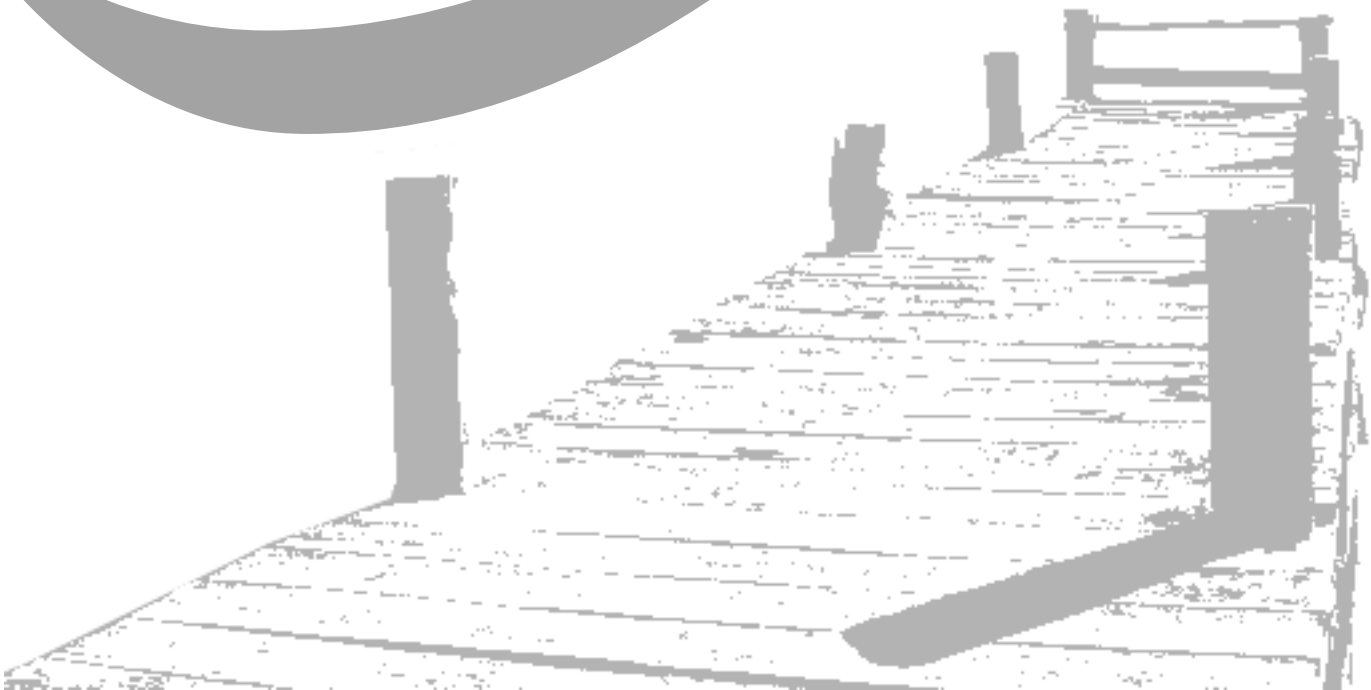
GCE
AS and A Level

Physics A

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 5A: Approved specimen mark scheme

Version 1.1



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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 2451

Specification A

PHA5A Astrophysics

Mark Scheme

The specimen assessment materials are provided to give centres a reasonable idea of the general shape and character of theplanned question papers and mark schemes in advance of the first operational exams.

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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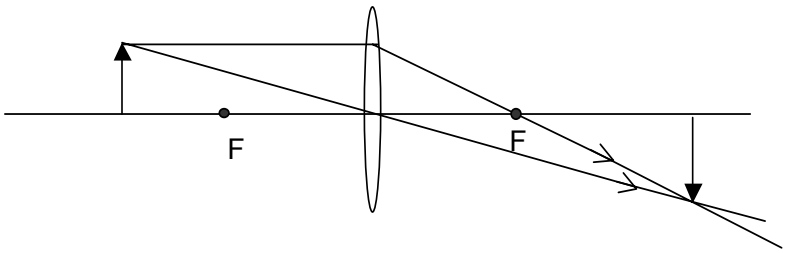
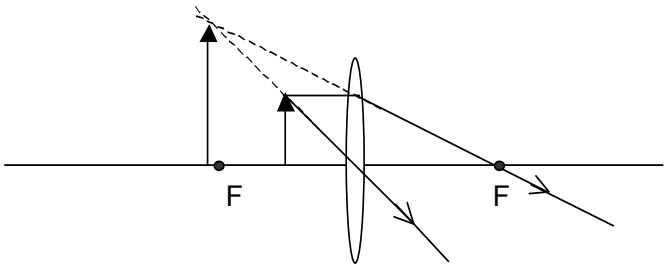
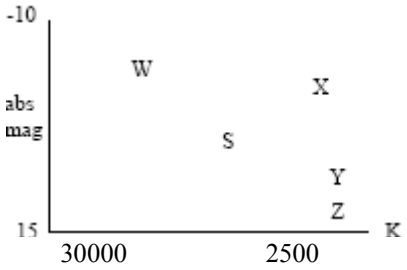
Dr Michael Cresswell Director General

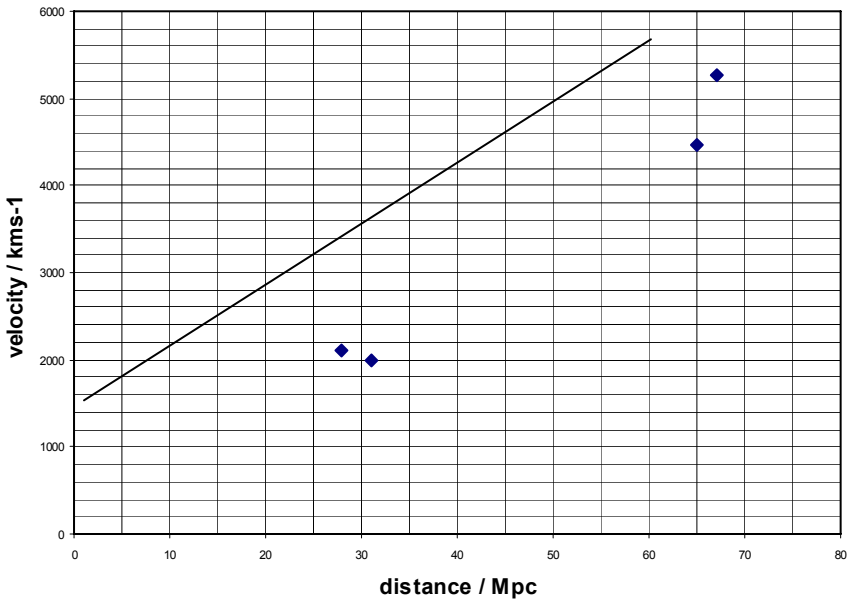
PHA5A: Astrophysics

Question 1		
(a)	for both diagrams: rays from top of object passes straight through centre of lens ✓ principal foci correctly labelled ✓ ray parallel to principal axis passes through focal point to form virtual image ✓ ray parallel to principal axis passes through focal point to form real image ✓   	**4**
(b)	P = 1/f = 1/u + 1/v 1/u = 1/0.1 + 1/0.25 ✓ u = 1/14 = 0.17 m = 0.07 m ✓	**2**
	Total	**6**

Question 2			
(a)	(i)	P, it has the lowest peak wavelength λ_{max} ✓ and $\lambda_{max} T$ = constant, so lowest λ_{max} means highest T ✓	**max 3**
	(ii)	use of $\lambda_{max} T = 0.0029$ and $\lambda_{max} = 300 \times 10^{-9}$ m ✓ gives T = 9 700 K ✓	
(b)	(i)	A and B ✓	**max 4**
	(ii)	light from the star passes through the atmosphere of the star ✓ which contains hydrogen with electrons in the n = 2 state ✓ electrons in the n = 2 state absorb certain energies and therefore frequencies of light ✓ the light is reemitted in all directions and therefore the intensity of the light of these frequencies in the direction of the observer is reduced, resulting in absorption lines in the spectrum ✓	
		Total	**7**

Question 3		
	3 marks for any of the following 3 features • compared with optical reflecting telescopes, radio telescopes: • are much longer • have a much lower resolving power • are not as affected by the atmosphere and so their positioning is less critical • have only one reflecting surface rather than two • have a similar structure in that a concave reflecting surface reflects the em radiation to a detector at the focal point	**3**
	explanations of resolving power radio telescopes have a lower resolving power: because the ratio of wavelength to telescope diameter is larger ✓ because radio wavelengths are very much larger than optical wavelengths (even though the diameters of radio telescopes are larger) ✓ **explanations of collecting power:** collecting power depends on the area of the objective which is much larger for radio telescopes (depends on the square of the diameter) ✓	**3**
	Total	**6**

Question 4			
(a)		brightness of star from a distance of 10 pc ✓	**1**
(b)	(i)	temperature from 30000 K to 2500 K ✓ absolute magnitude from +15 to −10 ✓	**7**
	(ii)	S at 6000, 5 ✓	
	(iii)	 W above and to left of S ✓ X above and to right of S ✓ Y below and to right of S ✓ Z below and to right of S ✓	
		Total	**8**

Question 5		
(a)	$\Delta \lambda/\lambda = -v/c$ $(660.86 - 656.28)/656.28 = (-)v/(3 \times 10^8)$ ✓ $v = (-)\ 2094\ km\ s^{-1}$ ✓  	**2**
(b)	graph points ✓, line through the origin ✓ $H = v/d$ = slope = 70 (± 4) km s^{-1} Mpc^{-1} ✓	**3**
(c) (i)	supernovae act as standard candles ✓ known amount of light emitted (absolute magnitude known), measured amount detected at Earth (apparent magnitude measured) ✓ inverse square law can be used to determine distance ✓	**max 3**
(ii)	dark energy ✓	
	Total	**8**

		Assessment Objectives	
Question No		*Ability tested*	*Marks*
1	(a)	AO2	**4**
	(b)	AO1	**2**
		Question Total	**6**
2	(a)	AO1/AO2	**3**
	(b)	AO2	**4**
		Question Total	**7**
3		AO1/AO2	**6**
		Question Total	**6**
4	(a)	AO1	**1**
	(b)	AO1/AO2	**7**
		Question Total	**8**
5	(a)	AO1	**2**
	(b)	AO2/AO3	**3**
	(c)	AO2/AO3	**3**
		Question Total	**8**
		Total	**35**

	Summary	
Marks	*Ability tested*	*%*
13	AO1 Knowledge and Understanding	37
19	AO2 Application	55
3	AO3 How Science Works	8

	Summary Common Section & Section A Astrophysics	
Marks	*Ability tested*	*%*
26	AO1 Knowledge and Understanding	35
43	AO2 Application	57
6	AO3 How Science Works	8