



NATIONAL 5 PHYSICS

ASTROPHYSICS

PROBLEM BOOKLET

1. A space shuttle is about to be launched from the surface of the Earth. It has a mass of  $7.9 \times 10^4$  kg.
  - a) What is the weight of the space shuttle at launch?
  - b) Describe and explain what happens to the weight of the space shuttle as it gets further away from the surface of the Earth.
2. A space rocket has a mass of  $9.0 \times 10^4$  kg. What engine thrust is required to make the rocket accelerate at  $25 \text{ m s}^{-2}$  at take off??
3. A pupil in a physics class makes the following statement: "The material used to protect space shuttles during re-entry needs to have a low specific heat capacity". Do you agree or disagree with this statement? Give a reason for your opinion.
4. Voyager 2 is a spacecraft that was launched on the 20<sup>th</sup> of August 1977. It took many photographs of Jupiter, Saturn, Uranus and Neptune in the 1980's and is still in contact with the Earth despite now being over  $1.50 \times 10^{13}$  metres away. Why is it useful to have explored these planets using spacecraft, such as Voyager 2, and telescopes?
5. Satellites which orbit the Earth are of great use to society. Give some examples of everyday use of satellites.
6. The Hubble Space Telescope orbits the Earth and is used to look at far away stars and galaxies. Why does the Hubble Space Telescope get clearer images of space than telescopes on the surface of the Earth?
7. How far is a light year, in metres?
8. On average, Jupiter is around  $7.78 \times 10^{11}$  metres from the Sun. How long does it take for light from the Sun to reach Jupiter?
9. Why are there parts of the universe that can't be observed from Earth?
10. Explain the 'Big Bang' theory regarding the origin of the universe.
11. How old is the universe believed to be? Explain how astronomers came to this estimate.

12. Complete this sequence to show the electromagnetic spectrum in order of increasing wavelength.

a)	X-Ray	b)	Visible	c)	Micro waves	(d)
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13. Why is it useful to study electromagnetic radiation from stars and galaxies which have wavelengths outside of the visible spectrum?
14. Why are radio telescopes often found in large groups called ‘arrays’?
15. COBE (Cosmic Background Explorer) is a satellite that detects infrared and microwave ‘background’ radiation in space. Why is COBE collecting this data?
16. SETI (Search for Extra-Terrestrial Intelligence) is a group of organisations that study electromagnetic radiation, in particular radio waves, from space. Why are the SETI organisations analysing this data?
17. Complete the table below:

Celestial Body	Average distance from the Sun (m)	Time taken for light from the sun to travel to body
Earth		8 minutes
Neptune	$4.503 \times 10^{12}$	
Proxima Centauri		4.3 years
Betelgeuse	$6.079 \times 10^{18}$	
		434 years

18. What would be the challenges facing a manned mission to Mars? Consider the issues at each stage of the mission (launch, transfer, landing on Mars, launch and transfer back to Earth, landing on Earth). How could these challenges be overcome?
19. What is the orbital period and radius of a satellite in an Earth geostationary orbit?
20. What are the challenges to space missions to Jupiter and beyond and how can they be overcome?