

第十八屆中學生天文訓練計劃

18th Astronomical Training Programme for Secondary School Students

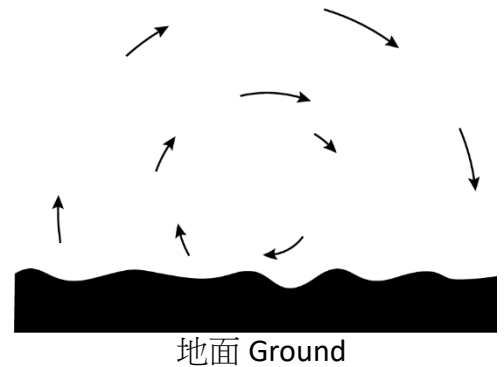
筆試試卷 Exam Paper

時間：30 分鐘 Time allowed: 30 mins

甲部：選擇題 (12 分)

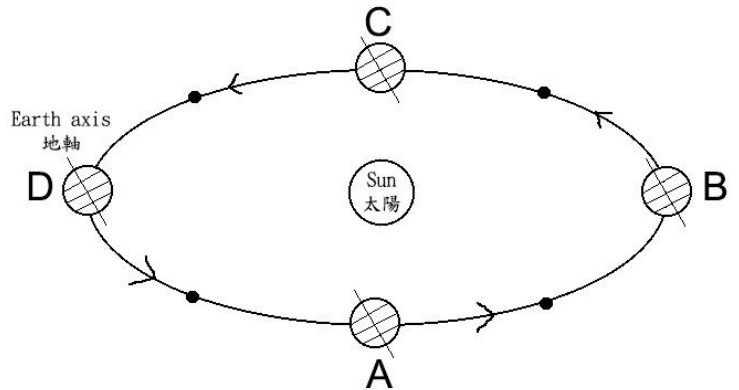
Section A: Multiple Choice Questions (12 Marks)

1. 根據相內星星的軌跡，請估計該處的位置及面向的方向。
According to the star trails in the figure, estimate the location of the place and the facing direction.



- A. 北半球北方 North at North Hemisphere
- B. 北半球南方 South at North Hemisphere
- C. 南半球北方 North at South Hemisphere
- D. 南半球南方 South at South Hemisphere

2. 根據右圖，那個位置代表北半球的秋分？
According to the graph, which position represents the autumnal equinox of the Northern Hemisphere?



- A. A
- B. B
- C. C
- D. D

3. 以下那個光譜類型與表面溫度是正確的？

Which of the following spectral class and surface temperature pair is correct?

- A. G Type 3000K
- B. O Type 6000K
- C. A Type 10,000K
- D. M Type 40,000K

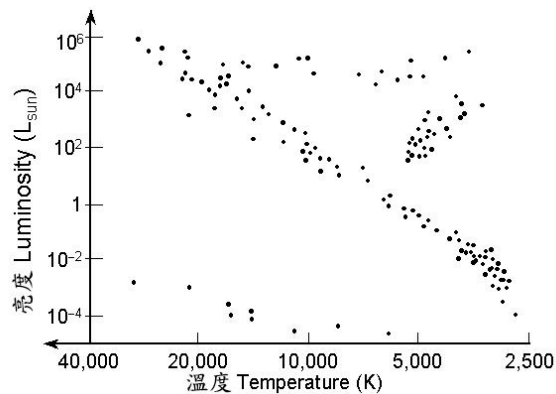
4. 以下那一個序列代表著太陽由內到外的結構？

Which of the following sequence represents the structure of the Sun (starts from the interior layer)?

- A. 日冕→輻射層→光球層→色球層 Corona, Radiative Zone, Photosphere, Chromosphere
- B. 日冕→輻射層→色球層→光球層 Corona, Radiative Zone, Chromosphere, Photosphere
- C. 輻射層→光球層→色球層→日冕 Radiative Zone, Photosphere, Chromosphere, Corona
- D. 輻射層→色球層→光球層→日冕 Radiative Zone, Chromosphere, Photosphere, Corona

5. 白矮星位於赫羅圖的：
In the HR diagram, white dwarfs locate at:

- A. 右上 Top right
- B. 右下 Bottom right
- C. 左上 Top left
- D. 左下 **Bottom left**



6. 右圖的深空天體屬於下列那一個天體列表中？
According to the figure, what catalogue does the deep sky object belong to?

- A. **梅西爾天體列表** **Messier Catalogue**
- B. 科德韋爾天體列表 Caldwell Catalogue
- C. 巴納德天體列表 Barnard Catalogue
- D. 赫歇爾天體列表 Herschel Catalogue



7. 天鵝座 X-1 屬於以下那一種黑洞？
Which of the following types of black hole does Cygnus X-1 belong to?

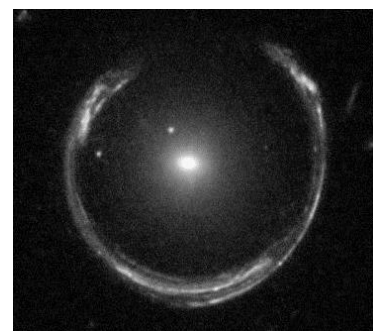
- A. **輕量級黑洞** **Stellar-mass black hole**
- B. 中量級黑洞 Intermediate-mass black hole
- C. 重量級黑洞 Supermassive black hole
- D. 以上皆非 None of the above

8. 以下那些是類木行星？
Which of the following planets belong to gas giant?

- I) 天王星 Uranus.
- II) 土星 Saturn.
- III) 金星 Venus.
- A. **只有 I 及 II** **I and II only**
- B. 只有 I 及 III I and III only
- C. 只有 II 及 III II and III only
- D. 以上皆是 All of the above

9. 以下那一個是右圖顯示的廣義相對論現象？
Which of the following is the general relativity phenomenon being shown in the figure?

- A. 重力紅移 Gravitational Redshift
- B. **重力透鏡** **Gravitational Lensing**
- C. 重力波 Gravitational Wave
- D. 重力彈弓 Gravitational Slingshot



10. 以下那項是用來估測星際距離的？

Which of the followings are used for estimating the stellar distance?

- I) 造父變星的週期及視亮度 The period and apparent magnitude of Cepheid variable star.
- II) H II 區域的大小 The size of H II region.
- III) Ia 型超新星光度的極大值 The peak intrinsic brightness of type Ia supernova.
- A. 只有 I 及 II I and II only
- B. 只有 II 及 III II and III only
- C. 以上皆是 All of the above**
- D. 以上皆非 None of the above

11. 銀河系是屬於那一種類型的星系？

What type of galaxies does Milky Galaxy belong to?

- A. 橢圓星系 Elliptical Galaxy
- B. 棒旋星系 Barred Spiral Galaxy**
- C. 不規則星系 Irregular Galaxy
- D. 以上皆非 None of the above

12. 以下那一個不是中國古天文的世界觀？

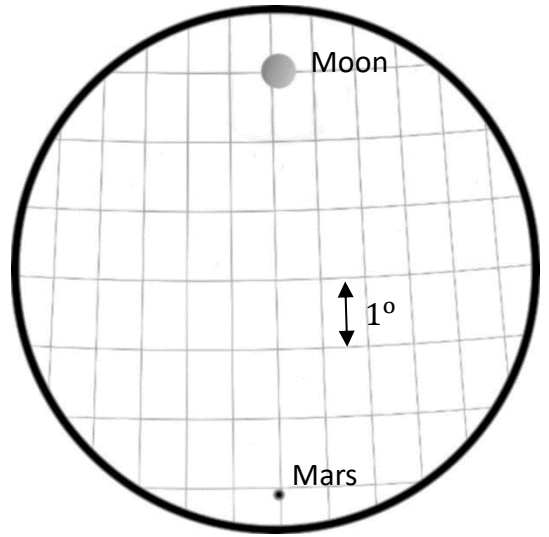
Which of the following is not the model of the universe in ancient Chinese Astronomy?

- A. 蓋天說 The theory of sphere-heavens
- B. 渾天說 The theory of canopy-heavens
- C. 渾沌說 The theory of chaos-heavens**
- D. 宣夜說 The theory of expounding appearance in the night sky

乙部：傳統題 (13 分)

Section B: Conventional Questions (13 Marks)

1. 小明攜帶了一支望遠鏡往沙特阿拉伯旅遊，並於當地時間 2018 年 7 月 27 日晚上 23 時 59 分南方觀看月球。他發覺月球正穿越當地子午線而且變了暗紅色，在同一子午線下方更觀測到火星。右圖是他在目鏡下觀測的記錄，當中記錄的垂直刻度每一格代表實視場的 1 度。



Siu ming travels to Saudi Arabia with a telescope. He observed the moon on 27th July, 2018 at local time 23:59. He discovered that the moon turned red and is transiting the local meridian. In addition, the mars is also locate at the same meridian. The figure shows his observation record and each vertical grid represents 1 degree in the true field of view.

(a) 根據文中所述，當晚發生了那兩種天文現象？ (2 分)
According to the text, what two astronomical phenomena happen? (2 marks)

- 月全食 Total Lunar Eclipse
- 火星衝 Mars Opposition

(b) 當天應該是農曆那一天？ (1 分)
What is the Lunar day on the date? (1 mark)

- 農曆十五/十六 Lunar 15th/16th

(c) 若該目鏡的視視場及焦距分別是 100° 及 25mm，請估算當時的放大率及主鏡焦距。 (2 分)
If the apparent field of view and the focal length of the eyepiece is 100° and 25mm respectively, please estimate the magnification and the focal length of the telescope. (2 marks)

整個視場大約佔 7.5/8 格，因此

$$\text{放大率 Magnification} = \frac{100}{7.5} \text{ or } \frac{100}{8} = 13.3 \text{ or } 12.5$$

$$\text{主鏡焦距 Focal length} = 13.3 \times 25 \text{ or } 12.5 \times 25 = 332.5\text{mm or } 312.5\text{mm}$$

(d) 若該望遠鏡的焦比是 $f/5$ ，使用該鏡是否有可能看到 10 等的暗星？試簡述之。 (2 分)
If the focal ratio of the telescope is $f/5$, is it possible to observe a faint star with apparent magnitude 10 by using this telescope? Explain your answer. (2 marks)

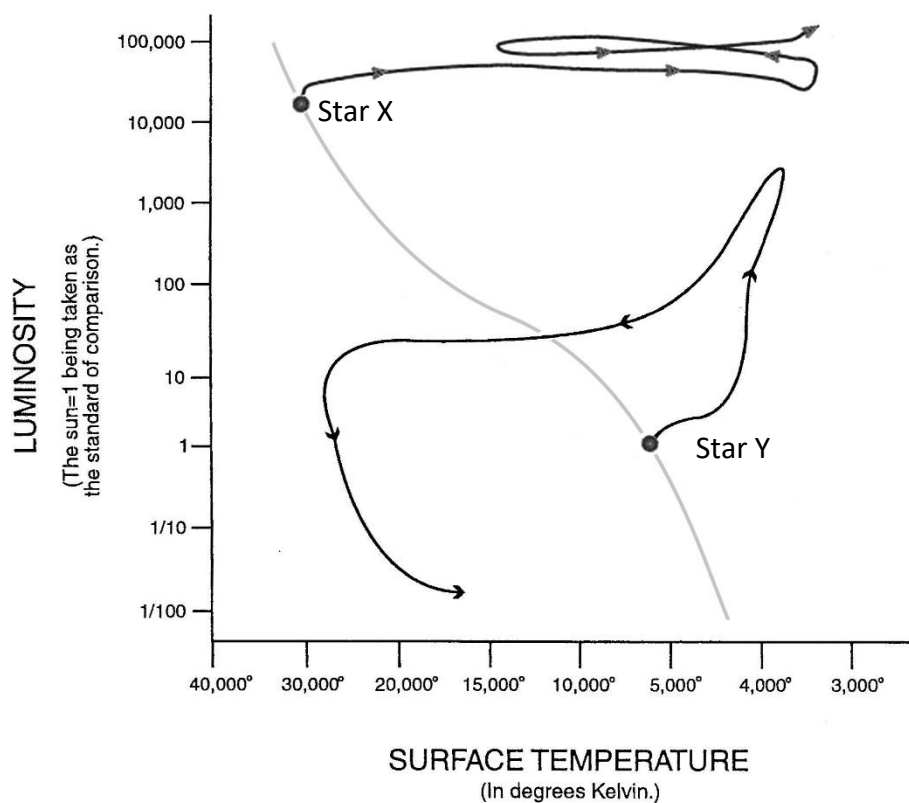
$$\text{望遠口徑 Aperture} = \frac{332.5}{5} \text{ or } \frac{312.5}{5} = 66.5\text{mm or } 62.5\text{mm}$$

$$\text{極限星等 Limiting Magnitude} = 6 + 5 \log\left(\frac{66.5}{7}\right) \text{ or } 6 + 5 \log\left(\frac{62.5}{7}\right) = 10.9 \text{ or } 10.8$$

可以看到 10 等暗星。Yes it can.

2. 下圖是來自兩顆主序星 X 及 Y 的演化赫羅圖。

The following HR diagram shows the evolution of two main sequence stars X and Y.



(a) 那一顆恆星質量較大？試簡述之。

(2 分)

Which star is more massive? Explain your answer

(2 marks)

因為 X 及 Y 也屬於主序星，而 X 的光度較高，所以 X 的質量較大。

X and Y both belong to main sequence and X has a higher luminosity, therefore, X has a greater mass.

(b) X 及 Y 分別會產生出甚麼星雲？

(2 分)

What kinds of nebula would X and Y produce respectively?

(2 marks)

X : 超新星殘骸 Supernova Remnant

Y : 行星狀星雲 Planetary Nebula

(c) 請為(b)內的星雲分別列舉出一個例子。

(2 分)

Give one example for each type of nebula in (b).

(2 marks)

X: M1 蟹狀星雲 Crab Nebula / C33 & C34 面紗星雲 Veil Nebula / Simeis 147 義粉星雲 Spaghetti Nebula

Y: M57 戒指星雲 Ring Nebula / M27 啞鈴星雲 Dumbbell Nebula / C63 螺旋星雲 Helix Nebula

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