OCR
RECOGNISING ACHIEVEMENT

GCSE

PHYSICS A

H **A333/02**

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.**

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) Röntgen discovered X-rays.

Describe two **different** properties of X-rays **discovered by Röntgen**.

1. ....

2. .... [2]

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

(i) The list describes one way 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]

(ii) Explain why other scientists wanted to repeat Röntgen's experiments when they read his report.

....

.... [2]

(c) X-Rays are now known to pose a risk for those who work with them.

(i) Explain how X-rays can harm people.

....

....

.... [2]

(ii) It was not until 25 years after the discovery of X-rays that there were regulations to limit exposure to X-rays.

Suggest and explain why.

....

....

.... [2]

(d) Dentists use X-rays to examine teeth.

Up until the 1950s children's feet were X-rayed to check the fit of shoes.

Use ideas about **cost** and **benefit** to discuss why dentists do use X-rays and shoe shops do not.

....

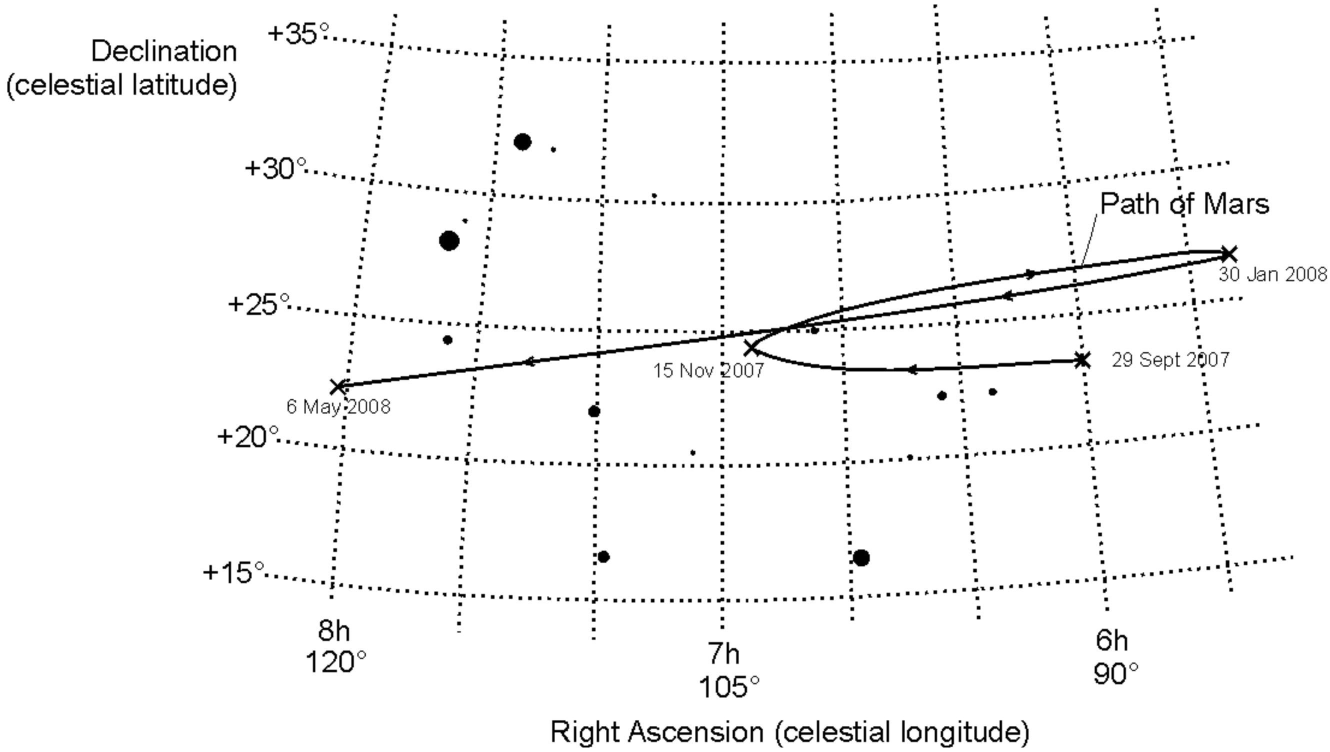
....

....

.... [2]

[Total: 13]

2. The diagram shows the map of part of the sky containing the constellation Gemini. Between September 2007 and May 2008, the planet Mars was in this part of the sky, moving along the path shown.



(a) The following table of data gives the co-ordinates of Mars during part of this time.

Date	Right Ascension hours	Right Ascension minutes	Right Ascension (°)	Declination (°)
28/09/2007	5	58	90	23.3
18/10/2007	6	33	98	23.7
07/11/2007	6	53	103	24.1
27/11/2007	6	51	103	25.1
17/12/2007	6	25	96	26.4
06/01/2008	5	52	88	27.0
26/01/2008	5	34	84	26.8
15/02/2008	5	40	85	26.5
06/03/2008	6	2	91	26.2

(i) State how the data in the table show that Mars appeared to change direction in its movement across the sky.

....

....

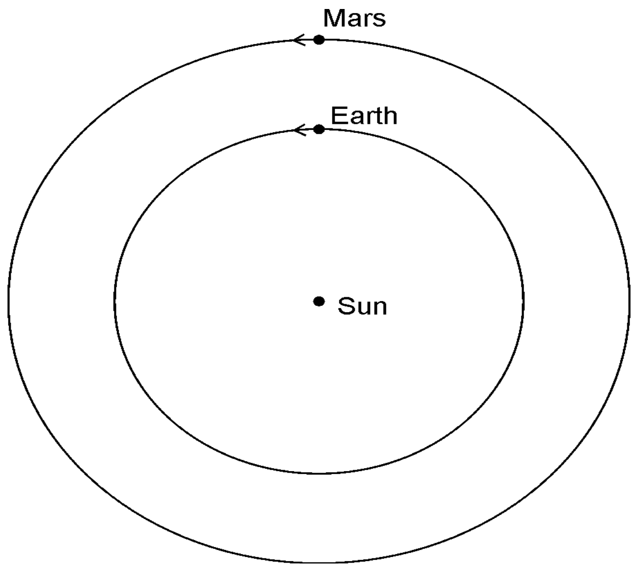
....

.... [2]

(ii) Use data from the table to mark with an **X** the position of the planet Mars on 17/12/ 2007 on the sky map.

[1]

(b) The diagram below shows the positions of Earth and Mars on 17/12/2007.



Use this diagram to explain:

(i) why Mars appears to be going from East to West in the night sky in December 2007.

....

....

.... [1]

(ii) why Mars appears to be going from West to East in the night sky in March 2008.

....

....

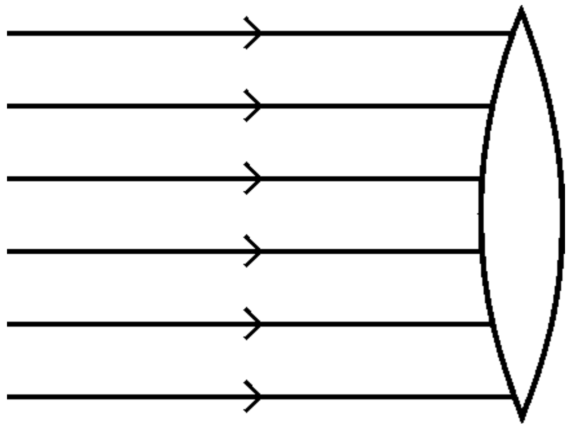
....

.... [2]

[Total: 6]

3. **(a)** This question is about lenses and telescopes.

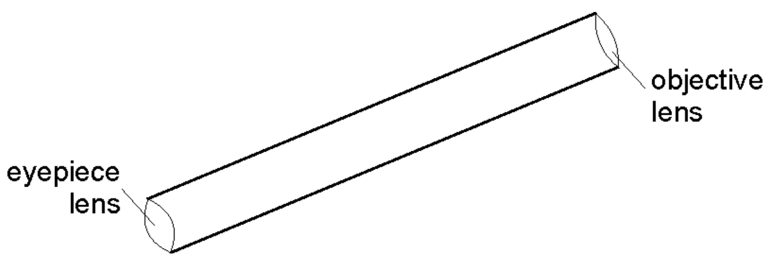
Complete and label the following diagram to show how a lens refracts parallel light.



[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]

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

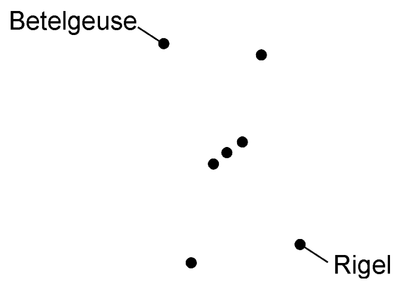
lens .... [1]

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

magnification .... [2]

[Total: 7]

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



The following four statements about these two stars are all true.

- Betelgeuse and Rigel are both about the same size.
- Betelgeuse is red, while Rigel is blue-white.
- Rigel gives out more than four times as much energy per second as Betelgeuse.
- From Earth, Betelgeuse appears slightly brighter than Rigel.

Use this information to write a comparison of these two stars.

One mark will be for a clear, ordered argument.

....

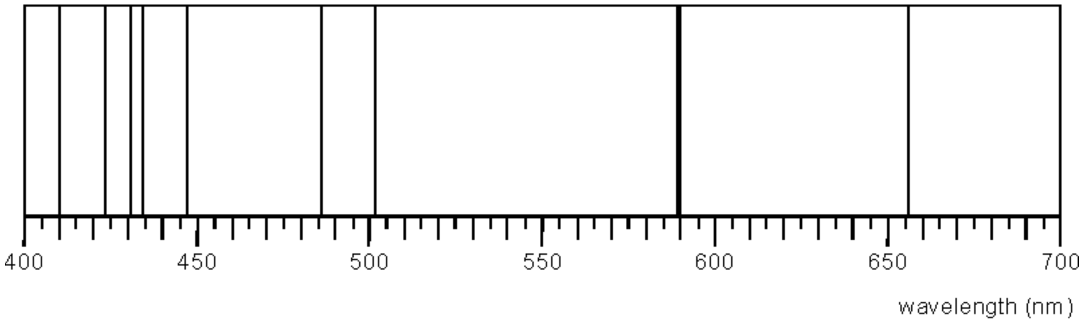
....

....

....

.... [2+1]

(b) The diagram shows the dark lines seen in the spectrum of visible light from a star.



(i) Use the table below to identify the elements present in this star. Put a tick (✓) or a cross (×) in every box in the last column.

Element	Wavelengths (nm)	Present in the star?
calcium	393, 397, 423, 431	
helium	447, 502, 588	
hydrogen	410, 434, 486, 656	
iron	431, 438, 467, 496, 527	
sodium	589, 590	

[1]

(ii) Knowing what elements are present in a star gives useful information about that star.

Suggest and explain what might be implied about a star which contained only small atoms.

....

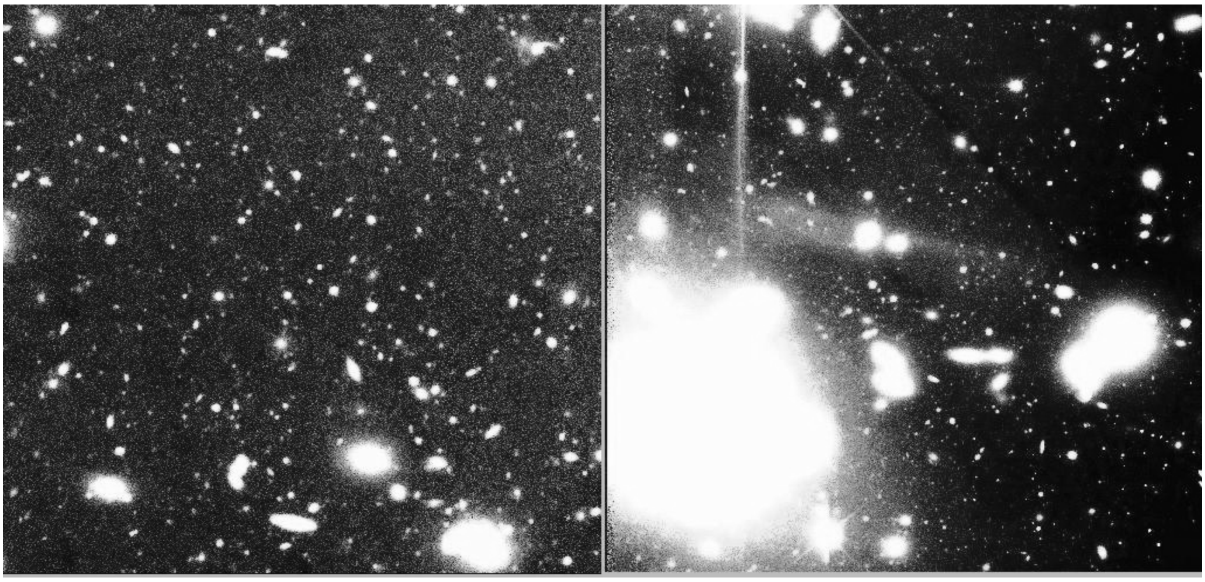
....

....

[2]

[Total: 6]

5. 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

(a) Use the data in the table to find the mean speed of the Coma cluster.

speed = ... km/s [2]

(b) 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 70 km/s/Mpc.

[2]

[Total: 4]

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

JEAN-CHARLES CUILLANDRE / CANADA-FRANCE-HAWAII TELESCOPE

(a) The telescope is on top of Mauna Kea, the tallest mountain in the Pacific. In recent years, telescopes such as the Canada-France-Hawaii Telescope have been getting more use than space-based telescopes operating at the same wavelengths.

Suggest why this might be the case.

....

....

.... [2]

(b) Suggest and explain one astronomical and one non-astronomical factor which needs to be considered in planning and building this telescope.

One mark will be for correct spelling.

Astronomical factor..

....

Non-astronomical factor ....

.... [4 + 1]

[Total: 7]

7. This question is about gases.

(a) The balloons are filled from a cylinder containing helium at a high pressure. The cylinder has four times the volume of a filled balloon.

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

....

....

....

.... [3]

(b) Lizzie buys a helium balloon on a bitterly cold day. She takes it into a hot room. She notices that the balloon skin seems tighter.

Use your ideas about molecular motion to explain why the balloon skin seems tighter.

....

....

....

.... [3]

[Total: 6]

8. This question is about the life cycle of stars.

(a) Explain how the hydrogen gas in a nebula becomes a star.

....

....

.... [2]

(b) Our Sun has stayed the same size for billions of years. Explain in terms of forces why the Sun does not explode like a hydrogen bomb.

....

....

.... [2]

(c) When the core of a star has too little hydrogen left, helium fusion starts. At this stage the star becomes much bigger. Explain in terms of forces the change in size of the star.

....

....

.... [2]

[Total: 6]

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GCSE

PHYSICS A

Physics A Unit 3 Ideas in Context plus P7

Specimen Mark Scheme

Maximum mark for this paper is [55]

H

A333/02

1 hour

This specimen mark scheme consists of 5 printed pages.

Registered Charity Number: 1066969

Question Number	Answers	Max Mark
1(a)	pass through: glass/wood/paper/sheet metal; cannot be seen; detected by photographic film/fluorescent material **(any 2 different properties NOT 2 penetration)**	[2]
1(b)i	(A) E B D C	[3]
1(b)ii	difficult to believe that these rays existed; to verify his results	[2]
1(c)i	ionise chemicals in cells; causing cells to behave differently; causing cancer	[2]
1(c)ii	took some time for damage to show; information was not collected together	[2]
1(d)	for teeth the benefit of keeping healthy teeth outweighs the low risk of an occasional X-ray; for feet there are other ways of checking the fit of the shoes, so the risk of X-raying is greater than the benefit of well fitting shoes; **(cost and benefit discussed for each one)**	[2]
	Total marks	[13]
2(a)i	RA changes direction; Twice	[2]
2(a)ii	On upper path of loop ≈ 1/5 of way from RA of 6h20 to 6h40	[1]
2(b)i	Earth travelling faster so ‘overtakes’ Mars	[1]
2(b)ii	Noting that Earth is going ‘vertically down’ on diagram while Mars will still be moving ‘sideways’; so Mars is moving left relative to Earth	[2]
	Total mark	[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]
	ratio of focal lengths = 500/25 = 20 ✓m✓e	[2]
	Total marks	[7]

Question Number	Answers	Max Mark
4(a)	Blue-white hotter than red ✓ hotter more luminous ✓ Betelgeuse should be dimmer ✓ Betelgeuse must be closer ✓ **(Any two points. One mark for clear ordered argument)**	**[2+1]**
4(b)i	All ticks except iron ✓	**[1]**
4(b)ii	Atoms created by fusion ✓Small atoms only suggest star is young (larger atoms not yet created) ✓ Heavier atoms may have been produced in a previous star ✓ **(Any two points)**	**[2]**
	Total marks	**[6]**
5(a)	Mean = 6750 km/s (6690 + 6760 + 6750 + 6830 + 6720) ÷ 5	**[2]**
5(b)	70 × 97 = 6790 6790 comparable with data in table **(Ora from data in table ecf for second mark)**	**[2]**
	Total marks	**[4]**
6(a)	Cost/benefit analysis discussed ✓ Technological advances in terrestrial telescopes ✓ Difficulties in getting time on space telescopes ✓ cut-backs/problems with space programmes ✓ **(Any two points)**	**[2]**
6(b)	astronomical: clear skies / less atmosphere ;	**[2]**
	non astronomical: cost of construction / availability of labour	**[2]**
	One mark for correct spelling **(sensible suggestions with some detail)**	**[1]**
	Total marks	**[7]**

7(a)	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 points)**	**[3]**
7(b)	Speed of molecules depends on KE; KE depends on temperature; faster molecules hit sides of balloon with more momentum; exerting larger force; and greater pressure **(any three points)**	**[3]**
	Total marks	**[6]**
8(a)	Gravity compresses gas and heats it ✓ When pressure and temperature high enough, nuclear fusion starts ✓	**[2]**
8(b)	Two forces involved due to gravity inwards and pressure of radiation outwards ✓ Forces balance ✓	**[2]**
8(c)	Greater output of radiation from helium fusion ✓ Greater outward force makes the star expand ✓ New equilibrium obtained (at larger size) ✓ **(any two points)**	**[2]**
	Total marks	**[6]**
	Overall marks	**[55]**

Physics A3 Ideas in context Higher Tier

Ques No	Spec Ref	AO1 K&U	AO2 Appl	AO3 Data	Total	G/U	F	E	D	C	B	A	A*	IaS	Dat a	EP	skills WDC
		18-24	31-37		55				24-31		24-31						4
1(a)	P2.1.4, .2.7		2							1	1						
1(b)i	IaS4.1		3						2	1				3			
1(b)ii	IaS4.2		2								1	1		2		2	
1(c)i	P2.2.3, 4, 5	2								1	1					2	
1(c)ii	P2.2.3, 5		2							2							
1(d)	IaS 6.1, 6		2		13							1	1	3		3	1
2(a)i	P7.1.2	1	1								2						
2(a)ii	P7.1.2		1								1						
2(b)i	P7.1.2		1									1					
2(b)ii	P7.1.2	1	1		6							1	1				
3(a)	P7.3.9	2							2								
3(b)i	P7.2.1	1							1								
3(b)ii	P7.2.2	1								1							
3(b)iii	P7.2.2	1								1							
3(b)iv	P7.2.7		2		7					2					2		
4(a)	P7.4.1	2	1							1	2						W
4(b)i	7.4.4		1							1							
4(b)ii	7.4.14		2		6							1	1				
5(a)	P7.3 Ma		2						1	1					2		
5(b)	P7.3.19		2		4				1	1					2		
6(a)	P7.5.2,5	1	1						1		1					2	
6(b)	P7.5.5,9	2	3							1	2	1	1			2	W
					7												
7(a)	P7.4.5	1	2						2	1					3		
7(b)	P7.4.6		3		6						1	1	1		3		
8(a)	P7.4.1	1	1							1	1					2	
8(b)	P7.4.1	1	1								1	1				2	
8(c)	P7.4.15	1	1		6							1	1			2	
total		18	37		55				24		31						