

ST/STE PreTest 3.4 2012 SOLUTIONS

ST PART

1. Which twisting constraint is experienced by buildings during earthquakes?

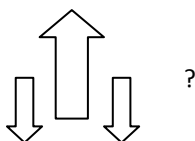
(A) Shearing

(B) Torsion

(C) Tension

(D) Compression

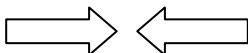
2. What constraint is symbolized by



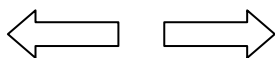
deflection

3. A) What is the difference between compression and tension?

Compression tends to squish an object.



Tension stretches an object.



b) Which of the two affects a car in a head on collision?

compression

List two elements with an atomic number less than 4 that have poor thermal conductivity.

He and H

4. What third period material has decent electrical conductivity but lousy thermal conductivity?

Si

5. A) Technically why is it **incorrect** to say that an example of copper's low specific heat is that it cools off quickly?

There's no time factor involved in specific heat.

b) What property should we be referring to instead?

Conductivity: amount of heat transmitted per meter in a second for every 1 °C change .

c) What property is being referred to if we note that it takes very little heat to get copper to reach a high temperature?

Specific heat= amount of heat needed to raise the temperature of a gram by 1 °C.

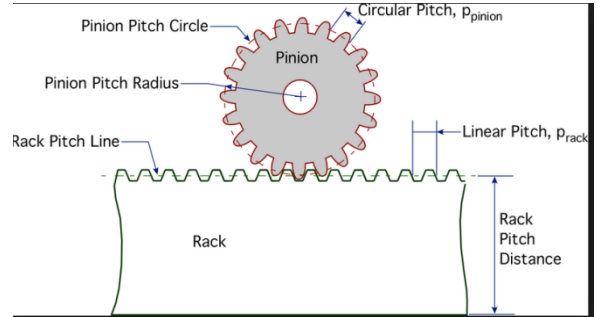
6. What is the symbol for bidirectional helical rotation?



7. It is possible to slide the rack to the left or right. In the diagram indicate the motion being described and the associated movement of the pinion. Use the two appropriate symbols.

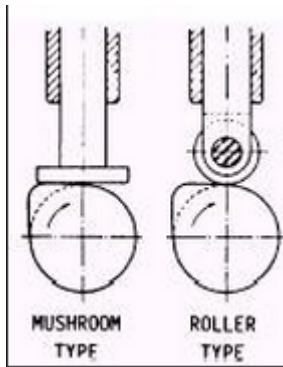
Pinion: bidirectional rotational

Rack: bidirectional translational



8. a) What motion transformation system is being represented below?

Cam and follower



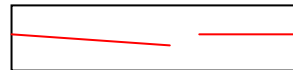
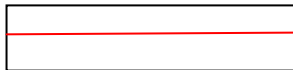
b) Use the appropriate symbol for motion experienced by the “mushroom” and “roller”. Note that both the roller and mushroom are normally called the same thing---hint: the antonym of a leader.

bidirectional translational



9. How does an electrical fuse work? Explain with words and a diagram.

When too many components are placed in parallel, overall resistance drops and total current increases. This melts the thin wire inside the fuse. The wire breaks and current stops flowing.

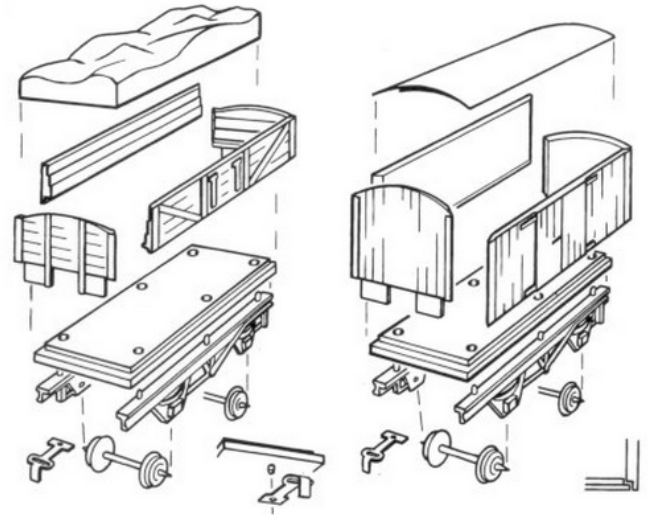


10. a) What kind of technical drawing is shown to the right?

Exploded view

- b) What advantage does it have over other types of technical drawings such as the one in number 8?

Shows all the parts in 3D



FORGOTTEN: What are the three types of guiding controls?

Examples?

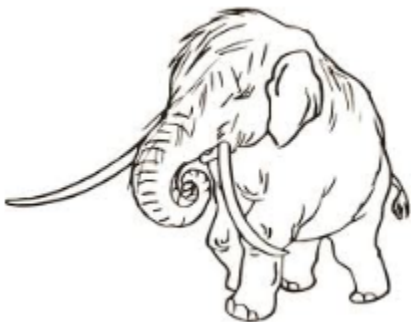
Translational: window or sliding door rack

Helical: c-clamp

Rotational: forks and axle of bicycle

ST FLASHBACK

11. List two countries whose northern areas and mountain tops are dominated by permafrost.
Russia and Canada



12. What greenhouse gas is released by permafrost during periods warm enough to melt upper layers?

methane

13. How do vegetation and topography impact watersheds?



The slope will determine where the water ends up. Lack of vegetation will cause more water to flow from a watershed into a river.

14. What term is used to describe the quantity of organic matter produced by plants in a given territory?

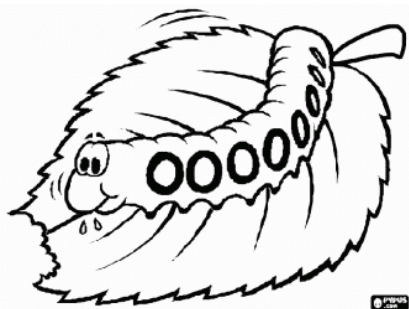
Primary productivity

15. Why aren't energy transfers between trophic levels 100% efficient?

Not all energy from the food is stored or used by the animal. Some is lost to the environment as heat.

16. To which trophic level does a leaf-eating caterpillar belong?

First order consumer



STE PART

17. What do artificial modern methods of plant cloning have in common with animal cloning? Differences? (STE)

Common: both produce genetically identical offspring.

Differences:

- (1) In plants, eggs are not stripped of their DNA. Parts of plants are removed, subjected to nutrients and/or hormones in test tubes and then transplanted to soil.
- (2) For animals, an egg cell is stripped of its nucleus and given the DNA of an animal to be cloned. A surrogate mother's uterus is then used to allow the clone egg to develop.

18. What is the purpose of a strawberry runner or potato eye?

It is used for asexual reproduction, a natural form of cloning.

19. a) Why are some plants changed so they produce Bt protein?

The protein will poke holes in the gut of animals that have a high pH (insects). They won't have to be sprayed with insecticide. The insects die when they try to feed off the plant.

- b) What is the role of a plasmid in genetic engineering? For example how is it used with getting Bt proteins to be produced by plants?

After the BT gene is isolated from bacteria, it is inserted into a lab-made circular piece of DNA called a plasmid. That is injected into young plant tissue, which incorporated it into its own DNA. As the cells divide, they all carry the Bt gene. The mature plant will then transcribe the gene and translate, resulting in the production of the Bt protein.

- 20.

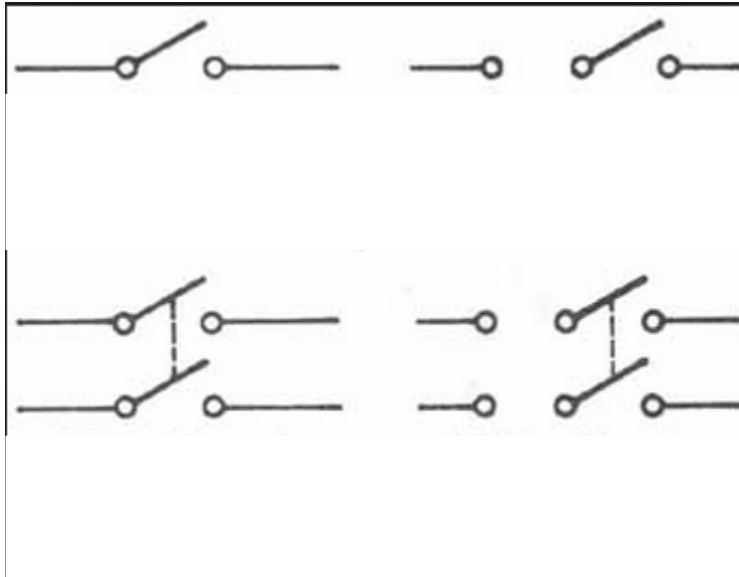
All ceramic materials contain oxides that include Al_2O_3 . What charge does aluminum have? Show why using simple algebra.

$$2\text{Al} + 3(-2) = 0.$$

$$2\text{Al} = 6$$

$$\text{Al} = 3$$

21. a) Identify each of the following switches.

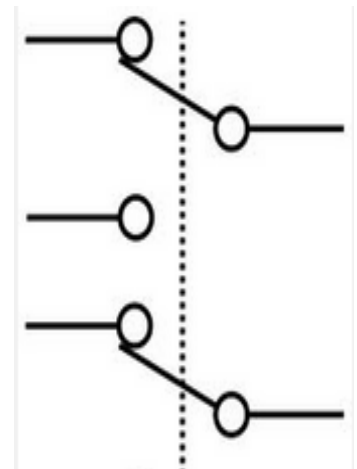


Top left: single pole, single throw

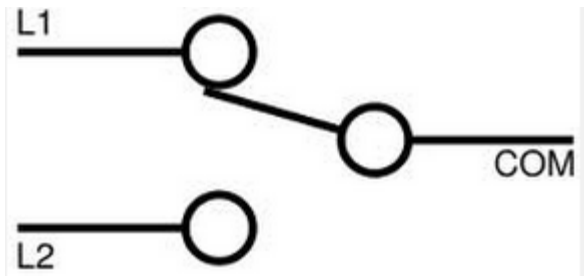
Top right: single pole, double throw

Bottom left: double pole, single throw

Bottom right: double pole, double throw



b) Show the usual ways of representing the single pole, double throw and the double pole, double throw switches.



single pole, double throw

double, double (wish it was ice cream)

22. Give the number of significant figures in each case.

- a) 2.3000 kg 5
- b) 0.00500 km 3
- c) 5.00×10^2 g 3
- d) 500 g 1

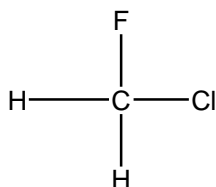
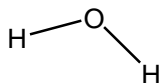
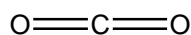
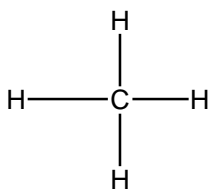
23. Find the molarity and express with the correct number of significant figures. 11.50 g of NaBr are dissolved in 250.0 ml of solution. Make sure you use molar masses with the right number of sig figs.

$$11.50\text{g}/(22.99 + 79.90 \text{ g/mol}) / 0.2500 \text{ L} = \text{mol/L} \quad (4 \text{ SF})$$

$$0.4471 \text{ mol/L}$$

FLASHBACK

Draw a dot structure for 4 different greenhouse gases. (STE)



- c) When ice melts, mass is conserved. Use this fact to derive an expression for the volume of water in terms of density ratios and the volume of ice. Then show that this is the same as the buoyancy formula, which proves that when ice melts the volume of water created is the same as the volume of submerged ice. The density of ice is about 0.912 g/ml. (STE)

Since mass is conserved during melting,

$d_{ice} * V_{ice} = d_{water} * V_{water}$, where V_{water} is the volume created by the melted ice

$$V_{water} = \frac{V_{ice}(d_{ice})}{d_{water}}$$

But if you rearrange the buoyancy formula:

$$\frac{V_{ice}}{V_{dw}} = \frac{d_{dw}}{d_{ice}}$$

$$V_{dw}(d_{dw}) = V_{ice}(d_{ice})$$

$$V_{dw} = \frac{V_{ice}(d_{ice})}{d_{dw}}$$

Since both are equal to the same thing, it follows that $V_{water} = V_{dw}$

- d) Soil originally with a concentration of 8 ppm of Cr^{6+} was tested a month later and the concentration dropped by 75%.
- a) If there was cabbage growing on the land and the roots' concentration of the same ion increased, what do you think happened?

It's an example of phytoremediation in which a toxin gets stuck in plant tissue.

- b) Calculate the final concentration of Cr^{6+} in the soil.

$$8\text{ppm} - 0.75(8\text{ppm}) = 2\text{ ppm}$$