FOR 2019 ASPIRANTS **MEDICAL EDT - 1** **DATE: 11 -03- 2019**

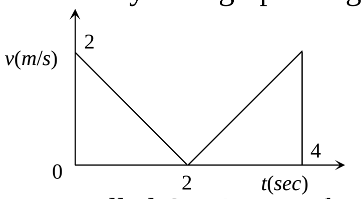
SOLUTIONS

1. (3) Given equation is dimensionally correct because both sides are dimensionless but numerically wrong because the correct equation is $\tan\theta = \frac{v^2}{rg}$.

2. (3) Percentage error in g = (%error in l) + 2(% error in T)= 1% + 2(3%) = 7%

3. (4) As $v^2 = u^2 + 2as \Rightarrow (2u)^2 = u^2 + 2as \Rightarrow 2as = 3u^2$
   Now, after covering an additional distance s, if velocity becomes v, then,
   $v^2 = u^2 + 2a(2s) = u^2 + 4as = u^2 + 6u^2 = 7u^2$
   $\therefore v = \sqrt{7}u$.

4. (2) The velocity time graph for given problem is shown in the figure.



Distance travelled S = Area under curve= 2+2=4m

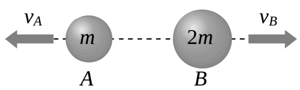
5. (4) $\frac{mv^2}{r} = 10 \Rightarrow \frac{1}{2}mv^2 = 10 \times \frac{r}{2} = 1\,J$

6. (3) Equation of trajectory for oblique projectile motion
   $$y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta}$$
   Substituting $x = D$ and $u = v_0$
   $$h = D\tan\theta - \frac{gD^2}{2v_0^2\cos^2\theta}.$$

7. (1) The coin falls behind him it means the velocity of train was increasing otherwise the coin fall directly into the hands of thrower.

8. (3) $v = \sqrt{\mu g r} = \sqrt{0.8 \times 9.8 \times 15} = 10.84\,m/s$

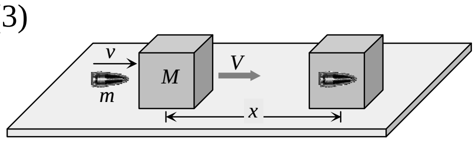
9. (1)



By the conservation of momentum, $m_A v_A = m_B v_B \Rightarrow m \times 16 = 2m \times v_B \Rightarrow v_B = 8\,m/s$

Kinetic energy of system $= \frac{1}{2}m_A v_A^2 + \frac{1}{2}m_B v_B^2 = \frac{1}{2} \times m \times (16)^2 + \frac{1}{2} \times (2m) \times 8^2 = 192\,m\,J$

10. (3)



Let speed of the bullet = v

Speed of the system after the collision = V

By conservation of momentum $mv=(m+M)V$

$\Rightarrow V = \frac{mv}{M+m}$

So the initial K.E. acquired by the system

$= \frac{1}{2}(M+m)V^2 = \frac{1}{2}(m+M)\left(\frac{mv}{M+m}\right)^2 = \frac{1}{2}\frac{m^2v^2}{(m+M)}$

This kinetic energy goes against friction work done by friction = $\mu R \times x = \mu(m+M)g \times x$

By the law of conservation of energy

$\frac{1}{2}\frac{m^2v^2}{(m+M)} = \mu(m+M)g \times x \Rightarrow v^2 = 2\mu gx\left(\frac{m+M}{m}\right)^2$

$\therefore v = \sqrt{2\mu gx}\left(\frac{M+m}{m}\right)$

11. (1)

V_{GJ} = *Relative velocity of gases with respect to jet plane*

$V_{GJ} = V_G - V_J$

$(+1500) = V_G - (-500)$

$1500 = V_G + 500$

$V_G = (1500 - 500)\ km/h$

$= 1000\ km/h$

1000 *km / h along the direction of emission of gases*

12. (3)

To cross the river in shortest time, man has to swim perpendicular to the river flow.

13. (1)

From t = 0 to 6 s, relative acceleration between them is zero, so distance between them will increase linearly.

At t = 6s, one stone strikes the ground.

From t = 6 s to 10 s, relative acceleration = g, so distance will decrease parabolically.

14. (3) Maximum force by surface when friction works

$F = \sqrt{f^2 + R^2} = \sqrt{(\mu R)^2 + R^2} = R\sqrt{\mu^2+1}$

Minimum force = R, When there is no friction

Hence ranging from R to $R\sqrt{\mu^2+1}$

We get, $Mg \le F \le Mg\sqrt{\mu^2+1}$

15. (1) Limiting friction between block and slab $= \mu_s m_A g = 0.6 \times 10 \times 9.8 = 58.8N$

But applied force on block A is 100 N. So the block will slip over a slab.

Now kinetic friction works between block and slab $F_k = \mu_k m_A g = 0.4 \times 10 \times 9.8 = 39.2\ N$

This kinetic friction helps to move the slab

$\therefore$ Acceleration of slab $= \frac{39.2}{m_B} = \frac{39.2}{40} = 0.98\ m/s^2$

16. (2)

$N\cos\theta = mg \quad \Rightarrow N = \frac{mg}{\cos\theta}$

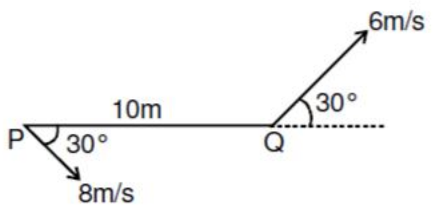
17. (4) In the condition of free fall apparent weight becomes zero.

18. (4) Net force = Applied force – Friction force

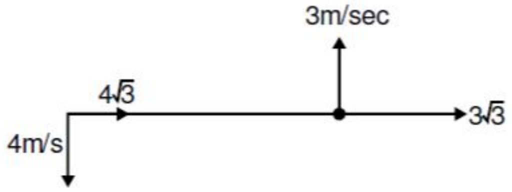
$$ma = 24 - \mu\, mg = 24 - 0.4 \times 5 \times 9.8 = 24 - 19.6$$

$$\Rightarrow a = \frac{4.4}{5} = 0.88\ m/s^2$$

19. (4)



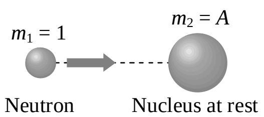
w.r.t to P



$$v_{\perp rel} = 8\sin 30° + 6\sin 30° = 7\ m/s$$

$$\omega = \frac{v_{\perp rel}}{R} = \frac{7}{10} = 0.7\,rad/sec$$

20. (1)



$$\left(\frac{\Delta k}{k}\right)_{retained} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)^2 = \left(\frac{1 - A}{1 + A}\right)^2$$

21.

(2)

When internal force acts.
Net force is zero.

$\therefore F = \frac{dP}{dt}$ Momentum conserved.

Internal force will not change the linear momentum.
But due to force, K.E. increases.

22. (1)

$$T - mg = ma$$

$$\therefore \quad T = m(g + a)$$

$$W_T = TS = T\left(\frac{1}{2}at^2\right) = \frac{m}{2}(g + a)at^2$$

23. (1)

$$mgh = (\mu mg)d$$

Here, d = distance travelled on rough surface.

$\therefore \quad d = \frac{h}{\mu} = \frac{1.0}{0.2} = 5\text{m}$

24. (2)

$U_i + k_i = U_f + k_f$ (Mechanical energy conservation)

$mgl(1-\cos\theta) = \frac{1}{2}mv^2$

$\frac{v_1^2}{v_2^2} = \frac{1-\cos\theta_1}{1-\cos\theta_2}$

$\frac{v_1}{v_2} = \sqrt{\frac{1-\cos\theta_1}{1-\cos\theta_2}}$

25. (1)

$E_i - E_f =$ Work done against friction

$\therefore \quad \frac{1}{2}mv^2 - \frac{1}{2}Kx^2 = (\mu mg)x$

Substituting the values we get, $x = 1\text{m}$

26. (2)

For all values of x, F is always negative while the block is displaced towards +ve$x$-axis (– 2m to 4m). The angle between force and displacement is 180°. So, the work done is negative.

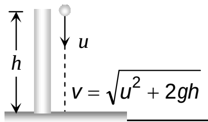
27. (3) From the principle of dimensional homogenity $[v]=[at] \Rightarrow [a]=[LT^{-2}]$. Similarly $[b]=[L]$ and $[c]=[T]$

28. (4)

$P = \frac{F}{A} = \frac{F}{l^2}$, so maximum error in pressure (P)

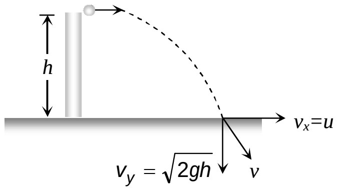
$\left(\frac{\Delta P}{P}\times 100\right)_{max} = \frac{\Delta F}{F}\times 100 + 2\frac{\Delta l}{l}\times 100 = 4\% + 2\times 2\% = 8\%$

29. (3) When particle thrown in vertical downward direction with velocity u then final velocity at the ground level



$v^2 = u^2 + 2gh \therefore v = \sqrt{u^2 + 2gh}$

Another particle is thrown horizontally with same velocity then at the surface of earth.



Horizontal component of velocity $v_x = u$

$\therefore$ Resultant velocity, $v = \sqrt{u^2 + 2gh}$

For both the particle final velocities when they reach the earth's surface are equal.

30. (4) $a = \frac{dv}{dt} = \frac{dv}{dx}\frac{dx}{dt} = v\frac{dv}{dx} = -\alpha x^2$ (given)

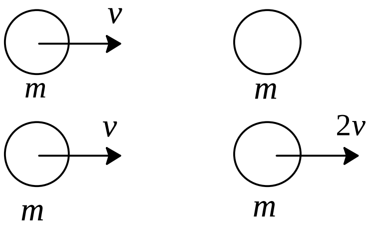
$$\Rightarrow \int_{v_0}^{0} v\,dv = -\alpha\int_0^S x^2dx \Rightarrow \left[\frac{v^2}{2}\right]_{v_0}^{0} = -\alpha\left[\frac{x^3}{3}\right]_0^S \Rightarrow \frac{v_0^2}{2} = \frac{\alpha S^3}{3} \Rightarrow S = \left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{3}}$$

31.
(4) Net downward force = Weight – Friction

$$\therefore\ ma = 25\times 9.8 - 2 \Rightarrow a = \frac{25\times 9.8-2}{25} = 9.72\ m/s^2$$

32. (3)

33. **(1)**



$$mu = mv + m(2v)$$

$$\frac{u}{3} = v \qquad ...(1)$$

$$e = \frac{2u-v}{u-0} = \frac{v}{u} = \frac{u/3}{u} = \frac{1}{3}$$

34. **(3)**

Change in linear momentum = Impulse

$$=(mg)\times t$$

$$=1\times 10\times 1 = 10\ \text{kg-m/s}$$

35. (1)

$$\frac{1}{2}\mu U_{rel}^2 = \frac{1}{2}Kx^2$$

$$\frac{1}{2}\left(\frac{3\times 6}{3+6}\right)(3)^2 = \frac{1}{2}\times 200\times x^2$$

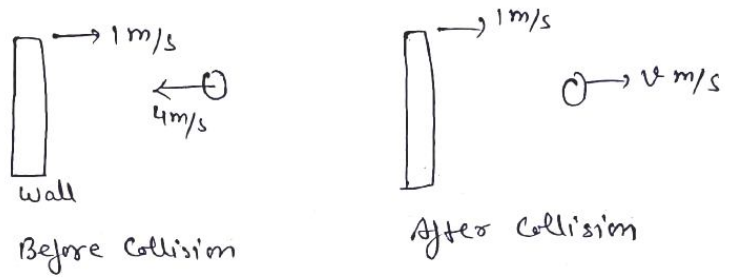
$$\frac{1}{2}\times(2)(9) = \frac{1}{9}\times 200\times x^2$$

$$x^2 = \frac{9}{100} \Rightarrow x = \frac{3}{10}m \text{ or } 30 \text{ cm.}$$

36. **(1)**

$$x_{cm} = \frac{\int \lambda\cdot dx}{\int \lambda \cdot dx} = \frac{\int_0^L \frac{Kx^3}{L}\cdot dx}{\int_0^L \frac{Kx^2}{L}\cdot dx} = \frac{\frac{K}{L}\int_0^L x^3\,dx}{\frac{K}{L}\int_0^L x^2\,dx} = \frac{\frac{L^4}{4}}{\frac{L^3}{4}} = \frac{3L}{4}$$

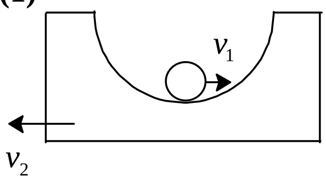
37. **(4)**



$$e = \frac{v-1}{5} = 1$$

$v = 6$ m/s away from wall

38. **(1)**



$$(1)(v_1) - (2)(v_2) = 0$$

$$v_1 = 2v_2 \qquad ...(1)$$

$$1 \times 10 \times 1 = \frac{1}{2} \times \left(\frac{1 \times 2}{1+2}\right)(v_1 + v_2)^2$$

$$10 = \frac{1}{2}\left(\frac{2}{3}\right)(3v_2)^2$$

$$10 = \frac{1}{3} \times 9v_2^2$$

$$v = \sqrt{\frac{10}{3}}\ \text{m/s}$$

39. **(2)**

$$\frac{1}{2}\left(\frac{2m.m}{2m+m}\right)u^2 = mgh$$

$$\frac{m}{3}u^2 = mgh$$

$$u = \sqrt{3gh}$$

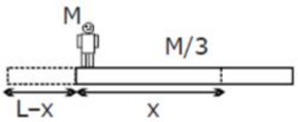
40. **(1)**

Using work energy theorem, $W_f + W_g = \Delta K$

$$-f.h - Wh = 0 - \frac{1}{2}m\,v_0^2$$

$$h = \frac{v_0^2}{2g\left(1 + \frac{f}{w}\right)}$$

41. (2)



$$\frac{M}{3}(L - x) = M - x \Rightarrow \quad x = \frac{L}{4}$$

.

42. **(2)**

$V_x = 8t - 2$

$d_x = (8t - 2)dt$

$x = 4t^2 - 2t + c$

$At\ t = 2,\ x = 14\ so\ 14 = 4 \times 2^2 - 2 \times 2 + c \Rightarrow c = 2$

$X = 4t^2 - 2t + 2$

$Also\ v_y = \frac{dy}{dt} = 2 \Rightarrow y = 2t + c'$

$At\ t = 2,\ y = 4\ \&\ c^1 = 0$

$\therefore Y = 2t \Rightarrow t = \frac{y}{2}$

So that $x = \frac{4y^2}{4} - \frac{2y}{2} + 2 = y^2 - y + 2$

43. **(2)**

$W = -\Delta U$

44. **(1)**

In this problem, while mass of the body is given in 4 significant figures, the speed of the moving body is given only in 3 significant figures. Therefore our result for momentum of the body is reliable only upto 3 significant figures. Note that it is only in choice (1) that the result is appearing in 3 significant figures (third figure rounded off), i.e.,

p = mv = 3.513 ×5.00 ≈17.6 kg m /s

45. **(3)**

The unit of energy kgm^2s^{-2}

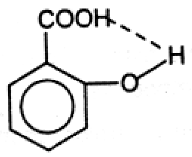
Energy = $\vec{F}.\vec{S}$ = $(m.a)\vec{S}$

Kg (ms^{-2}).m

Kgm^2s^{-2}

46. 0.01026 underlined digits are significant, so it has 4 significant figures
47. Cement is a mixture
48. Atomic radius increases down the group
49. Cl – Cl bond is more strong as there are inter atomic repulsions in F – F due to smaller size of F
50. CO_3^{2-} ion is trigonal planer.
51. As our element is making more the ove compound so it shows law of reciprocal proportions
52. All the above are correct relations
53. 10^{th} group
54. Nearly 17% see text

55.



Intramolecular H-bonding prevents association and lowers boiling point.

56. One mole of $K_4[Fe(CN)6]$

C is 6×12 in 0.5 mole C id $\frac{6\times12}{2}$=36g

57.

$$E=\frac{hC}{\lambda} \quad ; \quad \frac{E_1}{E_2}=\frac{\lambda_2}{\lambda_1}$$

$$\frac{E_1}{E_2}=\frac{4000}{2000}=2$$

58. One paired electron in d-orbital is $3d^6$ and the divalent $3d^6$ is Fe^{2+}

59. Both NH_3 and PH_3 involve SP^3 hybridization and have pyramidal geometry

60. S-orbital has only m=0 magnetic quantum no.

61.

m = volume × 3 = 0.5 × 1 = 0.5

When mass is 18 gm molecules is 6.022×10^{23}

When mass is 0.5 gm

molecules is $6.022\times10^{23}\times\frac{0.5}{18}$

$= 0.16727\times10^{23}$ molecules

62.

(i) $n_1 = 1$; n_2 is $\propto$

$$\frac{1}{\lambda}=R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right] \quad \therefore \quad \frac{1}{x}=R(1-0) \quad \text{So } R=\frac{1}{x}$$

$$\frac{1}{\lambda}=RZ^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

(ii) $n_1 = 2$ $\quad n_2 = 3$

$$\therefore \frac{1}{y}=\frac{1}{x}4\left(\frac{1}{4}-\frac{1}{9}\right) \qquad \therefore y=\frac{9x}{5}$$

63. An electron is added to fully filled stable electronic configuration.

64. XeF_2 has Sp^3d hybridization

65. Large jump between IE_4 and IE_5.

66.

y^{30} $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$
Valence e^-s in y are 2
Valency of y is + 2
T^{15} $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
Valence e^-s in T are 5
Valency of T is –3
Formula of the compound $Y_3 T_2$

67.

$$E = \frac{hc}{\lambda}$$

$$= \frac{6.625 \times 10^{-34} \times 3 \times 10^8}{242 \times 10^{-9}} = 0.0821 \times 10^{-17}\ J$$

For one mole of energy

$$= 0.0821 \times 10^{-17} \times 6.023 \times 10^{23} \times 10^{-3}\ kJ$$

$$= 4.94 \times 10^2\ kJ/mole$$

68. Mg < Na < K < Rb
69. More H-bonding with H_2O, more solubility.
70. Partially filled d- subshell
71.

$$N_1 V_1 + N_2 V_2 + N_3 V_3 = NV$$

$$20 + 30 \times 0.5 + 50 \times 0.2 = N\ 100$$

$$20 + 15 + 10 = N\ 100$$

$$N = \frac{45}{100} = 0.45\ N$$

72. Balmer series
73. Metallic nature.
74. Sp^3
75. More the oxidation state of the non metal atom attached with oxygen more is the acidic nature of oxide
76.

As in 54 g of N_2O_5 there are 0.5 moles
36g of H_2O has 2 moles
46 g of C_2H_5OH has 1 mole
1.5 moles of Ag

77. $\lambda = \dfrac{6.6 \times 10^{-34}}{3.3 \times 10^{-24}} = 2A$
78. CuO is basic oxide
79. Larger anion, more polarizability and more covalent.
80. Al_2O_3 is an amphoteric oxide

81.

$2KMnO_4 + 3H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$
(acidic)
$2KMnO_4 + 2KOH \longrightarrow 2K_2MnO_4 + H_2O + O$
(Basic)
$2KMnO_4 + H_2O \longrightarrow 2KOH + MnO_2 + 3O$
(neutral)

$\text{Eq. mass} = \frac{\text{mol.mass}}{\text{oxd}^n\text{ state}}$

$\text{acidic} = \frac{M}{5}$; $\text{basic} = \frac{M}{1}$

$\text{neutral} = \frac{M}{3}$; Ratio $\frac{M}{5} : \frac{M}{1} : \frac{M}{3}$

$= \frac{3:15:5}{15} = 3:15:5$

82. 19^{th} electron of chromium is present in 4s orbital
83. For law of triads atomic mass of the middle =Average atomic mass of 1^{st} and 3^{rd}
84. XeF_4 has SP^3d^2 hybridization but square planer structure
85. Pb shows inert pair effect.
86.

$AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$

$\text{conc. of } NO_3^- = \frac{0.1}{2} = 0.05$

87. 72-36=36
88. Zr and Hf, due to lanthanide contraction
89.

PCl_5 is having trigonal pyramidal geometry which is unstable so it exists as $[PCl_4^+][PCl_6^-]$ *i.e.*, a combination of tetrahedra and octahedra which is more stable.

90. Sp^2 hybridization
(91) The living world, Page no. 10
(92) Biological classification Page no. 17, last line
(93) Plant kingdom Page no. 33, 3.1.3
(94) The living world Page no. 9, 1.3.1
(95) Biological classification Page no. 27, viroids
(96) Plant kingdom Page no. 36, 3.2.2
(97) The living world Page no. 8, 3^{rd} paragraph
(98) Biological classification Page no. 26, last paragraph
(99) Plant kingdom Page no. 34, 3.2.(a)
(100) The living world Page no. 12, 1.4.3
(101) Biological classification Page no. 24, 2.3.3
(102) Plant kingdom Page no. 35 2^{nd} paragraph
(103) The living world Page no. 10, 1.3.6
(104) Biological classification Page no. 26, 2^{nd} paragraph
(105) Plant kingdom Page no. 36, 3.2.2
(106) The living world Page no. 16, 1.2, 2^{nd} last paragraph

(107) Biological classification Page no. 26, last paragraph
(108) Plant kingdom, fact based
(109) The living world, Page no. 4, 2nd paragraph
(110) Biological classification Page no. 21, 2.2.3
(111) Plant kingdom Page no. 37 fig 3.3
(112) The living world Page no. 11 and 12, 1.4.1, 1.4.2
(113) Biological classification Page no. 21, 2.2.2
(114) Plant kingdom Page no. 38, 1st paragraph
(115) The living world Page no. 12, 1.4.2
Maintaining a botanical golden is an ex-site conservation
(116) Biological classification Page no. (20,21) 2.2.1, 2.2.2, 2.2.3, 2.2.4
(117) Plant kingdom Page no. 39
(118) The living world Page no. 10
(119) Biological classification Page no. 20, 2.2.1
(120) Plant kingdom Page no 38, 3.4
(121) The living world
The third name in zoological nomenclature is subspecies
(122) Biological classification Page no 19, 2.1.2
(123) Plant kingdom, page no 38,39
(124) The living world, page no 10, yellow chart
(125) Biological classification page no. 19, fig. 2.2
(126) Plant kingdom Page no 38 and 39
(127) The living world Page no. (7), last paragraph
(128) Biological classification Page no. 19, 2.1.1
(129) Plant kingdom Page no. 40, 3.5
(130) The living world Page no. 14, 1st paragraph
(131) Biological classification Page no. 18, fig. 21
(132) Plant kingdom Page no. 29 and 30
(133) The living world Plant families and with suffix- aceae
(134) Biological classification Page no. 17 1st paragraph
(135) Plant kingdom page no. 38, 2nd paragraph