Standard Grade Physics

Number :

Name:

Strathaven Academy

Physics Department

UNIT 7

SPACE PHYSICS

PUPIL PACK

Study Guides
Summary Notes
Homework Sheets

SPACE PHYSICS
Working at Home

TO THE PUPIL

Each day you have physics at school, you should set aside time for work at home. By this stage you should be accepting more responsibility for your own learning and should undertake the following tasks on a regular basis:

- Tackle the supplied homework sheets as each section of work is completed in class.
- Check your own progress in the homework sheets by referring to the homework answer files available in class. Discuss any difficulties that arise with your class teacher.
- Complete any formal homework tasks that your teacher may issue from time to time and hand them in on the due date for marking.
- Revise the work you have covered in class activities by referring to your classwork jotters.
- Complete the supplied summary notes as the coursework allows you to, then use the summary notes to help you in your revision of the course content.
- Make your own short notes to cover each learning outcome in the supplied study guides.

TO THE PARENT

Your co-operation would be appreciated in ensuring that pupils are encouraged to complete homework. It would be helpful if you could talk over the work given for homework and sign the homework record sheet on this page after they have completed each exercise.

The physics department hopes that this record of your child's achievement will be of interest to you, and we would welcome any comments on this or other areas related to the work of the department.

Please sign here to confirm that you have seen the homework record sheet: _____

HOMEWORK RECORD SHEET

HOMEWORK	SECTION OF WORK	MARK	CHECK	PARENTAL SIGNATURE
7.1	Signals from Space 1			
7.2	Signals from Space 2			
7.3	Space Travel 1			
7.4	Space Travel 2			

Some questions in the pack are marked with symbols to give you specific information. Here is the key:

Credit Level question. This relates directly to the Credit Level learning outcomes.

Problem Solving question. This puts the knowledge you have gained into new contexts.

SPACE PHYSICS
Study Guide

Section 1 - Signals from Space

From Earth we can see the sun, the moon, some of the planets and hundreds of thousands of stars with our eyes. With the aid of telescopes, very faint objects can be seen, like the rest of the planets and millions more stars. However, there are other forms of radiation that arrive at our planet that may also contain a lot of information about the universe. In this section you will study these radiations and learn how they can be detected.

At General level, by the end of this section you should be able to:

- ❑ 1. Use these terms correctly: *star*, *sun*, *moon*, *planet*, *solar system*, *galaxy*, *the universe*.
- ❑ 2. Give rough values for the distance (in light years) from the earth to the following: *the sun, the next closest star* and *the edge of our galaxy*.
- ❑ 3. Draw a diagram of a refracting telescope, and label it to show the objective lens, the eyepiece lens and the light-tight tube.
- ❑ 4. State that the objective lens produces an image which is then magnified by the eyepiece lens.
- ❑ 5. State that different colours of light have different wavelengths.
- ❑ 6. List the colours red, blue and green in order of wavelength (longest wavelength first).
- ❑ 7. State how white light can be split to produce a spectrum of colours.
- ❑ 8. State that the line spectrum produced by a light source can give us information about the atoms in that source.
- ❑ 9. Give a definition of the electromagnetic spectrum.
- ❑ 10. State how radio waves from space can be picked up.

Additionally, at Credit level you should also be able to:

- ❍ 11. Use the term *light year* correctly as a unit of distance.
- ❍ 12. Draw a ray diagram to show how an image is formed by a magnifying glass.
- ❍ 13. Explain why the brightness of an image produced by a telescope depends on the diameter of the objective lens.
- ❍ 14. Recognise the members of the electromagnetic spectrum.
- ❍ 15. List the members of the electromagnetic spectrum in order of frequency or in order of wavelength.
- ❍ 16. Give an example of a detector for each of the members of the electromagnetic spectrum.
- ❍ 17. Explain why different types of telescopes are used to detect signals from space.

Section 2 - Space Travel

Humankind has been able to travel in space for less than 50 years. Currently, the limit of our travel is the moon that orbits our planet, but we have sent unmanned craft deep into space to explore planets, asteroids, comets and even the Sun itself (this was a one-way trip!) Who knows where we may be able to travel to within your lifetime? In this section you will study how things move in space.

At General level, by the end of this section you should be able to:

- ❑ 1. State that a rocket is pushed forward because the exhaust gases are pushed backwards.
- ❑ 2. Explain simple situations involving the rule that *if A pushes B, B pushes A back*.
- ❑ 3. Carry out calculations involving thrust (F), mass (m) and acceleration (a).
- ❑ 4. Explain why a rocket's motors don't have to be on during interplanetary flight.
- ❑ 5. State that the force of gravity near the earth's surface gives all objects the same acceleration if we ignore air resistance.
- ❑ 6. State what happens to the weight of an object on the moon or on other planets compared to its weight on earth.
- ❑ 7. State that objects in free fall appear to be weightless.
- ❑ 8. Explain the curved path of a projectile in terms of gravitational pull.
- ❑ 9. State that kinetic energy is transferred to heat due to friction.

Additionally, at Credit level you should also be able to:

- ❍ 10. State *Newton's Third Law*.
- ❍ 11. Identify pairs of action-reaction forces in situations involving several forces.
- ❍ 12. Explain why gravitational field strength and gravitational acceleration have the same numerical value.
- ❍ 13. Carry out calculations involving weight (W), mass (m) gravitational acceleration (a) and/or gravitational field strength (g). This may include situations where g is not equal to 10 Nkg^{-1}.
- ❍ 14. Use the following terms correctly: *mass*, *weight*, *inertia*, *gravitational field strength*, *gravitational acceleration*.
- ❍ 15. State that the weight of a body decreases as its distance from the earth increases.
- ❍ 16. Explain that projectile motion can be treated as two separate motions.
- ❍ 17. Use this idea to solve projectile motion problems.
- ❍ 18. Explain satellite motion using the theory from projectile motion.
- ❍ 19. Carry out calculations involving the relationships:

$$E_h = cm\Delta T$$
$$W = Fd$$
$$E_k = \tfrac{1}{2}mv^2$$

Homework 7.1 – Signals from Space I

1. Match the following explanations with the appropriate space term, and then write them in your homework jotter. (3)

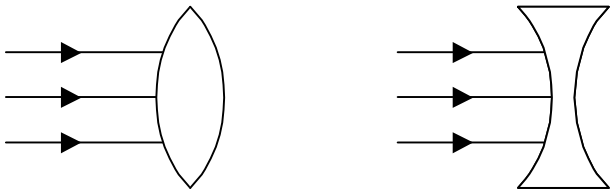
TERM	EXPLANATION
Moon	A massive object in space, consisting mainly of very hot gases, and producing vast amounts of energy.
Planet	The nearest star to Earth.
Sun	A huge cluster of stars.
Star	The Sun and the nine planets that orbit it.
Solar System	This moves around a star, held by its gravitational field. There are nine in orbit around the sun.
Galaxy	This is a natural satellite of a planet. The Earth only has one, but some planets have many.

2. Copy and complete the following table: (1½)

SOURCE	TIME TAKEN FOR LIGHT TO REACH US ON EARTH
Sun	
Next nearest star	
Edge of our Galaxy	

CR 3. (a) What is the definition of a light year? (1)
(b) The next nearest star to Earth after the sun is Proxima Centauri, about 4.3 light years away. How far is this in kilometres? (1)

4. (a) Draw a diagram of a refracting telescope and label it. (1½)
(b) Copy and complete the following diagrams to show what happens to the rays of light after passing through each lens: (1)



(c) Name each type of lens. (1)

Total 10 marks

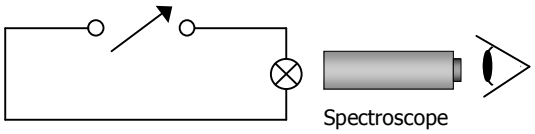
Homework 7.2 - Signals from Space II

1. (a) Use a diagram to show how white light can be split to form a spectrum. (1)
   (b) Name the piece of equipment used for this. (1)
   (c) List the three primary colours of light in order of increasing wavelength. (1)

PS 2. When a substance is strongly heated, a whole range of wavelengths is given out in the form of a continuous spectrum. The proportion of each colour depends on how hot the object is. When it starts to glow, an object is red hot. Eventually it may become white hot.

Metal workers can judge the temperature of steel by noting its colour. Astronomers can judge the temperature of the surface of stars by noting the colour of the stars.

(a) The experiment below was carried out to study the effect of temperature on colour. The voltage was adjusted, and the colour of the light produced by the 6 V bulb examined at 2 V, 4 V and 6 V. Copy the table, and predict the colours that would be observed. The first one has been given to you. (1)



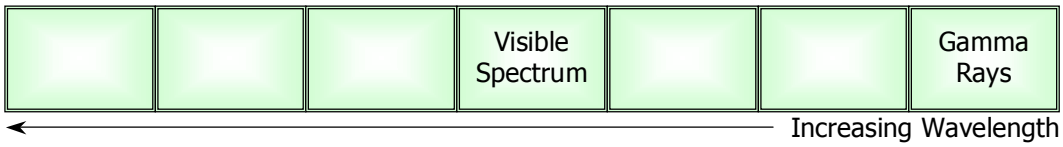
VOLTAGE	BRIGHTEST COLOUR
2 V	Red
4 V	
6 V	

(b) Study the following list, and put the stars in order of increasing surface temperature: (1)

BETELGEUX (*orange-red*) RIGEL (*bluish-white*) THE SUN (*yellow*) BARNARD'S STAR (*red*)

(c) Explain how metal workers can judge the temperature of steel by noting its colour. (1)

CR 3. (a) Copy and complete the electromagnetic spectrum diagram below using these words: (2½)
VISIBLE LIGHT, INFRARED, X-RAYS, ULTRAVIOLET, RADIO & TV, MICROWAVES, GAMMA RAYS
(b) On the diagram, mark the direction of increasing frequency. (½)

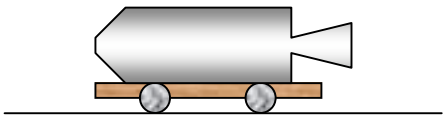


CR 4. (a) Reflecting telescopes are used to look at light from stars. What are radio telescopes used for? (½)
(b) What detector is used to pick up infrared waves? (½)

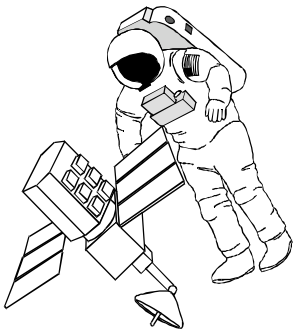
Total 10 marks

Homework 7.3 – Space Travel I

1. A rocket engine is being tested by allowing it to drive a wagon along a track. The mass of the rocket, wagon and fuel is 1000 kg to start with. The effects of friction can be ignored.



(a) If the engine provides a thrust of 40 000 N, calculate the initial acceleration of the truck. (2)
(b) What will be the new acceleration when 600 kg of fuel has been used up? (2)

2. 

A spacecraft is deep in space. An astronaut leaves the spacecraft to go to a small artificial satellite nearby. She has a jetpack strapped to her back.

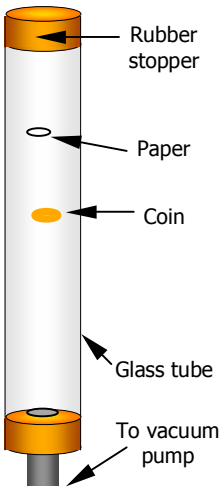
The astronaut and her equipment have a mass of 120 kilograms and the jets can exert a constant thrust of 24 N when switched on.

(a) Calculate her acceleration when she uses the jetpack. (1)
(b) Describe her motion once the jetpack is switched off. Explain your answer. (1)

3. A young boy writing a project for primary school writes "a rocket is pushed upwards because of the gases pushing against the ground". His older brother, a physics student, points out that this is wrong. What should his project say? (1)

PS

4. A teacher shows her class an experiment with a coin and a small piece of paper sealed in a glass tube. When the tube is turned over, the coin drops quickly to the bottom of the tube whilst the feather drops more slowly.



(a) Explain why the two objects fall at different rates. (1)
(b) What is likely to have been the coin's acceleration? (1)

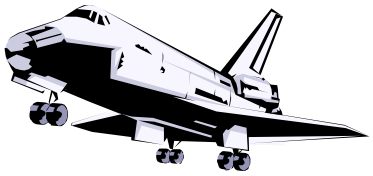
In a second experiment, the teacher then uses a vacuum pump to remove all the air from the glass tube. When the experiment is repeated now, the results are different.

(c) What happens to the coin and the piece of paper now? Explain why this happens. (1)

Total 10 marks

Homework 7.4 - Space Travel II

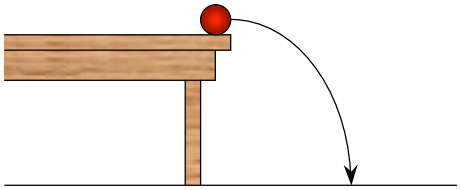
1. Why is the underside of the space shuttle fitted with special heatproof tiles? (1)



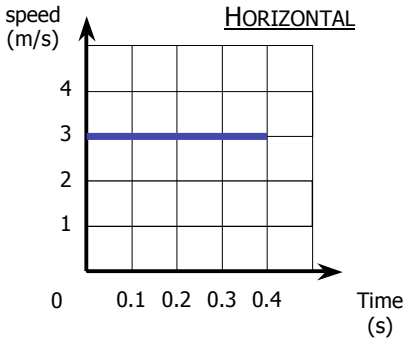
2. A distress line is fired from the top of a high cliff to a boat in the sea below with a horizontal speed of 50 m/s.

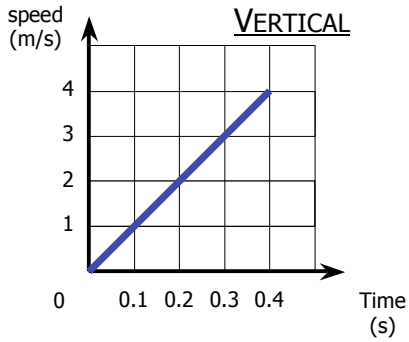
   (a) What is the horizontal speed of the line 2 seconds later? (1)
   (b) What is the initial vertical speed of the line? (1)
   (c) Sketch the path taken by the line. (½)
   (d) Explain why the path is this shape. (½)

CR 3. A ball is projected from the top of a table as shown.



Two graphs are produced for this motion; one for the horizontal speed, and one for the vertical speed. These are shown below.





   (a) How far out from the table did the ball land? (1)
   (b) How high is the table? (1)

CR 4. A space shuttle returning to Earth has a mass of 75 000 kg. It is travelling at 7000 m/s.

   (a) What is the shuttle's kinetic energy? (2)
PS (b) If the tiles that make up the shuttle's outer skin have a mass of 3000 kg, calculate the rise in temperature of the tiles. Assume that no energy is lost to the surroundings.
   (Specific heat capacity of the tiles = 1040 J/kg°C) (2)

Total 10 marks