Fermi, Enrico

demo  Section 1
Due Fri, Sep 6, 2002 at 08:00  Set 8
Physics 999: Demo Physics I  CAPA ID 3638

1. [1pt] The following are possible ways to express the quantity 0.476 (Give ALL correct answers, i.e., B, AC, BCD,...) Note: 3.45E-8 is a way you can enter the number $3.45 \times 10^{-8}$ in most computers.
   A) 0.000476E+4
   B) 47.6 \times 10^{-2}
   C) 0.0476E+1
   D) 0.00476 \times 10^{2}
   E) 4.76E-1
   F) 0.476E+1

2. [1pt] Calculate, in cm, the perimeter of a rectangle with a length of 18.5 cm and a width of 46 mm.

3. [1pt] Calculate the perimeter of a rectangle with a length of 22.5 cm and a width of 48 mm. Enter units.

4. [1pt] Test your calculator skills by checking that $(8,10)^2$ equals 65.61 and that $(8,10)^3$ equals 531.44. Now, find the value of $(8,10)^{2.27}$.

5. [1pt] Reduce the fraction $\frac{240}{1296}$ to its lowest terms. [If the result is 4/3, enter 4 (Answer1), and 3 (Answer2)]

6. [1pt] Calculate the volume of a spherical balloon which has a surface area of 0.0891 m$^2$.

7. [1pt] List the following in order of increasing lengths from shortest to longest. (If B is shortest, then A, then C, and D is longest, enter BACD )
   A) 0.060 m
   B) 1.00 in.
   C) 0.10 ft
   D) 40 mm

8. [2pt] Match each person with the most appropriate description. (If the first corresponds to B, and the next 6 to C, enter BCCCCC)
   1) Plato
   2) Sam Rayburn
   3) Alfred P. Sloan
   4) Percy Shelly
   5) Elizabeth Browning
   6) Socrates
   7) Claude Monet
   A. Philosopher
   B. Politician
   C. Painter
   D. Poet
   E. Philanthropist

9. [1pt] The sequences for each of three fragments of DNA are shown below:
   fragment 1 = CCGGACTGAAA
   fragment 2 = AAATGATAACTG
   fragment 3 = TCCAAGGCACG
   Assume that the target DNA sequence has 30 bases and reconstruct that DNA sequence.

10. [1pt] The nine elements of a 3x3 matrix are shown below.

   \[
   \begin{bmatrix}
   3 & 6 & 4 \\
   4 & -5 & -2 \\
   -6 & 1 & 7 \\
   \end{bmatrix}
   \]

   Evaluate the determinant of that matrix.

11. [2pt] In order to practice for a hammering-speed contest, a person purchases the following items:

<table>
<thead>
<tr>
<th>Item</th>
<th>Number</th>
<th>$ ea.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hammer</td>
<td>1</td>
<td>16.29</td>
</tr>
<tr>
<td>Nails</td>
<td>88</td>
<td>0.05</td>
</tr>
<tr>
<td>Wood Blocks</td>
<td>7</td>
<td>4.75</td>
</tr>
<tr>
<td>Band Aids</td>
<td>44</td>
<td>0.16</td>
</tr>
</tbody>
</table>

   Calculate the total cost, including a sales-tax of 4.90%. (in $)

12. [1pt] A block is at rest on an inclined plane whose elevation can be varied. The angle of elevation $\theta$ is increased slowly from the horizontal, and when it reaches 39.7 degrees, the block begins to slide. Calculate the coefficient of static friction.


14. [1pt] Using graphical methods, determine at $x=0.2$ the value of the derivative of function $F(x)$ plotted in the graph below.

15. [3pt] A fisherman and his young nephew are in a boat on a small pond. Both are wearing life jackets. The nephew is holding a large floating helium filled balloon by a string. Consider each action below independently, and indicate whether the level of the water in the pond R-Rises, F-Falls, S-Stays the Same, C-Cannot tell. (If in the first the level Rises, in the second it Falls, and for the rest one Cannot tell, enter RFCCCC)
   A) The nephew pops the balloon.
   B) The nephew gets in the water, looses his grip on the string, letting the balloon escape upwards.
   C) The fisherman lowers himself in the water and floats.
   D) The fisherman fills a glass with water from the pond and drinks it.
   E) The fisherman knocks the tackle box overboard and it sinks to the bottom.
   F) The fisherman lowers the anchor and it hangs vertically, one foot above the bottom of the pond.

(Over)
16. [3pt] Match the appropriate letter on the diagram with each organelle in the sequence in which they are listed. (Example: If the first organelle corresponds to D on the diagram and the next to C, begin your answer with DC...)

1) Cell or Plasma Membrane
2) Golgi Body
3) Tonoplast or Vacuolar Membrane
4) Cell Wall
5) Ribosomes
6) Vacuole
7) Mitochondrion
8) Peroxisome
9) Endoplasmic Reticulum
10) Nucleus
11) Nucleolus
12) Plastid (Chloroplast, proplastid, ...)
13) Nuclear Envelope

17. [2pt] Vector \( \mathbf{C} = \mathbf{A} \times \mathbf{B} \), where
\[
\mathbf{A} = 11i - 35j - 23k \\
\mathbf{B} = 15i - 7j - 26k
\]
The unit vectors in the x, y and z directions are \( \mathbf{i} \), \( \mathbf{j} \) and \( \mathbf{k} \) respectively. \( \mathbf{A} \) is a displacement and has units of \( m \), and \( \mathbf{B} \) is a force and has units of \( N \). Calculate vector \( \mathbf{C} \) and enter the numerical values of its x, y, and z components.

18. [5pt] Write a short essay (200 words or less) about how you spent your summer vacation.

19. [1pt] Consider the reaction of nitrous oxide \( \text{N}_2\text{O} \) with oxygen \( \text{O}_2 \) to form nitrogen dioxide \( \text{NO}_2 \):

\[
2\text{N}_2\text{O}(g) + 3\text{O}_2(g) \rightarrow 4\text{NO}_2(g)
\]
A 5.0 liter vessel contains \( \text{N}_2\text{O} \) gas at 4.0 \( \text{atm} \) pressure. A second vessel, 3.0 L in volume contains oxygen at 6.0 \( \text{atm} \) pressure. Now suppose that the two vessels are connected by a pipe of negligible volume and the two gases mix and react to produce as much nitrogen dioxide as possible. Assume that the temperature remains constant. What is the pressure in the apparatus at the end of the reaction?

20. [1pt] Determine the integral from 0 to \( x \) of the function below:

\[
f(x) = 4.300x - 0.530x^2
\]
Enter the answer as in a calculator:

EXAMPLE: 4.567 + 2.431 * \( x^4 \) - 0.310 * \( x^2 \)

21. [1pt] The decomposition of nitrous oxide

\[
2\text{N}_2\text{O}(g) \rightarrow 2\text{N}_2(g) + \text{O}_2(g)
\]
is catalyzed by \( \text{NO}(g) \). The following mechanism has been proposed to explain the experimental rate law.

(1) \( \text{N}_2\text{O} + \text{NO} \rightarrow \text{NO}_2 + \text{N}_2 \) slow
(2) \( 2\text{NO}_2 \rightarrow 2\text{NO} + \text{O}_2 \) fast

Write the rate law for the above chemical reaction derived from the proposed mechanism. Enter the answer as in a calculator:

EXAMPLE: \( k \times x^m \times y^n \)

Where:
\( k = \) rate constant
\( x = \text{N}_2\text{O} \)
\( y = \text{O}_2 \)
\( z = \text{NO}_2 \)
\( u = \text{NO} \)
\( v = \text{N}_2 \)
Remember that \( m, n \), etc. can have non-integer or negative values.

(Over)
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22. [1pt] A frictionless, massless pulley is attached to the ceiling, in a gravity field \( g = 9.81 \text{ m/s}^2 \).

\[
\begin{array}{c}
\text{T}_y \\
\text{T}_z \\
\text{T}_x \\
M_a \\
M_b
\end{array}
\]

Mass \( M_b \) is greater than mass \( M_a \). The tensions \( T_x, T_y, T_z \), and the constant \( g \) are magnitudes. (For each statement select T-True, F-False, G-Greater than, L-Less than, or E-Equal to, for example, GFLLEG)

A) The magnitude of the acceleration of \( M_b \) is ... the magnitude of the acceleration of \( M_a \).
B) The center-of-mass does not accelerate.
C) \( T_z \) is ... \( T_x \)
D) \( T_z \) is ... \( (M_a)g \)
E) \( T_y \) is ... \( (M_b)g + (M_a)g \)
F) \( T_x + T_z \) is ... \( T_y \)

23. [1pt] A quality control engineer counts the number of olives in a sample of jars. A histogram of the number of jars versus the number of olives is shown below. (Vertically: number of jars (0 to 9). Horizontally: number of olives in these jars (57 to 67).

[Histogram diagram]

Calculate the probability that a randomly selected jar will have fewer than 61 olives.