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)

WEDNESDAY 10 JUNE 2009: 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 (LEO/JG) OV90946 13230/1

INSTRUCTIONS TO CANDIDATES

- **Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.**
- **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.**
- **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 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

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

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

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

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

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

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

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

ELECTRIC CIRCUITS

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

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

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

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

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{time taken}} \times 100\%$$

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.

1 This question is based on the article, 'SHEFFIELD SUPERTRAM SYSTEM'.

(a) In the space below 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 in the space below 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 pages 4 and 5 to help you.

final speed = _____ m/s [4]

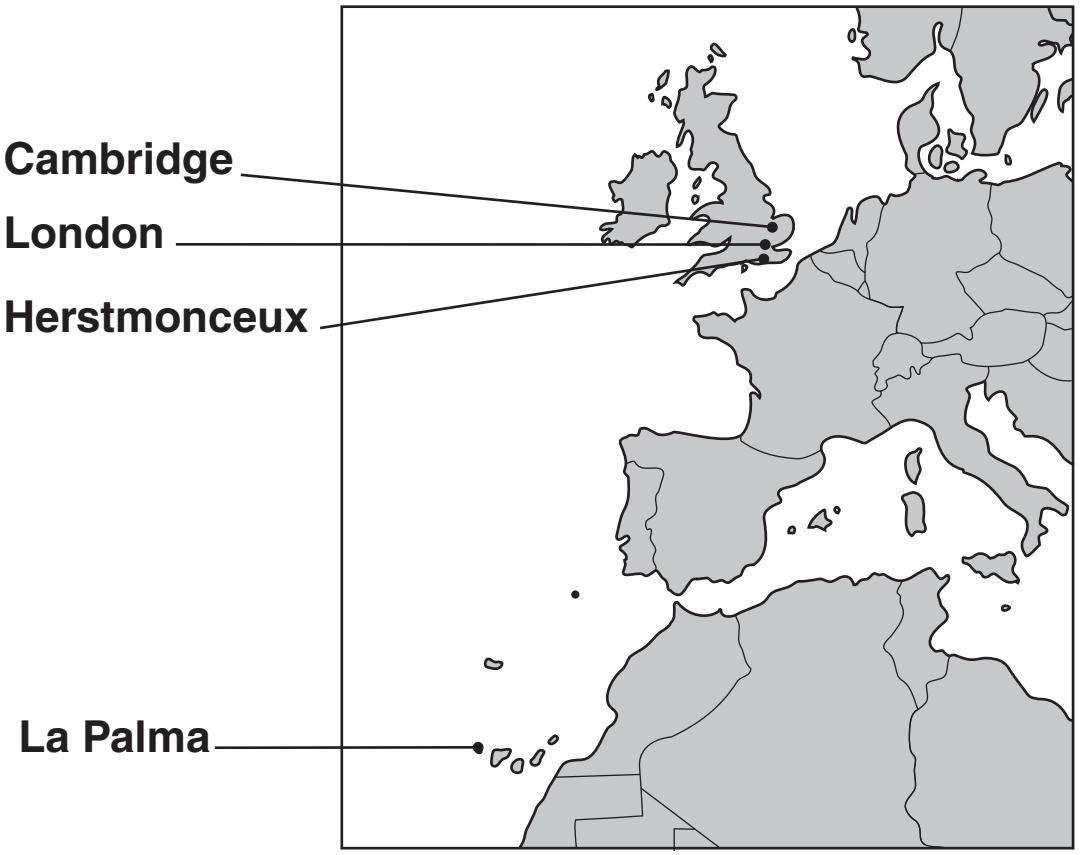
(ii) The speed measured was less than the speed you have calculated.
Explain why.

_____

_____ **[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 <u>ASTRONOMICAL</u> 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) When the main telescope was built on the top of a mountain on the island of La Palma many factors had to be taken into account.
Suggest two important <u>NON-ASTRONOMICAL</u> 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 _____

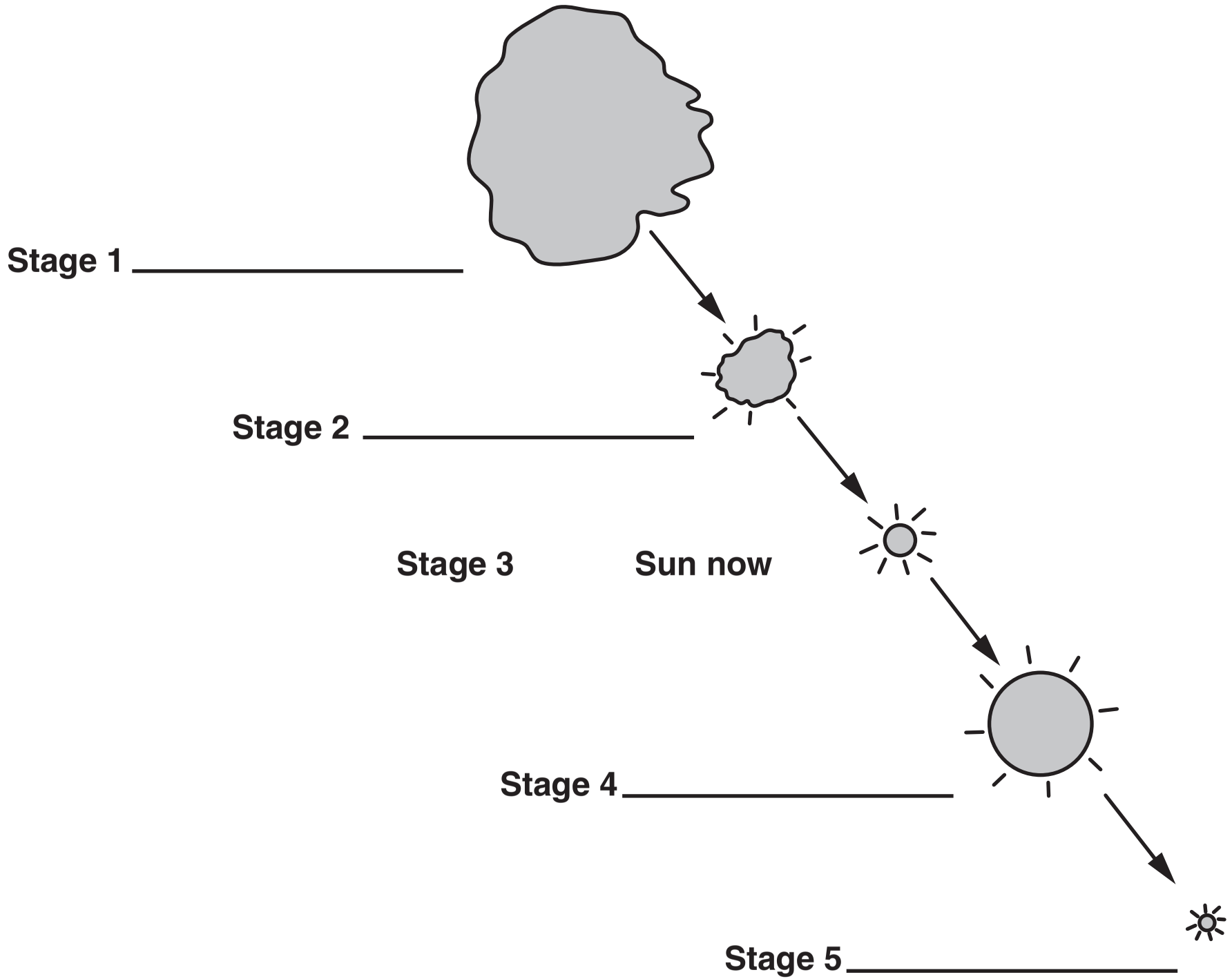
_____ **[2]**

[Total: 14]

3 (a) The diagram opposite 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.

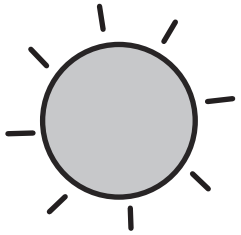
[4]


Stage 1
Stage 2
Stage 3
Sun now
Stage 4
Stage 5

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

[3]

stage 1 giant star now



stage 2 _____

stage 3 _____

stage 4 _____

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

When the hydrogen in the core is depleted, the processes taking place in a star change.

(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.**

_____

_____

_____

_____

_____

_____

_____

_____ **[4]**

[Total: 15]

4 (a) One way of measuring distances to stars is using parallax.

(i) In the space below 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) Another method of finding astronomical distance uses Cepheid variables.
The graph opposite shows the luminosity (intrinsic brightness) of Cepheid variable stars plotted against the period opposite.
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

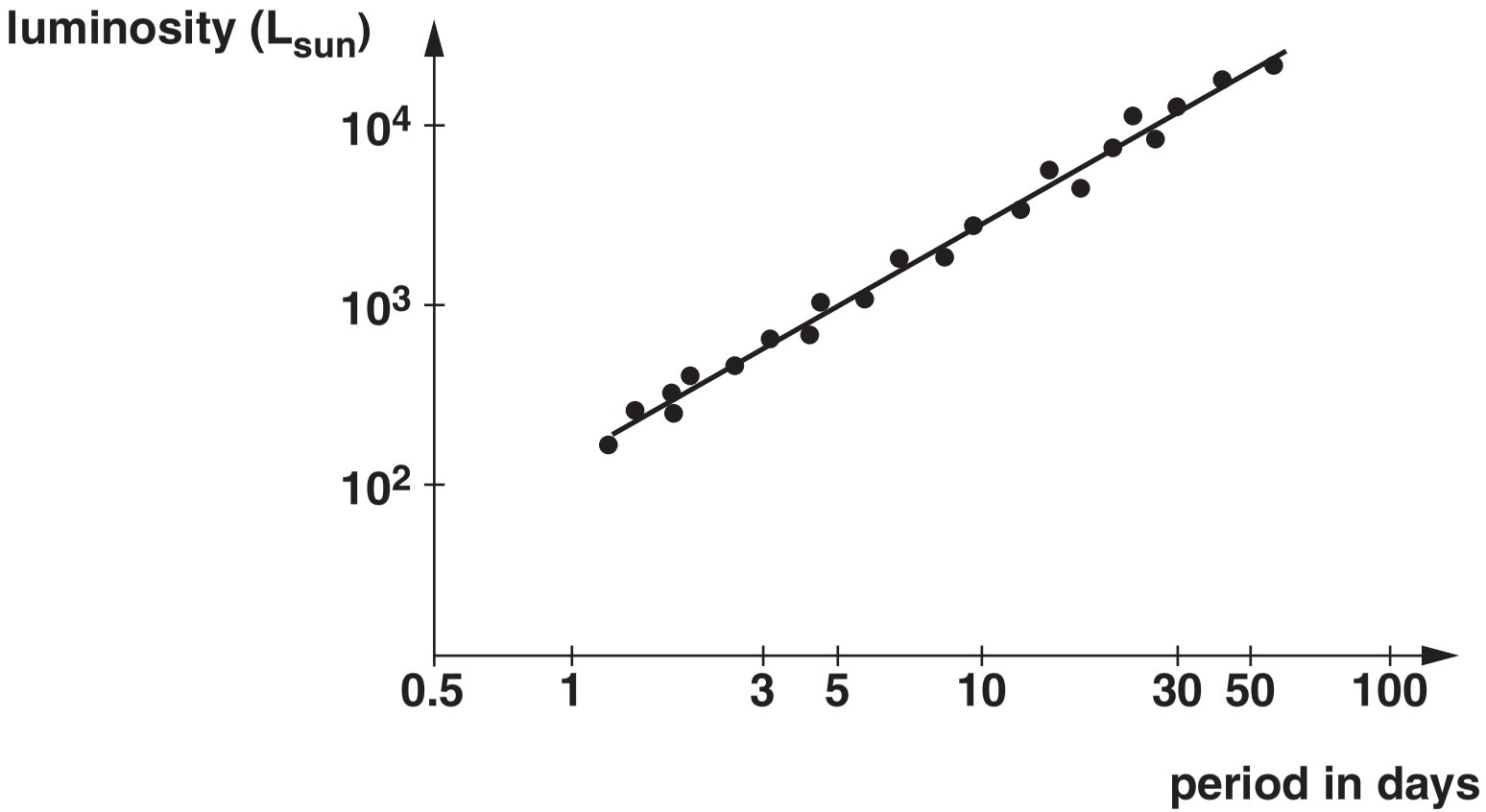
- **how the graph helps**
- **what other information is needed**
- **how these are used to give the distance.**

_____

_____

_____

_____ **[3]**


luminosity (L_{sun})
10^4
10^3
10^2
0.5
1
3
5
10
30
50
100
period in days

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

_____

_____

_____

_____

_____ **[3]**

[Total: 12]

END OF QUESTION PAPER