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)

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

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 **12** pages. Any blank pages are indicated.

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

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

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

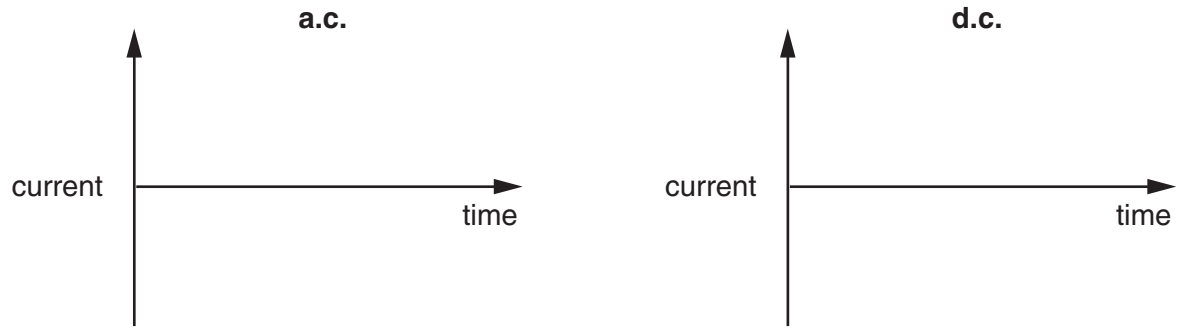
speed of recession = Hubble constant × distance

Answer **all** the questions.

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

(a) The tram uses both alternating current and direct current.

(i) Complete the two graphs, one to show an alternating current (a.c.) and the other to show a direct current (d.c.)



[2]

(ii) A device on the tram is used to store electrical energy and then produce a direct current.

What is the name of this device?

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

(b) The electrical power for the tram is supplied by the overhead power cables.

(i) What is the voltage used by the tram?

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

(ii) One of the motors on the tram uses a current of 30 amps.
Calculate the power produced by the motor.
Show your working.

power = ...watts **[3]**

(c) The motors provide the driving force on the tram.

(i) Write down two counter forces to the driving force on the tram.

1 .....

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

(ii) What can you say about the driving force and the counter force when the train is speeding up?

.....

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

(d) 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]

(e) 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]**

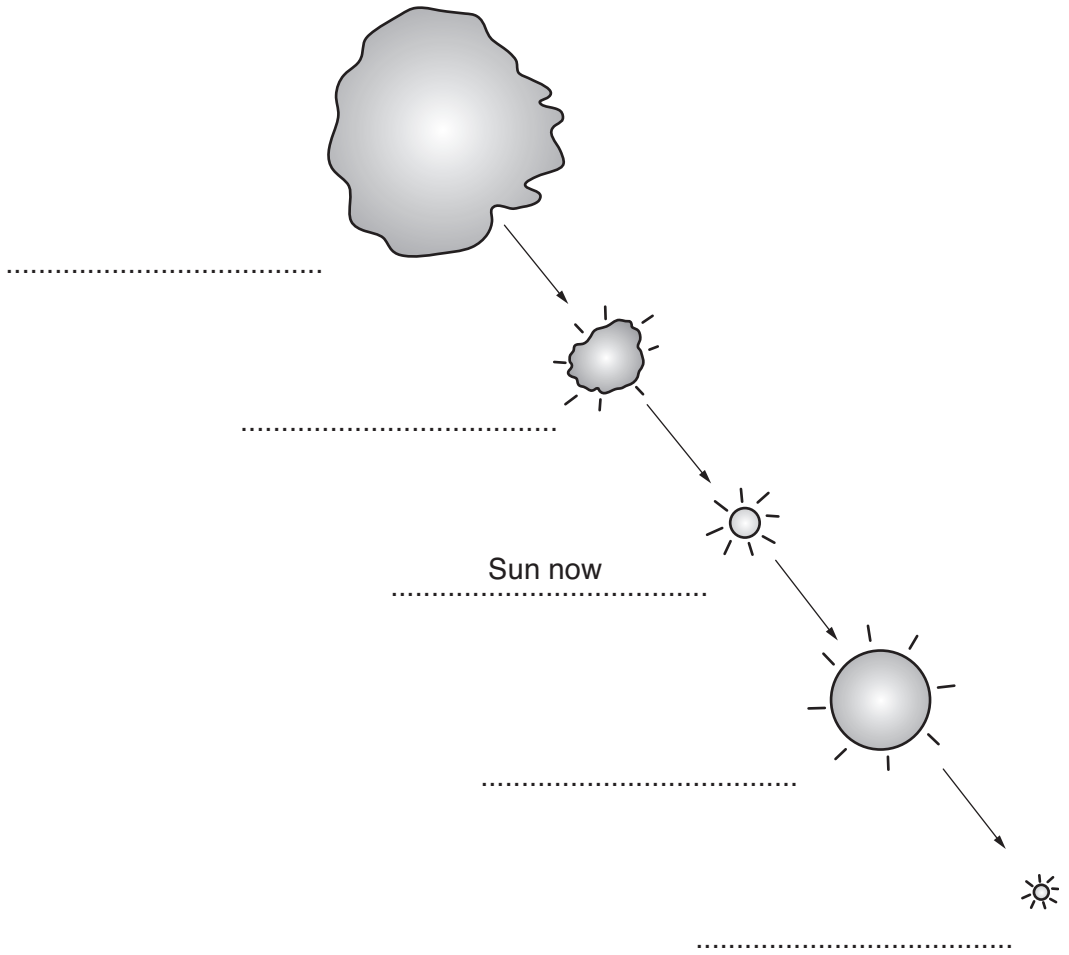
[Total: 14]

2 **(a)** The diagram shows the stages in the life of our Sun.

cloud of gas **neutron star** **protostar** **red giant**

Sun now **supernova** **white dwarf**

(i) Use some of the words from the list to label the different stages on the diagram.
The Sun as it appears now has been done for you.



[4]

(ii) A star that is much bigger than our Sun has different stages at the end of its life.
Which two stages in the list only happen in the life of a very large star?

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

(b) Heat produced in the core is transferred to the surface of the star.
What is the name of the part of a star that transfers the heat?

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

(c) Nuclear fusion takes place in the core of stars.

In nuclear fusion, elements with small nuclei fuse together to form elements with larger nuclei.
Use the table to help you answer the following questions.

element	size of nucleus (mass units)
hydrogen	1
helium	4
carbon	12
oxygen	16
iron	56
lead	207
uranium	238

(i) Which element in the table fuses to form helium when a young star forms?

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

(ii) Use one of the elements in the table to complete the sentence.

When stars run out of ..... in the core, they become red giants or red supergiants. **[1]**

(iii) Apart from helium, which **two** elements in the table might be produced in a red giant?

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

(iv) Iron is only likely to be produced in a red supergiant.
Put ticks (✔) in the boxes next to the **two** statements that best explain why.

Iron makes stars red.	☐
Very high pressures are needed.	☐
Iron has a large nucleus.	☐
There is no hydrogen to fuse.	☐

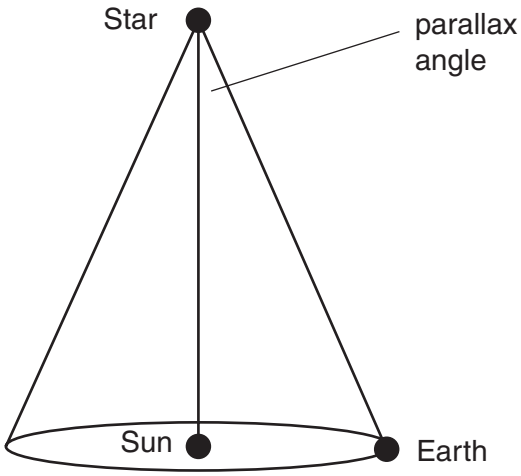
[2]

(v) Stars do not normally produce elements larger than iron.
Name an element from the table which could only be produced in a supernova.

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

[Total: 14]

3 **(a)** The diagram shows the parallax angle for a star.



(i) Sally is studying two stars, A and B.
Star A has a larger parallax angle than star B.
What can you say about the distances to star A and star B?

.....

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

(ii) The parallax angle measured for star A is 1/10 of a second of arc.
What is the distance to the star in parsecs?
Put a tick (✔) in the box next to the correct answer.

1 parsec	☐
10 parsecs	☐
100 parsecs	☐
1000 parsecs	☐

[1]

(b) The Hipparcos telescope was launched into space above the Earth's atmosphere.
It measured the parallax angle for many stars.
Give one advantage and one disadvantage of having a telescope in space.

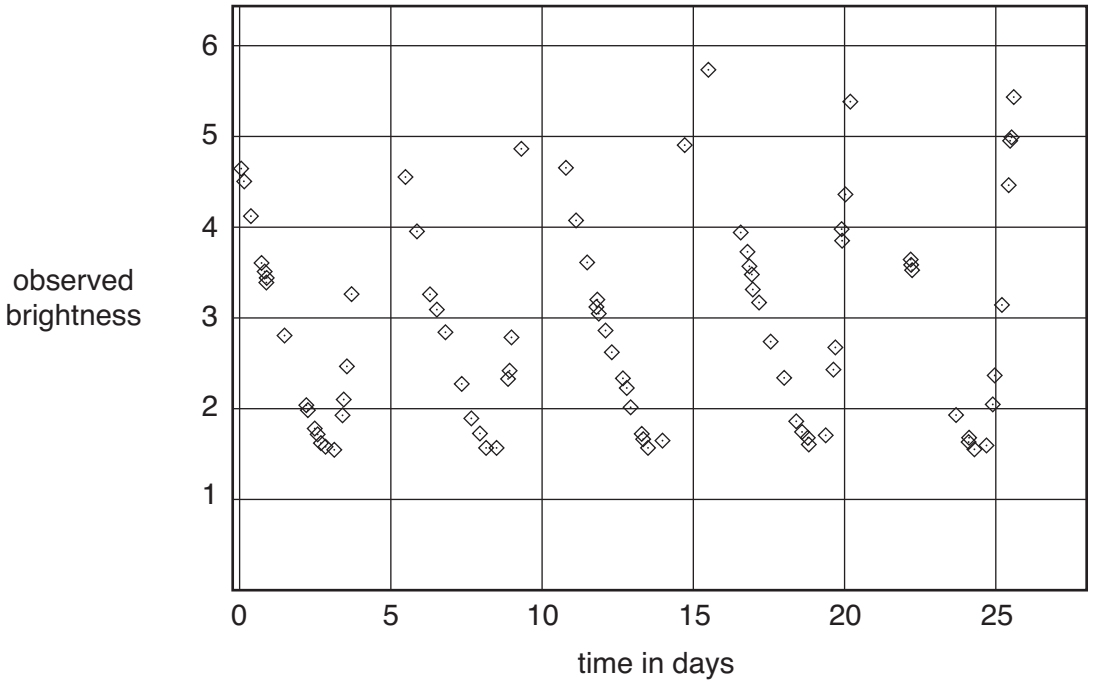
advantage .....

.....

disadvantage .....

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

(c) The graph shows how the observed brightness of the star, Delta Cephei, changes with time.



(i) What is the brightness of Delta Cephei at its dimmest?

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

(ii) The period is the time taken for one cycle of brightness.
What is the period of Delta Cephei?
Use the graph to find your answer.

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

(d) Astronomers use the luminosity (the intrinsic brightness) of stars to help work out the distance to a star.

(i) What **other** information about a star do astronomers need to work out the star's distance?

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

(ii) Which of the following factors affect the luminosity (intrinsic brightness) of a star?
Put ticks (✔) in the two boxes next to the correct factors.

size of star	☐
observed brightness	☐
temperature of star	☐
distance to star	☐

[2]

(e) **(i)** The following are units of distance.

metres **kilometres** **parsecs** **kiloparsecs** **megaparsecs**

Choose units from this list to complete the following sentences.

Distances between neighbouring stars in a galaxy are usually a few ..... .

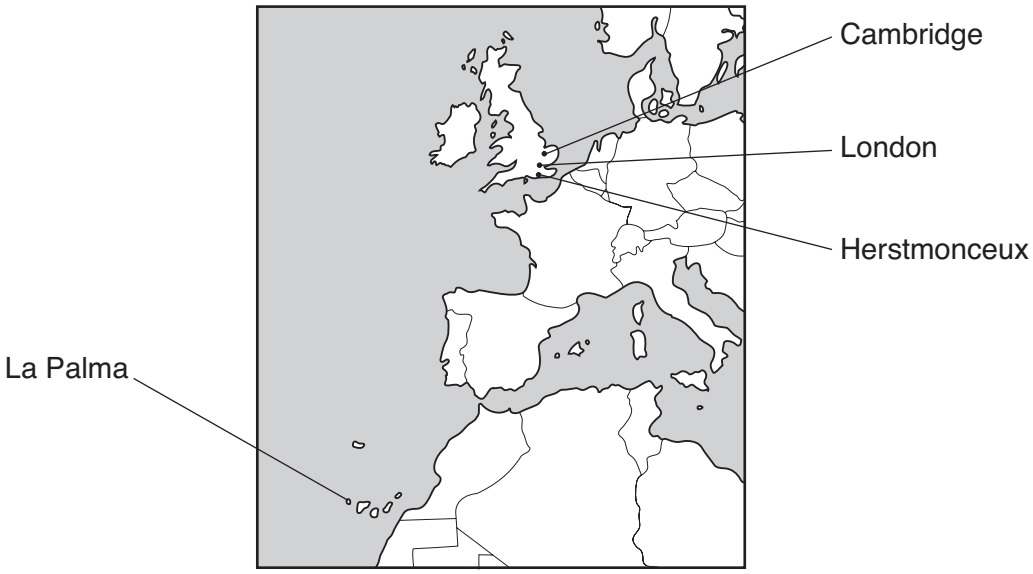
Distances between galaxies are usually measured in ..... . **[2]**

(ii) Write down the name of a distance unit that is not in the list, but is similar in size to a parsec.

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

[Total: 13]

4 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.

.....

.....

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

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

One mark is for a clear and well ordered answer.

.....

.....

.....

..... **[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]

END OF QUESTION PAPER