OCR
RECOGNISING ACHIEVEMENT

H

A333/02

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

PHYSICS A

Ideas in Context and Unit P7 (Higher Tier)

MONDAY 12 MAY 2008

Afternoon

Time: 60 minutes

Candidates answer on the question paper.
Additional materials (enclosed):
Insert

Calculators may be used.
Additional materials: Pencil
Ruler (cm/mm)

CUP/T58149

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or 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.

INFORMATION FOR CANDIDATES

- The number of marks for each question 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 useful relationships is included on page 2.

FOR EXAMINER'S USE		
Qu.	**Max**	**Mark**
1	**13**	
2	**14**	
3	**9**	
4	**5**	
5	**14**	
TOTAL	**55**	

This document consists of **12** printed pages and an insert.

[Turn over

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 Use the article on '**Should We Build New Nuclear Reactors?**' to help you answer this question.

(a) **(i)** The article says 'ionising radiation produced is harmful to living cells'.
Explain how ionising radiation harms living cells.

.....

.....

.....[2]

(ii) Cancer cells can be killed using ionising radiation from radioactive materials.
Suggest some benefits and risks a patient suffering from cancer should consider when deciding whether to have radiation treatment or not.

.....

.....

.....

.....[3]

(b) In a nuclear reactor the fission of a uranium nucleus can give rise to a chain reaction.
Explain what is meant by a chain reaction.
You may use diagrams to help.

.....

.....

.....[3]

(c) The article mentions some new safety features of modern reactor designs.
Explain how **one** of these features reduces the risk associated with a nuclear reactor.

.....

.....

.....[1]

(d) The two types of uranium isotopes U-235 and U-238 have similarities and differences in the particles that make up their nuclei.
Describe a similarity and a difference between the two nuclei.

.....

.....

.....

.....[2]

(e) Uranium 238 has a half life of 4.5 billion years.
How long would it take for a sample of U-238 to lose 7/8 of its radioactivity?
Show your working.

answer ..... years [2]

[Total: 13]

2 The photograph shows stars forming in a gas cloud.

When a cloud of gas is compressed a protostar forms.

(a) What causes the gas cloud to compress?

.....[1]

(b) As the gas cloud compresses the temperature of the gas increases.

(i) As the temperature increases, the pressure in the gas cloud changes.
Explain how the pressure changes.
Your answer should include
- what happens to the pressure
- how the behaviour of the particles of the gas changes.

.....

.....

.....[2]

(ii) Initially the temperature of the cloud is about 3 K.
What temperature is 3 K in °C?

..... °C [1]

(c) As the temperature inside the protostar increases all the electrons are removed from the atoms. This leaves positively charged nuclei.

(i) The nucleus of an atom can contain two types of particle.
Complete the table to show the names of the particles.

name of particle	charge on particle
	positive
	none

[1]

(ii) There is a strong attractive force which holds the particles together.
Another force pushes some of the particles in the nucleus apart.
What is this force?

.....[1]

(d) When the temperature is high enough, nuclei can fuse together to form new elements. This releases energy.

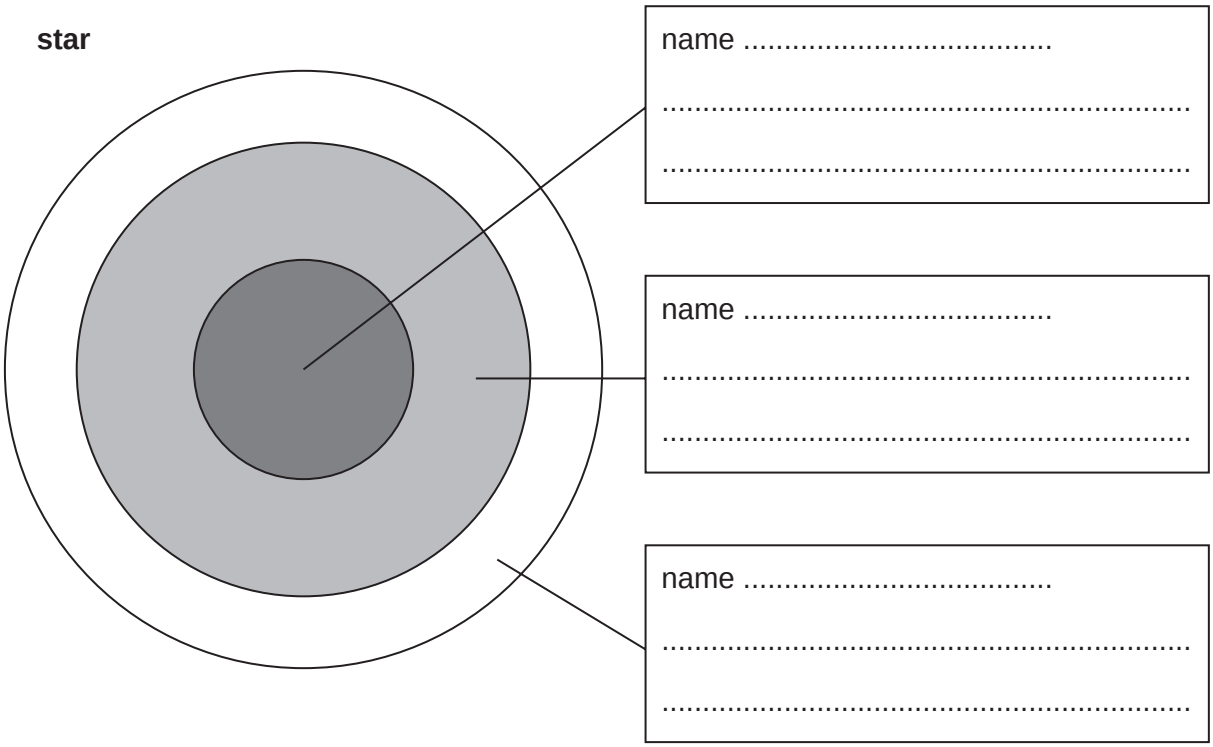
(i) Complete the equation for this fusion reaction with the names of the elements.

4 [.....] → [.....] + energy

[2]

(ii) The energy produced by the nuclear fusion is radiated into space.

The diagram shows the different regions inside a **star**.
Label each region with its name and say what is happening to the energy in that region.



[6]

[Total: 14]

3 **(a)** Sarah measures how long it takes the Sun and Moon to move across the sky.
The Sun takes 24 hours to move once around the sky.
The Moon takes **longer** than 24 hours.

(i) How much **longer** does the Moon take to move once around the sky?

.....[1]

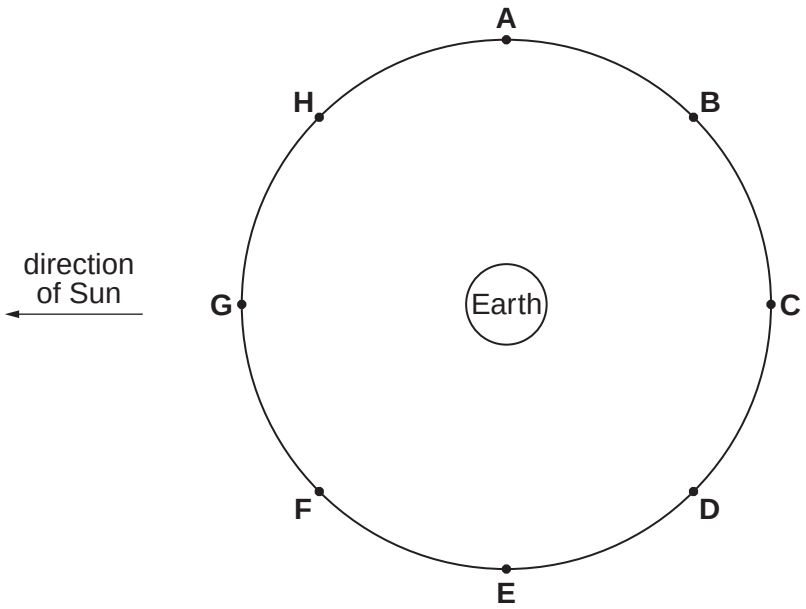
(ii) Explain why the Moon takes longer to move across the sky.

.....

.....

.....[2]

(b) The Moon orbits the Earth.
During an orbit it shows different phases.



Sarah sketches the phase of the Moon at different positions in its orbit.
Complete the table to show the position of the Moon in its orbit, for each phase.
One has been done for you.

phase of Moon	letter of position in orbit
	**A**
	
	
	

[3]

(c) The Moon orbits the Earth approximately once a month.
Solar eclipses occur much less often.
Explain what causes a solar eclipse and why they are so rare.
You may use a diagram to help you answer.

.....

.....

.....

.....

[3]

[Total: 9]

4 Many astronomical projects now involve international cooperation.
Describe one example of this.
Use your example to explain why international co-operation is important for big astronomical projects.

One mark will be for a clear and ordered answer.

.....

.....

.....

.....

.....

.....

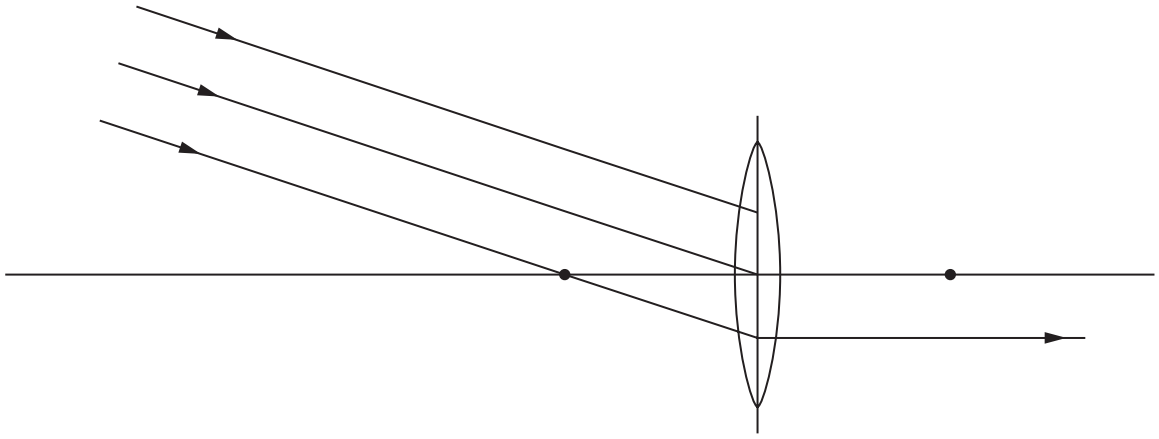
.....

.....[4+1]

[Total: 5]

5 Billy is making a simple telescope.

(a) He draws a diagram to show how a lens can produce an image of a distant object.
The focal points of the lens are shown by dots.
He draws three rays coming from the distant object.
Complete the diagram to show how the image is formed.
Label the position of the image on the diagram.



[3]

(b) Billy does some calculations to decide which lenses to use for his telescope.

(i) What is the focal length of a lens with power 20 dioptres?
You must show your calculation.

focal length = ... m [2]

(ii) The lenses he chooses have focal lengths of 0.5 m and 0.01 m.
What will be the magnification of the telescope?
You must show your calculation.

magnification = ... [2]

(iii) Explain why he should **not** choose two lenses with the same focal length.

.....

.....[1]

(c) Most astronomical telescopes do not use an objective lens.

(i) What do they use instead of an objective lens?

.....[1]

(ii) Draw a diagram to show how parallel rays of light are brought to a focus by your answer to part **(i)**.

[2]

(d) Radio waves and visible light waves have different wavelengths.
Radio telescopes must have much larger apertures than visible light telescopes to produce equally sharp images.
Explain why the radio telescopes need to be so much larger than optical telescopes.

.....

.....

.....

.....[3]

[Total: 14]

END OF QUESTION PAPER