INSTRUCTIONS TO CANDIDATES

- This paper consists of 25 multiple choice questions and 9 pages.
- Write your NAME, GRADE and NAME OF SCHOOL at the top of the separate answer sheet provided.
- For each question/statement FOUR (4) possible answers are given. Only ONE is correct. Select the correct answer and place a CROSS (*) over the letter only of the correct answer in your answer sheet.
- Ensure that your cross is in line with the question number you are working with. No credit will be given if there is more than one cross for a particular question.
- If a cross is placed in a wrong block then shade the incorrect block. Thereafter, place a cross in the correct block.
- Only the answer sheet must be submitted to the teacher at the end of the examination. The question booklet must be retained by you.
- Use a blue or black pen only.

SECTION-I

[15Q x 2M= 30 M]

1. The diagram below shows Earth in its orbit around the Sun. Positions A, B, C, and D represent Earth at the beginning of each season?

Position D

Position A

Position B

Position C
At which lettered position of Earth does New York State experience the first day of summer?

(a) A  (b) C
(c) B  (d) D

Base your answers to questions 2 to 5 on the diagram below, which represents the position of the Sun with respect to Earth’s surface at solar noon on certain dates. The latitudes of six locations on the same line of longitude are shown. The observer is located at 42° N in New York State. The date for the Sun at position A has been deliberately left blank.

2. At which New York State location could the observer be located?
   (a) Plattsburgh  (c) New York City
   (b) Mount Marcy  (d) Slide Mountain

3. When the Sun is at position A, which latitude receives the most direct rays of the Sun?
   a. Tropic of Cancer (23.5° N)
   b. Tropic of Capricorn (23.5° S)
   c. Equator (0°)
   d. Antarctic Circle (66.5° S)

4. When the Sun is at the March 21 position, New York State will usually have____?
   a. Longer days than nights
   b. 12 hours of daylight and 12 hours of darkness
   c. The lowest annual altitude of the Sun at solar noon
   d. The highest annual altitude of the Sun at solar noon
5. Which graph best represents the relative periods of rotation of Mercury, Venus, Earth, and Mars? Ans: 1

6. The photograph below shows an escarpment (cliff) located in the western United States. The directions for north and south are indicated by arrows. A fault in the sedimentary rocks is shown on the front of the escarpment.

The photograph shows that the fault most likely formed

a. After the rock layers were deposited, when the north side moved downward.
b. The north side moved downward the north side moved upward.

c. Before the rock layers were deposited, when the south side moved downward.
d. Before the rock layers were deposited, when the south side moved upward.
7. Which statement about *Polaris* is best illustrated by the diagrams shown below?

At Equator

At New Orleans, Louisiana

At North Pole

a. *Polaris* is located in a winter constellation.
b. *Polaris* is located at the zenith at each location.
c. *Polaris‘* apparent movement through the sky follows a south-to-north orientation.
d. *Polaris‘* altitude is equal to a location’s latitude.

Base your answers to questions 8 to 10 on the table below, which shows eight inferred stages describing the formation of the universe from its beginning to the present time.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description of the Universe</th>
<th>Average Temperature of the Universe (°C)</th>
<th>Time From the Beginning of Universe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>the size of an atom</td>
<td>?</td>
<td>0 second</td>
</tr>
<tr>
<td>2</td>
<td>the size of a grapefruit</td>
<td>?</td>
<td>$10^{-42}$ second</td>
</tr>
<tr>
<td>3</td>
<td>“hot soup” of electrons</td>
<td>$10^{27}$</td>
<td>$10^{-32}$ second</td>
</tr>
<tr>
<td>4</td>
<td>Cooling allows protons and neutrons to form.</td>
<td>$10^{13}$</td>
<td>$10^{-6}$ second</td>
</tr>
<tr>
<td>5</td>
<td>still too hot to allow the forming of atoms</td>
<td>$10^6$</td>
<td>3 minutes</td>
</tr>
<tr>
<td>6</td>
<td>Electrons combine with protons and neutrons, forming hydrogen and helium atoms. Light emission begins.</td>
<td>10,000</td>
<td>300,000 years</td>
</tr>
<tr>
<td>7</td>
<td>Hydrogen and helium form giant clouds (nebulae) that will become galaxies. First stars form.</td>
<td>$-200$</td>
<td>1 billion years</td>
</tr>
<tr>
<td>8</td>
<td>Galaxy clusters form and first stars die. Heavy elements are thrown into space, forming new stars and planets.</td>
<td>$-270$</td>
<td>13.7 billion years</td>
</tr>
</tbody>
</table>
8. How soon did protons and neutrons form after the beginning of the universe?

(A) 10–43 second          (B) 10–6 second
(C) 10–32 second          (D) 13.7 billion years

9. What is the most appropriate title for this table?

(A) The Big Bang Theory          (C) The Law of Superposition
(B) The Theory of Plate Tectonics         (D) The Laws of Planetary Motion

10. According to this table, the average temperature of the universe since stage 3 has____?

(A) Decreased, only          (C) remained the same.
(B) Increased, only          (D) Increased, then decreased

11. The geologic cross section below shows an unconformity in Hyderabad bedrock layers that have not been overturned. Index fossils found throughout some rock layers are shown.

Ans: 2

Which Hyderabad layers index fossil may have been present in a rock layer that is missing due to the unconformity?
Base your answers to questions 12 & 13 on the diagram below, which represents Earth in its orbit around the Sun. The position of Earth on the first day of each season is labelled A, B, C, and D.

12. Which diagram correctly shows the directions of Earth’s revolution and rotation? Ans: 2

13. At which location are the Sun’s noontime rays perpendicular to Earth’s surface at the Tropic of Cancer (23.5° N)?

   (1) A  (3) C
   (2) B  (4) D
The table below shows the duration of insolation at different latitudes for three different days during the year.

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Day 1 Duration of Insolation (hours)</th>
<th>Day 2 Duration of Insolation (hours)</th>
<th>Day 3 Duration of Insolation (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90° N</td>
<td>24</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>80° N</td>
<td>24</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>70° N</td>
<td>24</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>60° N</td>
<td>18 1/2</td>
<td>12</td>
<td>5 1/2</td>
</tr>
<tr>
<td>50° N</td>
<td>16 1/2</td>
<td>12</td>
<td>7 3/4</td>
</tr>
<tr>
<td>40° N</td>
<td>15</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>30° N</td>
<td>14</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>20° N</td>
<td>13 1/2</td>
<td>12</td>
<td>10 3/4</td>
</tr>
<tr>
<td>10° N</td>
<td>12 1/2</td>
<td>12</td>
<td>11 1/2</td>
</tr>
<tr>
<td>0°</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

14. Which dates are represented most correctly by Day 1, Day 2, and Day 3, respectively?
   a. March 21, September 22, December 21
   b. June 21, September 22, December 21
   c. September 22, December 21, March 21
   d. December 21, March 21, June 21

15. The diagram below shows the apparent path of the Sun as viewed by an observer at a certain Earth location on March 21.

![Diagram of the Sun's apparent path]

At which latitude is the observer located?

(A) The Equator (0°)   (B) 66° N
(C) 23°N   (D) 90° N
Fossils and the History of Earth’s Rotation

Data from coral fossils support the hypothesis that Earth’s rotation rate has been slowing down by about 2.5 seconds per 100,000 years. Scientists believe this is due to the frictional effects of ocean tides. This slowing rotation rate decreases the number of days in the year. Scientists have discovered that corals produce a thin layer of shell every day, resulting in growth rings. These daily layers are separated by yearly ridges. The Devonian coral fossil, *Pleurodictyum*, has approximately 400 growth rings between each yearly ridge, which suggests that there were about 400 days in a year during the Devonian Period. Supporting this hypothesis, scientists have found coral from the Pennsylvanian Period that have about 390 growth rings per year, while present-day corals have about 365 growth rings per year.
2. Approximately how many fewer Earth days per year are there today than there were during the Devonian Period?

   (A) 10          (B) 35
   (C) 25          (D) 40

3. What inference can be made about the number of growth rings per year for a coral from the Permian Period and Ordovician Period compared to the number of growth rings per year for the Devonian coral, *Pleurodictyum*?

   a. Ordovician coral would have fewer, but Permian coral would have more.
   b. Ordovician coral would have more, but Permian coral would have fewer.
   c. Both Ordovician and Permian coral would have fewer.
   d. Both Ordovician and Permian coral would have more.

4. The evidence of the fossil *Pleurodictyum* found in surface bedrock in the Finger Lakes region of New York State suggests that this region was once____?

   a. Covered by a glacial ice sheet
   b. Covered by a warm, shallow sea.
   c. Located in a desert area
   d. Located in a tropical rain forest

**Passage I**

Several factors affect the rate (how fast the chemicals react) at which a chemical reaction proceeds. Reaction rate is affected by the concentrations (relative amounts per unit volume) of the chemicals being reacted and the temperature at which the reaction takes place. The addition of a catalyst (substance that affects the rate of a reaction without itself being used up) can also increase the reaction rate.

**Experiment 1**

Students mixed 20 ml each of Solutions A and B at 22.2° C, and stirred the mixture as the reaction proceeded. The students recorded the time that it took for the mixture to turn dark blue. This was repeated four more times. The average time for the five trials was 29 seconds (sec).

The students then mixed 20 ml of Solution A, 10 ml of Solution B, and 10 ml of distilled water, all at 22.2° C. The average reaction time for five trials was 71 sec.

The students then mixed 10 ml of Solution A, 10 ml of distilled water, and 20 ml of Solution B, all at 22.2° C. The average reaction time for five trials was 72 sec.
Experiment 2

The students mixed 20 ml each of Solutions A and B at three different temperatures. Each time, they stirred until the reaction was complete. The average reaction times for five trials are shown in the table.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Time until reaction was completed (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.0</td>
<td>58</td>
</tr>
<tr>
<td>22.2</td>
<td>29</td>
</tr>
<tr>
<td>32.2</td>
<td>15</td>
</tr>
</tbody>
</table>

Experiment 3

The students added 5 drops of copper sulphate, a catalyst, to 20 ml of Solution A. When this was mixed at 22.2° C with 20 ml of Solution B, the average reaction time for 5 trials was 19 sec.

5. Which of the following indicated that the reaction was completed in the experiments?
   a. Solution A was added to Solution B.
   b. The two solutions were stirred.
   c. The mixed solutions turned clear and colourless.
   d. The mixed solutions turned dark blue.

6. Based on the results of Experiment 2, what is the relationship, if any, between the temperature of the mixture and the reaction time?
   a. As the temperature increases, the reaction time decreases.
   b. As the temperature increases, the reaction time stays the same.
   c. As the temperature decreases, the reaction time increases then decreases.
   d. There is no relationship between the temperature and the reaction time.

7. How is the experimental design of Experiment 1 different from that of Experiment 2?
   a. Experiment 1 varies the concentration of the solutions and Experiment 2 varies the temperature of the mixture.
   b. Experiment 1 varies the temperature of the mixture and Experiment 2 varies the concentration of the solutions.
   c. Experiment 1 varies the concentration of the solutions and Experiment 2 adds a catalyst.
   d. Experiment 1 adds a catalyst and Experiment 2 varies the temperature of the mixture.
8. Based on the results of Experiment 2, one would predict that if the reaction was repeated at 2° C, the reaction time would be approximately:

a. 8 sec.
b. 30 sec.
c. 60 sec.
d. 116 sec.

9. Based on the results of Experiments 2 and 3, which of the following conditions would most likely lead to the longest reaction time?

a. A reaction temperature of 50° C and the use of a catalyst.
b. A reaction temperature of 50° C and no catalyst.
c. A reaction temperature of 30° C and the use of a catalyst
d. A reaction temperature of 10° C and no catalyst

10. Which diagram best represents the Moon’s phase observed on June 11?

Ans: 3