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Monday 23 June 2014 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE PHYSICS A/FURTHER ADDITIONAL SCIENCE A

A183/01 Module P7 (Foundation Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✐).
- A list of useful relationships is printed on pages 2 and 3.
- 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 **60**.
- This document consists of **16** pages. Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

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

Explaining motion

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

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

momentum = mass × velocity

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

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

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

Electric circuits

power = voltage × current

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

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

Radioactive materials

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

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

pressure × volume = constant

$$\frac{\text{pressure}}{\text{temperature}} = \text{constant}$$

$$\frac{\text{volume}}{\text{temperature}} = \text{constant}$$

energy = mass × [speed of light in a vacuum]^2

Answer **all** the questions.

1 Much of our knowledge about stars comes from the light we receive from the stars.

(a) (i) It is very useful to produce a spectrum of the light from a star.

Draw a labelled diagram to show how a prism can produce a spectrum from a beam of light.

[3]

(ii) What is the name of the process in the prism that causes the spectrum?

Put a (ring) around the correct answer.

absorption **parallax** **reflection** **refraction**

[1]

(iii) What else can be used to produce a spectrum, other than a prism?

.... **[1]**

(b) The spectrum from a star can give important information about the star.

Complete the sentences about lines in a spectrum.

Choose the best words from the list.

electrons **light** **lines** **neutrons** **sound**

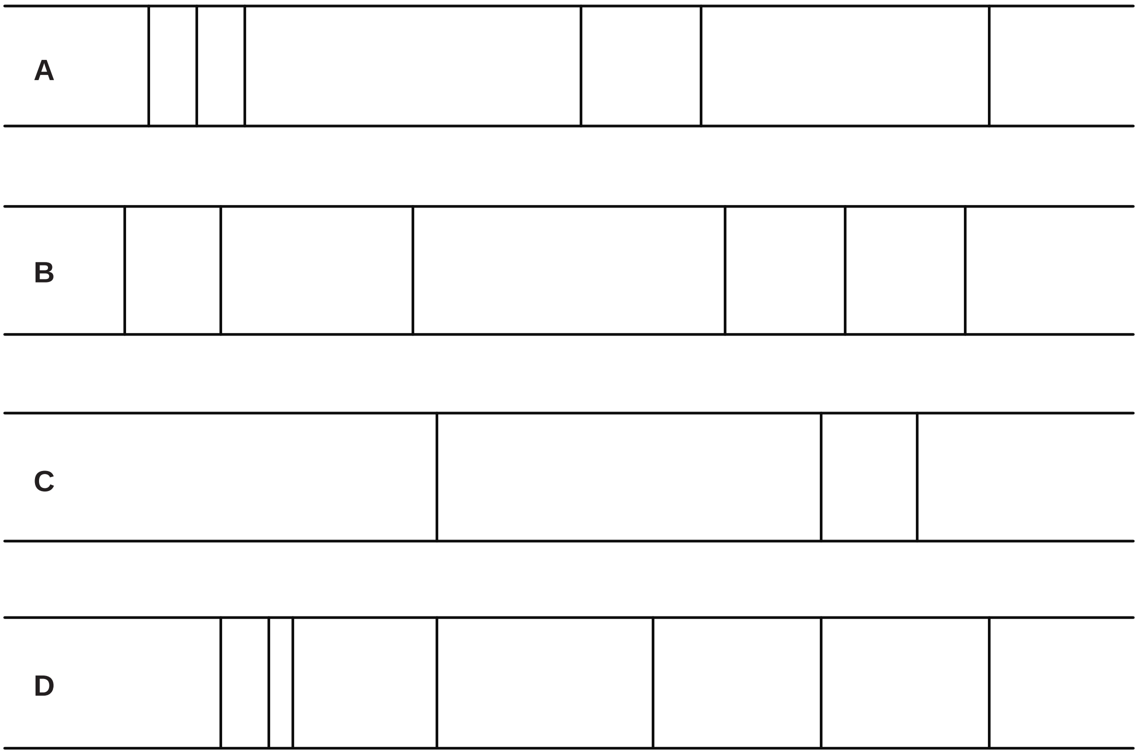
Dark lines in the spectrum are produced when .... is absorbed.

Each element gives a different pattern of .... in a star's spectrum.

[2]

(c) **(i)** The diagram shows the spectrum from a star

Use the spectra for the elements **A**, **B**, **C**, **D** shown below to work out which **two** elements are in the star.



Which **two** elements **A**, **B**, **C** or **D** are in the star?

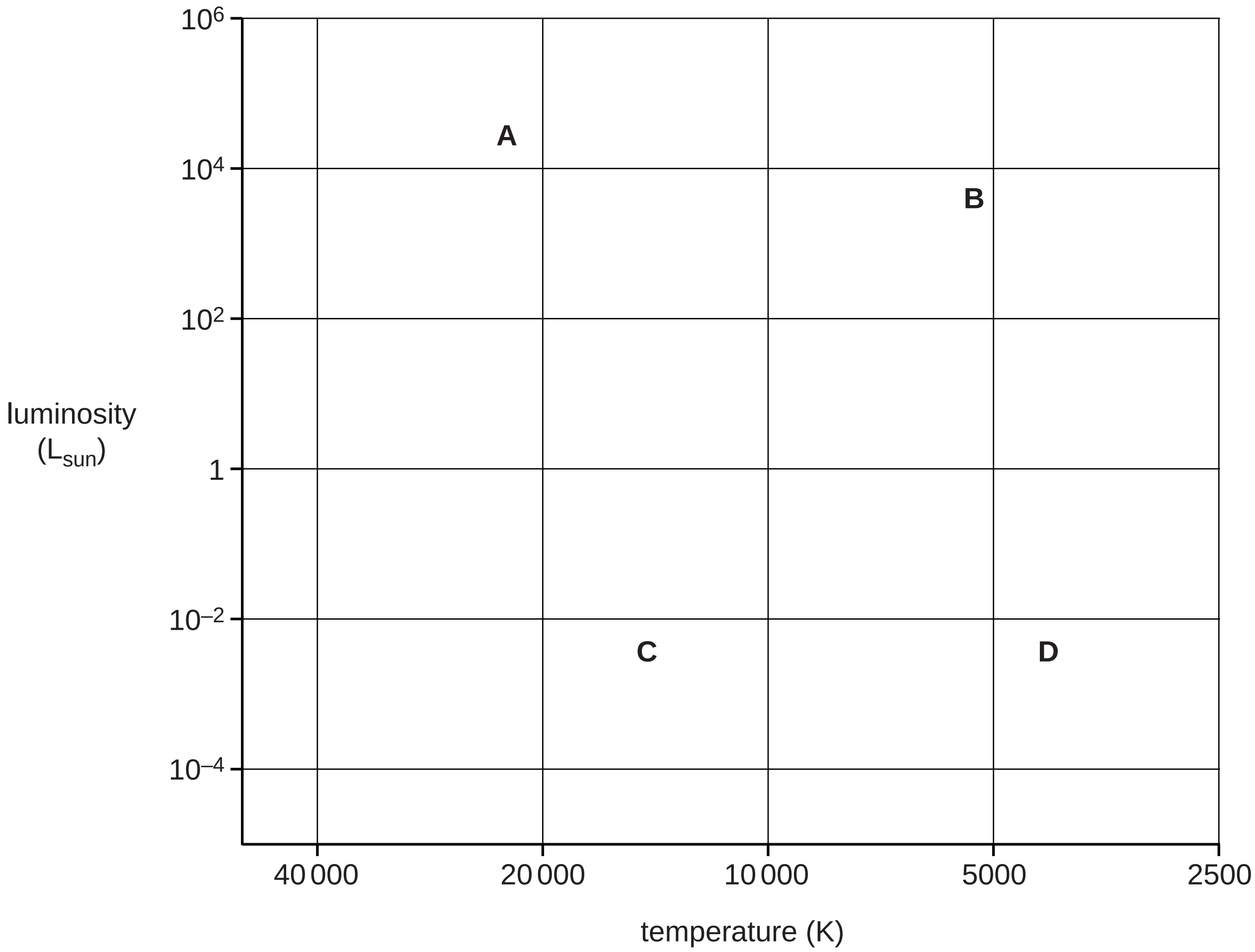
answer .... and .... **[2]**

(ii) What are the **names** of the two most common elements in a young star?

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

[Total: 11]

2 This question is about the Hertzsprung-Russell diagram.



(a) The Hertzsprung-Russell diagram above shows the temperature and brightness of four objects **A**, **B**, **C** and **D**.

Which object on the Hertzsprung-Russell diagram will be:

hottest and brightest? answer **A**, **B**, **C** or **D**? ....

coolest and dimmest? answer **A**, **B**, **C** or **D**? ....
[2]

(b) What type of object is the Hertzsprung-Russell diagram designed to show?

Put a (ring) around the correct answer.

galaxies **moons** **planets** **stars**
[1]

(c) (i) The Sun has a temperature of about 5000 K and luminosity of 1 L_{sun}.

Plot and label the position of the Sun on the Hertzsprung-Russell diagram above. **[2]**

(ii) The average temperature of the Earth is about 15 °C.

What is this temperature in kelvin (K)?

temperature = ... K **[2]**

(iii) The Earth can not be plotted on this Hertzsprung-Russell diagram.
Why not?

.... **[1]**

(d) **A**, **C** and **D** on the Hertzsprung-Russell diagram are stars.

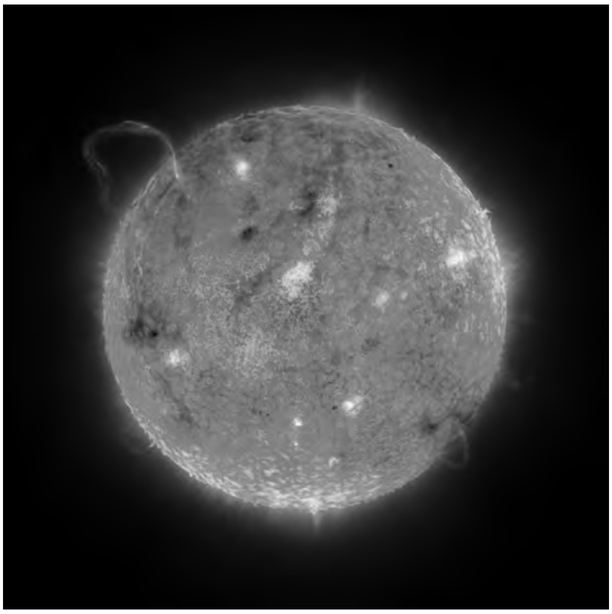
Draw straight lines to connect the **stars** to the **type of star**.

stars	**type of star**
A and **D**	main sequence
C	red giant
	supergiant
	white dwarf

[2]

[Total: 10]

3



Describe the life of a star like the Sun, from its formation to its death.

The quality of written communication will be assessed in your answer.

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.... **[6]**

[Total: 6]

4 The table gives some information about possible sites for a new astronomical observatory.

Site	**Height above sea level in m**	**Average cloudless nights per year**	**Distance to nearest town in km**
W	5000	360	100
X	1000	120	150
Y	6000	270	50
Z	500	230	30

Which site would be the best for an astronomical observatory?
By considering each site, explain and justify your choice.

The quality of written communication will be assessed in your answer.

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.... **[6]**

[Total: 6]

5 In recent years, scientists have observed things outside our solar system.
These observations make them think it is more likely that life will be found outside our solar system.

(a) What have scientists observed and how do these observations make it more likely that life will be found outside the solar system?

....

....

....

.... **[2]**

(b) How many species of extraterrestrial life have scientists found?

.... **[1]**

[Total: 3]

6 Draw a labelled diagram to explain a **lunar** eclipse.

[3]

[Total: 3]

7 In the late 1700s, the Titius-Bode Law was published.

The law was used for calculating the distance of the planets from the Sun. The distance from the Earth to the Sun is 1 AU. This is what the law says:

To find the distance in AU:

- take the sequence of numbers 0, 3, 6, 12, 24, 48, 96, … (each number after the first two is double the previous number)
- add 4 to each number in the sequence
- divide each number by 10 to give the distance.

Titius-Bode distance calculation in AU	Planet	Actual distance from Sun in AU
(0 + 4) / 10 = 0.4	Mercury	0.39
(3 + 4) / 10 = 0.7	Venus	0.72
(6 + 4) / 10 = 1.0	Earth	1.00
(12 + 4) / 10 = 1.6	Mars	1.52
(48 + 4) / 10 = 5.2	Jupiter	5.20
(96 + 4) / 10 = 10	Saturn	9.54

(a) Suggest why the Titius-Bode Law was only applied to the six planets out to Saturn in the first instance.

....

.... **[1]**

(b) Bode thought there should be a planet between Mars and Jupiter.

(i) Calculate the distance using the Titius-Bode Law.

distance = ... AU **[2]**

(ii) In 1801, the astronomer Giuseppe Piazzi discovered a new (dwarf) planet, *Ceres*, at a distance of 2.77 AU from the Sun.
Does this support the Titius-Bode Law?
Explain why.

....

.... **[1]**

(iii) Giuseppe Piazzi did not make enough observations to describe the orbit of *Ceres*. Other astronomers could not find the planet.

Why is it important that other astronomers observe the new planet?

....

....

.... **[2]**

(c) The table below gives the data for other more recently discovered planets.

Titius-Bode calculation of distance in AU	Planet	Actual distance from Sun in AU
(192 + 4) / 10 = 19.6	Uranus	19.18
(384 + 4) / 10 = 38.8	Neptune	30.06
(768 + 4) / 10 = 77.2	Pluto	39.44

Discuss how these results affect confidence in the Titius-Bode Law.

....

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.... **[4]**

[Total: 10]

8 One of the most distant objects visible to the naked eye is the Andromeda galaxy.

Edwin Hubble first measured the distance to the Andromeda galaxy using Cepheid variables. He measured the distance as about 1 million light years. Modern measurements using Cepheid variables, give a distance of 2.5 million light years.

Telescopes in space have made it possible to make better measurements of parallax and of the brightness of stars.

Explain:

- how using space telescopes gives better measurements of parallax and brightness
- how this improves measurement of distance to Cepheid variables.

The quality of written communication will be assessed in your answer.

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.... **[6]**

[Total: 6]

9 Ian is a young scientist at university. He reads about some research in a peer reviewed scientific journal.

(a) What is meant by 'peer reviewed'?

....

....

....

.... **[2]**

(b) The research measured the speed of recession of a galaxy.
Ian's supervisor asks him to reproduce the results.

(i) Ian looks up the distance to the galaxy in a reference book and then calculates the speed of recession for the galaxy using the Hubble constant.
distance to galaxy = 2000 Mpc
Hubble constant = 70 km/s per Mpc

Calculate the speed of recession of the galaxy.

speed of recession = ... km/s **[2]**

(ii) Ian's results agree with the published research.
However Ian's supervisor tells him that he has not reproduced the results.
What is the problem with Ian's method?

....

.... **[1]**

[Total: 5]

END OF QUESTION PAPER

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