AVIRAL CLASSES
CREATING SCHOLARS
FOR JEE (Main & advance), PMTs & FOUNDATION

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FINAL TEST SERIES NEET -2017
TEST-04

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[PHYSICS]

1. As $T^2 \propto R^3$

Hence $\frac{T_2^2}{T_1^2} = \frac{R_2^3}{R_1^3}$ or $\frac{T_2^2}{(24\,\text{hrs})^2} = \left(\frac{3R}{6R}\right)^3$

[Here T_1 = 24 hrs, as satellite is geostationary, hence its time period is equal to the time period of the earth (=24 hrs)]

[Further, $R_2 = R + 2R = 3R$
and $R_1 = R + 5R = 6R$]

$\therefore \quad T_2 = 24 \times \left(\frac{1}{2}\right)^{3/2} = \frac{12}{\sqrt{2}} = 6\sqrt{2}\text{hrs}$

2. Light cannot escape from a black hole,

$V_{esc} = c$

$\sqrt{\frac{2GM}{R}} = c$ or $R = \frac{2GM}{c^2}$

$$R = \frac{2 \times 6.67 \times 10^{-11}\text{Nm}^2\text{kg}^{-2} \times 5.98 \times 10^{24}\text{kg}}{(3 \times 10^8\text{ms}^{-1})^2}$$

$= 8.86 \times 10^{-3}\text{m} \approx 10^{-2}$ m

3. For a point inside the earth, *i.e.*, $r < R$

$E = -\frac{GM}{R^3}r$

where M and R be mass and radius of the earth respectively.

At the centre, $r = 0$

$\therefore \quad E = 0$

For a point outside the earth, *i.e.*, $r > R$,

$E = -\frac{GM}{r^2}$

On the surface of the earth, *i.e.*, $r = R$,

$E = -\frac{GM}{R^2}$

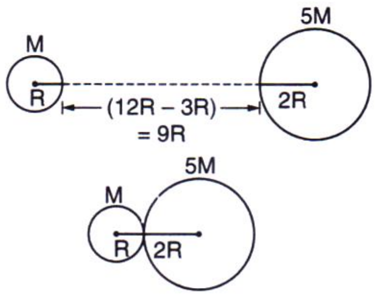
The variation of E with distance r from the centre is as shown in the figure. "

4. We know that

$$T^2 = \frac{4\pi^2}{GM}r^3$$

So, $K = \frac{4\pi^2}{GM}$ ro $GMK = 4\pi^2$

5. Suppose smaller body moves a distance x_1 while bigger body moves a distance x_2, till they collide with each other.



As ther *C.M.* will remain stationary, hence

$mx_1 = 5Mx_2$ ....(i)

For touching of two bodies :

$x_1 + x_2 = 9R$ ....(ii)

Solving, $x_1 = 7.5\ R$

i.e., correct option is (b).

6. $\Delta v = v_e - v_0 = \sqrt{2gR} = \sqrt{gR}$

$$= (\sqrt{2}-1)\sqrt{gR}$$

$$= (\sqrt{2}-1)\sqrt{\frac{GM}{R}}$$

7. $\frac{1}{2}mv^2 = m\left[-\frac{GM}{R} + \frac{3GM}{2R}\right] = \frac{GMm}{2R}$

(increase in KE = decrease in PE)

or $v = \sqrt{\frac{GM}{R}}$

Momentum of $mv = m\sqrt{\frac{GM}{R}}$

$\therefore$ Impulse required $= m\sqrt{\frac{GM}{R}}$

8. $\frac{1}{2}mv^2 = \frac{mgh}{1+\frac{h}{R}}$

$\therefore$ $h = \frac{v^2}{2g - \frac{v^2}{R}} = \frac{R}{\left(\frac{2gR}{v^2}\right)-1}$

9. $\frac{mv^2}{r} \propto r^{-n}$

$\therefore$ $v \propto r^{(1-n)/2}$

$T = \frac{2\pi r}{v}$ or $T \propto rv^{-1}$

or $T \propto r.r^{(n-1)/2}$

or $T \propto r^{(n+1)/2}$

10. Field strength is uniform inside the cavity. Let us find at its centre

$E_T = E_P + E_C$ (T = Total, R = Remaining, C= Cavity)

$\therefore$ $E_R = E_T - E_C$

$$= \frac{GM}{R^3}\frac{R}{2} - 0 = \frac{GM}{2R^2}$$

$\therefore$ $F = mF_R = \frac{GMm}{2R^2}$

11. $B = \frac{-\Delta p}{(\Delta V / V)}$

For incompressible liquid $\Delta V = 0$ $\therefore$ B = $\propto$

12. Maximum stress = Y × (maximum strain)

$$\frac{Mg}{A} = 2\times10^{11}\times10^{-3} = 2\times10^{8}$$

$\therefore$ $M = \frac{2\times10^{8}\times3\times10^{-6}}{10}$

= 60 kg

13. Energy per unit volume $= \frac{1}{2}\times\text{Stress}\times\text{strain}$

$$= \frac{1}{2}\times(Y\times\text{strain})\times\text{strain}$$

$$= \frac{1}{2}\times Y\times E^2$$

14. $F = \left(\frac{YA}{l}\right).\Delta l$

i.e., F - Δl graph is a straight line with slope $\frac{YA}{l}$ or slope proportional to Y.

(Slope)$_A$ > (slope)$_B$

$\therefore$ $Y_A > Y_B$

15. $\Delta l = \frac{Fl}{AY} = \frac{(2)l}{(10^4)(2\times10^{-4})} = l$

$\therefore$ New length will become 2l.

16. $\text{Strain} = \frac{\text{Stress}}{Y} = \frac{S}{Y}$

Now, energy stored per unit volume

$$= \frac{1}{2}\times\text{stress}\times\text{strain}$$

$$= \frac{1}{2}\times S\times\frac{S}{Y} = \frac{S^2}{2Y}$$

17. $d\rho = \frac{\rho}{B}.dp$

or $\frac{d\rho}{\rho} = \frac{d\rho}{B}$

$$\frac{0.1}{100} = \frac{dp}{2.1\times10^{9}}$$

$\therefore$ $dp = 2.1\times10^{6}$ N/m^2

18. Due to own weight $\Delta l = \dfrac{mgl}{2AY}$

$$= \frac{(lA\rho)gl}{2AY}$$

$$= \frac{l^2\rho g}{2Y}$$

$$= \frac{(8)^2(1.5\times10^3)(9.8)}{2\times5\times10^6}$$

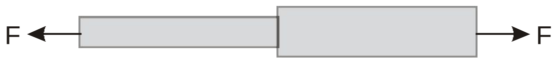
$= 9.4 \times 10^{-2}$ m = 9.4 cm

19. $\Delta l = \dfrac{Fl}{AY}$ or $\Delta l \propto \dfrac{l}{d^2}\left(A = \dfrac{\pi}{4}d^2\right)$

Therefore Δl will be maximum for that wire for which $\dfrac{l}{d^2}$ is maximum.

20. c

21. $(\Delta l)_b = (\Delta l)_s$



or $\left(\dfrac{Fl}{AY}\right)_b = \left(\dfrac{Fl}{AY}\right)_s$ $(F_b = F_s)$

or $\left(\dfrac{l}{AY}\right)_b = \left(\dfrac{l}{AY}\right)_s$

$\therefore$ $l_s = \left(\dfrac{A_sY_s}{A_bY_b}\right)l_b$

$$= \left(\frac{1.0\times2.0\times10^{11}}{2.0\times1.0\times10^{11}}\right)(2\text{m}) = 2\text{m}$$

22. $T_{max} = m(g + a) = 2000)\ (9.8 + 1.5) = 22600$ N

Maximum stress = $\dfrac{T_{max}}{\text{Area}}$

$\therefore$ Area $= \dfrac{T_{max}}{\text{Maximum stress}}$

$$= \frac{22600}{7\times10^7}$$

$= 3.22 \times 10^{-4}$ m² $= 3.22$ cm²

23. At middle T = weight of half the length of steel bar

$$= \left(\frac{L}{2}\right)A\rho g$$

$\therefore$ Stress $= \dfrac{T}{A} = \dfrac{L\rho g}{2}$

24. When iron block was floating, it displaces V_1 volume of water such that weight of this V_1 volume of water is equal to weight of block. But since density of iron is more than density of water, this volume V_1 will be greater than volume V_2 of iron block.

When iron block sinks in the pond, it displaces water of volume equal to its own volume V_2.

Since $V_1 > V_2$, displaced volume in first case was more than displaced volume in second case. Hence level will fall

25. Force exerted by gas on its hemispherical end = Pressure of gas × Projected area = $p_0(\pi r^2)$.

26. Upthrust on sphere from the liquid makes equal and opposite pair of forces. Hence there will be no effect on the pressure at bottom of vessel.

Or $p = p_0 + \rho gh$

27. W = Upthrust = $V_i\rho lg$ or $V_i = \dfrac{W}{\rho lg}$

If density of liquid ρl is increased,immersed volume V_i will decrease or the ball will go up.

28. Pressure inside the bubble

= Pressure outside it + $\dfrac{2T}{r}$

$$= (p_0 + \rho gh) + \frac{2T}{r}$$

$$= 10^5 + (10^3 \times 10 \times 10) + \frac{2\times7\times10^{-2}}{10^{-3}}$$

$= 2.0014 \times 10^5$ N/m²

29. $3g = 4(g - a)$

$\therefore$ $g - a = \dfrac{3g}{4}$

Upthrust = $(5 \times 10^{-4})\ (10^3)\left(\dfrac{3g}{4}\right)\text{N} = 0.375$ kg

Apparent weight = (3 – 0.375) = 2.625 kg

30. For work-energy theorem

work done by all the forces = change in kinetic energy.

$\therefore$ (Work done by gravity for 7 m) + (work done by upthrust for 2 m) + (work done by resistive forces) = 0 as ΔKE = 0

$\therefore$ (1) (10) (7) cos0º + $\left(\dfrac{1}{2/3\times\rho_w}\right)(\rho_w g)$

(2) cos 80º + work done by resistive forces = 0

$\therefore$ Work done by resistive forces = – 40 J

31. W = Upthrust

or $(m_1 + m_2)\, g = [(m_1/0.5 \times \rho_w) + (m_2/2.5 \times \rho_w)]\, \rho_w g$

or $m_1 + m_2 = 2m_1 + 0.4\, m_2$

or $m_1 = 0.6\, m_2$

$$\therefore \quad \frac{m_1}{m_2} = 0.6 = \frac{3}{5}$$

32. Increase in pressure

$$= \frac{\text{Force exerted by the cylinder on the liquid}}{A}$$

$$= \frac{\text{Upthrust}}{A}$$

33. Common height after they are connected can be determined by equating the volumes. Hence

$(A_1 + A_2)\, h = A_1 h_1 + A_2 h_2 \qquad (A_1 = A_2 = A)$

$$\therefore \quad h = \frac{h_1 + h_2}{2}$$

Work done by gravity = $-\Delta U = U_i - U_f$

$$= \left\{ A h_1 \rho . g . \frac{h_1}{2} + A h_2 \rho . g . \frac{h_2}{2} \right\} - A(h_1 + h_2)\rho . g . \frac{(h_1 + h_2)}{4}$$

$$= \frac{\rho A g}{4}(h_2 - h_1)^2$$

34. d

35. When a capillary tube is broken at a height of 6 cm, the height of water column will be 6 cm.

As $$h = \frac{2S\cos\theta}{\rho r g}$$

or $$\frac{h}{\cos\theta} = \text{constant}$$

$$\therefore \quad \frac{8}{\cos 0^{\circ}} = \frac{6}{\cos\theta}$$

or $$\cos\theta = \frac{6\cos 0^{\circ}}{8} = \frac{3}{4}$$

$$\theta = \cos^{-1}\left(\frac{3}{4}\right)$$

36. Here, surface tension, $S = 0.03\ \text{Nm}^{-1}$

$r_1 = 3\ \text{cm} = 3 \times 10^{-2}\text{m}$, $r_2 = 5\ \text{cm} = 5 \times 10^{-2}\text{m}$

Since, bubble has two surfaces,

Initial surface area of the bubble

$= 2 \times 4\pi r_1^2 = 2 \times 4\pi \times (3 \times 10^{-2})^2$

$= 72\pi \times 10^{-4}\text{m}^2$

Final surface area of the bubble

$= 2 \times 4\pi r_2^2 = 2 \times 4\pi(5 \times 10^{-2})^2 = 200\pi \times 10^{-4}\text{m}^2$

Increase in surface energy

$= 200\pi \times 10^{-4} - 72\pi \times 10^{-4} = 128\pi \times 10^{-4}$

$\therefore$ Work done = S × increase in surface energy

$= 0.03 \times 128 \times \pi \times 10^{-4} = 3.84\pi \times 10^{-4}$

$= 4\pi \times 10^{-4}$ J = 0.4π mJ.

37. The wett ability of a surface by a liquid depends primarily on angle of contact between the surface and the liquid.

Hence, correct answer is (c).

38. Let n droplets each of radius r coalesce to form a big drop of radius R.

$\therefore$ Volume of n droplets = Volume of big drop

$$n \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$$

$$n = \frac{R^3}{r^3} \qquad \text{.......(i)}$$

Volume of big drop, $V = \frac{4}{3}\pi R^3$ ......(ii)

Initial surface area of n droplets,

$$A_i = n \times 4\pi r^2 = \frac{R^3}{r^3} \times 4\pi r^2 \quad \text{[Using eqn. (i)]}$$

$$= 4\pi\frac{R^3}{r} = \left(\frac{4}{3}\pi R^3\right)\frac{3}{r} = \frac{3V}{r} \quad \text{[Using eqn. (ii)]}$$

Final surface area of big drop

$$A_f = 4\pi R^2 \left(\frac{4}{3}\pi R^3\right)\frac{3}{R} = \frac{3V}{R} \quad \text{[Using eqn. (ii)]}$$

Decrease in surface area

$$\Delta A = A_i - A_f = \frac{3V}{r} - \frac{3V}{R} = 3V\left(\frac{1}{r} - \frac{1}{R}\right)$$

$\therefore$ Energy released = Surface tension × Decrease in surface area

$= T \times \Delta A$

$$= 3VT\left(\frac{1}{r} - \frac{1}{R}\right)$$

39. Temperature shown on faulty thermometer will be

$$t = 5 + \left(\frac{95-5}{100}\right) \times 40 = 41^{\circ}$$

40. According to Wein's displacement law,

$$\lambda_1 T_1 = \lambda_2 T_2$$

or $$\frac{\lambda_1}{\lambda_2} = \frac{T_2}{T_1} = \frac{0.26}{0.13} = 2$$

$\therefore$ $T_2 = 2T_1$

By stefan's law, emissive power $E = \sigma T^4$.

$E_1 = \sigma T_1^4$; $E_2 = \sigma T_2^4$

$$\therefore \frac{E_1}{E_2} \frac{\sigma T_1^4}{\sigma T_2^4} = \frac{T_1^4}{(2T_1)^4} = \frac{1}{16}$$

41. $T_1 = 27 + 273 = 300$ K

$T_2 = 327 + 273 = 600$ K

By Stefan's law, $$\frac{E_1}{E_2} = \frac{T_1^4}{T_2^4}\left(\frac{T_1}{T_2}\right)^4 = \left(\frac{300}{600}\right)^4$$

$\therefore$ $E_2 = 16E_1$.

42. a

43. d

44. **1st case**: As it is a series combination,

$$K_s = \frac{2K_1K_2}{K_1 + K_2}$$

2nd case: As it is a parallel to combination,

$K_p = (K_1 + K_2)/2$

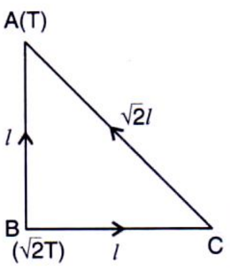
$$\therefore \frac{K_s}{K_p} = \frac{4K_1K_2}{(K_1+K_2)^2}$$

45. As $T_B > T_A$, heat flows from B to A through both paths BA and BCA.

Rate of heat flow in BC = Rate of heat flow in CA

$$\frac{KA(\sqrt{2}T - T_C)}{l} = \frac{KA(T_C - T)}{\sqrt{2}l}$$

Solving this, we get; $$T_C = \frac{3T}{\sqrt{2}+1}$$



[CHEMISTRY]

46. MnO_4^- : $x - 8 = -1$ $\Rightarrow$ $x = +7$

CrO_2Cl_2 : $x - 4 - 2 = 0$ $\Rightarrow$ $x = +6$

47. Calculations are done separately for N atom in NH_4^+ and NO_3^-.

48. d

49. I^- of HI is oxidised to I_2^0 and S^{6+} of H_2SO_4 has been reduced to S^{4+} of SO_2.

50. $$\underset{\text{(white)}}{\overset{0}{P_4}} + \underset{\text{(conc. hot)}}{3NaOH} + 3H_2O \rightarrow \overset{-3}{P}H_3 + NaH_2\overset{+1}{P}O_2$$

51. $$K\overset{+7}{I}O_4 + \underset{\text{reducing agent}}{2H_2O_2} \rightarrow K\overset{+5}{I}O_3 + 2H_2O + O_2$$

$$H_2\overset{-1}{N}OH + \underset{\text{oxidising agent}}{3H_2O_2} \rightarrow H\overset{+5}{N}O_3 + 4H_2O$$

52. d

53. $$\underset{\text{1 mol}}{Mg_3N_2} + 6H_2O \rightarrow 3Mg(OH)_2 + \underset{\text{2 mol}}{2NH_3}$$

54. c

55. All household bleaching solutions have H_2O_2 as bleaching agent.

$H_2O_2 + 2H^+ + 2I^- \rightarrow I_2 + 2H_2O$

$I_2 + Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$

Moles of H_2O_2 = moles of $I_2 = \frac{1}{2} \times$ moles of

$$Na_2S_2O_3 = \frac{1}{2} \times \frac{MV}{1000}$$

(2 moles of $Na_2S_2O_3 \equiv$ 2 moles H^+ $\Rightarrow$ x N = xM)

$$= \frac{1}{2} \times \frac{0.25}{1000} = 6 \times 10^{-3} \text{ moles}$$

Molarity of H_2O_2 =

$$\frac{\text{Moles of } H_2O_2}{V_{(L)}} = \frac{6 \times 10^{-3} \times 1000}{25} = 0.24M$$

56. Higher the value of reduction potential, stronger the oxidising agent.

$\because$ E° : Z < Y > X

$\Rightarrow$ Y will oxidise X but no Z.

57. $N_1V_1(KMnO_4) = N_2V_2(H_2O_2)$

$2 \times 100 = 1.786 \times V_2$

(10 volume H_2O_2 = 1.786 N)

$$V_2 = \frac{200}{1.786} = 111.98 \approx 112 \text{ mL}$$

58. b

59. $$Na + (x+y)NH_3 \rightarrow Na^+(NH_3)_x + \underset{\text{Solvated or ammoniated electrons}}{e^-(NH_3)_y}$$

60. Reactivity of alkali metals : Li < Na < K < Rb < Cs.
Reactivity of halogens : F > Cl > Br > I

61. d

62. d

63. The spontaneous cell reaction is :
$X^- + M^+ \rightarrow M + XE^o = 0.11$ V

64. $3Br_2 + 3Na_2CO_3 \rightarrow 5NaBr + NaBrO_3 + 3CO_2$

65. $$2KO_2 + CO_2 \rightarrow K_2CO_3 + \frac{3}{2}O_2$$
$$2KO_2 + H_2O \rightarrow 2KOH + \frac{3}{2}O_2$$

66. $:\ddot{O}^{2-} + H-OH \longrightarrow \bar{O}H + \bar{O}H$

67. b

68. CO_2 is acid oxide, H_2O is neutral, CaO is strongly basic and CuO is weakly basic. Therefore, order of acid strength is :
CaO < CuO < H_2O < CO_2

69. b

70. c

71. $$CaCO_3 \xrightarrow{\Delta} \underset{\text{(Basic oxide)}}{CaO} + \underset{\text{(Acid oxide)}}{CO_2}$$

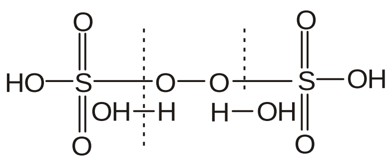
72. c

73. $CaSO_4$ dissolves in water to produce permanent hardness.

74. Through hydration and lattice energies of carbonates of magnesium group both decrease down the group, yet the lattice energy dominates and solubility down the group decreases for carbonates (also for sulphates)

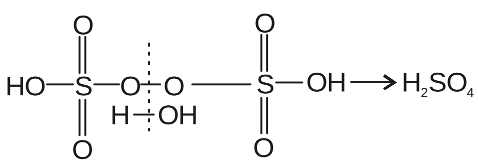
75. b

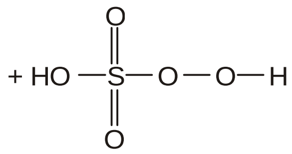
76. Perosodisulphuric acid ($H_2S_2O_8$) on complete hydrolysis gives two moles of H_2SO_4 and one mole of H_2O_2 as



$\rightarrow 2H_2SO_4 + H_2O_2$

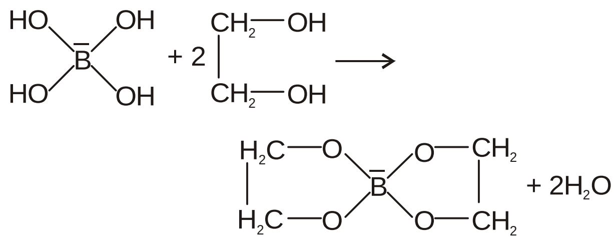
On partial hydrolysis, it gives one mole of H_2SO_4 and one mole of peroxomonosulphuric acid as





peroxo monosulphuric acid

77. Orthoboric acid is very weak acid, direct neutralization does not complete. However, addition of cis-diol allow the reaction to go to completion by forming a stable complex with $[B(OH)_4]^-$ as :



78. a

79. d

80. d

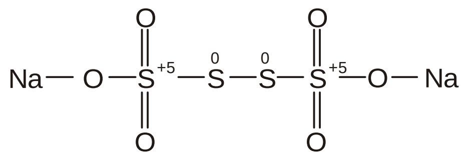
81. c

82. $B_2H_6 + 6CH_3OH \rightarrow 2B(OCH_3)_3 + 6H_2$
1 moles B_2H_6 gives 2 moles of Boron compound.
$\Rightarrow$ 3 moles of B_2H_6 will gives 6 moles of Boron compound.

83. Aqueous aluminium chloride *i.e.*, $[Al(H_2O)_6]^{3+}(Cl^-)_3$ on strong heating to dryness gives Al_2O_3.
$2[Al(H_2O)_6]^{3+}(Cl^-) \rightarrow Al_2O_3 + 9H_2O + 6HCl$

84. $KAl(SO_4)_2.12H_2O$ is the empirical formula of potash alu $K_2SO_4.Al_2(SO_4)_3.24H_2O$.

85. In BF_3 back pπ–pπ bonding in 2p–2p orbitals unless the bond strong and smaller.

86. 

87. b

88. a

89. b

90. O.N. are – 3, – 2, – 1, 0 respectively.