

CONSTANTS AND FORMULAS ON TEST:  $c$  for water = 4.19 J/(g°C) density of liquid water at 25 °C = 1.00 g/ml

$$Q = mc\Delta T$$

$$\text{energy efficiency} = \frac{\text{amount of useful energy}}{\text{amt. of energy consumed}} \times 100\%$$

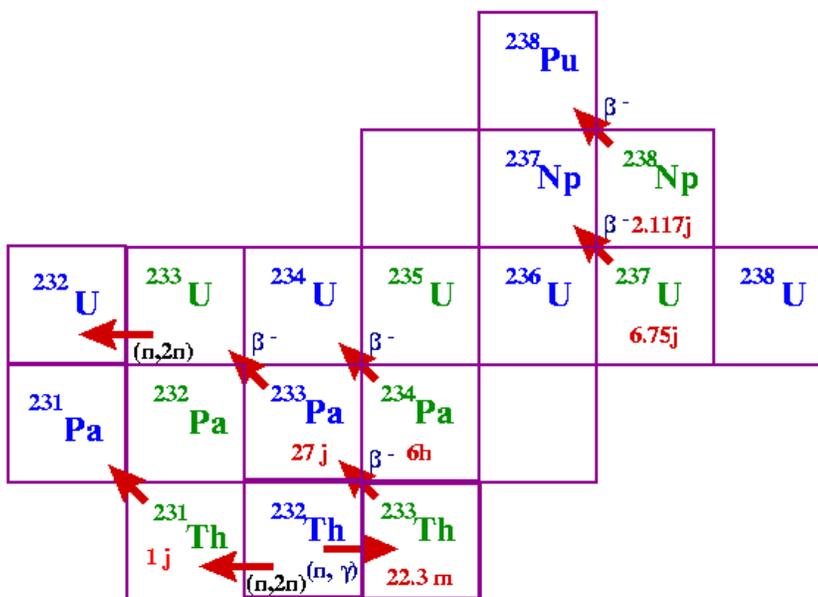
STE Pretest 2.2 v2014-15 ( on web site, scroll past questions to see the answers)

Test covers specific heat, reactions types, and radioactivity ; Flashback (pH and precipitation reactions)

1. Given:



- What particle is being emitted by  ${}^{22}\text{Na}$  in the first reaction? What transformation is taking place in the nucleus?
  - What particle is being absorbed by the second equation?
  - How do you know these are not chemical reactions?
2. a) If a nuclear reaction destroys the mass equivalent of  $2.8 \times 10^{-7}$  moles of  ${}^2\text{H}$ , how much energy is released? ( $E = mc^2$  where  $m$  must be in kg and  $c = 3.0 \times 10^8$  m/s. ) Pay attention to sig figs
- b) When  ${}^2\text{H}$  reacts, one of the products is helium. Is this fusion? Or fission?



3. Use the above diagram to write **three** balanced nuclear equations involving  ${}^{233}\text{U}$ ,  ${}^{238}\text{Np}$  and  ${}^{231}\text{Th}$ .

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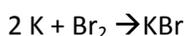
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4. What exothermic reaction involving water occurs while somebody is showering?
5. What common endothermic reaction occurs in the kitchen?
6. Olive oil's main fatty acid is oleic acid. When oxidized, it releases energy according to the following?



How many kJ does oleic acid release for every 1.00 gram of  $\text{C}_{18}\text{H}_{34}\text{O}_2$  oxidized? Pay attention to sig figs

7. Which reactant is playing the same role as oxygen does in a fire? Why?



8. An average sized banana (118 g) yields 454.300 kJ of heat when burnt to a crisp. If you managed to transfer all of the heat to a big pot of water (12 000 g) originally at 20 °C, how warm would the water get?  
Specific heat of water = 4.19 J/ (g C)
9. 200.0 grams of water at 38.0 °C are mixed with 550 g of water at 35.0 °C. What will be the temperature of the mixture?
10. If you had two substances(A and B) of the same mass at the same temperature, receiving the same amount of heat, which one will reach the highest temperature? substance A 's  $c = 2.0 \text{ J/g}^\circ\text{C}$   
B's  $c = 2.5 \text{ J/g}^\circ\text{C}$

### Flashback (pH and precipitation reactions)

11. What is the pH of a substance with 45 times more  $\text{H}^+$  than a pH = 3.54 solution?
12. If the  $\text{Na}^+$  ion is always soluble, what will be the precipitate if we mix  $\text{Na}_2\text{CO}_{3(\text{aq})}$  with  $\text{Pb}(\text{NO}_3)_{2(\text{aq})}$ ?

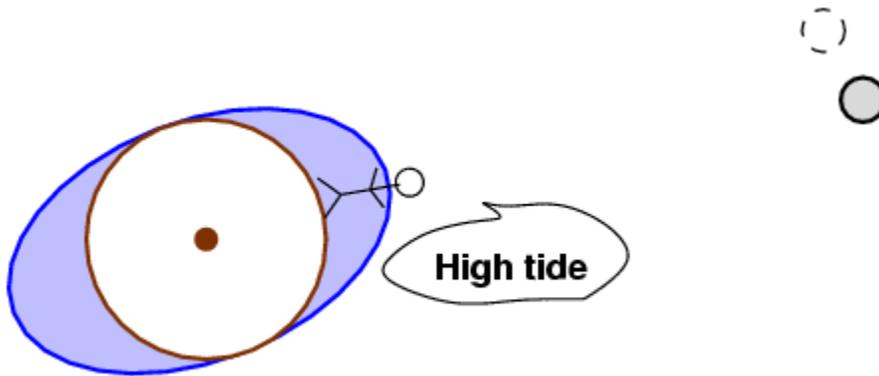
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**ST Part ( Test covers tides, and as flashback, energy and pH)**

1. How often in a day will the tide be coming in? How often will the tide be going out (water getting lower)?
2. Aside from the sun's minor role, what two things are responsible for causing tides?
3. Why is the tidal cycle of 2 low tides and two high tides about 25 hours long and not 24?



4. Of the two, when will you experiences higher tides? During spring tides (sun, moon and earth in a straight line) ? Or during neap tides?
5. It's 5 PM, and it's low tide. When will see the next high tide?
6. It's 23: 15 , and it's high tide. When will you see the next high tide?

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**Flashback: pH and energy**

2. *Tidal energy* has an *efficiency* of 80% in converting the *energy* of the water into electricity. (2 marks)
  - a) Where does the energy of the moving water come from?
  - b) Where does the other 20% go?
  - c) The generators are at a high temperature, yet the surrounding ocean water's temperature doesn't change very much. How come?
  
3.
  - a) What ion causes pH to go up?
  - b) In getting pH to rise, what does that ion react with?

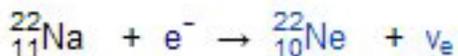
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### STE Pretest 2.2

1. Given:



d) What particle is being emitted by  ${}^{22}\text{Na}$  in the first reaction? What transformation is taking place in the nucleus?

A positron is being emitted. A proton is being lost and converted into a neutron and a positron. Notice that the mass number does not change since a neutron takes the place of a proton:



e) What particle is being absorbed by the second equation?

A beta particle.

f) How do you know these are not chemical reactions?

Elements are changing into different elements.

2. a) If a nuclear reaction destroys the mass equivalent of  $2.8 \times 10^{-7}$  moles of  ${}^2\text{H}$ , how much energy is released? ( $E = mc^2$  where  $m$  must be in kg and  $c = 3.0 \times 10^8$  m/s.)

$$c = 3.0 \times 10^8 \text{ m/s}$$

$$\text{a. } 2.8 \times 10^{-7} \text{ moles (2.0 g/mole)} = 5.6 \times 10^{-7} \text{ g}$$

$$5.6 \times 10^{-7} \text{ g (1kg/1000 g)} = 5.6 \times 10^{-10} \text{ kg}$$

$$E = mc^2 = 5.6 \times 10^{-10} \text{ kg}(3.0 \times 10^8 \text{ m/s})^2 = 5.0 \times 10^7 \text{ J, (2 sig figs) enough energy to power your computer for almost 70 hours---not bad from such a small amount of hydrogen.}$$

b) When  ${}^2\text{H}$  reacts, one of the products is helium. Is this fusion? Or fission?

fusion



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6. Given: Olive oil's main fatty acid is oleic acid. When oxidized, it releases energy according to the following?

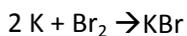


How many kJ does oleic acid release for every 1.00 gram of  $\text{C}_{18}\text{H}_{34}\text{O}_2$  oxidized?

$$1.00\text{g} / (282\text{g/mole}) = 0.003546099 \text{ moles (don't round yet!)}$$

$$0.003546099 \text{ mole} * 7050\text{kJ/mole} = 25.0 \text{ kJ ( 3 sig figs)}$$

7. Which reactant is playing the same role as oxygen does in a fire? Why?



In a fire oxygen "steals" electrons. So here bromine is the oxidizer because each Br atom takes an electron from each atom of K.



8.

An average sized banana (118 g) yields 454.300 kJ of heat when burnt to a crisp. If you managed to transfer all of the heat to a big pot of water (12 000 g) originally at 20.0 °C, how warm would the water get?

Specific heat of water = 4.19 J/ (g C)

$$Q = mc\Delta T$$

$$454\,300 \text{ J} = 12000 \text{ g}(4.19 \text{ J/(g } ^\circ\text{C)})(x - 20) ^\circ\text{C}$$

$$x = 29 ^\circ\text{C}$$

9. 200.0 grams of water at 38.0 °C are mixed with 550.0 g of water at 35.0 °C. What will be the temperature of the mixture?

$$-Q_{\text{hot}} = Q_{\text{cold}}$$

$$-m_{\text{H}}c_{\text{H}}\Delta T_{\text{H}} = m_{\text{C}}c_{\text{C}}\Delta T_{\text{C}}$$

$$-200(4.19)(x-38) = 550(4.19)(x-35)$$

$$x = 35.8 ^\circ\text{C}$$

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10. If you had two substances(A and B) of the same mass at the same temperature, receiving the same amount of heat, which one will reach the highest temperature? substance A 's  $c = 2.0$  J/g°C  
B's  $c = 2.5$  J/g°C

11. What is the pH of a substance with 45.0 times more  $H^+$  than a pH = 3.54 solution?

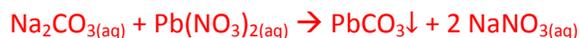
At pH = 3.54, the concentration of  $H^+ = 10^{-pH} = 10^{-3.54}$  M

For a solution that's 45.0 times more concentrated

pH=  $-\log(45.0 * 10^{-3.54} \text{ M}) = 1.89$

12. If compounds with the  $Na^+$  ion are always soluble, what will be the precipitate if we mix  $Na_2CO_{3(aq)}$  with  $Pb(NO_3)_{2(aq)}$ ?

$PbCO_3$  because:



### ST Part

7. How often in a day will the tide be coming in? How often will the tide be going out(water getting lower)?

Almost 2 times a day it will come in and almost twice a day it will flow out.

8. Aside from the sun's minor role, what two things are responsible for causing tides?

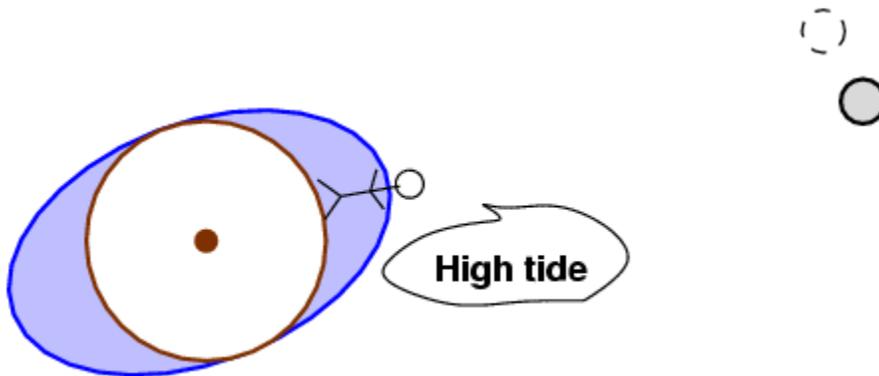
Moon's gravitational force and the earth and water's inertia

9. Why is the tidal cycle of 2 low tides and two high tides about 25 hours long and not 24?

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The moon moves around the earth while the earth rotates on its axis.

10. Of the two, when will you experience higher tides? During spring tides (sun, moon and earth in a straight line) ? Or during neap tides?

Spring tide

11. It's 5 PM and it's low tide. When will see the next high tide?

At about 5PM +6:15 min = 11:15 PM.

12. It's 23:15 and it's high tide. When will you see the next high tide?

At about 23:15 PM +12:30 min = 35:45 = 35:45-24:00 = 11:45 AM.

#### Flashback: pH and energy

4. Tidal energy has an efficiency of 80% in converting the energy of the water into electricity. (2 marks)

a) Where does the energy of the moving water come from?

The gravitational energy of the moon and earth

b) Where does the other 20% go?

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It's wasted as heat.

- c) The generators are at a high temperature, yet the surrounding ocean water's temperature doesn't change very much. How come?

Heat depends on mass and temperature. The mass of the generators is too small compared to the mass of the ocean.

- d) What ion causes pH to go up?

Hydroxide. (OH<sup>-</sup>)

- e) In getting pH to rise what does that ion react with?

H<sup>+</sup>