OCR
RECOGNISING ACHIEVEMENT

F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE PHYSICS A

A333/01

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

OCE/32802

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)

Tuesday 7 June 2011
Afternoon

Duration: 60 minutes

A 3 3 3 0 1

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- The insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. 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.
- Do **not** write in the bar codes.

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 page **2**.
- Where you see this icon you will be awarded a mark for the quality of written communication in your answer.
- This document consists of **16** pages. Any blank pages are indicated.

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)** Some telemetry signals are sent by microwaves and some by radio waves.

(i) Which of the following shows the correct positions of both microwaves and radio waves in the electromagnetic spectrum?

Put a tick (✓) in the box next to the correct answer.

gamma, X-ray, microwave, ultraviolet, visible light, infrared, radio ☐

gamma, X-ray, ultraviolet, visible light, infrared, microwave, radio ☐

gamma, microwave, X-ray, ultraviolet, visible light, infrared, radio ☐

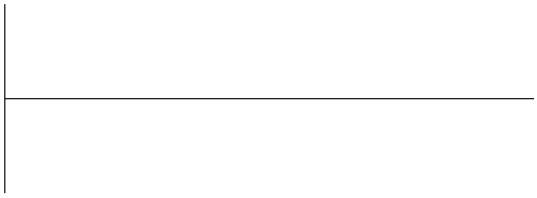
gamma, microwave, X-ray, ultraviolet, visible light, radio, infrared ☐

[1]

(ii) Draw diagrams to show the difference between an **analogue signal** and a **digital signal**.

analogue signal

digital signal



[2]

(b) **(i)** Use the graph in the article to find the maximum speed of the car between 3000 m and 4000 m.

maximum speed = ... km/h **[1]**

(ii) The racing car changes speed much more quickly when braking than when speeding up.

How will the force on the driver when braking compare to the force on the driver when speeding up?

..... **[1]**

(iii) What is the name of the force that is used to slow down the car when it is braking?

..... **[1]**

(c) Motor racing is dangerous because crashes can happen at high speeds.

This can cause drivers serious injuries.

(i) Suggest **two** reasons why a racing car driver might be willing to accept this risk of injury.

1 .....

.....

2 .....

.....

[2]

(ii) The HANS device helps protect the head and neck from injury during a crash.

Explain how it does this.

.....

.....

.....

..... **[2]**

(d) (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]**

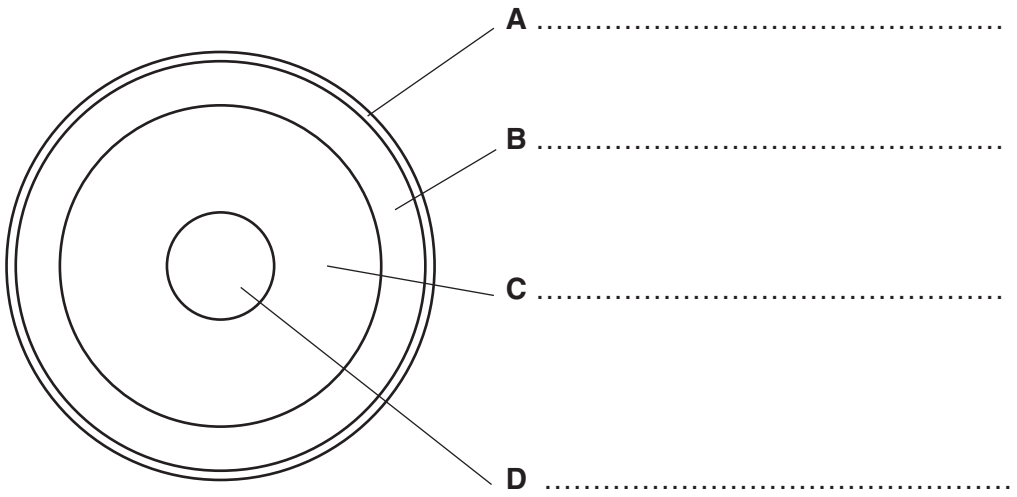
(ii) Calculate the kinetic energy of the car as it crosses the finish line with a velocity of 84 m / s. The car has a mass of 600 kg.

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

[Total: 14]

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

Four parts of the star are labelled **A**, **B**, **C** and **D**.



(a) Write the correct name of each part of the star next to its label.

Use words from the list.

convective zone **core** **liquid centre** **mantle** **photosphere** **radiative zone**

[4]

(b) **(i)** On the diagram draw an arrow to show the direction in which energy flows in the star. **[1]**

(ii) In part **D** of the star, energy is released from atoms.

What is the name of the process that releases the energy?

Put a (ring) around the correct answer.

combustion **fission** **fusion** **gravitation** **[1]**

(c) **(i)** What is the fuel used by a star like the Sun?

Put a (ring) around the correct answer.

helium **hydrogen** **iron** **petrol** **[1]**

(ii) What is the main fuel used by red giant stars?

Put a (ring) around the correct answer.

helium **hydrogen** **iron** **petrol** **[1]**

[Total: 8]

3 All we know about stars comes from the light that reaches us.

(a) Explain why the brightness of a star, seen from Earth, depends on **both** the luminosity of the star and its distance from Earth.

.....

.....

.....

.....

..... **[2]**

(b) Complete the following sentences about the electromagnetic radiation produced by stars.

Use words from the list.

colours **convection** **elements** **gravity**

ionisation **line spectra** **luminosity**

(i) As the temperature of a star increases so do both the peak frequency of the electromagnetic radiation produced and the star's ..... .

(ii) The change in peak frequency means that stars have different ..... .

(iii) The stars are hot enough for electrons to be removed from atoms. This process is called ..... .

(iv) At the surface of a star electrons move between energy levels in atoms. They absorb light and produce ..... .

(v) These can be used to identify the ..... present in the star.

[5]

[Total: 7]

4 **(a)** Astronomers often measure temperature using the unit Kelvin (K).

0 K is –273 °C.

The temperature of most of space is about –270 °C.

What is –270 °C shown as a temperature in Kelvin?

temperature = ... K **[1]**

(b) Stars are born in cold gas clouds.

The gas cloud becomes a protostar.

Describe how the temperature, pressure and volume of the gas cloud change as the protostar forms.

.....

.....

..... **[3]**

(c) When the protostar turns into a star, its volume stops changing and stays the same.

This is because the factor trying to shrink the star and the factor trying to expand the star are balanced.

Which two of the following factors are balanced in the star?

Put ticks (✓) in the boxes next to the **two** correct answers.

pressure	☐
colour	☐
gravity	☐
parallax	☐
Hubble constant	☐

[2]

[Total: 6]

5 **(a)** The stars appear to move for a variety of reasons.

Some of these reasons are given in the following statements.

A The Earth spins on its axis once a day.
B The Earth orbits around the Sun once a year.
C Comets orbit around the Sun.
D The star is moving outside the Solar System.

Write down the reason, **A**, **B**, **C** or **D**, for each movement below.

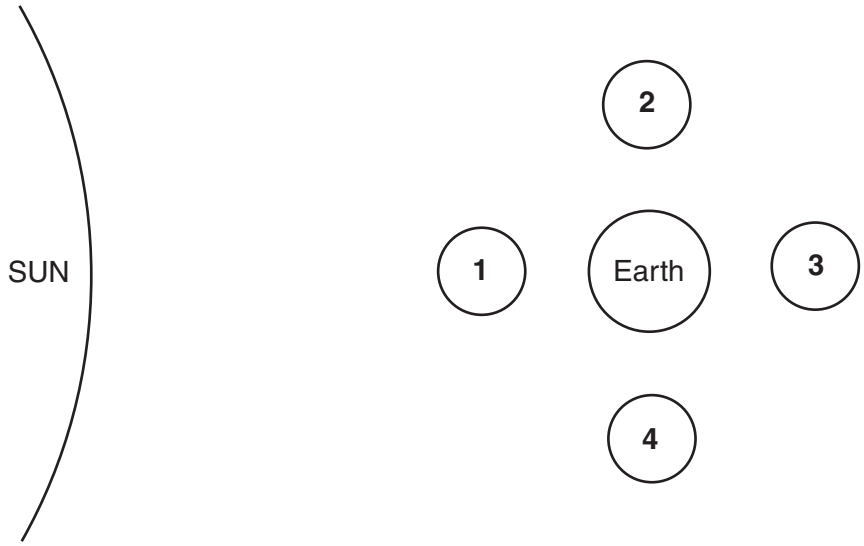
(i) The stars rotate around the pole star each day.

reason ..... **[1]**

(ii) Different stars are visible in the sky at different times of year.

reason ..... **[1]**

(b) **(i)** This is a diagram of the Moon, Earth and Sun. The Moon is shown in four positions, **1**, **2**, **3** and **4**, as it orbits the Earth.



Complete the table to show how the Moon would normally look as seen from the Earth at each position in its orbit.

Choose from the Moon's phases, **A**, **B**, **C**, **D**, **E** and **F**, below.

One has been done for you.

Moon's position in orbit	**1**	**2**	**3**	**4**
phase of Moon seen from Earth				**D**

[3]

(ii) The Moon moves across the sky.

In which direction?

Put a tick (✓) in the box next to the correct answer.

north to south	☐
east to west	☐
south to north	☐
west to east	☐

[1]

[Total: 6]

6 **(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]**

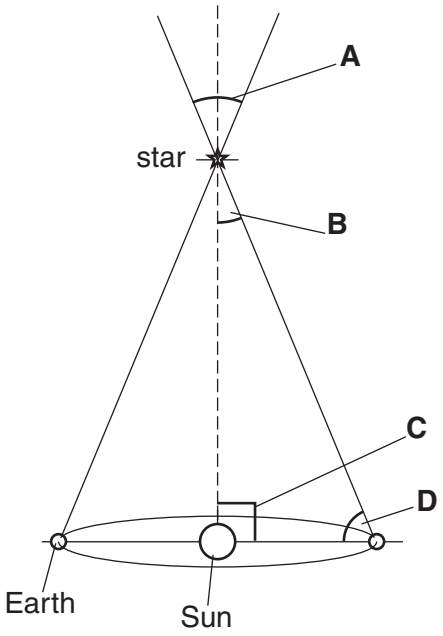
(ii) Which of these would be the most suitable unit to use for the distance between the Sun and the star Sirius?

unit ..... **[1]**

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

unit ..... **[1]**

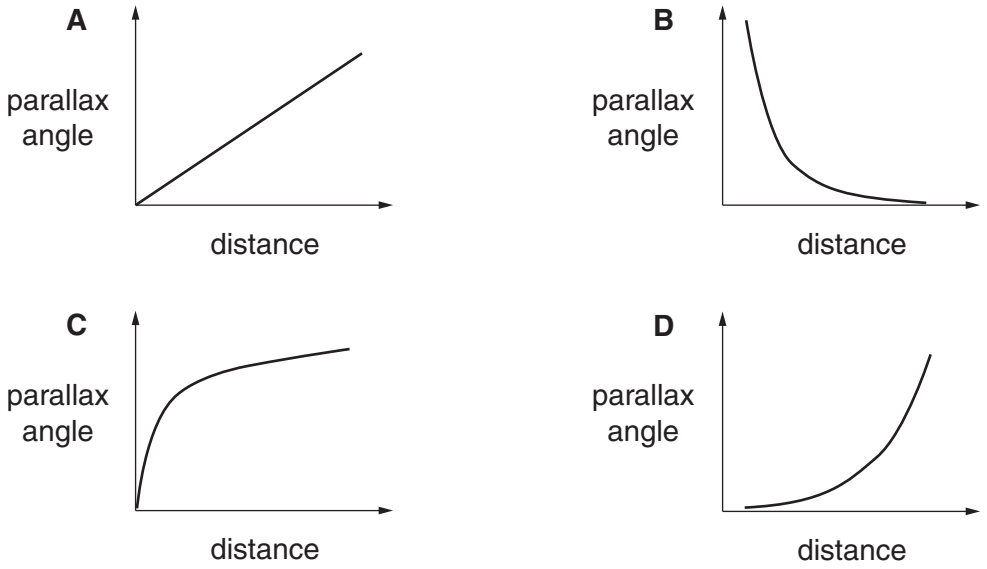
(b) One way of measuring astronomical distances is to use parallax.



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

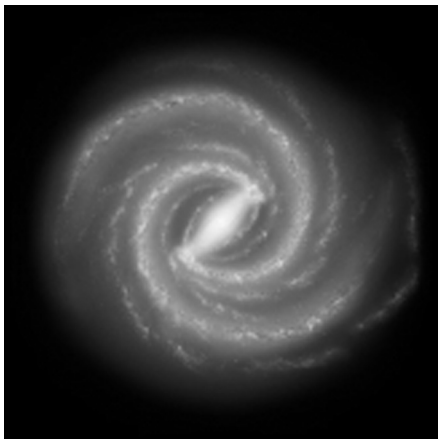
angle ..... **[1]**

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



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]

END OF QUESTION PAPER

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