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SCHOOL BASED SYLLABUS

ASTRONOMY
STANDARD LEVEL
PAPER 1

Candidate session number

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Tuesday 30 April 2013 (morning)

45 minutes

Examination code

2	2	1	3	–	9	0	0	4

INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is *[30 marks]*.

10 pages
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The following information may be useful

$1\,\text{AU} = 1.496\times10^{11}\,\text{m}$

$H_0 \approx 72\,\text{km s}^{-1}\,\text{Mpc}^{-1}$

1 light year $= 0.307$ parsecs $= 9.47\times10^{15}\,\text{m}$

$c = 3.00\times10^{8}\,\text{m s}^{-1}$

$G = 6.67\times10^{-11}\,\text{N m}^2\,\text{kg}^{-2}$

$\sigma = 5.67\times10^{-8}\,\text{W m}^{-2}\,\text{K}^{-4}$

$L_\odot \approx 3.84\times10^{26}\,\text{W}$

$T_\odot \approx 5770\,\text{K}$

$M_\odot \approx 1.99\times10^{30}\,\text{kg}$

$R_\odot \approx 6.96\times10^{8}\,\text{m}$

$k = 1.38\times10^{-23}\,\text{JK}^{-1}$

$M_\oplus = 5.98\times10^{24}\,\text{kg}$

1 parsec $= 206\,265\,\text{AU} = 3.09\times10^{16}\,\text{m} = 3.26$ light years

$1^\circ = 3600$ arcsec $= 1.75\times10^{-2}$ rads

$$M_\text{J} = \frac{9}{4}\left(\frac{1}{2\pi n}\right)^{\frac{1}{2}}\frac{1}{m^2}\left(\frac{kT}{G}\right)^{\frac{3}{2}}$$

$$F = \frac{GM_1M_2}{r^2}$$

$$e = \sqrt{1-\left(\frac{b}{a}\right)^2}$$

$$z = \frac{H_0}{c}d = \frac{\lambda_\text{obs}-\lambda_\text{em}}{\lambda_\text{em}}$$

$$v = \frac{d}{t}$$

$$F = ma$$

$$c = f\lambda$$

$$\text{KE} = \frac{1}{2}mv^2$$

$$\lambda_\text{max} = \frac{2.90\times10^{-3}}{\text{T}}$$

$$\text{GPE} = mgh$$

$$v_\text{escape} = \sqrt{\frac{2GM}{R}}$$

$$m_\text{B} - m_\text{A} = -2.5\log\left[\frac{b_\text{B}}{b_\text{A}}\right]$$

$$\text{PE} = -\frac{GMm}{r}$$

$$\text{f} = \frac{[\text{a}-\text{b}]}{\text{a}}$$

$$E = mc^2$$

$$L \approx 4\pi R^2\sigma T^4$$

$$L = F.4\pi d^2$$

$$N = R\,.\,f_\text{p}\,.\,n_\text{e}\,.\,f_\text{l}\,.\,f_\text{i}\,.\,f_\text{c}\,.\,L$$

$$L.\theta = d$$

$$F = \frac{L}{4\pi d^2}$$

$$d = \frac{1}{\phi}$$

$$\frac{\text{b}_1}{\text{b}_2} = 2.5^{(\text{m}_2-\text{m}_1)}$$

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*Answer **all** questions. Write your answers in the boxes provided.*

The Stars

1. Define the following terms. *[2]*

Parsec: . . . . . .

. . . . . .

Photosphere: . . . . . .

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2. The electromagnetic radiation emitted from a star can be used to measure many of its properties. This area of research is often referred to as spectroscopy.

It is known that the light given off by a particular element is specific to that element and can be thought of as a fingerprint – if evidence of this fingerprint is seen in the overall emission spectrum of the star, then it indicates the element's presence.

Figure 1 shows the emission spectrum for hydrogen as a set of emission lines in the visible spectrum.

Figure 1: The emission spectrum for hydrogen

Briefly explain how the visible emission spectrum for hydrogen is produced. *[2]*

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3. Stars on the main sequence have nuclear fusion occurring within their cores. In this process, hydrogen is turned into helium.

Although the exact mechanism can vary, for low mass stars the predominant fusion reaction is known as the ppI-chain.

State the basic equation for the ppI-chain occurring in the Sun. Your answer should clearly indicate the isotopes involved and the end products. *[2]*

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4. The star Albireo is the third brightest star in the constellation of Cygnus. Since Cygnus is known as the Swan, and Albireo is located at the head of the swan, it is sometimes called the beak star. It also forms part of the Northern Cross.

Figure 2: The star Albireo

Albireo looks like a single star but is actually three – a doublet and a single. Although the stars are quite far apart, there is evidence that they are gravitationally attached, with an extremely long orbit and an orbital period of at least 75 000 years.

The stellar parallax of Albireo is 0.009 arcsec. Calculate the distance of the star from the Sun. Express your answer in metres. *[2]*

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The Planets

5. Briefly explain how it is thought the Moon formed around the Earth. *[3]*

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6. Give **one** similarity and **one** difference between what is thought to be the source of magnetic field for the Earth and for a Jovian planet. *[2]*

Similarity: . . . . . .
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Difference: . . . . . .
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7. An extinction event is one which produces a sharp decrease in the number of species in a relatively short period of time. Mass extinctions affect an unusually large number of species in a short period.

In the past 550 million years there have been five major events where at least 50% of the planet's animal species died!

For such mass extinctions to occur, the following two factors are required:

1. Long-term pressure on the eco-system.
2. A sudden catastrophe towards the end of the period of pressure.

The following table gives some factors which could possibly combine to result in a mass extinction event. Complete the following table by ticking **one** box in each row to indicate if the factor is either long-term or short-term. *[2]*

Possible factors contributing to a mass extinction event		
Factor	**Long-term factor**	**Short-term factor**
Asteroid impact		
Continental drift		
Supernova event		

8. Give **one** reason why radio telescopes are particularly useful in searching for life in the universe. *[1]*

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Galaxies

9. Figure 3 shows two of the four main types of galaxy. Using the Hubble classification for naming galaxies, state what types of galaxy are shown. *[2]*

Figure 3: Two different types of galaxy

M100

M49

M100: . . . . . .

M49: . . . . . .

10. Define the following terms. *[2]*

Baade's window: . . . . . .

. . . . . .

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Nuclear bulge: . . . . . .

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11. Give **two** properties of Population II stars. *[2]*

Property 1: . . . . . .

Property 2: . . . . . .

12. The flattening factor for an elliptical galaxy has not been seen to be greater than 0.70. For this value, calculate the ratio of the semi-major to semi-minor axis. *[2]*

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Cosmology

13. There are thought to be four fundamental forces in the universe. One of these is the electromagnetic force.

For this force, state **two** characteristics that clearly distinguish it from the other three. *[2]*

Characteristic 1: . . . . . .

Characteristic 2: . . . . . .

14. Explain what is known as Olber's paradox and state how it may be explained. *[3]*

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15. Explain what is meant by the *cosmological principle*. *[1]*

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