2022-CE- 40-52

EE24BTECH11021 - Eshan Ray

40) The correct match between the physical states of the soils given in **Group I** and the governing conditions given in **Group II** is

Group I	Group II
1. normally consolidated soil	$P.$ sensitivity >16
2. quick clay	$Q.$ $dilation\,angle\, = 0$
3. sand in critical state	$R.$ liquid limit >50
4. clay of high plasticity	$S.$ over consolidation $ratio = 1$

   a) $1 - S, 2 - P, 3 - Q, 4 - R$
   b) $1 - Q, 2 - S, 3 - P, 4 - R$
   c) $1 - Q, 2 - P, 3 - R, 4 - S$
   d) $1 - S, 2 - Q, 3 - P, 4 - R$

41) As per Rankine's theory of earth pressure, the inclination of failure planes is $\left(45 + \frac{\phi}{2}\right)$ with respect to the direction of the minor principal stress.

   The above statement is correct for which one of the following options?
   a) Only the active state and not the passive state
   b) Only the passive state and not the active state
   c) Both active as well as passive states
   d) Neither active nor passive state

42) Henry's law constant for transferring O_2 from air into water, at room temperature, is $1.3 \frac{mmol}{liter-atm}$. Given that the partial pressure of O_2 in the atmosphere is $0.21\,atm$, the concentration of dissolved oxygen $\left(\frac{mg}{liter}\right)$ in water in equilibrium with the atmosphere at room temperature is

   $\left(\text{Consider the molecular weight of } O_2 \text{ as } 32\frac{g}{mol}\right)$
   a) 8.7
   b) 0.8
   c) 198.1
   d) 0.2

43) In a water sample, the concentrations of Ca^{2+}, Mg^{2+} and $HCO3^-$ are $100\,\frac{mg}{L}, 36\,\frac{mg}{L}$ and $122\,\frac{mg}{L}$, respectively. The atomic masses of various elements are :
   Ca = **40**, Mg = **24**, H = **1**, C = **12**, O = **16**.

   The total hardness and the temporary hardness in the water sample $\left(\text{in } \frac{mg}{L} \text{ as } CaCO_3\right)$ will be

    a) 400 and 100, respectively.

    b) 400 and 300, respectively.

    c) 500 and 100, respectively.

    d) 800 and 200, respectively.

44) Consider the four points P, Q, R, and S shown in the Greenshields fundamental speed-flow diagram. Denote their corresponding traffic densities by k_P, k_Q, k_R and k_S, respectively. The correct order of these densities is
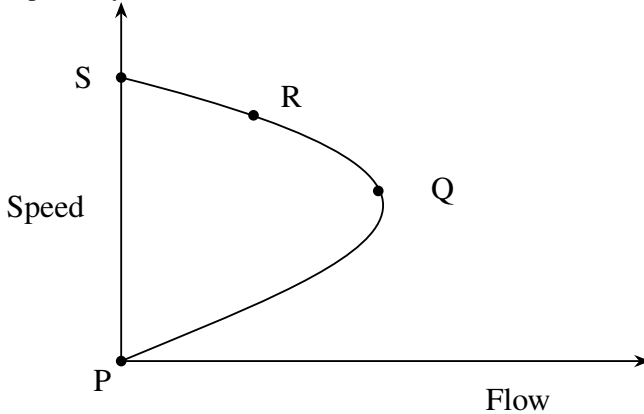
    a) $k_P > k_Q > k_R > k_S$

    b) $k_S > k_R > k_Q > k_P$

    c) $k_Q > k_R > k_S > k_P$

    d) $k_Q > k_R > k_P > k_S$

45) Let max $\{a, b\}$ denote the maximum of two real numbers a and b.

    Which of the following statement(s) is/are TRUE about the function

    $f(x) = max\{3 - x, x - 1\}$?

    a) It is continuous on its domain.

    b) It has a local minimum at $x = 2$.

    c) It has a local maximum at $x = 2$.

    d) It is differentiable on its domain.

46) A horizontal force of $P\,kN$ is applied to a homogeneous body of weight $25\,kN$, as shown in the figure. The coefficient of friction between the body and the floor is 0.3. Which of the following statement(s) is/are correct?

1 m

2 m

P
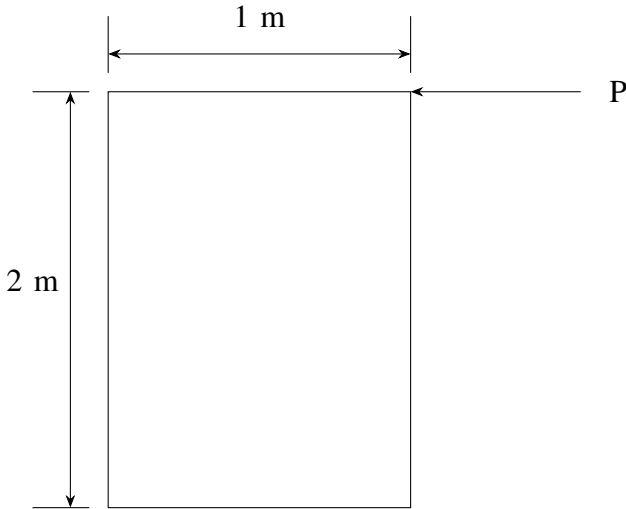
a) The motion of the body will occur by overturning.
b) Sliding of the body never occurs.
c) No motion occurs for $P \leq 6\,kN$.
d) The motion of the body will occur by sliding only.

47) In the context of cross-drainage structures, the correct statement(s) regarding the relative positions of a natural drain $\left(\frac{\text{stream}}{\text{river}}\right)$ and an irrigation canal, is/are

a) In an aqueduct, natural drain water goes under the irrigation canal, whereas in a super-passage, natural drain water goes over the irrigation canal.
b) In a level crossing, natural drain water goes through the irrigation canal.
c) In an aqueduct, natural drain water goes over the irrigation canal, whereas in a super-passage, natural drain water goes under the irrigation canal.
d) In a canal syphon, natural drain water goes through the irrigation canal.

48) Consider the differential equation

$$\frac{dy}{dx} = 4\,(x+2) - y$$

For the initial condition $y = 3$ at $x = 1$, the value of y at $x = 1.4$ obtained using Euler's method with a step-size of 0.2 is .... (*round off to one decimal place*)

49) A set of observations of independent variable (x) and the corresponding dependent variable (y) is given below.

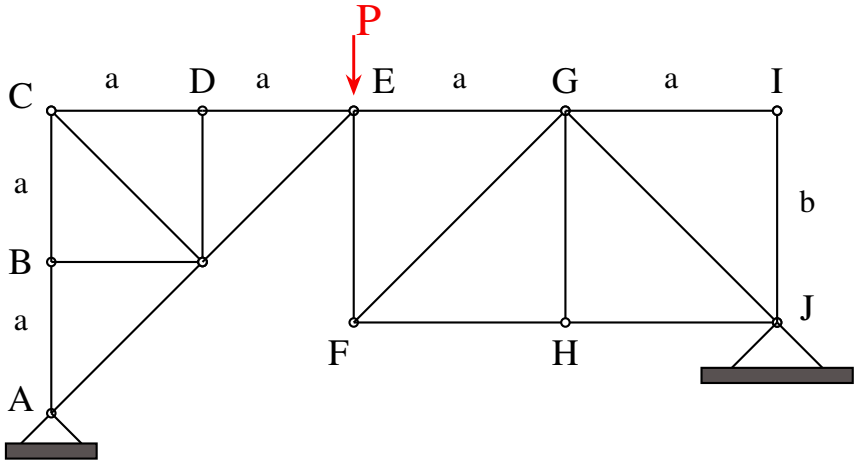| x	5	2	4	3
y	16	10	13	12

Based on the data, the coefficient a of the linear regression model

$$y = a + bx$$

is estimated as 6.1

The coefficient b is ...

50) The plane truss shown in the figure is subjected to an external force P. It is given that $P = 70\,kN$, $a = 2\,m$, and $b = 3\,m$.

The magnitude (absolute value) of force (in kN) in member EF is .... (*round off to one decimal place*)

51) Consider the linearly elastic plane frame shown in the figure. Members HF, FK and FG are welded together at joint F. Joints K, G and H are fixed supports. A counterclockwise moment M is applied at joint F. Consider flexural rigidity $EI = 10^5\,kN{-}m^2$ for each member and neglect axial deformations.
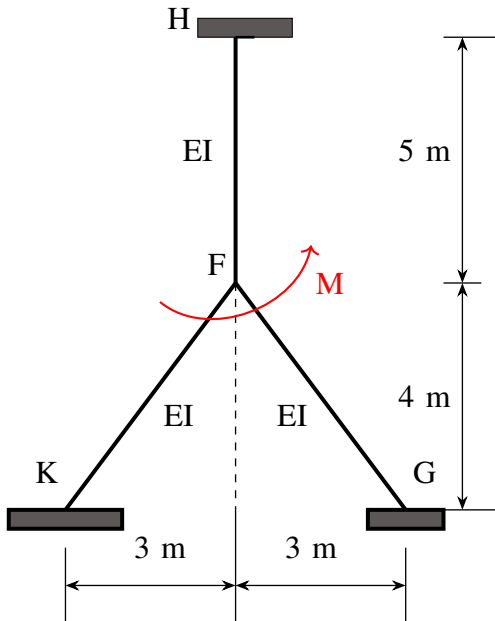
If the magnitude (absolute value) of the support moment at H is $10\,kN - m$, the magnitude (absolute value)

of the applied moment M (in kN-m) to maintain static equilibrium is ....
(*round off to one decimal place*)

52) Consider a simply supported beam PQ as shown in the figure. A truck having $100\,kN$ on the front axle and $200\,kN$ on the rear axle, moves from left to right. The spacing between the axles is $3\,m$. The maximum bending moment at point R is ... kNm. (*in integer*)