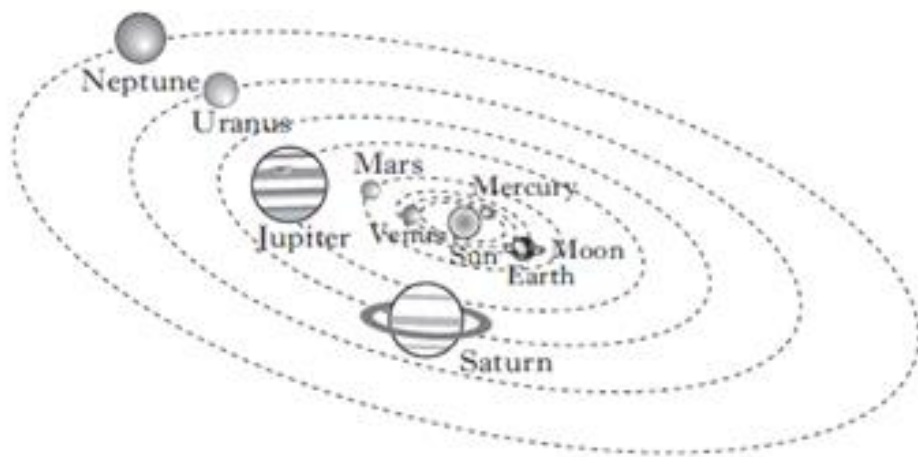


## Space Physics Questions – NAT 5

- 1) Write down the definitions of the following:
  - a) Moon
  - b) Planet
  - c) Sun
  - d) Star
  - e) Solar System
  - f) Exoplanet
  - g) Galaxy
  - h) Universe.
  
- 2) What is **cosmology** the study of?
  
- 3)
  - a) What is meant by the term 'light year'?
  - b) Calculate how far light travels in 100,000 years in metres.
  - c) Calculate how long will it take light to travel from Proxima Centauri(the nearest star) to the Earth, which is a distance of  $4.1 \times 10^{16}$ m.
  
- 4) Astronomers study space. Answer the questions from the diagram below.



- a) What is the Earth?
- b) Name the Earth's natural satellite.
- c) What does the diagram above show?

- 5) a) Complete the table below which involves the 8 planets in the solar system.

(AU – Astronomical units)

<u>Planet</u>	<u>Distance from the Sun(AU)</u>	<u>Scale distance (m)</u>
Mercury	0.4	1.2
	0.7	
	1.0	
	1.5	
Jupiter	5.2	15.6
	9.5	
	19	57.0
Neptune	30	

- b) It takes light from the sun **8 minutes** to reach the Earth.

Calculate the distance from the Sun to Earth in metres.

- c) The next nearest galaxy is called Andromeda which is  $2.4 \times 10^{22}$  m away from the Earth.

Calculate how many **years** it will take light to travel from Andromeda to the Earth.

- d) **1 AU =  $1.5 \times 10^{11}$  m.**

Using the table above, how far is Jupiter from the Sun in metres.

- e) Voyager 1 is a space probe that is the most distant man-made object. The probe is travelling around space at 3.4 AU per year.

- i) From the table above find the **scale distance** travelled from the Sun per year.
- ii) Convert this scale distance into metres.

6) The electromagnetic spectrum is a family of waves that travel at  $3 \times 10^8 \text{ms}^{-1}$  in space.

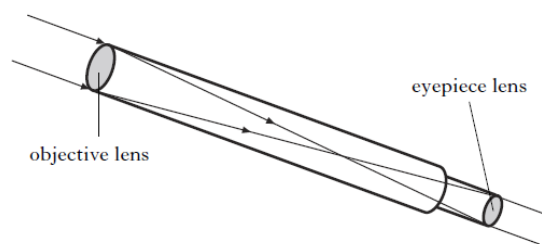
a) Complete the table below giving the detectors of the waves in the em spectrum.

Wave	Detector
Radio	Aerial and Radio Receiver
Television	
Microwaves	
Infrared	
Visible Light	Eye and Photographic film
Ultraviolet	
X-Rays	
Gamma Rays	Photographic Film and

b) The waves are listed in an order involving wavelength and frequency.

- i) Which wave has the highest frequency?
- ii) Which wave has the highest wavelength?
- iii) What is the relationship between the frequency and the wavelength of the waves?

7)



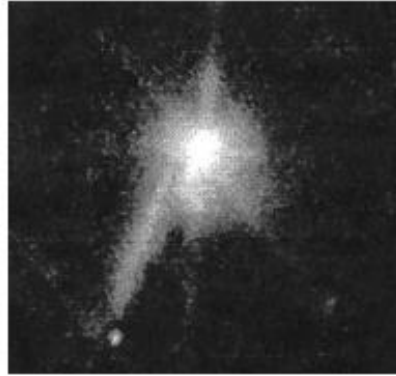
The diagram above shows a refracting telescope used by astronomers.

- a) What do the astronomers view with a refracting telescope?
- b) Which lens, the objective or the eyepiece has the longer focal length?
- c) What is the purpose of the objective lens?
- d) What is the purpose of the eyepiece lens?
- e) If the objective lens had a larger diameter, what difference would be noticeable in the object being viewed?

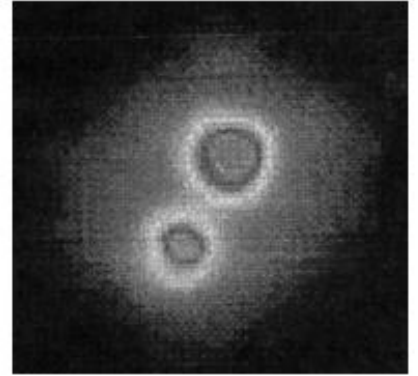
8) Images of a star are taken with three different types of telescope as show below.



Telescope A  
visible light



Telescope B  
infrared



Telescope C  
X-ray

- a) Explain why different types of telescope are used to detect signals from space.
- b) Place the telescopes in order of **increasing wavelength** of the radiation which they detect.
- c) State a detector that can be used in telescope C.
- 9) The abundance of light elements is considered as one piece of evidence in favour of the big bang model of the universe.
- a) What is meant by the statement: '*The abundance of light elements*'.
- b) State two other pieces of evidence for this theory.
- 10) An exoplanet is found to have an earth-like mass and to be within the habitable zone of its star.
- a) What is meant by the term *habitable zone*.
- b) What are the conditions necessary for life.
- 11) Re-entry is one of the most difficult parts of a space mission.
- Outline the difficulties encountered during re-entry.

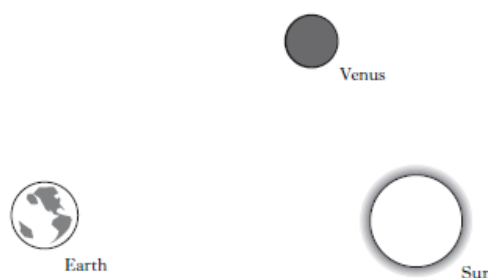
- 12) a) i) State the name of an optical device that can split white light into different colours.
- ii) Draw a diagram of white light entering this device and list the order of the colours produced when they come out of the other side of the device.
- b) Astronomers can use peak wavelength of light emitted by stars to provide information about their temperature. The peak wavelength corresponds to a particular colour.

Information about three stars is given in the table.

<i>Star</i>	<i>Colour of peak wavelength in visible spectrum</i>
Rigel	Blue
Betelgeuse	Red
Sun	Green

The **shorter** the peak **wavelength**, the **hotter** the **star** is.

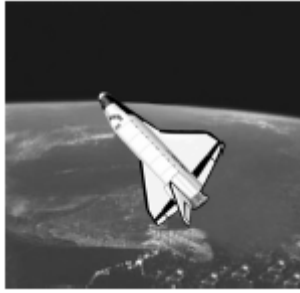
- i) Redraw the table in order of **increasing wavelength**.
- ii) Which star is the hottest?
- iii) Is the sun hotter, the same temperature or colder than Betelgeuse?
- c) Light from a star produces a line spectrum.
- What information is obtained about the star from the line spectrum?
- d) The planet Venus is often seen in the evening and morning close to the horizon.
- Draw light rays on the diagram to show how observers on Earth are able to see Venus.



13) A spacecraft is used to transport astronauts and equipment to a space station.

On its return from space the spacecraft must re-enter the Earth's atmosphere.

The spacecraft has a heat shield made from special silica tiles to prevent the inside from becoming too hot.



- a) i) Why does the spacecraft increase in temperature when it re-enters the Earth's atmosphere?
- ii) The mass of the heat shield is  $3.5 \times 10^3 \text{ kg}$  and the gain in heat energy is  $4.7 \times 10^9 \text{ J}$ . Calculate the **increase in temperature** of the silica tiles using the equation below.

$$\Delta T = E_H / (m \times 1033)$$

Where  $\Delta T$  = increase in temperature in  $^{\circ}\text{C}$

$E_H$  = gain in heat energy in **J**

$m$  = mass of the heat shield in **kg**

- iii) Why is the actual increase in temperature of the silica tiles less than that calculated in a)ii)?
- b) When a piece of equipment is loaded on to the spacecraft on Earth, two people are required to lift it. When travelling in space only one person is required to lift the same piece of equipment.  
Explain why this happens.

14) Radio waves emitted by galaxies are detected and used to provide images

of the galaxies.

- a) How does the wavelength of radio waves compare with the wavelength of visible light?
- b) Why are different kinds of telescopes used to detect signals from space?
- c) Why do astronomers sight different types of telescope on satellites above the Earth's atmosphere?

15) Some spectral lines of radiation from a distant star are shown below.



Spectral lines of radiation from distant star

The spectral lines of a number of elements are also shown.

Cadmium



Calcium



Krypton



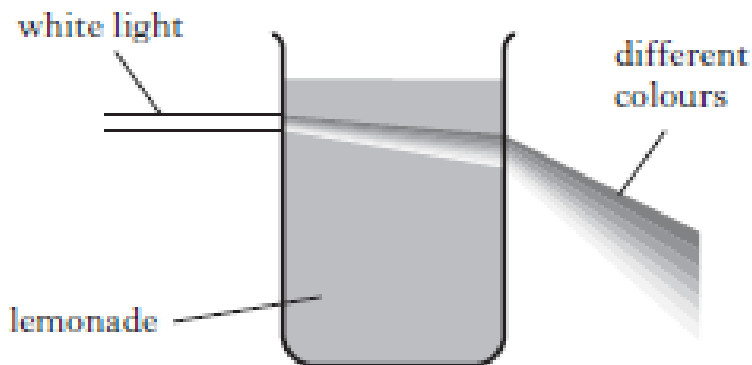
Mercury



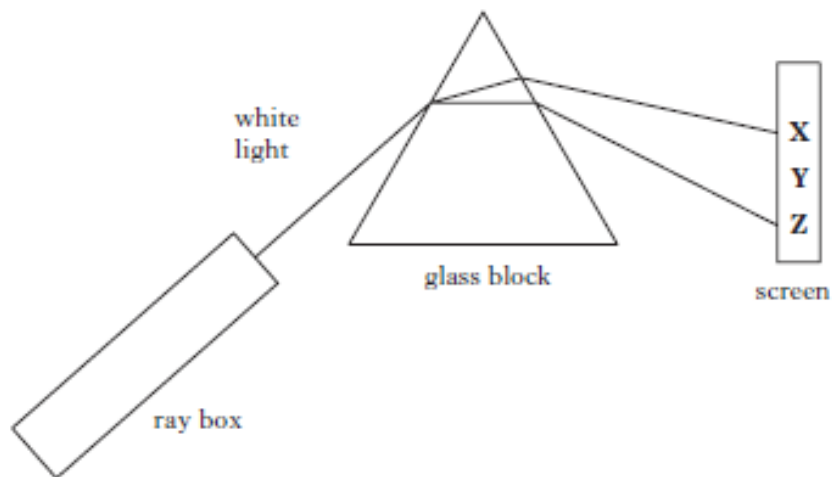
Use the spectral lines of the elements shown above to identify which of these elements are present in the distant star.

16) Visible light is part of the electromagnetic spectrum.

- a) What is the speed of all of the waves in the electromagnetic spectrum?
- b) A student notices that when white light passes through a glass of lemonade it is split into different colours.



The student decides to reproduce this effect in a laboratory using the following equipment.



- i) State the name of the glass block that the student uses to split the light into different colours.
- ii) When white light enters the glass block its speed and its direction changes.  
What name is given to this effect?
- iii) The colours green, red and blue can be seen on the screen.  
Match these colours with X, Y and Z .
- iv) Calculate the frequency of red light if it has a wavelength of  $6.8 \times 10^{-7} \text{m}$ .



17) The table below gives information about some of the planets in our solar system.

<i>Planet</i>	<i>Mercury</i>	<i>Venus</i>	<i>Earth</i>	<i>Mars</i>	<i>Jupiter</i>	<i>Saturn</i>	<i>Neptune</i>
<i>Distance from the sun (million kilometres)</i>	58	110	150	228	780	1430	4500
<i>Time to go around the sun once (years)</i>	0.25	0.6	1	1.9	12	30	165
<i>Time for one complete spin (in Earth days or hours)</i>	59 days	243 days	24 hours	25 hours	10 hours	10 hours	16 hours
<i>Acceleration due to gravity (metres per second per second)</i>	4	9	10	4	26	11	12

- Which two planets have the same length of day?
- On which planet would a 20kg object have the largest weight?
- Which planet has the shortest orbit time?

18) Images from outer space can be obtained using space telescopes.



Radioastron



Hubble

Two space telescopes which orbit the Earth are the Hubble space telescope and the Radioastron space telescope.

The Hubble telescope completes one orbit of the Earth in 97 minutes.

The Radioastron space telescope completes one orbit of the Earth in 9.5 days.

How does the orbital height of these two telescopes compare?