# A-Level
# Answers / Planet Pavilion

1. Use the equation to calculate what the diameter of the model Earth should be.

   Rearranging the equation gives:

   **Model Earth diameter = $\frac{\text{Real Earth diameter}}{\text{Real Sun diameter}}$ x Model Sun diameter**

   **The diameter of the Sun is approximately 100 times that of the Earth.**

   **∴ Model Earth diameter = 0.01 × 15 cm**

   **= 0.15 cm = 1.5 mm**

2. Write a similar equation to the one given, which can be used to calculate the orrery's Earth-Sun distance.

   $$\frac{\textbf{Real Sun Diameter}}{\textbf{Model Sun Diameter}} = \frac{\textbf{Real Earth - Sun Distance}}{\textbf{Model Earth - Sun Distance}}$$

   **Or:**

   $$\frac{\textbf{Real Earth Diameter}}{\textbf{Model Earth Diameter}} = \frac{\textbf{Real Earth - Sun Distance}}{\textbf{Model Earth - Sun Distance}}$$

3. Now use your equation to calculate what the Orrery's Earth-Sun distance should be, if the orrery were built to scale.

   Rearranging the equation gives:

   **Model Earth-Sun distance = Real Earth-Sun Distance x $\frac{\text{Model Earth/Sun diameter}}{\text{Real Earth/Sun diameter}}$**

   Real Earth-Sun Distance = 150 million km = 1.5 × 108 km = **$1.5 \times 10^{11}$ m**

   $\frac{\text{Model Earth diameter}}{\text{Real Earth diameter}}$ = 1.5 × 10-3 ÷ 1.5 × 107 = **$10^{-10}$** (diameter of Earth ≈15,000 km)

   **Or:**

   $\frac{\text{Model Sun diameter}}{\text{Real Sun diameter}}$ = 0.15 ÷ 1.5 × 109 = **$10^{-10}$** (diameter of Sun ≈1.5 million km)

   ∴ Model Earth-Sun distance = $1.5 \times 10^{11} \times 10^{-10}$ = **15m**

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4. The Orion nebula is the closest star-forming region to our Solar System. How far away is it?

   **1,300 lightyears**

5. Which nebula is the remnant of a star which was seen to explode in 1054 AD?

   **Crab nebula**

6. Our Solar System is part of the Milky Way galaxy. What is the name of our nearest large spiral galaxy?

   **Andromeda**

   How far away is it?

   **2.5 million lightyears**

7. At the centre of our Milky Way galaxy is a supermassive black hole called Sagittarius A*. How many times heavier than the Sun is this black hole?

   **4 million times**

   *Black holes aren't holes! They are objects floating in space, made of matter. This means they have mass. When things fall into black holes, they become part of it, and black holes get bigger and heavier as they grow.*

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1. What part of the EM spectrum do the telescopes at Jodrell Bank observe?

   **Radio waves**

2. What is the diameter of the Lovell telescope?

   **76.2 metres**

3. The dish of the Lovell telescope is a paraboloid shape. Why is this important?

   **It focuses the radio waves at the receiver**

4. What temperature is the receiver on the Lovell telescope and why does it have to be this temperature?

   **-260°C, to reduce noise in the electronics (caused by vibrating free electrons)**

5. List two sources of interference for the telescopes.

   **Anything that emits RF noise such as, Wi-Fi, mobile phones, microwave ovens, etc.**

6. How long after the Big Bang were the following things formed?

   a. Hydrogen and Helium nuclei. **3 minutes**

   b. Atoms. **380,000 years**

   c. First stars. **400 million years**

7. Explain what happens in terms of a flow of charge when you touch the plasma ball.

   **Charge flows from the centre of the plasma ball through the gas, through the person touching the ball, to the ground.**

8. Which astronomer first discovered pulsars?

   **Dame Jocelyn Bell Burnell**

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9. This demonstrates the transit method of detecting exoplanets. The amount of light from the star is being measured by a camera (in the red circle) and being displayed on screen. Explain how exoplanets can be discovered by this method.

   **As the planet passes between the star and the camera, some of the star's light is blocked, and a regularly repeating dip of starlight is recorded. This can indicate a planet is present.**

10. Which planet (small or large) is easier to detect? Why?

    **The large planet produces a larger (more easily detectable) dip. It also orbits closer to its star, so its dip is more frequent.**

11. How do astronomers measure the amount a star is wobbling?

    **Doppler shift of the star's light.**

12. The Lovell telescope is the third largest steerable telescope in the world. The second and first largest are the Effelsberg telescope and the Robert C. Byrd Green Bank telescope, respectively. What is the (approximate) diameter of these?

    **100 m**

13. Jodrell Bank is home to the project headquarters for the Square Kilometre Array, a future radio telescope which will be a giant network of many thousands of detectors. On what two continents will the SKA detectors be based?

    **Australia and (South) Africa**

14. How does this demonstrate one advantage of building big telescopes?

    **Increases collecting area, so can see fainter (and further) objects**

15. What were bright radio sources originally called, when first discovered in the 1940s?

    **Radio stars**

16. Name the two brightest radio sources that are 'visible' from Jodrell Bank.

    **Cygnus A and Cassiopeia A**

17. As a result of the interferometry techniques, the Jodrell Bank astronomers realised some of these very bright radio sources were coming from extremely small point sources on the sky. What had they discovered?

    **Quasars**

18. What is the equivalent size of the UK's e-MERLIN network of radio telescopes?

    **e-MERLIN has the resolving power of a telescope 217km across.**

19. Describe/sketch the view of galaxy M82 with the following sections active.

    a. Central core only. **Only broad details visible – image is fuzzy**

    b. Some spiral arms only. **Some of the brighter finer details seen, but little to no large scale structure (depends on how many arms active)**

    c. Central core and all arms active. **(High resolution, large and small scale structure visible)**