TARGET : PRE-MEDICAL 2020

PRACTICE TEST

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	4	3	4	1	2	4	2	4	4	4	4	3	4	1	4	1	3	2	2	2
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	3	4	1	3	2	4	2	2	1	4	4	3	4	2	3	2	3	2	4	2
Que.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	3	4	4	4	4	4	2	3	4	2	3	1	2	3	3	2	3	4	4
Que.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	2	3	3	2	2	4	2	3	2	1	4	4	2	4	4	3	4	4	4	2
Que.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	3	2	3	4	2	1	1	2	3	1	2	3	2	3	3	2	1	1	4	3
Que.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	1	4	2	3	4	4	2	3	2	3	4	4	2	4	2	3	4	3	2	1
Que.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	1	2	4	4	3	4	2	2	2	3	4	3	3	1	4	3	4	4	4	3
Que.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	4	2	4	3	4	2	3	3	4	3	4	2	4	3	4	3	3	3	4	3
Que.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	1	1	3	2	3	2	3	3	4	4	4	3	4	2	4	3	4	4	4	4

HINT – SHEET

1. For the rod, the gravitational force acts at the center, so from the pivot, we will write out Newton's Second Law in rotational form to obtain $\tau_{net} = I\alpha$. The moment of inertia of a rod is $\frac{1}{12}ML^2$ about the center. Using the parallel axis theorem, the moment of inertia about one end is computed as $I = \frac{1}{12}ML^2 + M\left(\frac{L}{2}\right)^2 = \frac{1}{3}ML^2$.

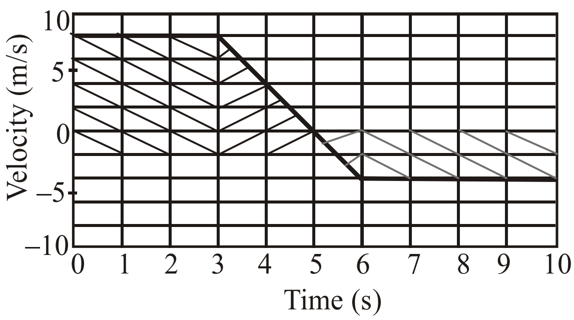
The torque from the gravitational force about the end is computed as

$\tau = (Mg)\left(\frac{L}{2}\right)\sin(90-\theta) = \frac{MgL}{2}\cos\theta$. Equating our results, we obtain $\frac{MgL}{2}\cos\theta = \frac{1}{3}ML^2\alpha$

$\Rightarrow \alpha = 3g/2L \cos\theta$

2. The car moves away from the origin initially and then slows to a stop at 5.0 seconds. One notes, though, that while the car is slowing down from t=3.0 to t=5.0 seconds… since the velocity is still positive, the car continues to move away from the origin. This is like coming to a stop light and applying the brakes… the car continues to move forward. After t=5.0 s, the car reverses direction as the velocity is negative and heads back toward the origin.

3. Average speed is distance divided by time. The total distance traveled by the car is found as the magnitude of the area under the velocity vs. time curve. Breaking this computation into pieces:



$t = 0 \rightarrow 3s : A = LW = (8\ m/s)\ (3s) = 24\ m$

$t = 3 \rightarrow 5s : A = \frac{1}{2}LW = (8\ m/s)\ (2s) = 8\ m$

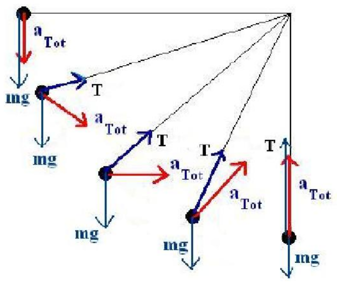
$t = 5 \rightarrow 6s : A = \frac{1}{2}LW = (-4\ m/s)\ (1s) = -2\ m$

$t = 6 \rightarrow 10s : A = LW = (-4\ m/s)\ (4s) = -16\ m$

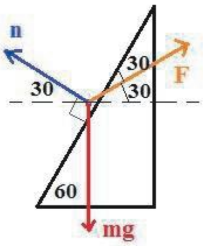
Adding the magnitudes of the position changes together gives a total distance traveled of $24 + 8 + 2 + 16 = 50m$.

Hence, $\langle v \rangle = \frac{50m}{10s} = 5.0\,m/s$

4. The acceleration at $\theta = 0°$ is straight down whereas the acceleration at $\theta = 90°$ is straight upward. In transitioning between these angles, the sum of the two forces acting on the mass effectively rotates by 180°. As a result, the acceleration undergoes a transition like that shown in the figure (not quite drawn to scale) here (the red vector is the total acceleration). One notes that this result holds whether the angle θ increases (mass falling) or decreases (mass rising) and that the total acceleration is directed along the string only at $\theta = 90°$, outside the range of angles allowed in the problem.



5. In order for the sum of 3 equal-sized vectors to be zero, the angle between each vector with any other needs to 120°. Since the gravitational force is straight downward, the normal force is directed 30° above the horizontal. A picture is useful! From the construction, we see that the angle θ = 60° making the applied force half-way between the horizontal and the level of the incline. So the applied force would have to be 30° below the incline's surface.



6. The area under the force-time curve gives the impulse on mass 2. By Newton's Third Law, the force on mass 1 has the same magnitude but is in the opposite direction. The area is computed as $\frac{1}{2}(10kN)\,(3ms) = 15Ns.$ So, the impulse for mass 1 is –15Ns. Using the impulse-momentum theorem, $\Delta p_1 = -15 = m_1(v_{1f} - v_{1i})$

$\Rightarrow -\frac{15}{3.50} = v_f - 7.0 \Rightarrow v_f = 2.71\ m/s$ So, using the impulse on mass 2, we find $\Delta p_2 = 15 = m_2(v_{2f} - v_{2i})$

$\Rightarrow m_2 = \frac{15}{2.71 - 0} = 5.54\ kg.$

7. The initial kinetic energy of the system is

$\frac{1}{2}m_1v_1^2 = \frac{1}{2}(3.50)\,(7.0)^2 = 85.75\ J.$ After the collision, the kinetic energy is computed as

$\frac{1}{2}(m_1 + m_2)v_f^2$

$= \frac{1}{2}(3.50 + 5.53)\,(2.71)^2 = 33.16\ J.$

The difference in these quantities is $\Delta KE = KE_f - KE_i = 33.16 - 85.75 = -52.6\ J.$

8. By using the right hand rule with the thumb directed along the current, we find that the wire on the right produces a field directed out of the plane of the page at the electron's location. Performing the same procedure for the left wire, that field also is directed out of the plane of the page. So, the total field is out of the plane of the page and from $\vec{F} = q\vec{v} \times \vec{B}$, the magnetic force is directed to the right (the cross term is to the left, but the electron makes the force to the right). Hence, we now need an electric force directed to the left to balance the magnetic force. From $\vec{F} = q\vec{E} \rightarrow \vec{E} = \frac{\vec{F}}{q}$, we see that if the force is to the left, then the field must be to the right since an electron is a negative charge.

9. We write $\tau_{net} = I\alpha$ and note that the moment of inertia of the rod is $I = \frac{1}{12}ML^2$ about an axis through the center of mass. To find the moment of inertia about the pivot, we need the parallel axis theorem to obtain $I = \frac{1}{12}ML^2 + md^2$ where $d = \frac{L}{6}$ (the distance between the center of the mass and the pivot) leading to $I = \frac{1}{12}ML^2 + m\left(\frac{L}{6}\right)^2 = \frac{1}{9}ML^2$. Calculating the torque from the gravitational force at the center of the stick gives τ = Fd sin θ = $Mg\left(\frac{L}{6}\right)\sin-(90°) = -\frac{MgL}{6}$. (The minus sign for clockwise).

So, $\tau_{net} = I\alpha \Rightarrow -\frac{MgL}{6} = \frac{1}{9}ML^2\alpha \Rightarrow \alpha = -\frac{3}{2}\frac{g}{L}$.

Using $a_t = r\alpha$ leads to $a_t = \left(\frac{L}{6}\right)\left(-\frac{3}{2}\frac{g}{L}\right) \Rightarrow |a_t| = \frac{g}{4}$.

10. From the figure, we see that the string length from the oscillator to the pulley went from being one full wavelength on the left to being two full wavelengths on the right. This means that the wavelength is now ½ as large with the mass submerged. Since the oscillator is not changing the frequency of vibration, this means that the wave speed for the string is now ½ as large from v = fλ. The wavespeed on a string is determined as $v = \sqrt{T/\mu}$ which means to cut the speed in half resulted from a tension now ¼ as large.

11. From the free body diagram of the mass hanging on the string in the figure on the left, we find $F_{net} = Ma \rightarrow T - Mg = 0 \rightarrow T = 80N$. Since we determined in the previous question that tension is now 20 N with the mass submerged. This means that there is a buoyant force of 60 N acting on the mass from the water. So, $B = \rho_w g V_{dis} \rightarrow 60 = (1000)(10)V_{dis} \rightarrow V_{dis} = 0.006m^3$ where V_{dis} is the volume of displaced water (which is the same as the volume of the mass). Since the mass is a cube, $L^3 = 0.006m^3 \rightarrow L = 0.182$ m.

12. Lenz's Law is required to answer this question. The magnetic field associated with the long wire is into the page to the right of the wire and out of the page to the left of the wire. As the loop on the right is moved away, there are weaker field lines penetrating into the loop. As a result, there is an induced current oriented to try to replace the missing field lines. This means that the current in the right loop is oriented clockwise to put field lines into the plane in the interior of the loop. Likewise, on the left side of the long wire, there are again weaker field lines coming out of the plane of the loop. Here, the induction would be for a current oriented counterclockwise to have additional field lines out of the plane through the interior of the loop.

13. The density of the fluid in the pool $\left(500\frac{kg}{m^3}\right)$ is less than the density of water $\left(1000\frac{kg}{m^3}\right)$, which is very close to the density of a human being. This means that when the person jumps into the pool, they will sink all the way to the bottom.

14. The unit of a time constant for an RL circuit is $\tau = \frac{L}{R}$ which means L = Rτ. Hence, an ohm-second is the same thing as a henry (unit of inductance).

15. Bulbs in series have the same current, so the resistor with higher resistance will be brighter (more power) from $P = I^2R$. This means that $R_X > R_Y$. Bulbs connected in parallel have the same potential difference. From $P = \frac{\Delta V^2}{R}$, the smaller resistance bulb has more power and will be brighter. This means that $P_Y > P_X$ and bulb Y is now brighter. Further, in the parallel configuration, both bulbs get the potential difference associated with the battery, whereas in series, each bulb only gets a fraction of the potential difference. This means that both bulbs now are brighter than before.

16. From the right-hand rule, the thumb points along the direction of current and the right fingers wrap in the sense of the magnetic field lines. Consequently, for the 2-A current, the field points downward anywhere to the left of the wire and upward anywhere to the right of the wire on the x-axis. Likewise, the 3-A current produces fields that point downward anywhere to the right of the wire and upward everywhere to the left of the wire. To have no total field, the individual magnetic fields must cancel (point in opposite directions) and that only occurs in Regions I and III. However, since points in Region III always are closer to the larger current, there is no way for the smaller current, acting from further away, to cancel the field from the larger current. The only way the fields can cancel is if the larger current is acting from a greater distance which corresponds to a location in Region I.

17. As there is no friction on the pond, there are no horizontal forces acting on the plank-person-box system. This means that the center-of-mass of the system remains stationary throughout. Locating the box at x = 0m, the person at x = 9.20m and the center of the plank at x 4.60m, we have

$$x_{cm} = \frac{m_{box}x_{box} + m_{pl}x_{pl} + m_{per}x_{per}}{M_{total}}$$

$$= \frac{(0) + m_{pl}(4.60) + (71)(9.2)}{52 + 71 + m_{pl}} = \frac{653.2 + 4.6m_{pl}}{123 + m_{pl}}.$$

After the person moves, this same expression can be rewritten as

$$x_{cm} = \frac{m_{box}x_{box} + m_{pl}x_{pl} + m_{per}x_{per}}{M_{total}}$$

$$= \frac{(52)(3.84) + m_{pl}(4.60 + 3.84) + (71)(3.84)}{52 + 71 + m_{pl}}$$

$$= \frac{472.32 + 8.44m_{pl}}{123 + m_{pl}}.$$

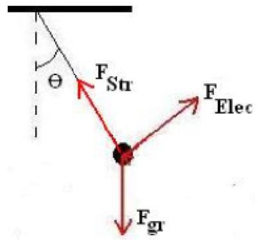
Equating the c.o.m. expressions gives

$$\frac{653.2 + 4.6m_{pl}}{123 + m_{pl}} = \frac{472.32 + 8.44m_{pl}}{123 + m_{pl}} \rightarrow 180.88$$

$$3.84m_{pl} \rightarrow m_{pl} = \frac{180.88}{3.84} = 47.1\text{ kg}$$

18. There are 3 forces acting on the mass... a gravitational force, the force from the string, and an electric force (see the FBD to the right). Using Newton's Second Law in equilibrium, we have

$$\vec{F}_{gr} + \vec{F}_{str} + \vec{F}_{elec} = 0 \;\Rightarrow\; \vec{F}_{gr} + \vec{F}_{elec} = -\vec{F}_{str}.$$



That is, the sum of the gravitational and electric forces is equal and opposite to the force from the string. By removing the string, there is therefore a net force directed oppositely to the string force. This gives the direction of the constant acceleration acting on the object and since it starts from rest, the mass will move in a straight line.

19. Since the area is changing size at the same rate on both sides (related to the speed of the bar, ξ = Blv), the currents are equal since the induced emf is the same. Because the change in flux is into the page in the right loop, a counterclockwise current will exist resulting in current up the plane through Y. Likewise, as there is a lessening flux in the left loop, there will be a clockwise current resulting in current directed upward through X.

20. To compute the angular momentum we are going to approximate the Earth as point-like since its radius is small compared to that of its orbit radius. So, $L = I\omega = (MR^2)\omega$. The distance from the Earth to the Sun can be approximated as the distance that light travels in about 10 minutes. That is,

$$R = vt = \left(3\times10^{8}\,\frac{m}{s}\right)\left(10\,\text{min}\times\frac{60s}{1\,\text{min}}\right) = 1.8\times10^{11}\,m.$$

The mass is on the constants sheet and the angular speed of the Earth around the Sun is approximately

$$\omega = \frac{2\pi\text{ rad}}{1\text{ yr}}\times\frac{1\text{ yr}}{365\text{ dy}}\times\frac{1\text{ dy}}{24\text{ hr}}\times\frac{1\text{hr}}{60\text{ min}}\times\frac{1\text{min}}{60\text{ s}}$$

$= 1.99\times10^{-7}\,\frac{\text{rad}}{s}$. Putting this together gives the angular momentum as $L = (6.0\times10^{24})(1.8\times10^{11})^2(1.99\times10^{-7}) = 3.87\times10^{40}\ \text{kgm}^2/\text{s}$.

21. Conservation of mechanical energy can be employed here. This gives $\Delta KE + \Delta PE = 0$ and we note that we have two forms of kinetic energy (translational and rotational). Incorporating both, we write

$\Delta KE_{tr} + \Delta KE_{rot} + \Delta PE = 0 \rightarrow$

$$(1/2\,mv_f^2 - 0) + (1/2\,I\omega_f^2 - 0) + (0 - 1/2\,kx_1^2) = 0$$

Noting from the equation sheet that $I_{cyl} = \frac{1}{2}MR^2$, we can write, using $v = r\omega$, that

$$\frac{1}{2}mv_f^2 + \frac{1}{2}\left(\frac{1}{2}MR^2\right)\omega^2 = \frac{1}{2}kx_i^2 \rightarrow$$

$$mv^2 + \frac{1}{2}mv^2 = kx_i^2 \Rightarrow v_{cm} = \sqrt{\frac{4}{3}\frac{k}{m}}$$

$x_i = 1.15$ m/s

22. $$\varepsilon_{eq} = \frac{\frac{\varepsilon}{2R}+\frac{\varepsilon}{3R}}{\frac{1}{R}+\frac{1}{2R}} = \frac{5\varepsilon}{6\times\frac{3}{2}} = \frac{5\varepsilon}{9}$$

In steady state

$$V_{cap} = \frac{5\varepsilon}{9}$$

23. If one places a converging lens at a distance between the focal length and twice the focal length, the resulting image will be real (inverted) and it would be larger. If the lens is placed at a distance equal to twice the focal length, the image is the same size as the object... placing the object outside of twice the focal length results in a smaller inverted image. The diverging lens always produces a smaller virtual image and by placing the object inside the focal length of the converging lens produces a larger but virtual image.

24. Block 1 will experience no friction and will therefore travel the distance in the least amount of time. Blocks 2 & 3 will experience equivalent amounts of friction and will take equal amounts of time to travel.

25. Protons in the metal are not free to move as they are in the nuclei of the atoms. The mobile charges here are electrons. There are no positrons ("positive electrons") in the metal.

26. There are 2 forces on the free body diagram of the hanging mass (T, G). Writing Newton's Second Law for this problem, we have $F_{net} = Ma \rightarrow T - G = F$. Since the elevator is said to be moving downward with a constant speed of 3.0 m/s, we have $F = 0 = T - G$ and so, $T = G$. Hence, this gives as our result that $F < T = G$

27. At point 'P' $v = \sqrt{2gL}$

$a = mg$

$F = \frac{mv^2}{L} = 2mg = 2G$

$T = mg + \frac{mv^2}{L} = 3mg = 3G$

So, $G < F < T$

28. By disconnecting the battery, the charge on the capacitor plates is fixed. By removing the dielectric, the capacitance is reduced by a factor of k. So, by using $U = \frac{1}{2}\frac{Q^2}{C}$, with the reduction in the capacitance by k with no charge change, the energy is increased by a factor of k.

29. By closing the switch in the circuit, the light bulbs have been put into parallel, thereby reducing the resistance of the grouping. In order to maintain the same brightness, there must be the same ratio of potential difference for the light bulbs compared to the two resistors in the circuits so that the potential differences do not change. In other words, we write

$$\frac{I\,R_{bulb}}{I(r+R)}=\frac{\left(\frac{1}{2}I_2\right)R_{bulb}}{I_2(r+R')}$$ where I is the current in the initial circuit and I_2 is the current in the circuit with both bulbs. This expression leads to

$$\left(\frac{1}{8+26}\right)=\frac{1}{2}\left(\frac{1}{8+R'}\right)\to 2(8+R')=34$$

$$\to\ 8+R'=17\to\ R'=9\Omega$$

30. From the kinetic theory of gases, the rms speed is found as $v=\sqrt{\frac{3RT}{M}}$ where M is the molar mass of the gas. Using the ideal gas equation, we have PV = nRT $\Rightarrow RT=\frac{PV}{n}$ and so we rewrite the rms speed as $v_{rms}=\sqrt{\frac{3PV}{nM}}=\sqrt{\frac{3PV}{m}}$ where represents the mass of the gas (# moles * mass/mole = total mass). Lastly, the quantities for pressure, mass, and volume must be converted to MKS units resulting in

$$P = 3\text{ atm}\times\frac{1.013\times10^5\,\text{Pa}}{1\,\text{atm}}=3.039\times10^5\,\text{Pa}$$

$$m = 0.058\text{ kg and } V = 6L\times\frac{1m^3}{1000\,L}=6\times10^{-3}\,m^3$$

Finally, we compute the speed as

$$v_{rms}=\sqrt{\frac{3PV}{m}}$$

$$=\sqrt{\frac{3(3.039\times10^5)(6\times10^{-3})}{0.058\,\text{kg}}}=307\text{m / s}$$

31. The coefficient of performance is computed as "what you get divided by what you pay for". For the refrigerator, you are paying for energy to be removed from the cold temperature reservoir to the high temperature reservoir and paying for the work done to remove the energy.

In equations, this is $\text{cop}_{\text{fridge}}=\frac{|Q_C|}{|W|}$. For the PV diagram given, the magnitude of the work done is equal to magnitude of the area under PV curve which here is $W = P_0V_0 = nRT_0$ where T_0 is the temperature at point A in the cycle. For the processes shown, there is heat lost from the cold surroundings in processes AB and BC. For a monatomic ideal gas, the heat associated with these processes is computed as $Q_{BC} = nC_v\Delta T_{BC}$ and $Q_{AB} = nc_p\Delta T_{AB}$.

Here, $c_v=\frac{3}{2}R$ and $\Delta T_{BC}=2T_0;\ \Delta T_{AB}=T_0$

Using the ideal gas equation, the temperatures at A,B,C, and D are found as T_0, $2T_0$, $4T_0$ and $2T_0$, respectively, allowing us to find the temperature changes.

So $Q_C=n\left(\frac{3}{2}R\right)(2T_0)+n\left(\frac{5}{2}R\right)(T_0)=\frac{11}{2}nRT_0$.

This means that the coefficient of performance is

$$\text{cop}_{\text{fridge}}=\frac{\frac{11}{2}nRT_0}{nRT_0}=\frac{11}{2}$$

32. To solve this problem, we need a combination of Bernoulli's Equation along with the Equation of Continuity. The mass flow rate is the same at the top and bottom portion of the pipe, hence we can write ρAv = constant . Since the fluid is ideal, the density is the same throughout, leading to $A_{top}\,v_{top} = A_{bot}\,v_{bot} \Rightarrow (10)\,(9) = (30)\,v_{bot} \Rightarrow v_{bot} = 3.0$m/s. Now employing Bernoulli's equation for two points along a streamline at the center of the tube, we write

$$P_B+\frac{1}{2}\rho v_B^2+\rho g y_B=P_T+\frac{1}{2}\rho v_T^2+\rho g y_T$$

Choosing the location of the lower pipe to be $y_B = 0$,

we have $P_B + \frac{1}{2}\rho v_B^2 = P_T + \frac{1}{2}\rho v_T^2 + \rho g y_T$

$$\Rightarrow P_B + \frac{1}{2}(1000)(3)^2$$

$$= P_T + \frac{1}{2}(1000)(9)^2 + (1000)(10)(2) \text{ and so}$$

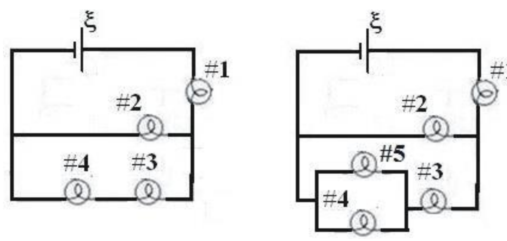
$P_B - P_T = 40500 + 20000 - 4500 = 56000 = 56\text{kPa}$

33. The expression for the period of a simple pendulum at small angles is

$$T = 2\pi\sqrt{\frac{L}{g}}. \text{ So, } 2 = 2\pi\sqrt{\frac{L}{10}} \text{ leads to}$$

$$\frac{1}{\pi} = \sqrt{\frac{L}{10}} \Rightarrow L = \frac{10}{\pi^2} = 1.0\text{m}$$

34. The equivalent circuit before and after the switch is closed for the resistors is shown in the figure.



In words, by closing the switch the resistance of the entire circuit goes down since the resistance of the bottom branch drops from 2R to $\frac{3}{2}$. Since there is less resistance in the circuit, there is more current, meaning that there is more current through bulb #1 directly connected to the battery. Bulb #1 gets brighter and has more potential difference. Consequently, there is less potential difference now for bulb #2 from Kirchhoff's Loop Rule with the battery and bulb #1. Bulb #2 is dimmer. Finally, since the resistance of the bottom branch decreased, it now gets a higher percentage of a slightly higher current. With the switch closed, bulbs #4 and #5 now share the current equally, resulting in less current through bulb #4, thereby making it dimmer than before. At the same time, all of the slightly higher current is now through #3, thereby making it brighter.

35. $\frac{hc/e}{4000\text{Å}} = \phi + 1.3\text{eV}$ .....(1)

$$\frac{hc/e}{4500\text{Å}} = \phi + 0.9\text{eV}$$

$$\frac{4000}{4500} = \frac{\phi + 0.9}{\phi + 1.3}$$

$\phi = 2.3$ eV

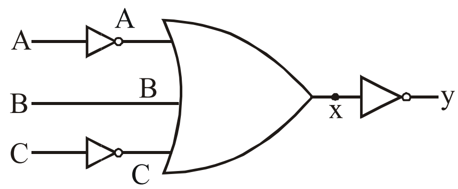
36. To have equal probabilities, the rates of decay must be equal

So $\lambda_1 N_1 = \lambda_2 N_2 \Rightarrow \frac{N_1}{N_2} = \frac{\lambda_2}{\lambda_1} = \frac{3}{2}$

37. Q represents K_α and P represents K_β

40. In common emitter amplifier circuit input and out put voltage are out of phase. When input voltage is increased then i_b is increased, i_c also increases so voltage drop across R_c is increased. However increase in voltage across R_C is in opposite sense.

41.



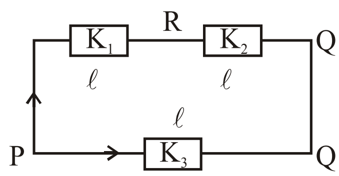
$$x = \bar{A} + B + \bar{C}$$

$$x = \overline{\bar{A} + B + \bar{C}}$$

$$= \bar{\bar{A}}.\bar{B}.\bar{\bar{C}}$$

$$= A.\bar{B}.C$$

42.



$K_{eq}. = \dfrac{2k_1k_2}{k_1+k_2}$

$i_{PRQ} = i_{PQ}$

$$\frac{KA(\theta_1-\theta_2)}{2\ell}=\frac{K_3A(\theta_1-\theta_2)}{\ell}$$

$$\frac{2K_1K_2}{2(K_1+K_2)} = K_3$$

$$\boxed{K_3=\frac{K_1K_2}{K_1+K_2}}$$

43. $\gamma_r = \gamma_1 + 3\alpha_1 = \gamma_2 + 3\alpha_2 \Rightarrow \alpha_2 = \dfrac{\gamma_1-\gamma_2+3\alpha_1}{3}$

44. Phase difference corresponding to given path difference

$$\phi=\frac{2\pi}{\lambda}\Delta x=\frac{2\pi}{\lambda}\times\frac{\lambda}{8}=\frac{\pi}{4}$$

$$\therefore I_R = I_0 + 2I_0 + 2\sqrt{I_0\times 2I_0}\cos\frac{\pi}{4} = 5I_0$$

45. Resolving power of microscope

$$P=\frac{2\mu\sin\beta}{1.22\lambda_0}=\frac{2\sin\beta}{1.22\lambda}$$

where λ is wavelength in given medium.

$$\therefore\ \frac{P}{P'}=\frac{\frac{5\lambda}{3}}{\lambda}=\frac{5}{3}$$

$$\Rightarrow\ P'=\frac{3}{5}P$$

46. S.C. is divided for each reactant and product.

$$\frac{-d[H_2]}{(1/2)dt}=\frac{-d[I_2]}{(1/2)dt}=\frac{d[HI]}{dt}$$

48. $PbSO_4 + 2OH^- \longrightarrow PbO_2 + H_2SO_4 + 2e^-$

1 mole (2 mole) = 2f

$\frac{1}{2}$ mole (1F)

$\left(\frac{1}{2}\times 0.1\right)\times 303$ (0.1F)

$\Rightarrow$ 15.15 g

49. $(\Delta T_b)_X < (\Delta T_b)_Y$

m and k_b same

$i_X < i_Y$, hence Y undergoing dissociation in water.

50. $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

1 mole 2 mole 1 mole i.e. $\Rightarrow$ 2gm H_2

$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$

1 mole 1 mole

$\frac{1}{2}$ mole H_2 i.e. $\Rightarrow$ 1 gm H_2

2g and 1g

51. $CH_3OH(l) + 3/2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$

$\Delta G^o_{rxn} = (\Delta G^o_f)_{Products} - (\Delta G^o_f)_{Reactants}$

$\Rightarrow -394 - 2(237) - (-166) = -702\ kJ\ mol^{-1}$.

$$\text{Efficiency } (\eta) = \frac{\Delta G}{\Delta H}\times 100$$

$$94 = \frac{-702}{\Delta H}\times 100$$

$$\Delta H = \frac{-702}{94}\times 100 = -746.8\ kJ/mol$$

52. $Cr(OH)_3 \rightleftharpoons Cr^{+3} + 3OH^-$

s 3s

$K_{sp} = s(3s)^3$

$6\times 10^{-31} = 27s^4$

$$(Cr^{+3}) = s = \left(\frac{6}{27}\times 10^{-31}\right)^{\frac{1}{4}}$$

53. Orbital angular momentum = $\sqrt{\ell(\ell+1)}\,\hbar$

$\ell=1$ for p = $\sqrt{1(1+1)}\,\hbar = \sqrt{2}\,\hbar$

54. In NaCl, Cl^- is in contact with 6 Na^+ ions and Na^+ ions is in contact with 6 Cl^- ions.

55. $\Delta G^o = -2.303\ RT \log K_{eq}$

$= -2.303\times 8.314\times 10^{-3}\times 1000 \log (8.4\times 10^{-5})$

$= 78.03$ kJ/mol.

56. 1.5 gm ice is melt by 500 J at 0ºC

1 gm ice is melt by $\left(\dfrac{500}{1.5}\right)$

for molar heat of fusion (1 mole ice i.e. 18 gm)

18 gm ice is melt by $\dfrac{500}{1.5}\times 18$

= 6000 J = 6 kJ/mol.

58. By increasing temperature average speed increases, no collision increases, pressure increases.

59. In diamond unit cell total 8 THV but only half are occupied by (C) atoms.
Hence 4.

60. (i) $\frac{22.4\times10^{-4}}{22.4}$ mole $\Rightarrow 10^{-4}$ mole $\times N_A$

(ii) $\frac{0.18}{18}$ mole $\Rightarrow 10^{-2}$ mole $\times N_A$

(iii) $\frac{18}{18}$ mole $\Rightarrow$ 1 mole $\times N_A$

(iv) 10^2 mole $\times N_A$

61. PHBV $\left(-O-\underset{CH_3}{\underset{|}{CH}}-CH_2-\underset{O}{\underset{\|}{C}}-O-\underset{C_2H_5}{\underset{|}{CH}}-CH_2-\underset{O}{\underset{\|}{C}}-\right)_n$

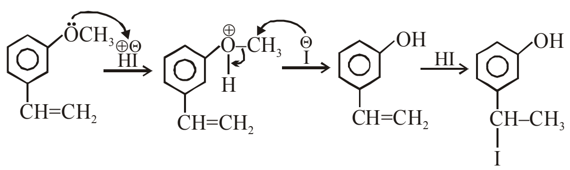
Monomer

$CH_3-\overset{*}{C}H(OH)-CH_2-COOH$ and

3-hydroxybutanoic acid

$CH_3-CH_2-\overset{*}{C}H(OH)-CH_2-COOH$

3-hydroxypentanoic acid

62. 

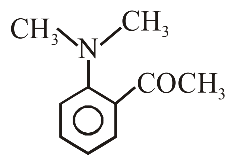
63. Y give positive carbyl amine test it means its primary amine.
Option 1 and 2 are not 1° amide
option 4 is not amide.
Option 3

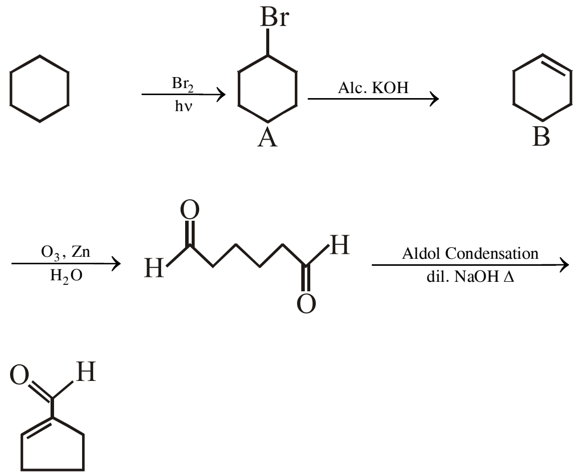
$$CH_3-\underset{CH_3}{\underset{|}{CH}}-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow[NaOH]{Br_2} CH_3-\underset{CH_3}{\underset{|}{CH}}-NH_2$$

64. 2, 4 DNP test is given by carbonyl compound $\left(-\underset{O}{\underset{\|}{C}}-\right)$

Iodoform test is given by methyl ketone $\left(CH_3-\underset{O}{\underset{\|}{C}}-\right)$ group.

Azo test is given by 1° amine.

So correct ans is 

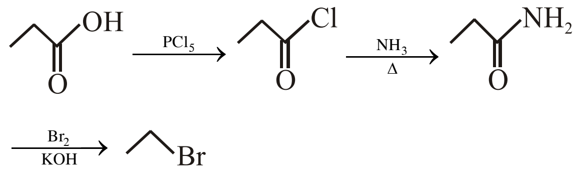
65. 

66. $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-OC_2H_5 \rightleftharpoons$

keto
Acetoacetic ester

$$CH_3-\overset{OH}{\overset{|}{C}}=CH-\overset{O}{\overset{\|}{C}}-OC_2H_5$$

enol

67. 

68. $CH_3-\underset{OH}{\underset{|}{CH_2}} \xrightarrow{KMnO_4} \underset{\text{A acid}}{CH_3-\underset{O}{\underset{\|}{C}}-OH} \xrightarrow[Base]{Ca(OH)_2}$

$$\left(CH_3-\overset{\overset{\large O}{\|}}{C}-O\right)_2 Ca \xrightarrow[\Delta]{-CaCO_3} CH_3-\overset{\overset{\large O}{\|}}{C}-CH_3$$

69. $C_2H_5Br \xrightarrow[(R)]{KCN} C_2H_5CN \xrightarrow[(S)]{LiAlH_4} C_2H_5\text{–}CH_2NH_2$

$R \Rightarrow KCN$ $\qquad$ $S \Rightarrow LiAlH_4$

70. Ribose is a pentose sugar, it is polyhydroxy aldose.

71. Sucralose does not provide calories.

72. Acetaldehyde gives iodoform test

$$CH_3-\overset{\overset{\large O}{\|}}{C}-H \xrightarrow[NaOH]{I_2} CHI_3 \text{ yellow ppt}$$

Acetaldehyde

$$CH_3-CH_2-\underset{\underset{\large O}{\|}}{C}-H \xrightarrow[NaOH]{I_2} \text{no ppt.}$$

73. Polythene is example of chain growth polymerisation.

74. Stability of $\overset{\oplus}{C} \propto$ resonance

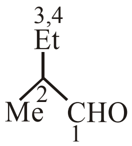
$\propto$ No. of α-H

1. $CH_3-\overset{\oplus}{C}H_2$ $\quad$ 3αH

2. $CH_3-\overset{\oplus}{C}H-CH_3$ $\quad$ 6αH

3. $CH_3-\underset{\underset{\large CH_3}{|}}{CH}-\overset{\oplus}{C}H_2$ $\quad$ 1αH

4. $Ph-\underset{\underset{\large Ph}{|}}{\overset{\oplus}{C}}-Ph$ $\quad$ Resonance (most stable)

75. 

$\Rightarrow CH_3\text{–}\underset{2}{C}H(\overset{3}{C}H_2\text{–}\overset{4}{C}H_3)\text{–}\underset{1}{C}HO$

2-Methyl butanal

76. (1) (EAN = atomic no. – Ox. st + 2 × coord. no.)

EAN = 26 – 2 + 2 × 6

EAN = 36

(2) White vitriol = $ZnSO_4.7H_2O$

Crystalline zinc sulphate

77. In period : Across left to right generally I.E. increases.

Concept of half filled/fully filled apply on those element which is adjacent (ΔZ = 1).

78. PH_3 has the lowest b.p., because it does not form hydrogen bond.

order of boiling point :

$$SbH_3 > \underset{\underset{\text{H – bonding}}{\uparrow}}{\boxed{NH_3}} > AsH_3 > PH_3$$

80. Octahedral complexes of type $[MA_4B_2]$, $[MA_2B_4]$, $[MA_3B_3]$ exhibit G.I. They can have identical ligands at cis/trans positions.

81. Polarizability is the case with the electron cloud can be distorted. Larger molecules ae often more Polarizable as they have Large no. of less tightly held $e^{\ominus}$. Hence Xe has larger amongst all.

82. Solder is an alloy of (Pb+Sn).

It is fusible metal alloy.

83. (1) Bosch's process :

$$\underbrace{CO + H_2}_{\text{Water gas}} + H_2O \xrightarrow{\text{Catalyst}} CO_2 + 2H_2$$

(2) pig iron :

It is the most impure form of iron and contains highest proportion of carbon (2.5 – 4%).

(3) Malachite → $Cu(OH)_2.CuCO_3$

84. The atomic radius of transition metals (3d-seies) on going from left to right in a period first decreases then remains constant and finally increases.

85. CO_2 is linear,

Compounds having linear structure are

O=C=O, Cl–Hg–Cl, HC≡CH

86. As $CoCl_3.3NH_3$ is represented as $[Co(NH_3)_3Cl_3]$. It means it does not have any ionisable Cl^- hence no white ppt of AgCl is possible. In other three complexes given here ionisable Cl^- is possible.

So white ppt of AgCl is possible

$[Co(NH_3)_3Cl_3] \xrightarrow{AgNO_3}$ no ppt.

87. $Fe^{+2} = 3d^6$ (no. of d-electrons = 6)

In Cl = $1s^22s^22p^63s^23p^5$ (no. of p-electrons = 12)

In Fe (no. of d-electrons = 6) and in Mg (no. of s-electrons = 6).

88. On moving down the group size of cation increases so hydration energy decreases and solubility decreases.
Due to very small size of Mg^{+2}, Mg^{+2} shows maximum hydration energy and $MgSO_4$ is more soluble.
Solubility order :

$$\xrightarrow[\text{H.E.}\downarrow \quad \text{Sol.}\downarrow]{MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4}$$

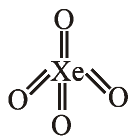
89. Ni^{+2} = [Ar] $3d^8$

$\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow}\boxed{\uparrow}$

Ni^{+2} has two unpaired electron
n = 2

$\mu = \sqrt{n(n+2)} = \sqrt{2(2+2)}$

$= \sqrt{8}$ = 2.83 BM.

90. XeO_4 :


4σ
4π

91. NCERT Pg # 228
93. NCERT Pg # 197
94. NCERT Pg # 217, Reduction step
95. NCERT Pg # 249, Para-15.4.3.3
96. NCERT Pg # 201, Fig. 12.3
98. NCERT Pg # 204 IInd point
99. NCERT-XI (E) Pg # 272
100. NCERT-XI (E) Pg # 272
105. NCERT-XI (E) Pg # 260
106. NCERT-XI (E) Pg # 263
111. Catactrolamine [epinephrine, norepinephrine] in above list can be metabilised by monoamine oxidase.
112. Apneustic centre present in Pons
125. Direct formation of sporophyte from any cell of embryo sac other than egg without fertilization in known as apogomy.
167. NCERT XI, Page # 33
168. Truffles are members of ascomycetes.
173. *Selaginella* is heterospoprous but not a fern.
174. Sexual reproduction in absent in the member of deuteromycetes
175. Musterd - Tetramerous flower
Onion - Trimerous flower
176. NCERT XI, page # 68
178. NCERT XI, page # 98
179. NCERT XI page # 88, 91, 96, 97