Candidate forename		Candidate surname	

Centre number						Candidate number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A333/02

TWENTY FIRST CENTURY SCIENCE
PHYSICS A

Unit 3: Ideas in Context plus P7 (Higher Tier)

TUESDAY 7 JUNE 2011: Afternoon
DURATION: 60 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the question paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

Insert (inserted)

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (RW/SW) 11MEP06179 46721/1

INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. Pencil may be used for graphs and diagrams only.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**
- **Answer ALL the questions.**

INFORMATION FOR CANDIDATES

- **The number of marks is given in brackets [ ] at the end of each question or part question.**
- **The total number of marks for this paper is 55.**
- **A list of physics equations is printed on pages 4 and 5.**
-  **Where you see this icon you will be awarded a mark for the quality of written communication in your answer.**

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

EXPLAINING MOTION

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

ELECTRIC CIRCUITS

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{potential difference} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

THE WAVE MODEL OF RADIATION

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

FURTHER PHYSICS, OBSERVING THE UNIVERSE

$$\text{lens power} = \frac{1}{\text{focal length}}$$

$$\text{magnification} = \frac{\text{focal length of objective lens}}{\text{focal length of eyepiece lens}}$$

$$\text{speed of recession} = \text{Hubble constant} \times \text{distance}$$

Answer ALL the questions.

This question is based on the article 'TELEMETRY IN MOTOR RACING'.

1 (a) (i) The engineers in the pit lane decide to find the momentum of the racing car.

How will the engineers do this?

Your answer should include

- **what data is needed**
- **how the data is used to find the momentum.**

_____

_____

_____

_____ **[3]**

(ii) Calculate the kinetic energy of the car as it crosses the finish line with a velocity of 84 m/s. The car has a mass of 600 kg.

kinetic energy = _____ **J [1]**

(b) (i) The safety regulations used in motor racing are decided by the regulatory bodies that govern the sport.

Motor racing is dangerous because crashes can happen at high speeds. This can cause drivers serious injuries.

Suggest what principle the regulatory body uses to make decisions about safety rules. Explain how this principle works using the case of the HANS device as an example.

_____

_____

_____ **[2]**

(ii) Explain how crumple zones reduce the forces experienced by a driver in a crash.

_____

_____

_____

_____

_____ **[3]**

(c) The engineers use both microwaves and radio waves to transmit data.

(i) Both microwaves and radio waves are parts of the electromagnetic spectrum.

Complete the diagram to show all the regions of the electromagnetic spectrum in order.

gamma
_____
_____
visible light
_____
_____
_____

[1]

(ii) Describe ONE difference and ONE similarity, other than both being electromagnetic radiation, between microwaves and radio waves.

difference _____

_____

similarity _____

_____

[2]

(d) Some Formula 1 teams have switched from analogue to digital for their radios.

Describe the difference between analogue and digital signals.

You may use diagrams to illustrate your answer.

_____

_____

_____

_____ **[2]**

[Total: 14]

2 (a) Here are some units of distance.

millimetre
light-second
kilometre
megaparsec
metre
parsec

Use words from the list to answer the questions.

(i) Which of these would be the most suitable unit to use for the distance between the Milky Way and the Andromeda galaxy?

unit _____ [1]

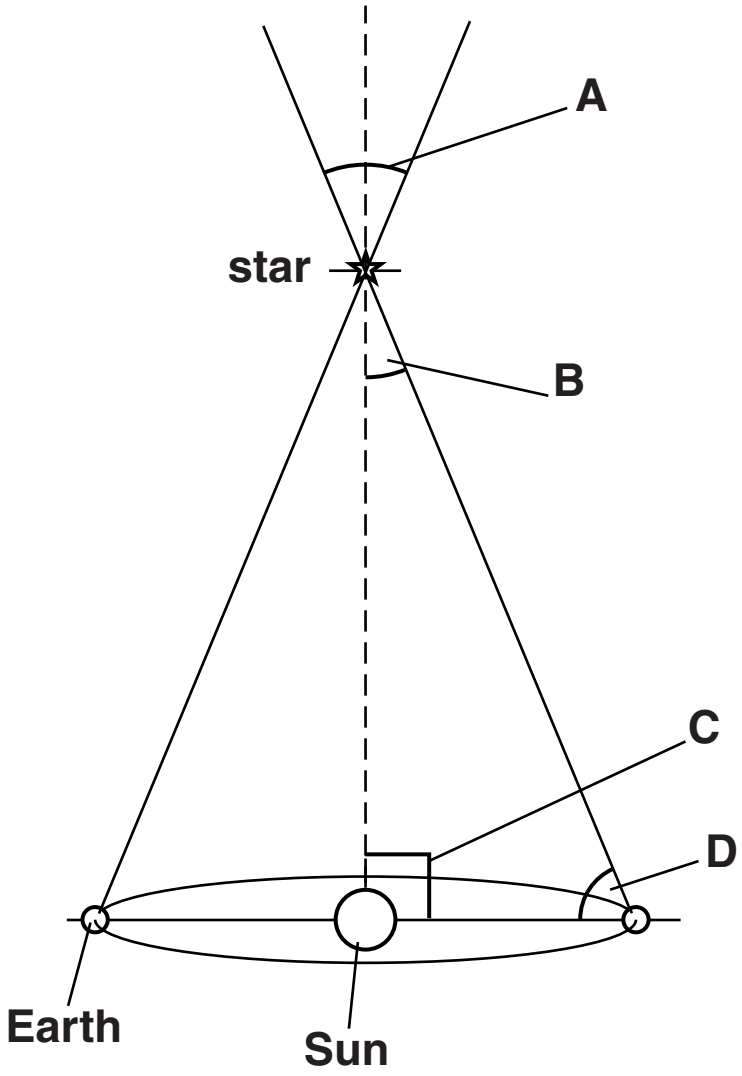
(ii) Which of these would be the most suitable unit to use for the distance between the Sun and the star Sirius?

unit _____ [1]

(iii) Which unit is nearest in size to a light-year?

unit _____ [1]

(b) One way of measuring astronomical distances is to use parallax.

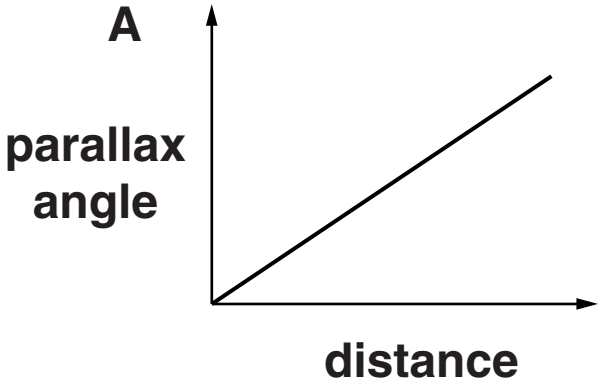


(i) Which angle, A, B, C or D, is the parallax angle of the star?

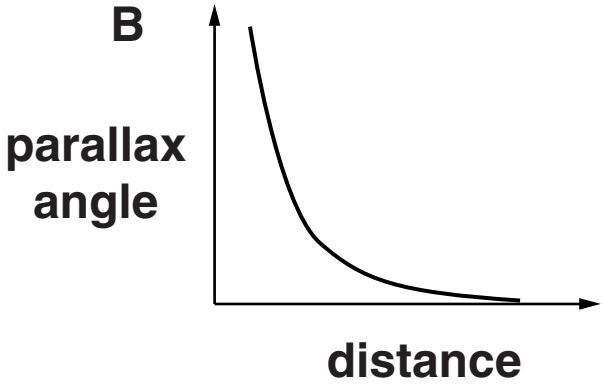
angle _____ **[1]**

(ii) **Which graph, A, B, C or D, shows the correlation between distance and parallax angle?**

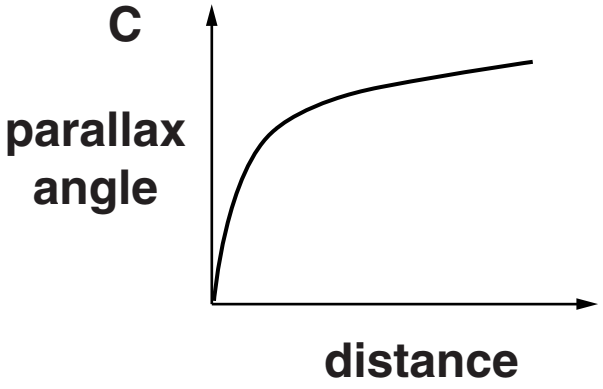
A



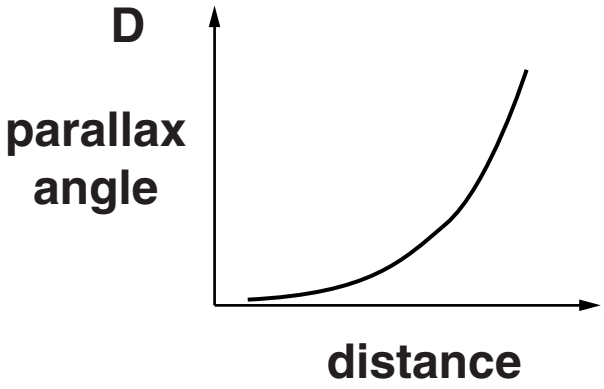
B



C



D



graph _____ **[1]**

(c) Complete the following sentences about discoveries related to the Milky Way.

In 1610 Galileo used a telescope to reveal that the Milky Way consists of many

_____ .

Telescopes also showed many fuzzy objects.

These were called _____ .

The Curtis-Shapley debate in the 1920s was about whether the fuzzy objects were in the Milky Way or

in a separate _____ .

In the late 1920s Edwin Hubble showed that at least one fuzzy object was outside the Milky Way by measuring the distance to a

_____ star.

[4]

(d) (i) Major optical and infrared astronomical observatories are located in which of the following countries?

Put ticks (✔) in the boxes next to the TWO correct answers.

Australia ☐

Belgium ☐

Chile ☐

Japan ☐

United Kingdom ☐

[1]

(ii) These days professional astronomers very rarely look through the eyepiece of a telescope.

Describe how they would work with a telescope.

One mark is for a clear and well ordered answer.

_____

_____

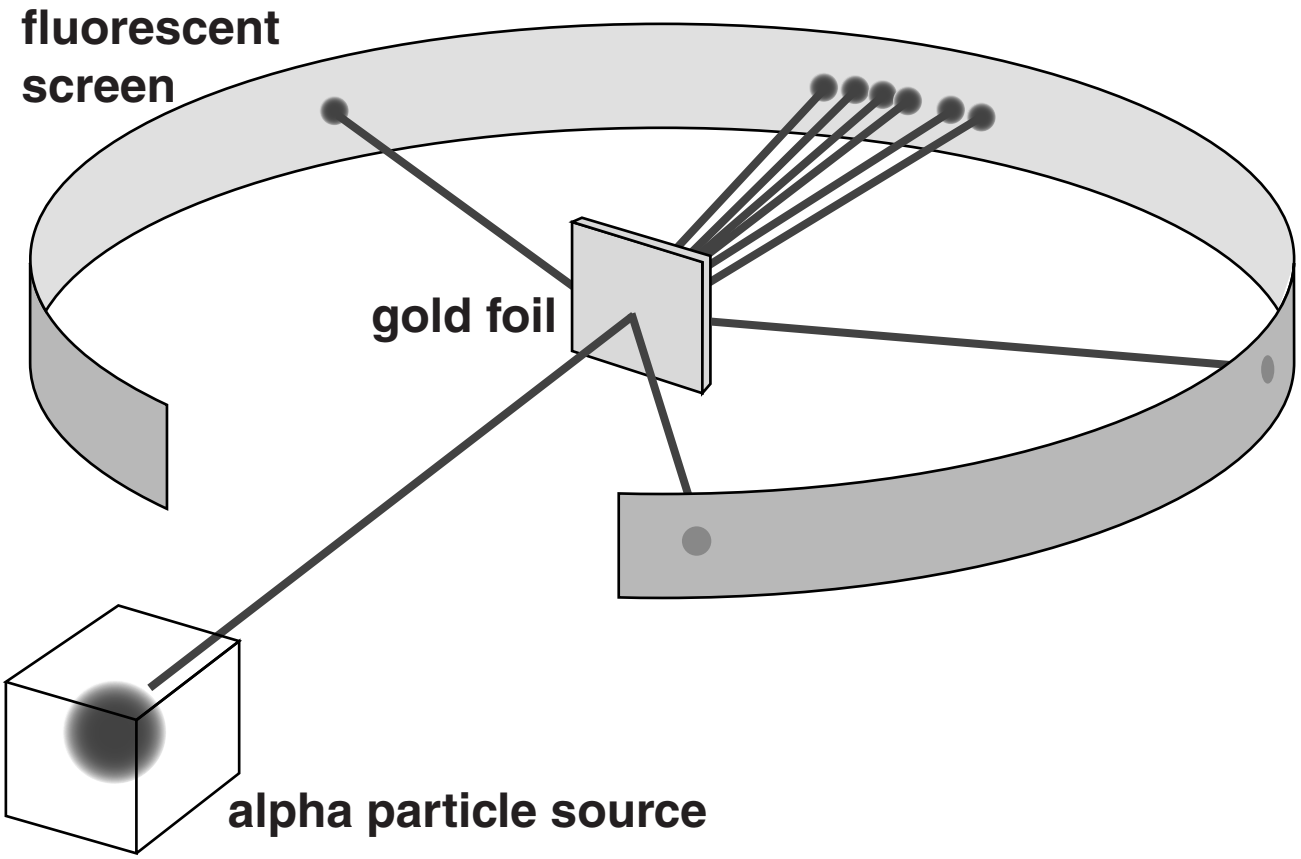
_____

_____ **[3+1]**

[Total: 14]

3 (a) The Rutherford scattering experiment changed scientists' understanding of the structure of atoms.

In the experiment positively charged alpha particles are fired at a thin sheet of gold foil.



Most of the alpha particles are deflected by the gold atoms, but some pass straight through.

The numbers of alpha particles are then counted at different positions around the gold foil.

The results show that

- **most of the alpha particles are deflected through very small angles**
- **very few of the alpha particles are scattered back in the direction they had come from.**

What do the results suggest about the structure of atoms?

Your answer should

- **describe what the experiment shows about the structure of the atom**
- **explain how the experiment's results support the conclusions about the structure of the atom.**

_____

_____

_____

_____

_____

_____

_____ **[4]**

(b) Explain why a strong force is needed to hold the particles in the nucleus together.

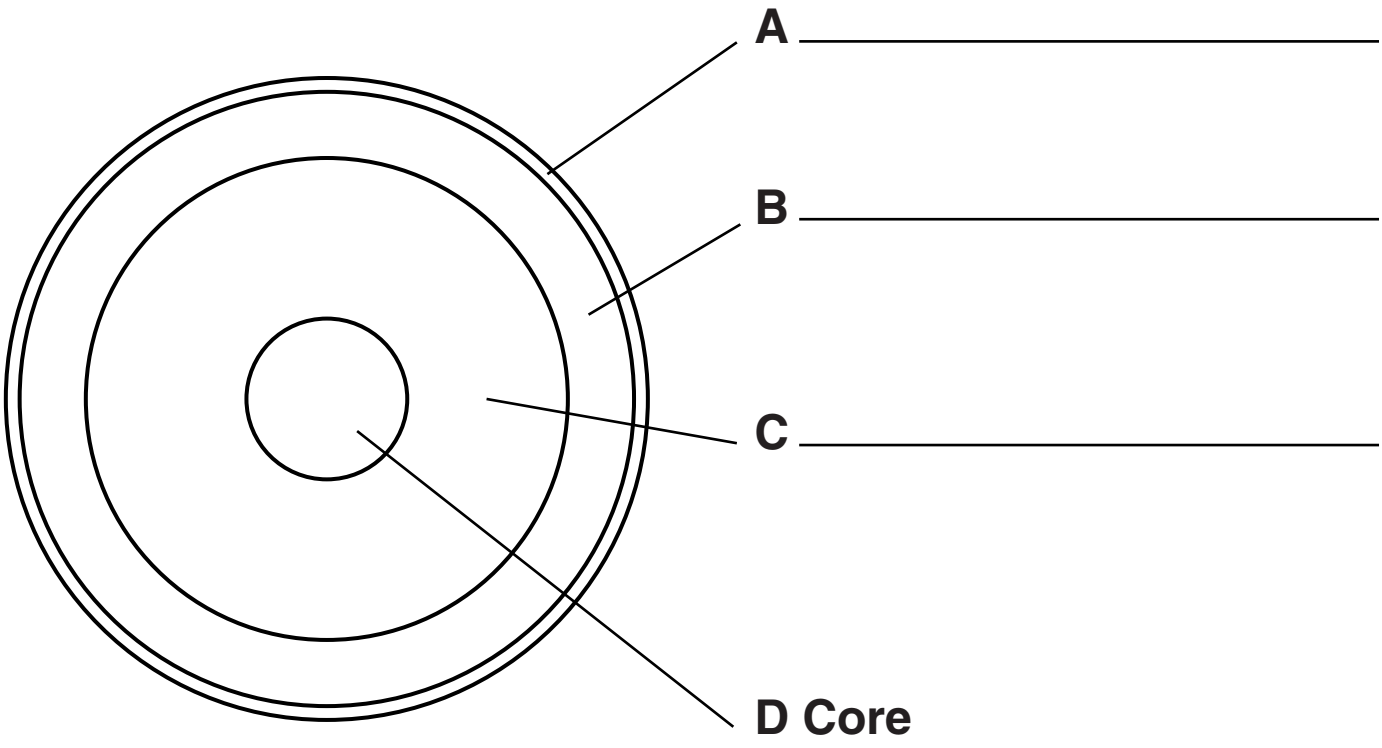
_____

_____

_____ **[3]**

[Total: 7]

4 This is a diagram of the structure of a star like the Sun.



(a) Complete the labels on the diagram. One has been done for you. [3]

(b) Energy is released in the core of the star.

(i) Complete the sentences describing the process that releases energy in the core of a star like the Sun.

_____ nuclei are forced together and combine to produce _____ .

This process is called _____ and results in energy being released.

[3]

(ii) The energy produced in the core transfers outwards.

Describe the main method of energy transfer in the region labelled A.

_____

_____ [1]

[Total: 7]

5 Electromagnetic radiation produced by a star can provide information about the chemical elements in the star and the temperature of the star.

Explain how this is done.

Your answers should include both the relevant feature of the electromagnetic radiation and how scientists interpret it.

(a) The chemical elements in the star.

_____

_____

_____

_____

_____

_____ **[3]**

(b) The temperature of the star.

_____

_____

_____

_____

_____

_____ **[3]**

[Total: 6]

6 The temperature of most of space is about 3 K.

(a) What is this temperature in °C?

temperature = _____ °C [1]

(b) (i) Stars are born in cold gas clouds.

As the gas cloud becomes a protostar its temperature increases.

Explain why its temperature increases.

Use ideas about particles in your answer.

_____

_____

_____

_____ **[3]**

(ii) The increasing temperature of a protostar eventually results in the star reaching a steady volume. This will last most of its life as a stable star.

Explain what keeps the star at a steady volume.

_____

_____

_____ **[3]**

[Total: 7]

END OF QUESTION PAPER