Note: Some UNSW Global assessments are only available online.

Science

DO NOT OPEN THIS BOOKLET UNTIL INSTRUCTED.

Read the instructions on the ANSWER SHEET and fill in your NAME, SCHOOL and OTHER INFORMATION. Use a pencil. Do NOT use a coloured pencil or a pen. Rub out any mistakes completely.

You MUST record your answers on the ANSWER SHEET.

Mark only ONE answer for each question. Your score will be the number of correct answers. Marks are NOT deducted for incorrect answers.

Use the information provided to choose the BEST answer from the four possible options. On your ANSWER SHEET fill in the oval that matches your answer.

You may use a calculator and a ruler.
For questions 1 and 2 use the information below.

The key distinguishes between types of supernova according to the light they emit.

1. Does the spectrum contain hydrogen lines?  
   Yes  go to 4  
   No  go to 2

2. Does the spectrum contain silicon lines?  
   Yes  Type 1a  
   No  go to 3

3. Does the spectrum contain helium lines?  
   Yes  Type 1b  
   No  Type 1c

4. Are helium lines dominant in the spectrum?  
   Yes  Type 2b  
   No  go to 5

5. Does the light curve decay linearly after peak brightness?  
   Yes  Type 2l  
   No  Type 2p

1. A supernova shows both hydrogen and helium lines in its spectrum but the helium lines are much stronger than the hydrogen lines.  
What type of supernova is it?  
(A) Type 1b  
(B) Type 2b  
(C) Type 2l  
(D) Type 2p

2. Which description best fits the spectrum of a Type 1c supernova?

<table>
<thead>
<tr>
<th>Hydrogen lines</th>
<th>Helium lines</th>
<th>Silicon lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) present</td>
<td>absent</td>
<td>present</td>
</tr>
<tr>
<td>(B) absent</td>
<td>absent</td>
<td>absent</td>
</tr>
<tr>
<td>(C) present</td>
<td>present</td>
<td>present</td>
</tr>
<tr>
<td>(D) absent</td>
<td>present</td>
<td>absent</td>
</tr>
</tbody>
</table>
3. In general, solvents with the lowest boiling points release the most vapour into the air. Flammable solvents can explode if a spark or flame is present.

The table gives facts about some commonly used solvents. The solvents listed can all enter the body through the lungs or skin or by swallowing.

<table>
<thead>
<tr>
<th>Name</th>
<th>Boiling Point (°C)</th>
<th>Flammability</th>
<th>Toxicity</th>
<th>Solubility in water</th>
<th>Carcinogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>acetone</td>
<td>57</td>
<td>high</td>
<td>low</td>
<td>very soluble</td>
<td>no</td>
</tr>
<tr>
<td>acetic acid</td>
<td>118</td>
<td>low</td>
<td>low</td>
<td>very soluble</td>
<td>no</td>
</tr>
<tr>
<td>carbon tetrachloride</td>
<td>77</td>
<td>nonflammable</td>
<td>medium</td>
<td>insoluble</td>
<td>probably</td>
</tr>
<tr>
<td>chloroform</td>
<td>61</td>
<td>nonflammable</td>
<td>high</td>
<td>insoluble</td>
<td>probably</td>
</tr>
<tr>
<td>ethanol</td>
<td>79</td>
<td>high</td>
<td>low</td>
<td>very soluble</td>
<td>yes, heavy drinkers only</td>
</tr>
<tr>
<td>ether</td>
<td>35</td>
<td>very high</td>
<td>medium</td>
<td>slightly soluble</td>
<td>no</td>
</tr>
<tr>
<td>methanol</td>
<td>65</td>
<td>high</td>
<td>high</td>
<td>very soluble</td>
<td>no</td>
</tr>
</tbody>
</table>

Methanol is used as a fuel in motor racing. People fuelling cars with methanol have been known to spill a large amount of fuel on themselves and catch alight.

Which option describes the best way of dealing with the fire and removing the methanol?

(A) Allow the methanol to burn away then use the fire blanket.
(B) Spray the person with carbon tetrachloride.
(C) Hose the person with cold water.
(D) Wrap the person in an airproof fire blanket.
4. In forensic science, blood alcohol content is tested at the time of sampling and, if challenged in court, from a stored sample.

A student wanted to know how the tightness of the lid of a screw-topped container affected the loss of alcohol over time. He assumed alcohol behaved the same way in blood and water.

He partially filled three containers with equal quantities of 0.1 g L\(^{-1}\) alcohol solution. He then tightened the lids as follows.

- loose lid - tighten until resistance is experienced then turn lid back 1 mm.
- firm lid - tighten until resistance is just experienced.
- tight lid - tighten until resistance is just experienced then turn a further 1 mm forward. The solutions were then stored in a storage cabinet at 30 °C for a number of weeks.

His results are shown in the graph.

By how many grams per litre has the concentration dropped after three weeks in the container with the tight lid?

(A) 0.005
(B) 0.01
(C) 0.09
(D) 0.095
5. Acceleration due to gravity is different on different planets. It depends on the mass and the radius of the planet, as shown in the formula.

\[ g = \frac{G \cdot m}{r^2} \]

\[ \text{KEY} \]

- \( g \) is the acceleration of an object due to the planet’s gravity
- \( G \) is a constant
- \( m \) is the mass of the planet
- \( r \) is the radius of the planet

The table below shows the mass and radius of some planets compared to Earth.

<table>
<thead>
<tr>
<th>Planet</th>
<th>Mass compared to Earth</th>
<th>Radius compared to Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>0.055</td>
<td>0.38</td>
</tr>
<tr>
<td>Venus</td>
<td>0.86</td>
<td>0.95</td>
</tr>
<tr>
<td>Earth</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Mars</td>
<td>0.11</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Which planet has the smallest acceleration due to gravity on the surface?

(A) Mercury (B) Venus (C) Earth (D) Mars
HOW TO FILL OUT THIS SHEET:

Use a pencil.

- Print your details clearly in the boxes provided.
- Make sure you fill in only one oval in each column.
- Rub out all mistakes completely.
- Do not use a coloured pencil or pen.

**FIRST NAME** to appear on certificate

**LAST NAME** to appear on certificate

**Are you male or female?**

- Male
- Female

**Does anyone in your home usually speak a language other than English?**

- Yes
- No

**School name:**

- 

**Town / suburb:**

- 

**Today's date:** ___ / ___ / ___

**Postcode:** ___
TO ANSWER THE QUESTIONS

Example:

Ari added cordial to water to make a jug of drink. What will be the volume of the drink in the jug?

(A) 50 mL  
(B) 150 mL  
(C) 200 mL  
(D) 250 mL

The answer is 250 mL, so you would fill in the oval D, as shown.

USE A PENCIL
DO NOT USE A COLOURED PENCIL OR PEN
<table>
<thead>
<tr>
<th>QUESTION</th>
<th>KEY</th>
<th>KEY REASONING</th>
<th>LEVEL OF DIFFICULTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B</td>
<td>Start at the top, number 1. The supernova has hydrogen lines, go to number 4. It has dominant helium lines therefore it is Type 2b.</td>
<td>Easy</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>In the key, work backwards from Type 1c, starting from number 3. The supernova does not have helium lines in number 3 (so C and D are wrong). At number 2, Type 1c didn’t have silicon lines in order to get to number 3 (so A and C are wrong). Finally, at number 1, Type 1c didn’t have hydrogen lines in order to get to number 2 (so A and C are wrong).</td>
<td>Easy</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>Methanol is water soluble, thus removing the highly toxic chemical, would cool the person’s burns, thus reducing the severity of any burns, and cool the flames, thus putting out the fire. Carbon tetrachloride is a chemical that will probably cause cancers and is also moderately toxic so should not be used to spray on people. Therefore B is wrong. Methanol is highly toxic so wrapping the split methanol with the person in a fire blanket would not be recommended, so D is wrong.</td>
<td>Medium</td>
</tr>
<tr>
<td>4</td>
<td>A</td>
<td>The tight column in the graph shows that after three weeks the concentration in the tight lidded container dropped from 0.10 gL(^{-1}) to approximately 0.095 gL(^{-1}) which is a difference of 0.005 gL(^{-1}). Please note that the question asks for the difference after three weeks and not seven weeks.</td>
<td>Hard</td>
</tr>
<tr>
<td>5</td>
<td>A</td>
<td>Calculations – compared to Earth’s gravity, where ( g_E = \frac{m_E}{r_E^2} ) = 9.8m/s(^2): Mercury: ( g = \frac{0.055 m_E}{(0.38 r_E)^2} = 0.055 \left( \frac{m_E}{r_E^2} \right) = 3.7m/s^2 )</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Venus: ( g = \frac{0.86m_E}{(0.95r_E)^2} = 0.86 \left( \frac{m_E}{r_E^2} \right) = 9.3m/s^2 )</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mars: ( g = \frac{0.11m_E}{(0.53r_E)^2} = 0.11 \left( \frac{m_E}{r_E^2} \right) = 3.8m/s^2 )</td>
<td></td>
</tr>
</tbody>
</table>

**LEGEND**

Level of difficulty refers to the expected level of difficulty for the question.

- **Easy** more than 70% of candidates will choose the correct option.
- **Medium** about 50–70% of candidates will choose the correct option.
- **Medium/Hard** about 30–50% of candidates will choose the correct option.
- **Hard** less than 30% of candidates will choose the correct option.
## THE FOLLOWING YEAR LEVELS SHOULD SIT THIS PAPER

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Year/Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia(^1)</td>
<td>Year 10</td>
</tr>
<tr>
<td>Brunei</td>
<td>Form 5</td>
</tr>
<tr>
<td>Egypt</td>
<td>Year 10</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>Form 4</td>
</tr>
<tr>
<td>Indian Subcontinent(^2)</td>
<td>Class 10</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Year 11</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Form 4</td>
</tr>
<tr>
<td>Middle East(^3)</td>
<td>Class 10</td>
</tr>
<tr>
<td>New Zealand/ Pacific(^4)</td>
<td>Year 11</td>
</tr>
<tr>
<td>Singapore</td>
<td>Secondary 3</td>
</tr>
<tr>
<td>Southern Africa(^5)</td>
<td>Grade 10</td>
</tr>
</tbody>
</table>

1. All international schools registered with UNSW Global (which have an 8-digit school code starting with 46) should sit the papers according to the Australian year levels.
2. Indian Subcontinent Region: India, Sri Lanka, Nepal, Bhutan and Bangladesh.
3. Middle East Region: United Arab Emirates, Qatar, Kuwait, Saudi Arabia, Bahrain, Oman, Turkey, Lebanon, Tunisia, Morocco, Libya, Algeria, Jordan and Pakistan.