecules much closer together; exert high pressure in small volume (in cylinder); when released can fill a much larger volume at lower pressure; **Any three**	**[3]**
	Total marks	**[5]**

8(a)	Upper box: photosphere ✓	
	Lower box: core ✓	**[2]**
8(b)	Core (or ecf from part (a)) ✓	**[1]**
8(c)	➔ Red giant ✓ ➔ White dwarf ✓	**[2]**
	Total marks	**[5]**
	Overall marks	**[55]**