OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

A333/02

PHYSICS A

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

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)

Wednesday 10 June 2009
Afternoon

Duration: 60 minutes

A333302

OCE/12687

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

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.

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful Relationships

Explaining Motion

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

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved by the force

change in energy = work done

change in GPE = weight × vertical height difference

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

Electric Circuits

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

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

energy transferred = power × time

power = potential difference × current

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

The Wave Model of Radiation

wave speed = frequency × wavelength

Further Physics, Observing the Universe

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

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

speed of recession = Hubble constant × distance

Answer **all** the questions.

1 This question is based on the article, '**Sheffield Supertram System**'.

(a) Draw a circuit diagram to show the tram circuit.
Include two trams in the circuit.
Use a resistor symbol for each tram.
Label the parts of your circuit.
You should include labels for

- overhead cable
- rail
- trams
- power supply.

[3]

(b) Calculate the momentum of the tram with no passengers when travelling at its maximum speed of 80 km/h (22 m/s).

momentum = ... kg m/s **[1]**

(c) (i) The a.c. electricity of the national grid is produced by generators.
At its simplest, a generator is a coil of wire and a magnet.
Describe how an a.c. generator works and sketch a graph to show the voltage produced.

.....

.....

.....

.....

[3]

(ii) Explain why the electricity is transmitted as a.c. from the power station to the local sub-stations.

.....

.....

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

(d) During a safety test the fully loaded supertram is rolled down a slope without using its brakes, to see what its final speed will be.

The slope is 20 m high.
The mass of the fully loaded tram is 85 000 kg.
The weight of the fully loaded tram is 850 000 N.

(i) Calculate the final speed expected.
Use equations on page 2 to help you.

final speed = ...m/s **[4]**

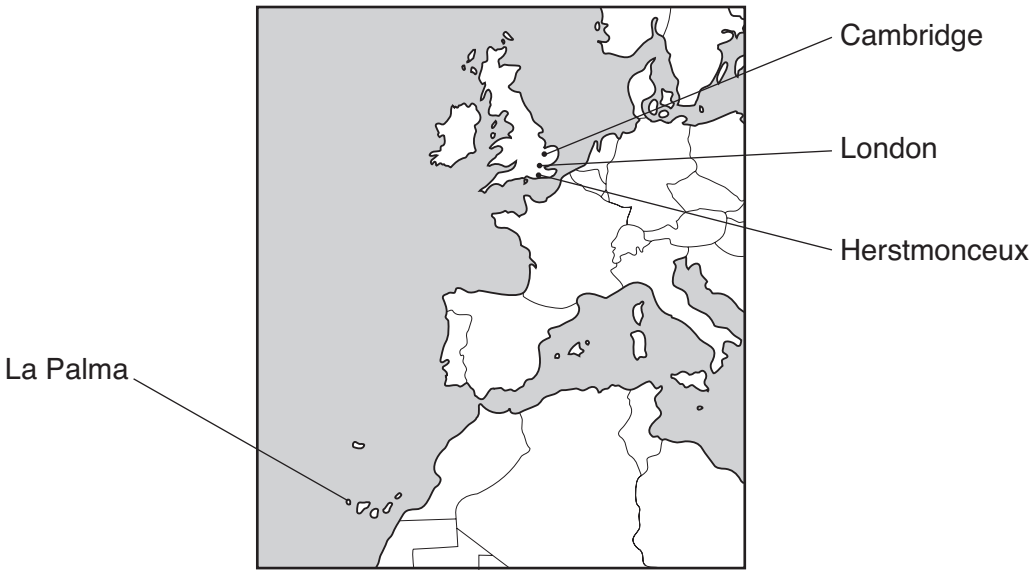
(ii) The speed measured was less than the speed you have calculated.
Explain why.

.....

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

[Total: 14]

2 The Royal Greenwich Observatory was built in London near the river Thames in 1675. During the 1950s the observatory telescopes were moved to Herstmonceux in the countryside south of London. In 1979 a new telescope was opened at La Palma, in the Canary Islands. Since 1990 astronomers located in Cambridge have operated the La Palma telescope remotely.



(a) (i) Suggest an **astronomical** reason for moving the observatory from London to Herstmonceux, in the Sussex countryside.

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

(ii) One of the telescopes moved from London to Herstmonceux was the 26-inch Thompson telescope.
The 26-inch diameter lens has a focal length of 6.2 m.
Calculate the power of the lens.

power = ... dioptre **[1]**

(iii) How would the power of the eyepiece lens compare with the power of the 26-inch objective lens?

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

(b) Many factors had to be taken into account when the main telescope was built on the top of a mountain on the island of La Palma.
Suggest two important **non-astronomical** factors to consider when choosing the site.

factor 1 .....

.....

factor 2 .....

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

(c) A new telescope, the Great Canary Telescope, at La Palma is a joint project involving several European countries. It has a mirror diameter of 10.4 metres.

(i) Very large telescopes use mirrors to collect the light.
Draw a diagram to show how a mirror can bring parallel rays of light to a focus.

[2]

(ii) The mirrors in modern astronomical telescopes are usually very large.
Explain why.

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

(d) Modern telescopes are controlled by computers.
Explain the advantages of computer control.

One mark is for a clear and well ordered answer.

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..... **[2+1]**

(e) Many astronomical projects now involve international co-operation.

Suggest two reasons for international co-operation.

reason 1 .....

.....

reason 2 .....

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

[Total: 14]

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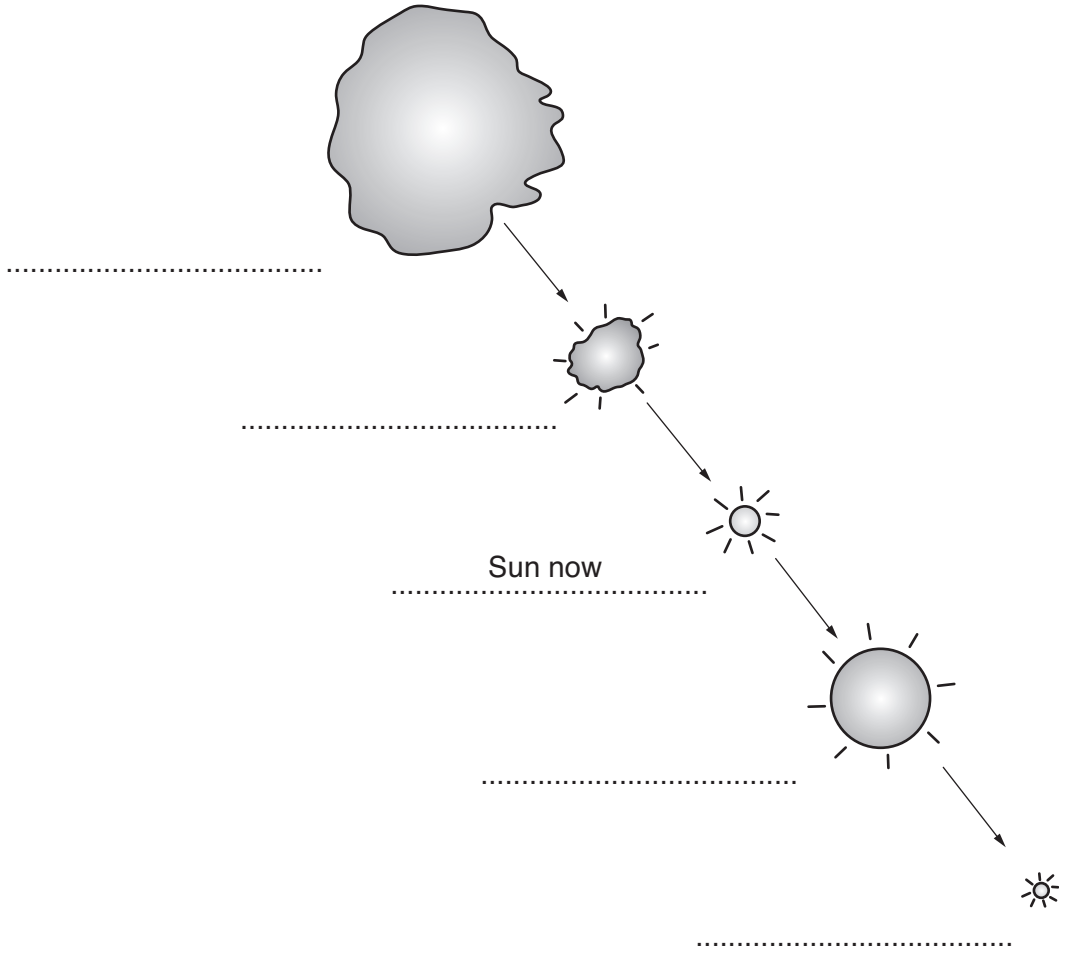
Question 3 starts on page 10.

3 **(a)** The diagram shows the stages in the life of a low mass star such as the Sun.

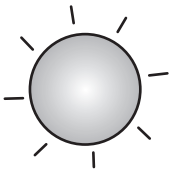
Complete labels for the different stages on the diagram.
The Sun as it appears now has been done for you.



[4]

(b) Complete and label a similar diagram for the later stages in the life of a star with very high mass.

giant star now



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[3]

(c) Nearly all the elements are produced in stars by nuclear fusion.

The processes taking place in a star change when the hydrogen in the core is depleted.

(i) What type of star is formed?

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

(ii) Write down two elements that are formed by fusion in this type of star

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

(iii) Which element fuses to form these elements? ..... **[1]**

(iv) Elements with large nuclei are produced in very massive stars.
The higher the mass of a star, the higher the core temperature will be.
Explain why elements with larger nuclei are produced in very massive stars.

Your answer should include ideas about:

- the structure of nuclei
- forces between charges
- nuclear fusion
- temperature and pressure in stars.

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..... **[4]**

[Total: 15]

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Question 4 starts on page 14.

4 **(a)** Using parallax is one way of measuring distances to stars.

(i) Draw and label a diagram to show the parallax angle of a star.

You should include
- the parallax angle
- the star
- the Sun
- the Earth.

[3]

(ii) The parallax angle measured for a star is 0.2 seconds of arc.
What is the distance to the star in parsecs?
Show your working.

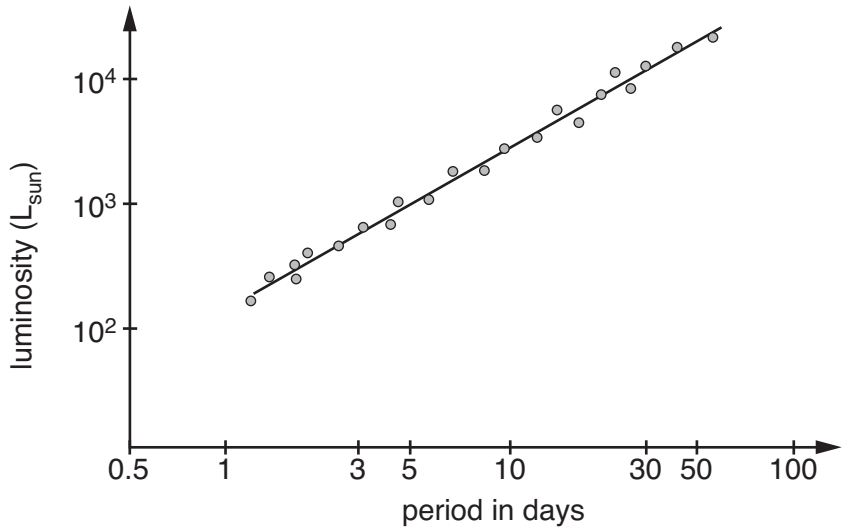
distance = ...parsecs **[1]**

(iii) In 1989 the Hipparcos satellite was launched to make parallax measurements.
The Hipparcos satellite was able to make more accurate measurements than Earth-based telescopes.
Give a reason why the Hipparcos satellite could make better measurements.

.....

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

(b) Using Cepheid variables is another method of finding astronomical distance.
The graph shows the luminosity (intrinsic brightness) of Cepheid variable stars plotted against the period.
The unit of luminosity (intrinsic brightness) is L_{sun}. This is the number of times the star is brighter than the Sun.



(i) What is the luminosity (intrinsic brightness) of a Cepheid variable with period 5 days?

.....L_{sun} **[1]**

(ii) Explain how the distance to a Cepheid variable star can be worked out.
Include in your answer

- how the graph helps
- what other information is needed
- how these are used to give the distance.

.....

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.....

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

(c) Explain how Edwin Hubble used observations of Cepheid variables to address the Curtis-Shapley debate.

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

[Total: 12]

END OF QUESTION PAPER