

DAILY TEST SERIES FOR IIT-JEE 2009 FROM VIDYA DRISHTI

04.04.2009

Physics

Paragraph for comprehension 1 to 3

A 4.0 kg mass is hung from a vertical wire 2.0 m long and $5.0 \times 10^{-3} \text{ cm}^2$ in cross-sectional area. The wire is securely fastened to the ceiling. Now assume that the mass is very slowly pulled downward 0.06 cm from its equilibrium position by an external force F . Given, Young's modulus of steel = $2.0 \times 10^{11} \text{ N/m}^2$ and $g = 9.8 \text{ m/s}^2$. Then,

1. Work done by gravity is
 - (a) 0.009 J
 - (b) 0.024 J
 - (c) 0.033 J
 - (d) Zero
2. Work done by the applied force F is
 - a) 0.009 J
 - b) 0.024 J
 - c) 0.033 J
 - d) Zero
3. The change in elastic potential energy is
 - a) 0.009 J
 - b) 0.024 J
 - c) 0.033 J
 - d) Zero

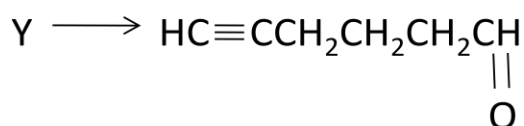
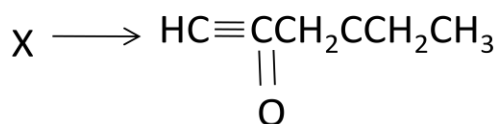
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Chemistry

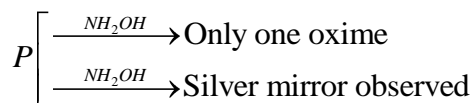
Paragraph for comprehension 4 to 6

Tollen's reagent is used to distinguish aldehydes from ketones. The same reagent distinguishes terminal alkynes from non-terminal alkynes or alkadienes. In previous case a shining mirror is observed while in second case a white ppt. is observed.

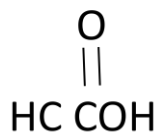
4. Which statement is incorrect about following compound X and Y?



- (a) X and Y are metamers.
 (b) X and Y are functional isomers.
 (c) X and Y can be distinguished by Tollen's reagent.
 (d) X and Y will give positive test with Tollen's reagent
5. Identify compound P with the help of following reactions



(a)



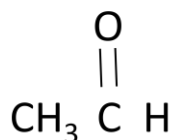
(b)



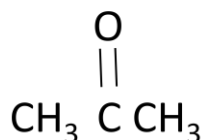
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(c)



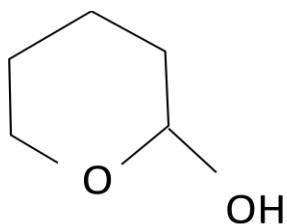
(d)



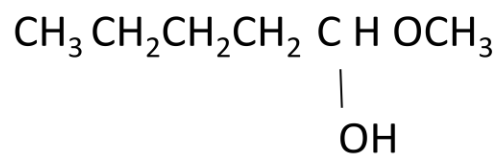
6. Which of the following compound will **not** give positive Tollen's test?

(a) CH_3CHO

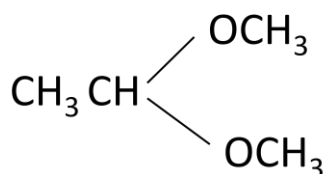
(b)



(c)



(d)



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Mathematics

Paragraph for comprehension 7 to 9

Newton's law of cooling: The rate at which a body undergoes a change in temperature is proportional to the difference between its temperature and temperature of the surrounding medium. If $y = f(t)$ is the temperature of the body at time t and $M(t)$ denotes the temperature of the surrounding medium, Newton's law lead to the differential equation

$$\frac{dy}{dt} = -k[y - M(t)] \quad \text{or,} \quad \frac{dy}{dt} + ky = kM(T)$$

where k is a positive constant. Let a body cools from 200 OC to 100 OC in 40 minutes while immersed in a medium whose temperature is kept constant. Let $M(t) = 10$ OC. If we measure t in minutes and $f(t)$ in degrees then,

7. $f(t)$ must be equal to

- (a) $10 + 180e^{-kt}$
- (b) $10 + 140e^{-kt}$
- (c) $10 + 100e^{-kt}$
- (d) $10 + 190e^{-kt}$

8. The value of k must be

- (a) $\frac{\log 19 - \log 9}{100}$
- (b) $\frac{\log 19 - \log 9}{80}$
- (c) $\frac{\log 19 - \log 9}{40}$
- (d) None of these

9. Suppose the same system a body cools from 400 OC to 200 OC with $M(t) = 10$ OC then time taken for cooling must be equal to

- a) $40 \log 19$
- b) $40 \log 9$
- c) $40 \frac{\log 19 - \log 9}{\log 39 - \log 19}$
- d) $40 \frac{\log 39 - \log 19}{\log 19 - \log 9}$

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SOLUTIONS:

1. (b)
2. (a)
3. (c)
4. (a)
5. (b)
6. (d)
7. (d)
8. (c)
9. (d)

EXPLANATIONS

Physics

Let us first calculate the elongation Δl of the wire before force F is applied. Clearly,

$$\Delta l = \frac{Fl}{AY} = \frac{Mgl}{AY} = \frac{4 \times 9.8 \times 2.0}{(5.0 \times 10^{-7}) \times (2 \times 10^{11})}$$

$$\Rightarrow \Delta l = 7.84 \times 10^{-4} m \quad \dots(1)$$

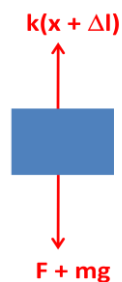
Work done by gravity

$$W_g = (mg)(s) = 4 \times 9.8 \times 6 \times 10^{-4}$$

$$\Rightarrow W_g = 0.024 J \quad \dots(2)$$

Equivalent force constant of wire is

$$k = \frac{YA}{l} \quad \dots(3)$$



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As the mass is pulled very **slowly (meaning acceleration = 0)**, therefore from FBD we have

$$F + mg = k(x + \Delta l) \quad \dots(4)$$

∴ Work done by the applied force and gravity would be

$$W_{F+g} = \int_{x=0}^{x=6 \times 10^{-4}} (F + mg) dx$$

$$\Rightarrow W_{F+g} = \int_{x=0}^{x=6 \times 10^{-4}} k(x + \Delta l) dx$$

$$\Rightarrow W_{F+g} = k \left[\frac{x^2}{2} + x\Delta l \right]_{x=0}^{x=6 \times 10^{-4}}$$

$$\Rightarrow W_{F+g} = \frac{YA}{l} \left[\frac{x^2}{2} + x\Delta l \right]_{x=0}^{x=6 \times 10^{-4}}$$

$$\Rightarrow W_{F+g} = 0.033J \quad \dots(5)$$

(Putting values)

Hence the work done by the applied force would be

$$W_{F+g} = W_F + W_g$$

$$\Rightarrow W_F = W_{F+g} - W_g$$

$$\Rightarrow W_F = 0.033 - 0.024$$

$$\Rightarrow W_F = 0.009J \quad \dots(6)$$

The change in elastic potential energy = work done by applied force and force of gravity = 0.033 J.

NOTE: One more question can be asked. Find the work done by the force the wire exerts on the mass.

The work done by force the wire exerts on the mass will be $-W_{F+g}$ or $-0.033 J$.

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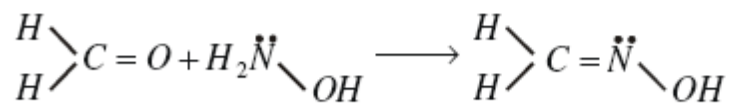
Chemistry

4.

In metamerism migration of CH_2 takes place to form metamer but here C_2H_5 group is migrating hence incorrect.

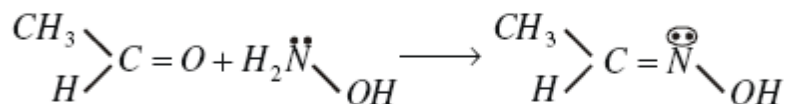
5.

Aldehydes give positive test with Tollen's Reagent but in case of formaldehyde.

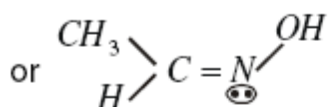


only one oxime is possible (No Geometrical isomerism)

Anti & syn in case of Acetaldehyde oximes will be formed.



Anti



Syn

6. d

Mathematics

7.

$$\frac{dy}{dx} = -k [y - M(t)]$$

$$\int \frac{dy}{y - M(t)} = \int -k dt$$

$$\int \frac{dy}{y - 10} = -\int k dt + C$$

$$\Rightarrow \log(y - 10) = -kt + c$$

$$\Rightarrow (y - 10) = ce^{-kt}$$

When $t = 0, y = 200$

$$\Rightarrow c = 190 \quad \therefore y - 10 = 190e^{-kt}$$

8.

$$\int_{200}^{100} \frac{dy}{y - 10} = -k \int_0^{40} dt$$

$$[\log_e (y - 10)]_{200}^{100} = -k \times 40$$

$$\frac{\log 90 - \log 190}{-40} = k$$

$$\Rightarrow k = \frac{\log_e 9 - \log_e 19}{-40} = \frac{\log 19 - \log 9}{40}$$

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9.

$$\begin{aligned}\int_{100}^{200} \frac{dy}{y-10} &= -k \int_0^t dt \\ \Rightarrow [\log_e y - 10]_{100}^{200} &= -kt \\ \Rightarrow \frac{\log 190 - \log 390}{-k} &= t \\ \Rightarrow \frac{\log 39 - \log 19}{k} &= t \\ \Rightarrow 40 \frac{(\log 39 - \log 19)}{(\log 19 - \log 9)} &= t\end{aligned}$$