1. (c)

Sol. By comparing the coefficient of x in given equation with standard equation $y = x\tan\theta - \dfrac{gx^2}{2u^2\cos^2\theta}$ $\tan\theta = \sqrt{3}$

$\therefore \theta = 60°$

2. (b)

Sol. $\vec{v} = \vec{\omega} \times \vec{r} = \begin{vmatrix} \hat{i} & \hat{J} & \hat{k} \\ 3 & -4 & 1 \\ 5 & -6 & 6 \end{vmatrix}$

$\vec{v} = (-24+6)i - (18-5)\hat{J} + (-18+20)\hat{k}$

$= 18\hat{i} + 13\hat{J} - 2\hat{k}$

3. (b)

Sol. Reaction on inner wheel $R_1 = \dfrac{M}{2}\left[g - \dfrac{v^2h}{ra}\right]$ and

Reaction on outer wheel $R_2 = \dfrac{M}{2}\left[g + \dfrac{v^2h}{ra}\right]$

$\therefore\ R_1 < R_2$.

4. (a)

Sol. $\omega_1 = 600\ rev/\min = 10\,rev/sec$, $\omega_2 = 0$ and $\theta = 60\ rev$ From the equation $\omega_2^2 = \omega_1^2 - 2\alpha\theta \Rightarrow$ $0 = (10)^2 - 2\alpha\,60$

$\therefore \alpha = \dfrac{100}{120} = \dfrac{5}{6}$

Again $\omega_2 = \omega_1 - \alpha t \Rightarrow 0 = \omega_1 - \alpha t$

$t = \dfrac{\omega_1}{\alpha} = \dfrac{10\times 6}{5} = 12\,sec$.

5. (b)

Sol. $T = \dfrac{2u\sin\theta}{g} = \dfrac{2\times 9.8\times\sin 30^o}{9.8} = 1\text{sec}$

6. (c)

Sol. $R = \frac{u^2 \sin 2\theta}{g}$ and $T = \frac{2u \sin\theta}{g}$

$\therefore R \propto u^2$ and $T \propto u$ (If θ and g are constant).

In the given condition to make range double, velocity must be increased upto $\sqrt{2}$ times that of previous value. So automatically time of flight will becomes $\sqrt{2}$ times.

7. (a)

Sol. $H = \frac{u^2 \sin^2\theta}{2g}$ and $T = \frac{2u \sin\theta}{g}$

$\therefore \frac{H}{T^2} = \frac{u^2 \sin^2\theta / 2g}{4u^2 \sin^2\theta / g^2} = \frac{g}{8} = \frac{10}{8} = \frac{5}{4}$

8. (b)

Sol. Initial velocity $= (6\hat{i} + 8\hat{j}) m/s$ (given)

Magnitude of velocity of projection $u = \sqrt{u_x^2 + u_y^2}$

$= \sqrt{6^2 + 8^2}$ = 10 m/s

Angle of projection $\tan\theta = \frac{u_y}{u_x} = \frac{8}{6} = \frac{4}{3}$ $\therefore$ $\sin\theta = \frac{4}{5}$ and $\cos\theta = \frac{3}{5}$

Now horizontal range $R = \frac{u^2 \sin 2\theta}{g}$ $\sqrt{\frac{rF}{m}}$

$= \frac{(10)^2 \times 2 \times \frac{4}{5} \times \frac{3}{5}}{10} = 9.6\, meter$

9. (a)

Sol. $R_{max} = 400 m$ [when $\theta = 45°$]

So from the Relation $R = 4H \cot\theta \Rightarrow 400 = 4H \cot 45°$

$\Rightarrow H = 100\, m.$

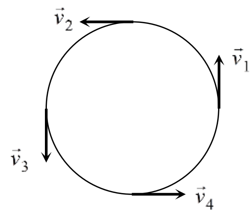
10. (a)

Sol. $T = \frac{2u \sin\theta}{g} = 10 \sec \Rightarrow u \sin\theta = 50$ so c

$= \frac{(50)^2}{2 \times 10} = 125\, m$.

11. (c)

Sol. In uniform circular motion velocity vector changes in direction but its magnitude always remains constant.



$|\overrightarrow{v_1}| = |\overrightarrow{v_2}| = |\overrightarrow{v_3}| = |\overrightarrow{v_4}|$ = constant

12. (c)

Sol. Given $r = 4\,m$ and $T = 2$ seconds.

$\therefore a_c = \frac{4\pi^2}{T^2} r = \frac{4\pi^2}{(2)^2} 4 = 4\pi^2\ m/s^2$

13. (d)

Sol. Centripetal acceleration = $\frac{v_1^2}{r_1} = \frac{v_2^2}{r_2}$ (given)

$\therefore \frac{r_1}{r_2} = \left(\frac{v_1}{v_2}\right)^2 = \left(\frac{90}{15}\right)^2 = \frac{36}{1}$

14. (b)

Sol. Due to the centrifugal force.

15. (c)

Sol. $\Delta p = m(v_f - v_i) = m\left[(6\hat{i} - 8\hat{j}) - (6\hat{i} + 8\hat{j})\right] = -16m\hat{j}$.

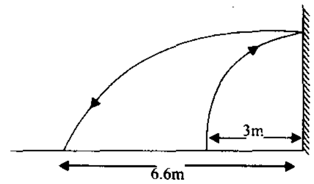
$|\Delta p| = 16$ m

16. (d)

Sol. $T = \frac{2u_y}{a_y} = \frac{2 \times 8}{10} = 1.6s$

t = 3/6 = 0.5 s

$x = u_x (T - t) = 6(1.6 - 0.5) = 6.6$ m



17. (b)

Sol. Speed of boat v = 5 km/h

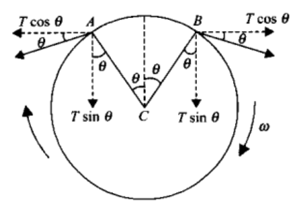
Speed of boat in flowing water v_b = 1/¼ = 4 km/h

Speed of the river $v_r = \sqrt{v^2 - v_b^2} = \sqrt{5^2 - 4^2} = 3 \text{km h}^{-1}$

18. (c)

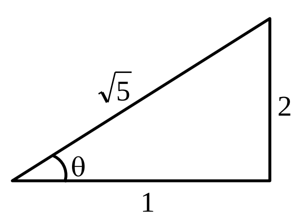
Sol. Let T = tension in the ring. For the section AB, the net force is 2T sin θ. As θ is small, therefore 2T sin θ ~ 2Tθ, and the net force is towards C. Mass of section AB = (2rθ) m. For circular motion,

$(2r\theta m)r\omega^2$ or $T = mr^2\omega^2$.



19. (a)

Sol. $\tan\theta = \frac{u\sin\theta}{u\cos\theta} = \frac{2}{1}$



The desired equation is :

$y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta}$

or $y = x(2) - \frac{(10)(x)^2}{2(\sqrt{2^2+1^2})^2\left(\frac{1}{\sqrt{5}}\right)^2}$

or $y = 2x - 5x^2$.

20. (c)

Sol. Angular speed $= 3000\, rpm = 50\, rps = 50 \times 2\pi\, rad/\sec = 100\pi\, rad/\sec$

i.e. angle described by the shaft in one second is 100π rad.

21. (a)

Sol. Only magnitude remain constant and direction changes

22. (d)

Sol. Centripetal accelerations, $a_c = \frac{v^2}{R}$

Where v is the speed of an object and R is the radius of the circle.
It is always directed towards the centre of the circle. Since v and R are constant for a given uniform circular motions, therefore the magnitude of centripetal accelerations is also constant. However, the direction of centripetal accelerations changes continuously. Therefore, a centripetal acceleration is not a constant vector.

23. (a)

Sol. Force on the rocket $= \frac{udm}{dt}$

$\therefore$ Rate of combustion of fuel

$$\left(\frac{dm}{dt}\right) = \frac{F}{u} = \frac{210}{300} = 0.7 kg/s.$$

24. (c)

Sol. When fireman slides down, Tension in the rope

$T = m(g - a)$

For critical condition m(g – a) = 2/3 mg $\Rightarrow mg - ma = \frac{2}{3}mg \quad \therefore \; a = \frac{g}{3}$

So, this is the minimum acceleration by which a fireman can slides down on a rope.

25. (c)

Sol. From $v = u - at \Rightarrow 0 = u - at \quad \therefore t = \frac{u}{a}$

for upward motion on an inclined plane

$a = g(\sin\theta + \mu\cos\theta) \quad \therefore t = \dfrac{u}{g(\sin\theta + \mu\cos\theta)}$

Substituting the value of $\theta = 30^o, t = 0.5\,\text{sec}$ and

$u = 5m/s$, we get $\mu = 0.6$

26. (b)

Sol. Kinetic energy acquired by body = Total work done on the body – Work done against friction

= $F \times S - \mu mgS$ = 25 × 10 – 0.2 × 5 × 10 ×10 = 250 – 100

= 150 J.

27. (c)

Sol. Maximum friction i.e. limiting friction between A and B, F_l = 12 N.

If F is the maximum value of force applied on lower body such that both body move together

It means Pseudo force on upper body is just equal to limiting friction

$F' = F_l \Rightarrow m\left(\dfrac{F}{m+M}\right) = \left(\dfrac{4}{4+8}\right)F = 12 \quad \therefore F = 36N.$

28. (d)

Sol. $v = u - at \quad = u - \mu g\,t = 0$

$\therefore \quad \mu = \dfrac{u}{gt} = \dfrac{6}{10 \times 10} = 0.06$.

29. (a)

Sol. $v^2 = u^2 + 2aS = 0 + 2 \times g\sin 30 \times 2 \quad v = \sqrt{20}$

Let it travel distance 'S' before coming to rest

$S = \dfrac{v^2}{2\mu g} = \dfrac{20}{2 \times 0.25 \times 10} = 4m.$

$\omega_{\min} = \sqrt{\dfrac{g}{\mu r}}$

$\therefore$

30. (a)

Sol. $v = \sqrt{\mu r g} = \sqrt{0.5 \times 500 \times 10} = 50\, m/s.$

31. (a)

Sol. Here the given angle is called the angle of repose

So, $\mu = \tan 30^o = \frac{1}{\sqrt{3}}$

32. (c)

Sol. T = mg = 10 (9.8) = 98 N

33. (b)

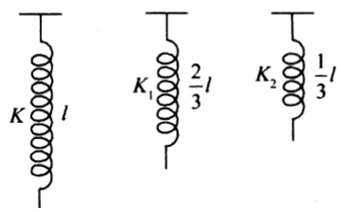
Sol. T = $\frac{2Mmg}{M+m}$. As M > > m × T $\simeq$ 2mg

34. (b)

Sol. Consider the man and the child to be simple masses hung from two ends of a string passing over pulley. Being a system, the man and child both have same magnitude of acceleration but opposite directions.

35. (b)

Sol. $l_1 = 2l_2 = 2/3\ l$

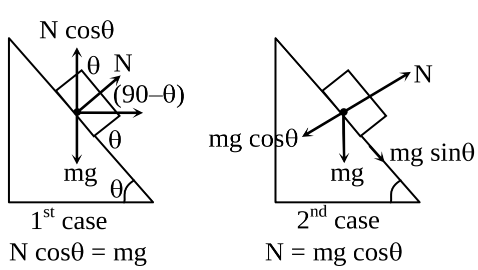


Force constant K ∝ 1/length of spring

∴ K = 3/2 K

36. (c)

Sol.



37. (c)

Sol. Let the thickness of each plank = x then from third equation of motion,

$0 = u^2 - 2a\,(2x)$

$\Rightarrow u^2 = 4ax$ ...(i)

If velocity is doubled, let n planks are required

then,

$0 = (2u)^2 - 2a(hx)$

$\Rightarrow n = \frac{4u^2}{2ax} = \frac{4(4ax)}{2ax} = 8$

38. (d)

Sol. $\because$ F = nmv

$\therefore n = \frac{F}{mv} = \frac{144}{(40\times10^{-3})\times1200} = 3$

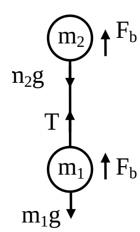
39. (b)

Sol. $m = \frac{|\vec{F}|}{a} = \frac{\sqrt{8^2+6^2+10^2}}{1} = 10\sqrt{2}$ kg

40. (a)

Sol. $F = \frac{dp}{dt}$ or $ma = \frac{dm}{dt} \times v$

or $2 \times a = 1 \times 5 \Rightarrow a = 2.5$ m/s



41. (c)

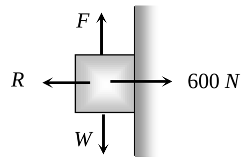
Sol. $v^2 = u^2 + 2as,\ s = \frac{u^2}{2\mu g}$

42. (c)

Sol. Due to buoyant force on the aluminium block the reading of spring balance A will be less than 2 kg but it increase the reading of balance B.

43. (d)

Sol. Friction = $\mu R = 0.5 \times 600 = 300$ N, Weight = 600 N



ma = W – F $\Rightarrow a = \frac{W-F}{m} = \frac{600-300}{60}$

$\therefore \quad a = 5\, m/s^2$

44. (b)

Sol. Let forces are F and 2F and angle between them is θ and resultant makes an angle α with the force F.

$$\tan\alpha = \frac{2F\sin\theta}{F + 2F\cos\theta} = \tan 90 = \infty$$

$\Rightarrow F + 2F\cos\theta = 0 \;\therefore\; \cos\theta = -1/2$ or $\theta = 120°$

45. (b)

Sol. $a = \left(\frac{m_2 - m_1}{m_1 + m_2}\right) g = \frac{g}{8}$; by solving $\frac{m_2}{m_1} = 9/7$

46. (c)

Sol. $Cr_{24} = (Ar)3d^5\ 4s^1$ Electronic configuration because half filled orbital are more stable than other orbitals.

47. (c)

Sol. If m = –3, then l = 3, for this value n must be 4.

48. (d)

Sol. As a result of attraction, some energy is released. So at infinite distance from the nucleus energy of any electron will be maximum. For bringing electrons from ∞ to the orbital of any atom some work has to be done be electrons hence it bill loose its energy for doing that work.

49. (c)

Sol. This space is called nodal space where there is no possibility of oressene of electrons.

50. (b)

Sol. According to Bohr's model for hydrogen and hydrogen like atoms the velocity of an electron in an atom is quantised and is given by $v \propto \frac{2\pi Ze^2}{nh}$ so $v \propto \frac{1}{n}$ in this cases $n = 3$

51. (c)

Sol. $K.E_1 = h\nu_1 - h\nu_0$

$K.E_2 = h\nu_2 - h\nu_0$

$\Rightarrow \frac{2}{1} = \frac{h\nu_1 - \nu_0}{h\nu_2 - h\nu_0}$

$\Rightarrow 2\,h\nu_2 - 2h\nu_0 = h\nu_1 - h\nu_0$

$\Rightarrow \nu_0 = \frac{2\nu_2 - \nu_1}{1}$

52. (c)

Sol. $\because = r \propto \frac{n^2}{Z}$ $\therefore$ $\frac{r_H}{r_{Li^{2+}}} = \frac{Z_{Li}}{Z_H}$

$\Rightarrow r_{Li^{2+}} = r_H \times \frac{Z_H}{Z_{Li}} = \frac{r}{3}$

53. (d)

Sol. $\frac{1}{\lambda_{shortest}} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$= 109678 \times 1^2 \times \left(\frac{1}{2^2} - \frac{1}{\infty^2}\right)$

$\lambda = 3.647 \times 10^{-5}$ cm = 3647 Å

54. (a)

Sol. ${}^{14}_{6}C, {}^{15}_{7}N, {}^{17}_{9}F$

55. (d)

Sol. $\lambda = \frac{c}{\nu}$

56. (d)

Sol. Factual

57. (c)

Sol. P.E. $= \frac{1}{4\pi\varepsilon_0} \frac{(+ze)(-e)}{r}$

$= \frac{\frac{1}{4\pi\varepsilon_0}}{\frac{(+2e)(-e)}{r}} = \frac{e^2}{2\pi\varepsilon_0 r}$

58. (d)

Sol. Na^+ has stable electronic configuration.

59. (d)

Sol. Numerical value of m cannot be greater than that of ℓ

60. (c)

Sol. $E = -13.6 \frac{z^2}{n^2}$ eV

61. (c)

Sol. For 4   orbital electrons, n = 4

ℓ = 3 (because) m = + 3, + 2, + 1, 0, –1, –2, –3 s = + 1/2.

62. (d)

Sol. $\lambda = \frac{hc}{\Delta E} \therefore \lambda \alpha \frac{1}{\Delta E}$

63. (c)

Sol. Visible lines $\Rightarrow$ Balmer series

$(5 \to 2, 4 \to 2, 3 \to 2)$. So, 3 lines.

64. (d)

Sol. According to energy, $E_{4\to1} > E_{3\to1} > E_{2\to1} > E_{3\to2}$.

According to energy, Violet > Blue > Green > Red.

$\therefore$ Red line $\Rightarrow$ $3 \to 2$ transition.

65. (a)

Sol. For a charged particle $\lambda = \frac{h}{\sqrt{2mqV}}$, $\therefore \lambda \propto \frac{1}{\sqrt{V}}$

66. (a)

Sol. s orbital is spherical so non-directional.

67. (c)

Sol. The lobes of d_{xy} orbital are at an angle of 45^0 with X and Y axis. So along the lobes, angular probability distribution is maximum.

68. (d)

Sol. $\lambda = v$

then $\lambda = \frac{h}{mV}$ or $\lambda^2 = \frac{h}{m}$ so, $\lambda = \sqrt{\frac{h}{m}}$.

69. (b)

Sol. $\frac{\lambda_y}{\lambda_x} = \frac{m_x v_x}{m_y v_y} \Rightarrow \frac{\lambda_y}{1} = \frac{m_x v_x}{(0.25m_X)(0.75V_X)} = \frac{16}{3}$.

70. (a)

Sol. Cr : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$

$n + \ell = 3$

so the combinations are 2p, 3s. So 8 electrons.

71. (c)

Sol. The lobes of orbital are alligned along X and Y axis. Therefore the probability of finding the electron is maximum along x and y-axis.

72. (c)

Sol. First line in balmer series means transition from n = 3 to n = 2. Now, 9^{th} orbit of Li^{2+} has same energy as third orbit of 'H' atom & 6^{th} orbit of Li^{2+} has same energy as second orbit of 'H' atom. So n = 9 to n = 6 transition in Li^{2+} would have same wavelength as first line in balmer series of H–spectrum.

73. (d)
Sol. For g orbital, value of l is 4 .

(0 = s, 1 = p, 2 = d, 3 = f, 4 = g)
Since l = n -1, n should be 5.

74. (b)
Sol. When n = 4; l = 0, 1, 2, 3
Number of orbitals, = 1 + 3 + 5 + 7 = 16
Number of electrons,= 2 + 6 + 10 + 14 = 32

75. (b)
Sol. The correct representation of the ground state electronic configuration of Cu (29)is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$

76. (c)
Sol. No. of angular nodes, = l
For 4d orbital,n = 4, l = 2
$\therefore$ No. of angular nodes for 4d orbital = 2

77. (c)
Sol. Total no. of orbitals in n^{th} shell $= n^2$

$\therefore$ Total no. of orbitals in 3^{rd} shell (n = 3) = $3^2 = 9$

78. (a)
Sol. Orbital angular momentum $= \sqrt{l(l+1)}\,\frac{h}{2\pi}$
Thus, it depends on 'l' only.

79. (a)
Sol. The charge on an electron was found by millikan's oil drop method. Oil drops in the form of mist produced by an atomizer were allowed to pass through a chamber with ionized air. The electrical charge on these oil droplets was acquired by collisions with gaseous ions. By carefully measuring the effects of an electrical field strength on the motion of oil droplets, millikan measured the charge on the droplet.

80. (a)
Sol. Mass of an electron $=9.1096\times10^{-31}\,\text{kg}$

1 g or $10^{-3}\,\text{kg}=\dfrac{1}{9.1096\times10^{-31}}\times10^{-3}$

$=1.098\times10^{27}$ electrons

81. (d)
Sol. $\text{mvr}=\dfrac{\text{nh}}{2\pi}=\dfrac{5\text{h}}{2\pi}=\dfrac{2.5\text{h}}{\pi}$

82. (b)
Sol. Nodal surfaces

83. (d)
Sol. When l = 3, magnetic quantum number has 7 values $m_l=(2l+1)$. These values are represented as

$-3,-2,-1,0,+1,+2,+3$

84. (d)
Sol. Isobars are the atoms with same mass number (i.e., sum of protons and neutrons) but different atomic number (i.e., no. of protons).

85. (b)
Sol. Heisenberg's uncertainty principle rules out the existence of definite paths or trajectories of electrons and other similar particles.

86. (c)
Sol. Let relative abundance of Cl – 37 = x%

then relative abundance of Cl – 35 = (100 –x)%
Average atomic mass,
$=\dfrac{x\times37+(100-x)35}{100}=35.5$
$\Rightarrow$ 37x+ 3500 – 35 x = 3550

$\Rightarrow$ x = 25

$\therefore$ 100 – x = 75

Thus, the ratio of Cl – 37 and Cl – 35 is x : (100 –x) = 25: 75 = 1: 3

87. (b)

Sol. $Cr(24): 3d^5 4s^1, Cr^{3+}: 3d^3$

$Fe(26): 3d^6 4s^2, Fe^{3+}: 3d^5$

$Mn(25): 3d^5 4s^2, Mn^{2+}: 3d^5$

$Co(27): 3d^7 4s^2, Co^{3+}: 3d^6$

$Sc(21): 3d^1 4s^2, Sc^{3+}: 3d^0$

Thus, Fe^{3+} and Mn^{2+} have same electronic configuration.

88. (b)

Sol. $\lambda = \frac{h}{mv}$ if v is same, then higher the value of m means lower will be the value of λ

Name	Electron	Proton	Neutron	α - particle (He^{2+})
Mass/u	0.00054	1.00727	1.00867	4.0026

Thus, α - particle has the largest mass i.e., shortest wavelength.

89. **Sol.** The five d – orbitals are degenerate and have equal energy. The shape of first four orbitals is similar which are $d_{xy,} d_{yz,} d_{zx} d_{x^2} - y^2$ but the fifth one, d_{z^2} has a different shape.

90. (b)

Sol. Spin angular momentum of the electron, a vector quantity can have two orientations relative to the chosen axis. These two orientations take the values of +1/2 or

-1/2 and are called two spin states of the electrons.

91- b

92- d

93- a

94- a

95- a

96.- c

97- a

98- b

99- b

100 -b

101- a

102- a, First generation is sporophytic of parent plant i.e., seed coat; second generation is gametophyte of parent plant and third generation is sporophyte of future plant i.e., embryo.

103- a

104- d

105- c

106- b

107- d

108- d

109- b

110- b

111- a

112- c

113- c

114- c

115- d

116- c

117- d

118- b

119- a

120- b

121- c

122- d

123- c

124- c

125- b

126- c

127- d

128- c, no wood is formed in bryophyte and bryokenin is a growth factor in bryophytes. For peat page 35 NCERT

129- b

130- b

131- c

132- d

133- d

134- c

135- a, A fern plant body is sporophytic (2n) and is differentiated into roots, stems and leaves. On the ventral surface of leaves sporangia are borne in a group called sori. Inside the sporangium are present the spores which are formed by reduction duvsion.

Thus the spores produced are haploid in nature and germinate to produce a prothallus that represents the gametophytic generation. Antheridium and archegonium are borne on this prothallus. Thus meiosis takes place at the stage of spore formation.

136- d

137- a

138- b

139- a

140- d

141- c

142- b

143- b

144- a

145- b

146- d

147- d

148- a

149- c

150- c

151- a

152- c

153- a

154- c

155- b

156- c

157-d

158- c

159- c

160- b

161- d

162- b

163- d

164- a

165- c

166- a

167- a

168- a

169- b

170- b

171- b, In birds, the muscles that power the wings are anchored to a large bony keel along the midline of the sternum.

172- c

173- c

174- b

175- a

176- d

177- d

178- a

179- d

180- a