BPSC TEST-01—FULL LENGTH

Date: 22 July, 2018

ANSWERS

1.	(b)	31.	(c)	61.	(a)	91.	(b)	121.	(d)
2.	(a)	32.	(d)	62.	(c)	92.	(d)	122.	(c)
3.	(c)	33.	(b)	63.	(c)	93.	(c)	123.	(b)
4.	(d)	35.	(a)	64.	(a)	94.	(b)	124.	(b)
5.	(b)	35.	(c)	65.	(a)	95.	(a)	125.	(c)
6.	(a)	36.	(d)	66.	(a)	96.	(c)	126.	(d)
7.	(c)	37.	(b)	67.	(c)	97.	(b)	127.	(c)
8.	(d)	38.	(a)	68.	(c)	98.	(d)	128.	(c)
9.	(b)	39.	(c)	69.	(b)	99.	(a)	129.	(b)
10.	(a)	40.	(d)	70.	(b)	100.	(a)	130.	(d)
11.	(c)	41.	(b)	71.	(d)	101.	(c)	131.	(b)
12.	(d)	42.	(a)	72.	(a)	102.	(b)	132.	(c)
13.	(b)	43.	(c)	73.	(a)	103.	(c)	133.	(c)
14.	(a)	44.	(d)	74.	(c)	104.	(c)	134.	(a)
15.	(c)	45.	(b)	75.	(d)	105.	(c)	135.	(d)
16.	(d)	46.	(a)	76.	(c)	106.	(c)	136.	(c)
17.	(b)	47.	(c)	77.	(c)	107.	(c)	137.	(b)
18.	(a)	48.	(d)	78.	(a)	109.	(d)	138.	(d)
19.	(c)	49.	(b)	79.	(c)	110.	(c)	139.	(d)
20.	(d)	50.	(a)	80.	(c)	111.	(b)	140.	(c)
21.	(b)	51.	(c)	81.	(a)	111.	(c)	141.	(a)
22.	(a)	52.	(b)	82.	(b)	112.	(b)	142.	(d)
23.	(c)	53.	(a)	83.	(c)	113.	(c)	143.	(d)
24.	(d)	54.	(d)	84.	(b)	114.	(d)	144.	(b)
25.	(b)	55.	(d)	85.	(c)	115.	(b)	145.	(b)
26.	(a)	56.	(a)	86.	(c)	116.	(d)	146.	(b)
27.	(c)	57.	(d)	87.	(d)	117.	(c)	147.	(d)
28.	(d)	58.	(b)	88.	(c)	118.	(a)	148.	(c)
29.	(b)	59.	(d)	89.	(c)	119.	(a)	149.	(b)
30.	(a)	60.	(a)	90.	(d)	120.	(c)	150.	(c)

BPSC TEST-01—FULL LENGTH

SOLUTIONS

Date: 22 July, 2018

1. **(b)**

2. **(a)**

3. **(c)**

4. **(d)**

5. **(b)**

6. **(a)**

7. **(c)**

8. **(d)**

9. **(b)**

10. **(a)**

11. **(c)**

12. **(d)**

13. **(b)**

14. **(a)**

15. **(c)**

16. **(d)**

17. **(b)**

18. **(a)**

19. **(c)**

20. **(d)**

21. **(b)**

22. **(a)**

23. **(c)**

24. **(d)**

25. **(b)**

26. **(a)**

27. **(c)**

28. **(d)**

29. **(b)**

30. **(a)**

31. **(c)**

32. **(d)**

33. **(b)**

35. **(a)**

35. **(c)**

36. **(d)**

37. **(b)**

38. **(a)**

39. **(c)**

40. **(d)**

41. **(b)**

42. **(a)**

43. **(c)**

44. **(d)**

45. **(b)**

46. **(a)**

47. **(c)**

48. **(d)**

49. **(b)**

50. **(a)**

51. **(c)**

52. **(b)**

Since change in internal energy for an isothermal process is zero, the heat transfer is equal to work transfer.

53. **(a)**

54. **(d)**

55. **(d)**

56. **(a)**

57. **(d)**

58. **(b)**

Mechanical efficiency

$$= \frac{\text{Brake power}}{\text{Brake power} + \text{Friction power}}$$

$$= \frac{80}{80+20} = 0.8$$

59. **(d)**

60. **(a)**

$$\varepsilon = \frac{E}{E_b}$$

61. **(a)**

62. **(c)**

63. **(c)**

64. (a)

As sun emits the energy through radiation phenomenon, and temperature of the sun is very high so we require special kind of thermometer to sustain such temperature and compatible with this thermal process.

All other thermometer is basically for low temperature measurement.

65. (a)

66. (a)

The charge of one electron is 1.6×10^{-19} coulomb. Again 1 A current means transferring of 1 coulomb charge per one second.

$$1\text{ A} = \frac{1}{1.6\times10^{-19}} = 0.625\times10^{19}$$

67. (c)

The resistivity is a property of a material, defined as the resistance between two opposite faces of a cube of a material of unit volume. That is why resistivity is only the unique property of a material and it does not depend upon the dimension of any piece of material.

68. (c)

The expression of capacitance is given as

$$C = \frac{\varepsilon A}{d}$$

Where ε is the permittivity of the medium. Hence it is seen that the capacitance of a capacitor is directly proportional to the permittivity of the medium used as dielectric. Therefore to obtain a high value of capacitance, the permittivity of dielectric medium should be high.

69. (b)

$$\text{Resistance, } R = \frac{pL}{A} \Rightarrow p = \frac{RA}{L}$$

$$\Rightarrow \frac{\Omega\times\text{meter}\times\text{meter}}{\text{meter}} = \Omega-\text{m}$$

70. (b)

As a shunt field current I_f decreases, flux also decreases and the speed rises as speed is inversely proportional to flux.

71. (d)

Eddy current loss $P_c = Kf^2 B_m^2$

So eddy current loss will depend upon frequency, flux density and the area of the eddy current loop.

72. (a)

Hysteresis loss $P_h = K_h B_m^{16} f$

So, hysteresis loss will depends on frequency.

73. (a)

Thin laminations are used in order to reduce the eddy current losses only. Due to laminations the area of the eddy currents loops are minimized and the losses due to eddy current are minimized.

74. (c)

Hysteresis loop will represents only hysteresis losses. It is found out by area of B-H loop curve of a magnetic material

75. (d)

76. (c)

The unit of magnetic flux is called Weber in honor of famous scientist Wilhelm Edward Weber (1804 – 1891). Magnetic flux has also another unit named Maxwell. 1 Maxwell = 10^{-8} Weber.

77. (c)

78. (a)

The power in both of the connections is same either it is connected in Star or Delta.

Power for Star a Delta = $\sqrt{3}\times V_L \times I_L$

79. (c)

When the element is not capable of delivering energy independently, it is called as passive element. Both resistor and bulb are the passive elements as they can't increase the energy level of a circuit.

80. (c)

81. (a)

Given, $P_1 = P$

$P_2 = P$

$\theta = 60°$

Let resultant force be R

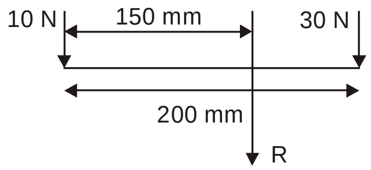
$$R = \sqrt{P_1^2 + P_2^2 + 2P_1P_2\cos 60°}$$

$$= \sqrt{P^2 + P^2 + 2P^2 \times \frac{1}{2}}$$

$$= \sqrt{3P^2}$$

$$= \sqrt{3}P$$

82. (b)



Let resultant force b 'R'

$$R = 40 \text{ N}$$

Let point of application of 'R' be 'x' mm from left end

$$x = \frac{10 \times 0 + 30 \times 200}{40} = 150 \text{ mm}$$

83. (c)

Lami's theorem is valid for equilibrium of three co-planar and concurrent forces.

84. (b)

Given, V = final value = 0

V = initial velocity = 36 km/hr

= 10 m/sec

t = 2.5 seconds (duration of application of brakes)

$\Rightarrow$ $V = U + at$

$0 = 10 + a \times 2.5$

$\Rightarrow$ $a = -4$ m/sec^2

$\Rightarrow$ $V^2 = U^2 + 2as$

$0 = 10^2 - 2 \times 4 \times s$

$$s = \frac{10^2}{2 \times 4} = 12.5\text{m}$$

85. (c)

$$\text{Coefficient of restitution} = \frac{\text{Velocity of seperation}}{\text{Velocity of approach}}$$

Its value is '0' for inelastic bodies and '1' for elastic bodies

86. (c)

Let compression in spring be 'x' mm.

Change in kinetic energy of truck

$$= \frac{1}{2}mV^2 = \frac{1}{2} \times 16 \times 1000 \times 3 \times 3$$

= 72000 kN-mm

$$\text{Work done in spring} = \frac{1}{2} \times x \times \frac{x}{2.5} = \frac{1}{5}x^2$$

$\because$ Change in K.E. = work done in spring

$$72000 = \frac{1}{5}x^2$$

$$x = 600 \text{ mm}$$

87. (d)

Impulse is defined as the change in momentum as a result of the force acting on it for a period of time.

Impulse = Force × time = $\vec{F} \times \Delta t$

Also, Impulse = $\Delta\vec{P} = \vec{P}_{final} - P_{initial}$

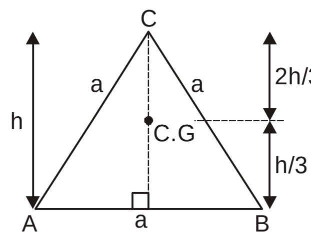
= change in momentum

$\therefore$ Units of impulse are

$\therefore$ Newton-second

or, Dyne-second

88. (c)



From pythagoras theorem,

$$a^2 = h^2 + \frac{a^2}{4}$$

$$\Rightarrow \quad h^2 = \frac{3}{4}a^2$$

$$\text{or,} \quad h = \frac{\sqrt{3}\,a}{2}$$

We know, centroid of a triangle from base is at a distance 'h/3'

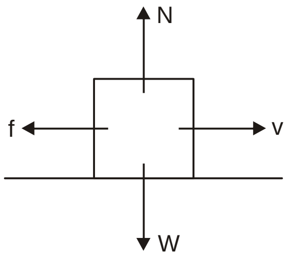
$$\therefore \text{ Centroidal distance} = \frac{h}{3} = \frac{\sqrt{3}\,a}{6} = \frac{a}{2\sqrt{3}}$$

89. (c)

As per newton's third law, "Every action has an equal and opposite reaction".

Thus the force at which a bullet is fired from the gun, same force will be felt on the gun in the opposite direction. Hence the gun recoils.

90. **(d)**



$$N = W \text{ (from force equilibrium)}$$

$$f = \text{friction resistance} = \mu N$$

$$\therefore \quad \frac{f}{N} = \mu = \text{co-efficient of friction}$$

'f' acts in the direction opposite to the one in which the body moves.

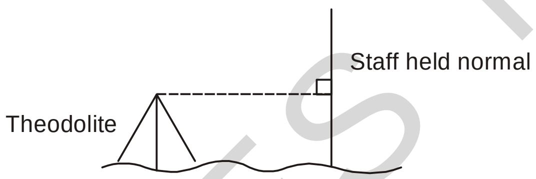
91. **(b)**

92. **(d)**

$$T = \frac{\text{Angular distance}}{\text{Angular velocity}} = \frac{2\pi}{\omega}$$

93. **(c)**

94. **(b)**

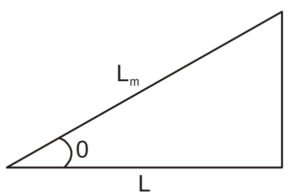


Perpendicular distance is the shortest distance.

95. **(a)**

Closed contours of decreasing values towards the centre represent a depression.

96. **(c)**



$$\text{Measured length} = L_m$$

$$\text{Exact length} = L$$

$\therefore$ Correction = True value – Measured value

$$= L - L_m$$

$$= L_m \cos\theta - L_m$$

$$= -L_m(1-\cos\theta)$$

$$= (-)L_m \times 2\sin^2(\theta/2)$$

97. **(b)**

Induced angle is defined s the difference between fore bearing of next line and back bearing of previous line at a point.

Point is B

F.B. of next line = F.B. of BC = 68°30′

B.B. of previous line = B.B. of AB

$$= 146°30' + 180°$$

$$= 326°30'$$

$$\therefore \quad \angle ABC = (68°30' - 326°30') + 360°$$

$$= 102°$$

98. **(d)**

R.L. of height of collimation = 100 + 1.5 = 101.5 m

R.L of top of roof = 101.5 – (– 1.5) = 103 m

$\therefore$ Floor level below the slab = 103 – 100 = 3 m

99. **(a)**

Cross-staff is used for setting out right-angles

Gradiometer is used for setting out any required gradient

Line ranger is used for locating intermediate stations on survey line

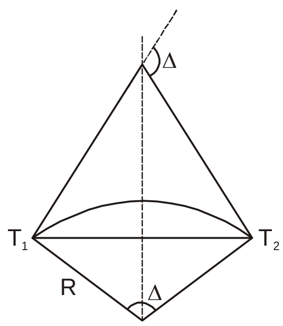
100. **(a)**

In undulated areas, tachometer is preferred because only angular measurements and staff-sighting is involved in it.

In all the other processes linear measurements of horizontal distances are required which involves error due to undulations.

In compass survey, both angular and linear measurements are made.

101. **(c)**



Tangent length = $R\tan\frac{\Delta}{2}$

Long chord = $2R\sin\frac{\Delta}{2}$

Equating the two, $R\tan\frac{\Delta}{2} = 2R\sin\frac{\Delta}{2}$

$\because \quad \Delta = 120°$

102. (b)

Dial gauge measures small linear distances

Feeler gauge measures gap width or, clearance between surfaces and bearings.

Poker gauge measures propeller stern shaft clearance

Bridge gauge measures amount of wear of main engine bearing

103. (c)

An energy meter integrates energy over a period of time

104. (c)

Due to axial tension or compression,

Strain energy = $U_1 = \frac{1}{2}\times\sigma\times\frac{\sigma}{E}\times V = \frac{\sigma^2 V}{2E}$

Due to bending,

$$\text{Strain energy} = U_2 = \int_0^L \frac{M^2\,dx}{2EI} = \frac{M^2 L}{2EI}$$

$$= \frac{\sigma^2\times I^2\times L}{2\times y^2\times E\times I} \qquad \left(\because \frac{M}{I}=\frac{\sigma}{y}\right)$$

$$= \frac{\sigma^2\times\frac{bd^3}{12}\times L}{2\times d^2/4\times E} = \frac{\sigma^2\times V}{6E}$$

$$\therefore \quad \boxed{\frac{U_2}{U_1}=\frac{1}{3}}$$

105. (c)

Torsion equation : $\frac{T}{J}=\frac{\tau}{R}$

The strength of a shaft is given by

$$T_{solid} = \frac{\tau\times J_{solid}}{R} = \frac{\tau\times\frac{\pi D^4}{32}}{D/2}$$

$$T_{hollow} = \frac{\tau\times J_{hollow}}{R} = \frac{\tau\times\frac{\pi\left(D^4-\frac{D^4}{16}\right)}{32}}{D}$$

$$\therefore \quad \frac{T_{solid}}{T_{hollow}} = \frac{1}{15/16}=\frac{16}{15}$$

106. (c)

We know,

In a rectangular beam

Maximum shearing stress = $\frac{3}{2}$ × Average shear stress

$$\therefore \quad \tau_{max} = \frac{3}{2}\times\frac{V}{bd}$$

$$30 = \frac{3}{2}\times\frac{10000}{20\times d}$$

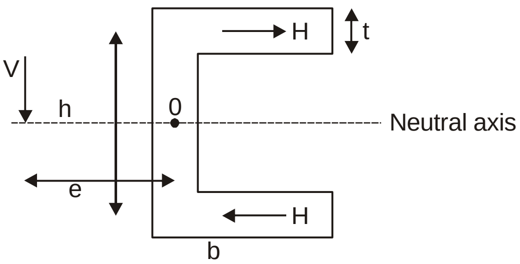
$$\therefore \quad d = 25\text{ cm}$$

107. (c)

$$\lambda = \text{Slenderness ratio} = \frac{l}{\sqrt{\frac{I}{A}}}$$

$$\lambda = \frac{500}{\sqrt{\frac{10^4}{12\times10\times10}}} = \frac{500}{5}\times\sqrt{3}\,0 = 173.2$$

108. (d)



$$\Rightarrow \quad \Sigma M_0 = 0$$

$$Ve = H\times h$$

$$\Rightarrow \quad e = \frac{Hh}{V}$$

$$H = \frac{q_{av}}{t}\times b\times t = \frac{1}{2}\times\frac{V(bt)\times\frac{h}{2}}{I\times t}\times b\times t$$

$$= \frac{Vh+b^2}{4I}$$

$$e = \frac{Vh+b^2}{4I}\times\frac{h}{V} = \frac{b^2h^2t}{4I}$$

There, ‘h’ = ‘d’ = depth of section

$$\therefore \qquad e = \frac{b^2 d^2 t}{4I}$$

109. (c)

$$\text{Strain in axial direction} = \frac{P}{AE} = + \frac{P \times 4}{\pi d^2 \times E}$$

$$\therefore \text{ Strain in lateral direction} = -\frac{\mu \times P \times 4}{\pi d^2 \times E}$$

$$= -\frac{P}{\pi d^2 E}$$

$$\therefore \text{ Change in diameter} = -\frac{P \times d}{\pi d^2 E} = -\frac{P}{\pi d E}$$

110. (b)

Most conservative theory is maximum shear stress theory

Most appropriate theory for brittle material is maximum principal stress theory.

111. (c)

Elasticity is the property by which material regains its original shape after removal of force.

Fatigue is the deterioration of a material under repeated cycles of stress or strain resulting in progressive cracking

112. (b)

Moment of resistance of a section = fy × z

where, fy = permissible stress

z = section modulus

$$\text{MOR} = fy \times \frac{bd^2}{6}$$

For uniform strength, bending moment at every section must be equal to the moment of resistance of that section.

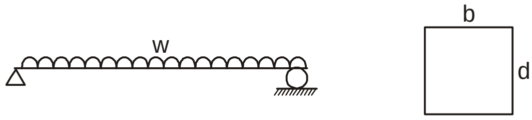
$$M = \text{MOR}$$

$$M = fy \times \frac{bd^2}{6}$$

$$M \propto bd^2$$

$$d \propto \sqrt{M}$$

113. (c)



$$\text{Deflection at centre } (\Delta_1) = \frac{5}{384} \frac{wL^4 \times 12}{E \times bd^3}$$

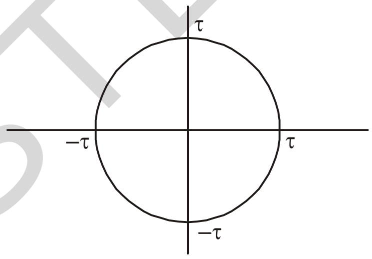
Now, if ‘b’ and ‘d’ are interchanged

$$\Delta_2 = \frac{5}{384} \times \frac{wL^4 \times 12}{E \times db^3}$$

$$\therefore \qquad \frac{\Delta_2}{\Delta_1} = \frac{1/db^3}{1/ba^3} = \frac{bd^3}{db^3} = \left(\frac{d}{b}\right)^2$$

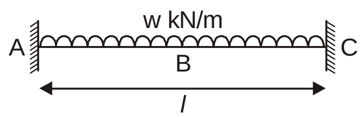
114. (d)

Pure shear’s Mohr circle :



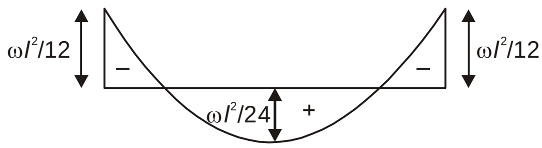
$$\therefore \text{ Sum of normal stresses} = \tau - \tau = 0$$

115. (b)



$$M_A = M_C = -\frac{\omega l^2}{12} \text{kN-m}$$

$$M_B = \frac{\omega d^2}{24} \text{kN-m}$$



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116. (d)

117. (c)

Cast iron is brittle

Mild steel is ductile and tough

118. (a)

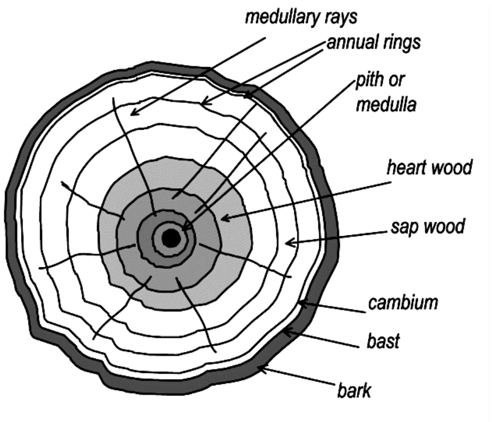
119. (a)

Tricalcium silicate is responsible for early strength

Dicalcium silicate imparts ultimate strength

Tri-calcium aluminate is responsible for quick or flash setting of cement.

120. (c)



The tree trunk showing growth rings

121. (d)

122. (c)

Quick lime is obtained from calcination of pure lime.

$CaCO_3 \rightarrow CaO(\text{quick lime}) + CO_2$

Quick lime (CaO) slakes with water to gear fat lime

$CaO + H_2O \rightarrow Ca(OH)_2$ (slaking)

Here, $Ca(OH)_2$ is called fat or white lime.

123. (b)

124. (b)

The moisture present in the aggregate forms a film around each particle. These films exert a force called surface tension. Due to this surface tension, each particles get away from each other. Because of this, there is no direct contact possible among individual particles and volume increases, which is called bulking.

However, in coarse aggregate the surface tension generated is not strong enough to keep the coarse aggregate particles apart.

125. (c)

126. (d)

127. (c)

As per IS – 712 (1984)

Initial setting time of eminently hydraulic time is 2 hours

128. (c)

Bitumen is obtained from the fractional distillation of petroleum

129. (b)

130. (d)

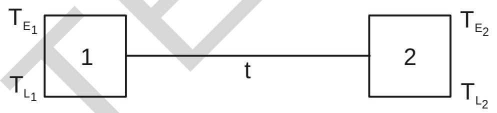
A dummy activity consumes no time or resource

It is not absolutely necessary in a network if the network is grammatically and logically correct.

It is represent by dashed arrow.

131. (b)

132. (c)



Total float = $(T_{L_2} - T_{E_1}) - t$

Independent float = $(T_{E_2} - T_{L_1}) - t$

Free float = $(T_{E_2} - T_{E_1}) - t$

Interference float = $T_{L_1} - T_{E_1}$ = Slack of event 1

Independent float affects neither the proceeding nor the succeeding activity

Total float affects both the proceeding and succeeding activities.

133. (c)

Standard deviation = $\sigma = \dfrac{t_p - t_0}{6}$

Given t_p = 22 minutes

t_0 = 10 minutes

$\therefore \quad \sigma = \dfrac{22-10}{6} = 2$ minutes

Variance = $\sigma^2 = 2 \times 2 = 4$

134. (a)

135. (d)

Unit of measurement for rivets is Quintal.

136. (c)

Size of modular brick is 19 cm × 9 cm × 9 cm.

The effective size of modular brick in masonary becomes 20 cm × 10 cm × 10 cm with mortar.

Hence, number of bricks in 20 m^3 brick work

$$= \frac{20}{0.2\times0.1\times0.1} = 10{,}000$$

137. (b)

Euler's mode law is applicable where apart from inertial force, only pressure force is dominant.

$$(E_u)_{model} = (E_u)_{prototype}$$

or $(E_u)_R = 1$

$$\therefore \frac{V_r}{\sqrt{\frac{P_r}{\rho_r}}} = 1$$

138. (d)

139. (d)

$$f = \text{Friction factor} = \frac{64}{Re}$$

Head loss through circular pipe $= \dfrac{32\,\mu VL}{\rho g D^2}$

From Darcy-Weisbach's equation

$$h_L = \frac{fLV^2}{2gD}$$

$$\therefore \frac{32\mu}{\rho g D^2} = \frac{fLV^2}{2gD}$$

$$f = \frac{64}{\rho VD}\times\mu = \frac{64}{Re}$$

140. (c)

In floating condition,

Weight of body = Buoyant force = (0.6 × 3 × 2 × 9.81) kN

(where, volume of water displaced = 0.6 × 3 × 2 m^3

$\therefore$ Weight of body = 35.3 kN

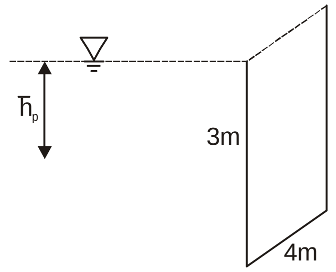
141. (a)

$$\text{Kinematic viscosity} = \frac{\text{Dynomic viscosity}}{\text{density}}$$

$$= \frac{\frac{kg}{m\,sec}}{\frac{kg}{m^3}}$$

$$= \frac{m^2}{sec}$$

142. (d)



$\bar{h}_p$ = depth of centre of pressure

$$= \bar{h} + \frac{I_{GG}\sin^2\theta}{A\bar{h}}$$

$$= \frac{3}{2} + \frac{\frac{4\times3^3}{12}\sin^2(90°)}{3\times4\times1.5}$$

= 2 m

143. (d)

'Slip' in a reciprocating pump is defined as the difference between theoretical and actual discharge.

Mathematically, Slip = $Q_{th} - Q_{act}$

$$\text{Percentage of slip} = \frac{(Q_{th}-Q_{act})}{Q_{th}}\times100$$

144. (b)

Specific speed	Turbine type
10 – 35	Single - jet pelton
35 – 60	Multi-get pelton
60 – 300	Francis
300 – 1000	Kaplan

145. (b)

COD measures oxygen demand for chemical decomposition of both bio-degradable and non bio-degradable organic matter

$COD - BOD_u$ = non bio-degradable organic matter

COD uses strong oxidizing agent like potassium dichromate under acidic conditions

Acidity is achieved by addition of sulphuric acid

146. (b)

Oxidation pond is an example of suspended growth system.

All the other three are examples of attached biomass-growth phase system.

147. (d)

Volume of sedimentation tank = 540 m^3

$$Q_{peak} = \text{peak discharge} = 0.05\ m^3/\text{seconds}$$

$$\therefore \quad t_d = \text{detention time} = \frac{V}{Q} = \frac{540}{0.05} = 10800 \text{ seconds} = 3 \text{ hours}$$

148. (c)

Sulphur dioxide is a primary air pollutant

PAN, ozone and photochemical smog are all secondary air pollutants

149. (b)

150. (c)

Nitrates from polluted drinking water form compounds in the body that change hemoglobin to methemoglobin, decreasing the ability of blood to carry oxygen. In infants the condition can be fatal.