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**OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION**

A333/01

**TWENTY FIRST CENTURY SCIENCE
PHYSICS A**

Unit 3: Ideas in Context plus P7 (Foundation 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

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

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

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

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

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

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

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

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

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

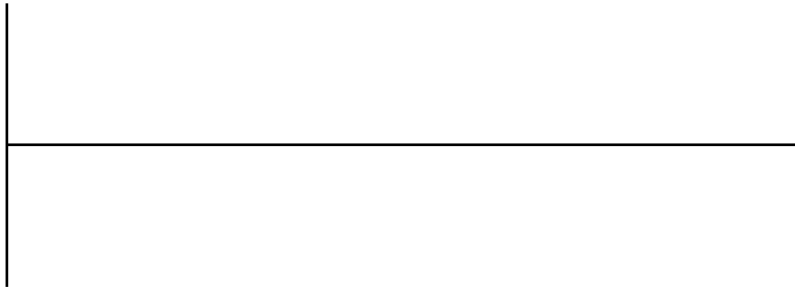
gamma, microwave, X-ray, ultraviolet, visible light, infrared, radio

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

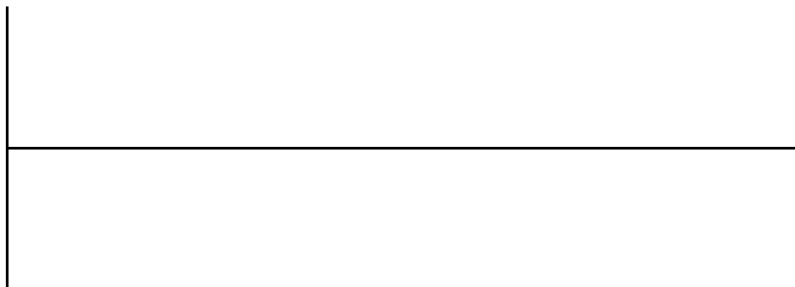
[1]

- (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]

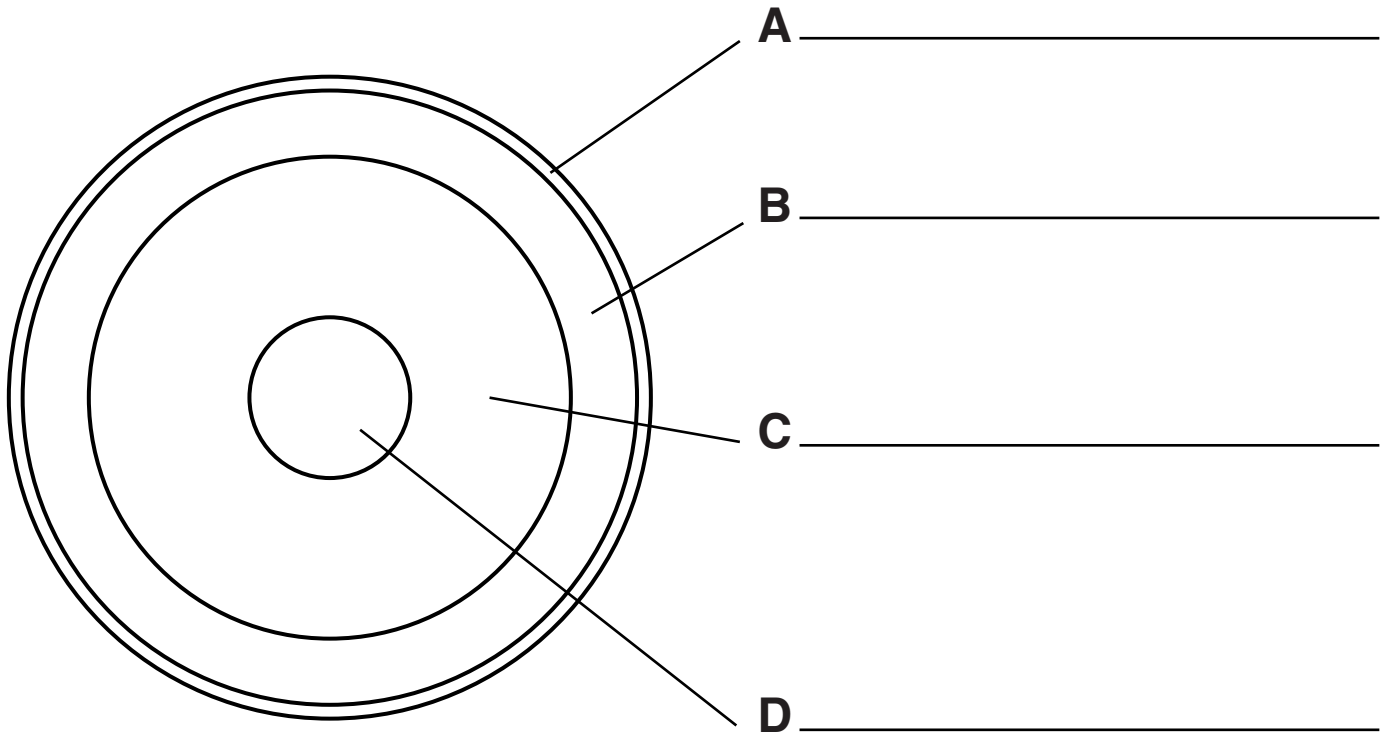
- (ii) Calculate the kinetic energy of the car as it crosses the finish line with a velocity of 84 m/s. The car has a mass of 600 kg.**

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 this 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 this 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.

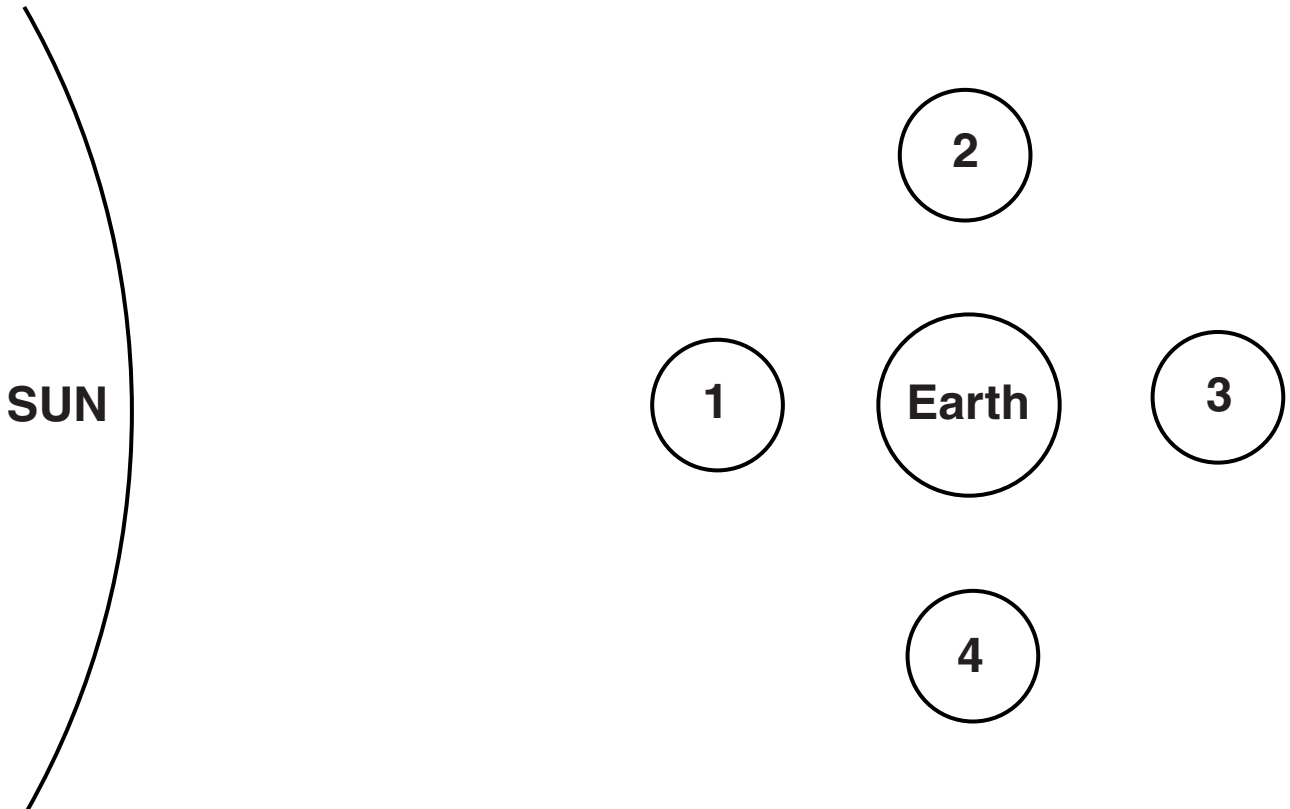
(i) The stars rotate around the pole star each day.

reason _____ [1]

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

reason _____ [1]

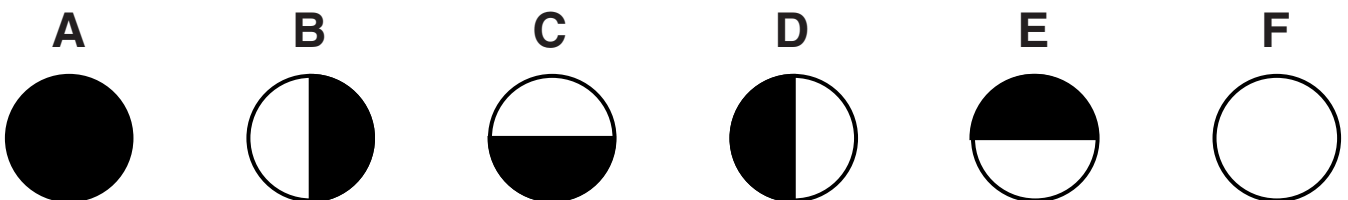
(b) (i) This is a diagram of the Moon, Earth and Sun. The Moon is shown in four positions, 1, 2, 3 and 4, as it orbits the Earth.



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]

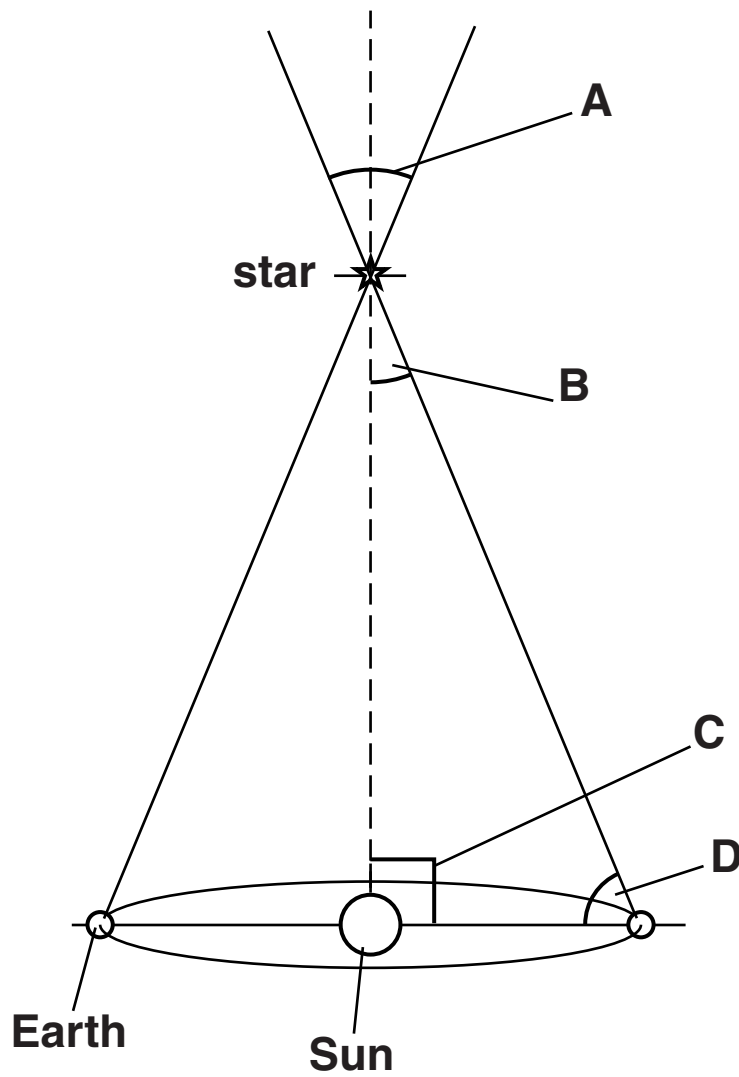
- (ii) Which of these would be the most suitable unit to use for the distance between the Sun and the star Sirius?**

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.

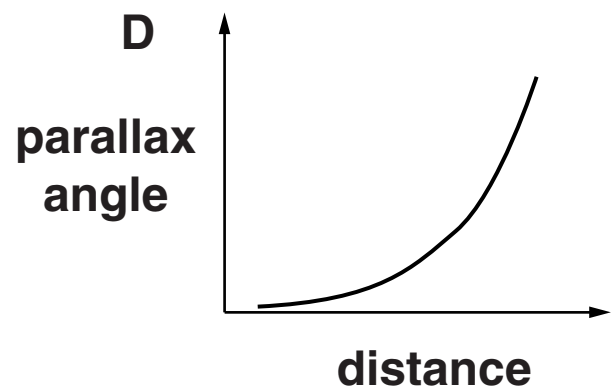
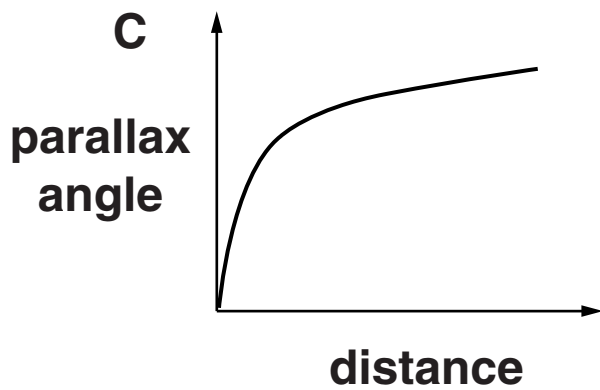
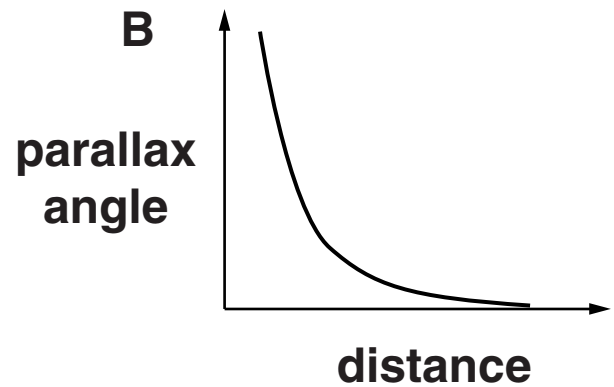
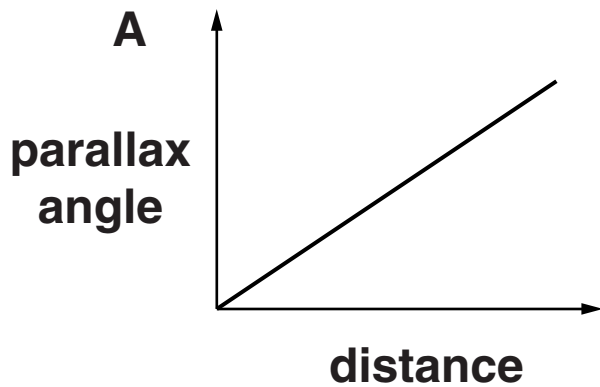


(i) Which angle, A, B, C or D, is the parallax angle of the star?

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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