

BPSC TEST-03—FULL LENGTH

Date: 05 August, 2018

ANSWERS

1. (c)	26. (d)	51. (c)	76. (d)	101. (b)	126. (d)
2. (d)	27. (b)	52. (a)	77. (b)	102. (c)	127. (a)
3. (b)	28. (a)	53. (d)	78. (c)	103. (c)	128. (d)
4. (a)	29. (c)	54. (c)	79. (c)	104. (b)	129. (a)
5. (c)	30. (d)	55. (c)	80. (b)	105. (b)	130. (b)
6. (d)	31. (b)	56. (d)	81. (d)	106. (a)	131. (c)
7. (b)	32. (a)	57. (a)	82. (c)	107. (d)	132. (a)
8. (a)	33. (c)	58. (d)	83. (b)	108. (c)	133. (b)
9. (c)	34. (d)	59. (a)	84. (c)	109. (d)	134. (d)
10. (d)	35. (b)	60. (c)	85. (b)	110. (b)	135. (c)
11. (b)	36. (a)	61. (c)	86. (d)	111. (b)	136. (b)
12. (a)	37. (c)	62. (a)	87. (d)	112. (d)	137. (d)
13. (c)	38. (d)	63. (a)	88. (a)	113. (c)	138. (a)
14. (d)	39. (b)	64. (c)	89. (d)	114. (b)	139. (d)
15. (b)	40. (d)	65. (b)	90. (d)	115. (c)	140. (a)
16. (a)	41. (a)	66. (d)	91. (d)	116. (c)	141. (c)
17. (c)	42. (c)	67. (b)	92. (b)	117. (d)	142. (c)
18. (d)	43. (b)	68. (d)	93. (b)	118. (c)	143. (a)
19. (b)	44. (a)	69. (c)	94. (c)	119. (d)	144. (c)
20. (a)	45. (c)	70. (d)	95. (d)	120. (b)	145. (a)
21. (c)	46. (d)	71. (b)	96. (c)	121. (d)	146. (c)
22. (d)	47. (b)	72. (d)	97. (a)	122. (d)	147. (a)
23. (b)	48. (a)	73. (d)	98. (c)	123. (c)	148. (a)
24. (a)	49. (c)	74. (c)	99. (b)	124. (d)	159. (d)
25. (c)	50. (d)	75. (a)	100. (a)	125. (b)	150. (a)

BPSC TEST-03—FULL LENGTH SOLUTIONS

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1. (c)
2. (d)
Australia has won the ODI Cricket world for five times (1987, 1999, 2003, 2007 and 2015)
3. (b)
The following communities have been notified as minority communities by the Government of India, Ministry of Minority Affairs; Sikhs, Muslims, Christians, Zoroastrians, Buddhists, and Jains.
4. (a)
5. (c)
Mithali Raj is the leading runs scorer in women's One Day International Cricket. She has scored 6373 runs till July 2018.
6. (d)
7. (b)
8. (a)
The state is divided into nine divisions and 38 districts, for administrative purposes. Bihar has 12 Municipal Corporations, 49 Nagar Parishads, and 80 Nagar Panchayats.
9. (c)
Bihar shares its borders with Uttar Pradesh to its west, Nepal to the north, the northern part of West Bengal to the east, with Jharkhand to the south.
10. (d)
2011 Census states that Bihar is the third most populous state of India with total population of 104,099,452. Uttar Pradesh is the most populous state followed by Maharashtra at number 2.
11. (b)
There are seventeen state universities and four central universities operating in Bihar.
AMU Kishanganj is off campus center of AMU, two deemed universities, and five private universities are currently functional & 1 more is proposed.
There is one IIT in Patna while Vikramshila Central University & National Skill central university is proposed.
12. (a)
Sheikhpura is the least populated district of Bihar and its population is 636,342.
13. (c)
14. (d)
The Champaran Satyagraha of 1917, (Champaran district in Bihar) was the first Satyagraha movement inspired by Mohandas Gandhi and a major revolt in the Indian Independence Movement.
15. (b)
Bihar has 40 Lok Sabha and 16 Rajya Sabha seats.
16. (a)
Indian Railways currently has four different gauges:
(a) The 1,676 mm (5 ft 6 in) broad gauge
(b) The 1,000 mm (3 ft 3 3/8 in) metre gauge
(c) Narrow gauge-1: 2 ft 6 in (762 mm)
(d) Narrow gauge-2: 2 ft (610 mm)
17. (c)
Jogbani Airport is located at Jogbani town in the Araria district of Bihar, India.
18. (d)
The hardest metallic elements are (in order of descending hardness): tantalum, niobium, titanium, zirconium, lutetium, nickel, vanadium, promethium, iron and gadolinium.
19. (b)
There are 17 international airports in India as on date. These are :
Netaji Subhash Chandra Bose International Airport, Kolkata, Chennai International Airport, Chennai, Thiruvananthapuram International Airport, Sardar Vallabh Bhai Patel International Airport, Ahmedabad, Guru Ram Dass Jee International Airport, Amritsar, Lokpriya Gopinath Bordoloi International Airport, Guwahati, Goa International Airport (Civil Enclave), Srinagar International Airport, Srinagar (Civil Enclave), Jaipur International Airport, Kozhikode Airport, Calicut, Veer Savarkar International Airport (Civil Enclave), Port Blair, A&N Islands (UT), Indira Gandhi International Airport, Delhi, Chattrapati Shivaji International Airport,

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- Mumbai, GMR Hyderabad International Airport, Hyderabad, Bangalore International Airport Limited, Bengaluru, Cochin International Airport, Kochi (Private) and Bharat Ratna Babasaheb Dr. B.R. Ambedkar International Airport, Nagpur (Maharashtra)
20. (a) Goddess Coyolxauhqui, Goddess Metztli, God Tecciztecatl see Metztli (all three from Aztec mythology) and Goddess Achelois, Goddess Phoebe, Goddess Artemis, Goddess Selene, Goddess Hecate (all five from Greek mythology) are lunar deities.
21. (c) Liquefied petroleum gas (LPG), contains propane or butane and are flammable mixtures which are used in heating appliances, cooking equipment, and vehicles.
22. (d) A lunar eclipse occurs when the Sun, the Earth and the Moon are so aligned that for a period of time, the full Moon passes through the shadow of Earth in space.
As the moon passes into Earth's shadow, it will dim and darken. The moon will turn this copper, blood-red color. It will turn a deep, deep red when it's at the greatest point in the eclipse.
23. (b) 21st FIFA World Cup was won by the European country France by defeating Croatia (4-2) in finals.
24. (a)
25. (c) India finished 3rd at the 2018 Common Wealth Games with 26 Gold medals and a total of 66 medals.
26. (d) RAM is Random Access Memory.
27. (b)
28. (a) The High Court of Bihar is Patna High Court and was established on 3 February 1916.
29. (c) Southern Bihar was ceded to form the new state of Jharkhand on November 15, 2000.
30. (d)
31. (b) Geosynchronous Satellite Launch Vehicle (GSLV) is the largest launch vehicle developed by India, which is currently in operation.
It is a three stage vehicle with four liquid strap-ons with the indigenously developed cryogenic Upper Stage forms the third stage of GSLV Mk II.
32. (a)
33. (c) 11 seasons of the IPL tournament have taken place. 2018 IPL title holders are the Chennai Super Kings. The most successful franchises in the tournament are the Chennai Super Kings and Mumbai Indians who have won 3 titles each.
34. (d) Kamet is the second highest mountain in the Garhwal region of Uttarakhand lies in the Chamoli District of Uttarakhand. Nanda Devi is the highest mountain in Uttarakhand and second highest in India after Kangchenjunga Mountains.
35. (b)
36. (a) Inder Kumar Gujral served as the 11th Prime Minister of India from April 1997 to March 1998.
He was the third PM to be from the Rajya Sabha (Bihar) after Indira Gandhi and then H. D. Deve Gowda and followed by Manmohan Singh.
37. (c)
38. (d) Gatimaan Express is the first semi-high speed train of India. It runs between Delhi and Jhansi.
39. (b) The maximum strength of Rajya Sabha is 250, out of which 12 members are nominated by the President and 238 are representatives of the States and of the two Union Territories.

The present strength of Rajya Sabha, is 245, out of which 233 are representatives of the States and Union territories of Delhi and Puducherry and 12 are nominated by the President.

40. (d)

England and Wales will host the ICC One Day International World Cup in 2019.

41. (a)

Caustic Soda is also known as lye and Sodium hydroxide (NaOH).

It is a white inorganic compound and is a strong base. It is used to manufacture soaps, rayon, paper, explosives, dyestuffs, and petroleum products.

42. (c)

Operation Vijay was an armed conflict between India and Pakistan which happened between May and July at Kargil (Jammu and Kashmir) in 1999.

43. (b)

Top 10 countries as per the geographical area:

- | | |
|------------------|--------------|
| 1. Russia | 2. Canada |
| 3. United States | 4. China |
| 5. Brazil | 6. Australia |
| 7. India | 8. Argentina |
| 9. Kazakhstan | 10. Algeria |

44. (a)

As per the Economic survey (2017-18), the GDP growth estimate for the fiscal year 2017-18 is 6.5% in the current fiscal, due to the poor performance of agriculture and manufacturing sector, as against 7.1% in the last fiscal.

45. (c)

The classical dance forms recognised by the Sangeet Natak Akademi and the Ministry of Culture are: Bharatanatyam, from Tamil Nadu, Kathak, from Northern and Western India, Kathakali, from Kerala, Kuchipudi, from Andhra Pradesh and Telangana, Odissi, from Odisha, Sattriya, from Assam, Manipuri, from Manipur and Mohiniyattam, from Kerala.

46. (d)

The National Institution for Transforming India (NITI Aayog) was formed via a resolution of the Union Cabinet on January 1, 2015.

It is the premier policy 'Think Tank' of the Government of India, providing both directional and policy inputs and designs strategic and long term policies and programmes for the Government of India. It also provides relevant technical advice to the Centre and States.

47. (b)

The retirement age of:

- Judges of Supreme court is 65
- Judges of High court is 62
- Judges of subordinate judicial officers is 60

48. (a)

Top 5 fast bowlers in test cricket (wickets): GD McGrath (AUS)-563, JM Anderson (ENG)-540, CA Walsh (WI)-519, N Kapil Dev (INDIA)-434 and Sir RJ Hadlee (NZ)-431

49. (c)

Major social media founders are:

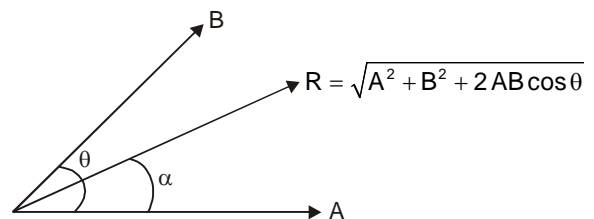
Mark Zuckerberg (Facebook), Jack Dorsey (Twitter), Ben Silbermann (Pinterest), Kevin Systrom (Instagram), Tom Anderson (Myspace), Reid Hoffman (LinkedIn), David Karp (Tumblr) and Chad Hurley (YouTube)

50. (d)

List of top 7 Private Sector Banks in India (market capitalization):

1. HDFC Bank (₹ 329,757.41 Crore), 2. ICICI Bank (₹ 158,503.49 Crore), 3. Axis Bank (₹ 151,877.77 Crore), 4. Kotak Mahindra (₹ 150,176.96 Crore), 5. IndusInd Bank (₹ 73,272.69 Crore), 6. Yes Bank (₹ 60,701.20 Crore) and 7. IDFC Bank (₹ 20,369.39 Crore)

51. (c)



$$\cos \alpha = \frac{A + B \cos \theta}{\sqrt{A^2 + B^2 + 2AB \cos \theta}}$$

52. (a)

$$R^2 = P^2 + Q^2 + 2PQ \cos \theta$$

$$R_{\max}^2 = P^2 + Q^2 + 2PQ = (P + Q)^2 = 40^2$$

$$R_{\min}^2 = P^2 + Q^2 - 2PQ = (P - Q)^2 = 10^2$$

$$\therefore P + Q = 40 \quad \dots(i)$$

$$P - Q = 10 \quad \dots(ii)$$

One solving

$$2P = 50$$

$$P = 25 \text{ kN}$$

$$Q = 15 \text{ kN}$$

53. (d)

Inertia force = $-m \times a$

54. (c)

Power needed at constant speed to overcome frictional resistance only

$$= F_t \times V$$

$$= 20 \times 10^3 \times 10 = 200 \text{ kW}$$

55. (c)

Power is required to overcome drag only

$$\therefore P = F_0 \times v = 10v^2$$

$$= 10 \times 50^2 \times 10^{-3} \text{ kW}$$

$$= 25 \text{ kW}$$

56. (d)

As friction is involved, there is energy loss. So conservation of energy is not possible.

57. (a)

$$V = \frac{ds}{dt} = 6t^2 + 3$$

For $v = 9$

$$t = 1 \text{ sec}$$

$$\therefore S = 2 \times 1^3 + 3 = 5 \text{ m}$$

58. (d)

59. (a)

$$\text{Elevator acceleration} = \frac{v - u}{t} = \frac{4}{2} = 2 \text{ m/sec}^2$$

$$\text{Tension in cable} = W - ma$$

$$= 10000 - \frac{10000}{10} \times 2$$

$$= 8000 \text{ kgf}$$

60. (c)

$$\text{Rotational k.E} = \frac{Mr^2 \omega^2}{4} \quad \left(\because I = \frac{MR^2}{2} \right)$$

Total kinetic energy

$$= \frac{1}{2} \times mv^2 + \frac{1}{2} \times I \omega^2 \quad \left(1 = \frac{mr^2}{2} \right)$$

$$= \frac{1}{2} \times mr^2 \omega^2 + \frac{1}{4} mr^2 \omega^2$$

$$= \frac{3}{4} Mr^2 \omega^2$$

Ratio of these two

$$= \frac{\frac{1}{4} Mr^2 \omega^2}{\frac{3}{4} Mr^2 \omega^2} = \frac{1}{3}$$

61. (c)

Mid-ordinates and average ordinates are used to calculate area.

62. (a)

Astronomic Survey : Surveys conducted for determination of latitudes, longitudes, azimuth, local time etc. at various places on the earth by observing heavenly bodies like sun or stars.

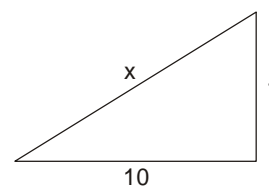
Cadastral Survey : Survey to produce plans of property boundaries for legal purposes.

Photogrammetric Survey : It is the science of taking measurements with the help of photographs.

63. (a)

$$R.F. = \frac{1 \text{ cm}}{10 \times 1000 \times 100 \text{ cm}} = 1/1000000$$

64. (c)



$$x = \sqrt{10^2 + 1^2} = 10.05$$

$$\therefore \text{Fall in 20m} = 20 \times \frac{1}{10.05} = 2\text{m}$$

$$\begin{aligned} \therefore \text{Slope correction (Cg)} &= -\frac{h^2}{2L} \\ &= \frac{-2^2}{2 \times 20} = -0.1\text{m} \\ &= -10\text{ cm} \end{aligned}$$

65. (b)

The quadrantal bearing of a line is measured with a surveyor's compass

The whole circle bearing is measured with a prismatic compass.

66. (d)

For a closed traverse,

$$\Sigma L = 0$$

$$\Sigma D = 0$$

The above equations should hold true.

However, open traverses are checked by method of chords.

67. (b)

Combined correction due to curvature and refraction

$$\begin{aligned} &= -0.0673 d^2 \text{ ('d' is in km)} \\ &= -0.0673 \times 3.4^2 \\ &= -0.778\text{ m} \end{aligned}$$

68. (d)

$$D = Ks + c$$

where, K = Multiplying constant = f/i

C = additive constant = f + d

69. (c)

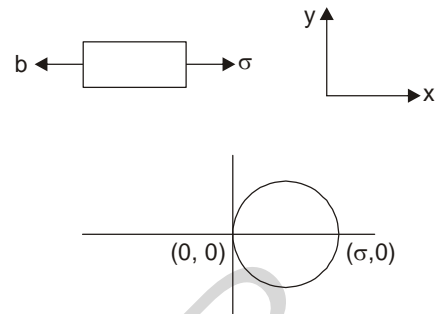
If quantity of given weight is divided by a factor, the weight of the result is obtained by multiplying its given weight by square of that factor

$$\therefore \text{Weight of 'a/3'} = 3 \times 3^2 = 27$$

70. (d)

71. (b)

72. (d)



Maximum normal stress occurs at the same section which is subjected to a direct tensile stress

Thus, inclination of the maximum normal stress w.r.t the normal of the given section is 0.

73. (d)

74. (c)

Rankine gordon formula

$$\frac{1}{R_R} = \frac{1}{P_C} + \frac{1}{P_e}$$

where, P_R = Rankine gailure load

P_e = Rankine failure load

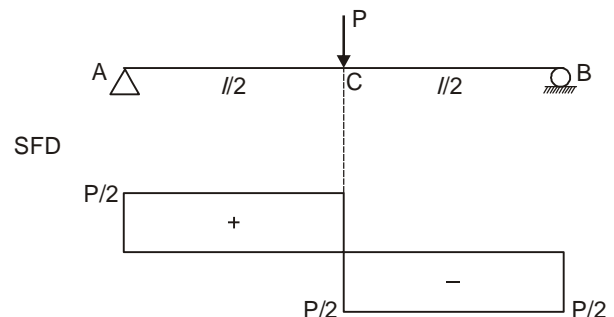
P_C = Crushing load

$$P_R = \frac{P_C P_e}{P_C + P_e} = \frac{P_C}{1 + \frac{P_C}{P_e}} = \frac{\sigma_y \times A}{1 + \frac{\sigma_y \times A \times \lambda^2}{n^2 E}}$$

$$P_R = \frac{\sigma_y \times A}{1 + \sigma \lambda^2}$$

$$P_R = \frac{P_C}{1 + \sigma \lambda^2}$$

75. (a)



At 'c', sudden decrease in SFD occurs while moving from left to right because of the concentrated load 'P' at C

76. (d)

77. (b)

$$\frac{\phi_{\max}}{\alpha} = \frac{\epsilon_x - \epsilon_y}{y}$$

$$\therefore \phi_{\max} = \epsilon_x - \epsilon_y$$

78. (c)

$$\tau_{\max} = \frac{\sigma_1 - \sigma_3}{2}$$

$$100 = \frac{100 - \sigma_3}{2}$$

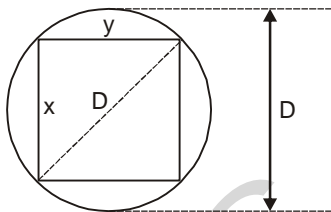
$$\begin{aligned} \sigma_3 &= -200 + 100 = -100 \text{ MPa} \\ &= 100 \text{ MPa (compressive)} \end{aligned}$$

79. (c)

$$\tau_{\text{mean}} = \frac{3 \times 10^3}{\frac{1}{2} \times 40 \times 20} = \frac{3000}{20 \times 20} = 7.5 \text{ MPa}$$

$$\therefore \tau_{\max} = \sigma_{\text{N.A}} = \frac{4}{3} \tau_{\text{mean}} = \frac{4}{3} \times \frac{15}{2} = 10 \text{ MPa}$$

80. (b)



$$x^2 + y^2 = D^2$$

$$x^2 = D^2 - y^2$$

$$z = \text{section modulus}$$

$$= y \times \frac{x^2}{6} = \frac{y(D^2 - y^2)}{6}$$

$$\frac{dz}{dy} = 0$$

$$\Rightarrow D^2 - 3y^2 = 0$$

$$y = \frac{D}{\sqrt{3}}$$

$$x = \sqrt{D^2 - y^2} = \sqrt{D^2 - \frac{D^2}{3}}$$

$$= \sqrt{\frac{2}{3}} D$$

81. (d)

Shock resistance implies that the steel should be able to bear impact. And resistance to impact loading is called toughness.

82. (c)

Diamond and graphite are allotropes of carbon.

The materials having more than one type of crystal structure called allotropic material

83. (b)

Before dye penetrant is applied on the surface of specimen, it is cleaned by removing dust on the surface. Then the dye penetrant is applied on the surface of specimen. After that excess penetrant is removed and developer is applied on the surface of specimen. If there is any defect on the surface, penetrant gets accumulated at the defect and defect is located.

84. (c)

Lower critical temperature is the temperature of austenite-to-pearlite eutectoid transformation. Below this temperature, austenite does not exit.

85. (b)

86. (d)

Tricalcium silicate is responsible for early strength of cement

Dicalcium silicate is responsible for ultimate strength of cement

Rapidly flash-set section is controlled by addition of 2 – 3% gypsum at the time of grinding of cement.

87. (d)

88. (a)

89. (d)

90. (d)

91. (d)

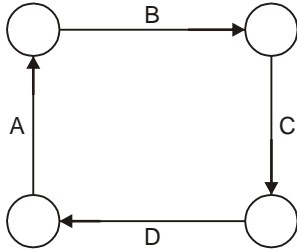
92. (b)

93. (b)

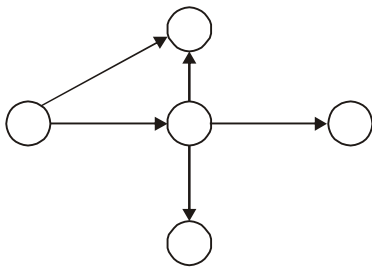
94. (c)

95. (d)

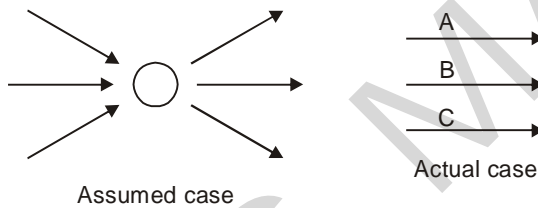
Cyclic error :



Dangling error : Network cannot have more than one end point.



Wagon wheel error : It is a conceptual error, difficult to spot.



96. (c)

97. (a)

PERT is used in R & D type projects because it follows probabilistic approach for time determination incorporating the uncertainties

CPM is used for repetitive type of projects and follows deterministic approach for time determination.

98. (c)

$$\text{Standard duration} = \frac{t_p - t_0}{6} = \frac{21 - 5}{6} = 2.67 \text{ days}$$

99. (b)

Negative total float → super-critical

Zero total float → critical

Positive total float → sub-critical

100. (a)

Indirect cost is associated with the project as whole

It includes overhead charges and liquidity damages or profit

If can't be associated to any individual activity.

101. (b)

$$\text{Cost slope} = \text{Rs } 75/\text{day}$$

$$\text{Cost of crashing} = \text{Rs } 75 \times 2 = \text{Rs } 150$$

$$\therefore \text{Tunnel crashed cost} = 350 + 150 = \text{Rs } 500$$

102. (c)

$$\text{Initial cost} = \text{Rs } 500$$

$$\text{Salvage value} = \text{Rs } 50$$

$$\text{Depreciation} = \frac{\text{Rs } 500 - \text{Rs } 50}{2} = \text{Rs } 225$$

103. (c)

104. (b)

Half brick wall is measured in square metres.

105. (b)

106. (a)

In a soap bubble,

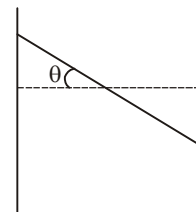
Net pressure intensity over and above atmospheric pressure

$$= \frac{8\sigma}{d} = \frac{8 \times 0.075}{\left(\frac{0.075}{1000}\right)} \text{ N/m}^2$$

$$= 8000 \text{ N/m}^2 = 0.8 \text{ N/cm}^2$$

107. (d)

108. (c)



$$\tan \theta = \frac{a_x}{a_z + g}$$

$$\text{Now, } a_z = 0$$

$$a_x = g$$

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$$\tan \theta = \frac{g}{g}$$

$$\theta = \tan^{-1}(1) = 45^\circ$$

109. (d)

$$v = \frac{\partial \psi}{\partial x} = 4 \times 2 \times x \times y = 8xy$$

$$u = -\frac{\partial \psi}{\partial y} = -4x^2$$

At (1, 1),

$$u = -4$$

$$v = 8$$

$$\therefore \text{Velocity} = \sqrt{u^2 + v^2} = \sqrt{(-4)^2 + (8)^2} \\ = 4\sqrt{5} \text{ units}$$

110. (b)

In a forced vortex,

$$v = \omega \times r$$

as radius \uparrow , velocity \uparrow

111. (b)

$$\text{Mass flow rate} = \rho Q = \rho \times A \times v \\ = 0.75 \times 1000 \times \frac{\pi}{4} \times 0.15^2 \times 3.96 \\ = 52.5 \frac{\text{kg}}{\text{sec}}$$

112. (d)

Given, $B = h$

$$h_f = \frac{P_1 - P_2}{\gamma} = \frac{12\mu QL}{\gamma \times h^3}$$

$$\therefore \boxed{h_f \propto \frac{1}{h^3}}$$

113. (c)

114. (b)

Given, $R_e = 0.2$

$$\therefore D_0 = \frac{24}{R_e} = \frac{24}{0.2} = 120$$

115. (c)

In capillary rise, apart from inertial forces, surface tension force is dominant.

Thus weber model law is used

$$\frac{V_r}{\sqrt{\frac{\sigma_r}{\rho_r L_r}}} = 1$$

116. (c)

A surge tank is provided :

- (i) To reduce the length of pipe affected by water hammer
- (ii) Provide storage of water rejected by turbine due to valve closure
- (iii) Provide a source of water to meet sudden demands due to sudden valve opening.

117. (d)

Power delivered to water = $\gamma Q H$

$$= 9.81 \times 0.5 \times 25$$

$$= 122.6 \text{ kW}$$

$$\therefore \text{Efficiency} = \frac{122.6}{150} \times 100$$

$$= 81.75\%$$

$$\approx 82\%$$

118. (c)

119. (d)

$$N_s = \text{Specific speed} = \frac{N\sqrt{P}}{H^{5/4}}$$

$$= \frac{300 \times \sqrt{1600}}{16^{5/4}}$$

$$= 375 \text{ rpm}$$

For $300 < N_s < 1000$,

We use Kaplan turbine

120. (b)

Jackson's turbidimeter is used when turbidity is greater than 25 ppm

In Nephelometer, turbidity less than one unit can also be measured.

Hence it is used for domestic water supplies.

121. (d)

Fluorides in water greater than 5 mg/l causes deformation of bones called bone fluorosis.

122. (d)

123. (c)

$$\text{Base area of tank (B} \times \text{L)} = 3\text{m} \times 12\text{ m}$$

$$= 36\text{ m}^2$$

$$Q = 1\text{ MLD}$$

$$= 1000\text{ m}^3/\text{day}$$

$$\begin{aligned} \therefore \text{Surface overflow rate} &= \frac{Q}{BL} \\ &= \frac{1000}{36}\text{ m}^3/\text{m}^2/\text{day} \\ &= 27.78\text{ m}^3/\text{m}^2/\text{day} \end{aligned}$$

124. (d)

$$\text{BOD} = \text{DO consumed} \times \text{Dilution factor}$$

$$= 8 \times \frac{\text{vol. of diluted sample}}{\text{vol. to undiluted sample}}$$

$$\text{Let, vol of diluted sample} = 100\text{ ml}$$

$$\therefore \text{Vol. of undiluted sample} = 1\text{ ml}$$

$$\begin{aligned} \therefore \text{BOD} &= 8 \times \frac{100}{1} \\ &= 800\text{ mg/L} \end{aligned}$$

125. (b)

126. (d)

Aerobic ponds should have max. depth 0.5 m

Anaerobic pond for industrial waste has depth between 2.5 – 5 m

The actual oxidation pond used for domestic sewage is actually facultative in nature in which 3 zones exist i.e. aerobic zone at the surface, anaerobic zone at the bottom and facultative zone at the mid-depth.

127. (a)

$$\begin{aligned} \text{Hydraulic retention time} &= \frac{\text{Volume}}{\text{Discharge}} \\ &= \frac{200\text{ m}^3}{\frac{2 \times 1000\text{ m}^3}{24\text{ hours}}} \\ &= 2.4\text{ hours} \end{aligned}$$

128. (d)

129. (a)

130. (b)

131. (c)

132. (a)

133. (b)

134. (d)

135. (c)

136. (b)

137. (d)

138. (a)

139. (d)

140. (a)

141. (c)

For any process energy is always conserved.

142. (c)

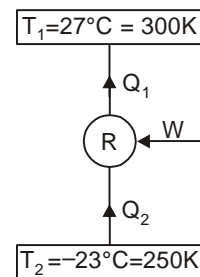
143. (a)

144. (c)

$$T \cdot dS = dU + p \cdot dV$$

Since the given relation is relationship between properties and all are independent of path so this is applicable to reversible and irreversible processes, both.

145. (a)



Refrigerator based on reversed carnot cycle-

The cooling rate-

$$Q_2 = 5\text{ kW}$$

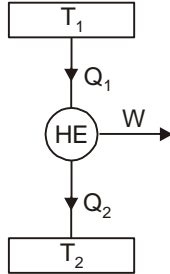
Since the refrigerator is carnot refrigerator,

$$\therefore \text{COP} = \frac{T_2}{T_1 - T_2} = \frac{250}{300 - 250} = 5$$

$$\therefore \frac{Q_2}{W} = 5$$

$$W = \frac{Q_2}{5} = \frac{5}{5} = 1 \text{ kW}$$

146. (c)



Inventor claims,

$$Q_2 = 0.4 Q_1$$

∴ Efficiency of inventor engine,

$$\begin{aligned} h_{\text{new}} &= 1 - Q_2 / Q_1 \\ &= 1 - \frac{0.4 Q_1}{Q_1} = 0.6 \end{aligned}$$

But temperature limits, and Carnot engine

$$T_1 = 327^\circ\text{C} = 600 \text{ K}$$

$$T_2 = 27^\circ\text{C} = 300 \text{ K}$$

Maximum or Carnot efficiency,

$$h_{\text{max}} = 1 - T_2/T_1 = 1 - \frac{300}{600} = 0.5$$

Hence $h_{\text{new}} > h_{\text{max}}$

But the Carnot engine is the most efficient engine between given temperature range. So the inventor's claim is wrong or engine is impossible.

147. (a)

The given term is

$$ds = \frac{\delta Q}{T}$$

Applying cyclic integral

$$\oint ds = \oint \frac{\delta Q}{T}$$

$$0 = \oint \frac{\delta Q}{T}$$

$$\therefore \oint \frac{\delta Q}{T} = 0$$

From Clausius Inequality,

This condition only for reversible processes

148. (a)

Brayton cycle – Heat addition as well as rejection at constant pressure, A–D–5. Otto cycle - heat addition as well as rejection at constant volume, B–E–2. Carnot cycle – heat addition as well as rejection at constant temperature, C–F–3. Rankine cycle – heat addition as well as rejection at constant pressure, so A–D –1

159. (d)

150. (a)