1.

A telescope	uses waveleng	gths in the rang	e 90 nm to 120 n	nm.		
	y this telescope					
Go on to di		entage that this	ed in space. telescope has co	ompared to a to	elescope with	the
Go on to di	scuss one adva	entage that this		ompared to a to	elescope with	the
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Go on to di	scuss one adva	entage that this		ompared to a to	elescope with	the

(3)

(Total 8 marks)

(c) The table below shows information about two telescopes.

Telescope	Diameter / m	Dish shape
Arecibo	305	spherical
Lovell	76	parabolic

Each telescope detects radio waves with a wavelength of 21 cm.

Compare the performances of the telescopes in the table above when both are used to observe the same faint radio objects.

2.

The Kielder Observatory in Northumberland includes two optical telescopes attached to the same mount, so that they can be used to view the same object.

Some of the properties of these telescopes are summarised in the table.

Telescope	Туре	Objective diameter/mm
А	refractor	70
В	refractor	400

А	retractor	70	
В	refractor	400	
he telescopes are	used to view the sa	ame object.	
uggest which teles	scope in the table p	roduces the brighter image.	
	er with a suitable ca		
he minimum angu riterion.	lar resolution of a te	elescope can be determined usi	ng the Rayleigh
xplain what is mea	ant by the Rayleigh	criterion.	

(c)	Discuss which of the two telescopes in the table would be better at resolving the images of two objects that are close together.
	(2) (Total 7 marks)
3. (a)	Draw a ray diagram for a Cassegrain telescope. Your diagram should show the paths of two rays up to the eyepiece lens. The rays should initially be parallel to the principal axis.
	principal axis

(b)	A spacecraft passes Pluto at a distance of 12 500 km. The telescope on board has a aperture of diameter 0.21 m and operates at a wavelength of 450 nm.	n
	Discuss whether this telescope is suitable for studying a crater with a diameter of approximately 1 km on Pluto.	
		(3)
(c)	The Hubble telescope has an aperture of diameter 2.4 m.	
	Compare the collecting power of the Hubble telescope with the telescope on the spa in part (b).	cecraft

	(d)	An astrophysicist had to decide whether to use a reflecting telescope or a refracting telescope on the spacecraft in part (b).	
		Discuss which type of telescope to use.	
		(Total	(3) 10 marks)
4.		Griffith Observatory in Los Angeles includes an astronomical refracting telescope (Griffith scope) with an objective lens of diameter 305 mm and focal length 5.03 m	ı
	(a)	Calculate the wavelength of light for which the Griffith telescope has a minimum angular resolution of 1.8×10^{-6} rad	r
		wavelength = m	
			(2)

(b) The Griffith telescope is used to observe two point objects which subtend an angle of 1.8×10^{-6} rad at the unaided eye.

The typical human eye has a minimum angular resolution of approximately $3.2 \times 10^{-4} \, \mathrm{rad}$

Calculate the focal length of the eyepiece lens so that an observer can just resolve the two objects when observing them through the Griffith telescope.

focal length =	m
roour rongin –	

(3)

(c)

The asteroid Apophis has a diameter of 325 m	
It has been calculated that, in 2029, its distance of closest approach to the Earth's surf will be 3.0×10^4 km	ace
The Griffith telescope may be used to view Apophis using the eyepiece calculated in question (b)	
Deduce whether this telescope is suitable to obtain a detailed view of Apophis. Support your answer with a calculation.	
	(2)

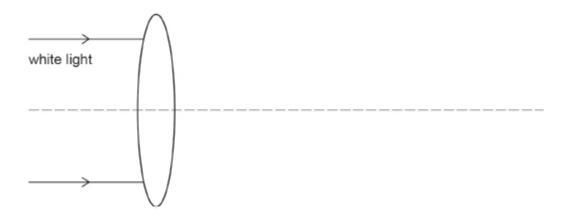
(3)

(Total 8 marks)

5.

(a) The lenses used in refracting telescopes can cause chromatic aberration.

Complete the diagram to show how a lens produces chromatic aberration.



(1)

(b) A Cassegrain telescope uses mirrors.

What are the shapes of the primary and secondary mirrors in a Cassegrain telescope?

Tick (**√**) **one** box.

Primary mirror	Secondary mirror	
concave	concave	
concave	convex	
convex	concave	
convex	convex	

(1)

(c) The table contains information about two telescopes, **A** and **B**. Each telescope is planned to be the biggest of its type in the world.

Telescope	Α	В
Туре	Optical reflecting telescope	Radio telescope
Diameter / m	39.3	110
Range of wavelengths detected	350 nm to 1800 nm	2.5 mm to 1000 mm

Discuss the similarities and differences between optical reflecting telescopes and radio telescopes. Your answer should include references to:

- structure
- positioning
- collecting power.

Go on to discuss which telescope, A or B , will give a more detailed image of an astronomical object that emits both radio waves and visible light.	
	
	(6) Total 8 marks)

6. Draw the ray diagram for a Cassegrain telescope. Your diagram should show the paths of two rays, initially parallel to the principal axis, as far as the eyepiece.

(Total 2 marks)