

DEPARTMENT OF WATER SUPPLY AND SANITATION PUNJAB

Dated: August 9, 2018

Thapar Institute of Engineering and Technology, Patiala conducted the test for recruitment to vacant posts of **Junior Engineer (Civil) and Junior Engineer (Mechanical/ Electrical)** in the **Department of Water Supply and Sanitation Punjab**, on **July 29th, 2018**. The answer key for the paper was uploaded on **July 31st, 2018** and the objections pertaining to the uploaded key were invited up to **August 3rd, 2018**.

After due consultation with the experts of the specific area, none of the objections were found valid.

POST CODE: Junior Engineer (Civil) JEC

I QUERIES FOR QUESTION FOUND INVALID AND THE ANSWER KEY AS UPLOADED WAS FOUND TO BE CORRECT.

In Hotel Ritz the rooms are numbered from 101 to 130 on the first floor, 221 to 260 on the second floor and 306 to 345 on the third floor, with no room on the ground floor. In the month of June 2018, the room occupancy was 60% on the first floor, 40% on the second floor and 75% on the third floor. If it is also known that the room charges are Rs. 200, Rs. 100 and Rs. 150 for each of the floors, starting from first floor to third floor, respectively, then what is the average income per room (in Rs.) for the month of June 2018?

- A) 65.70
B) 78.30
C) **88.18**
D) 151.50

Solution:

$$\text{Charges of room on first floor} = \frac{30 \times 60}{100} \times 200 = \text{Rs. } 3600$$

$$\text{Charges of room on second floor} = \frac{40 \times 40}{100} \times 100 = \text{Rs. } 1600$$

$$\text{Charges of room on third floor} = \frac{40 \times 75}{100} \times 150 = \text{Rs. } 4500$$

$$\text{Average Income} = \frac{\text{Total Income}}{\text{Total Number of rooms in hotel}} = \frac{9700}{110} = \mathbf{88.18}$$

Henceforth, the given choice C is correct.

The cost of typing all the pages of a magazine is Rs. 1000, the cost of running the printing machine is Rs. 120 per 100 copies of magazine, whereas, the cost of paper, ink etc. is 60 paisa per copy of the magazine. The magazines are sold at Rs. 2.75 each. A total of 900 copies of the magazine are printed, out of which only 784 copies are sold. In order to get a profit of 10% on the cost price of the printed magazines, what amount (in Rs.) should be obtained from advertisements?

- A) 720
C) 730
B) **726**
D) 736

Solution:

Total cost = Typing(one time cost only) + Printing + Paper, ink
= $1000 + 120 \times 9 + 900 \times 0.60 = 2620$;

Net sum to be recovered with profit of 10% = Rs. 2882;

Total magazine sold = $784 @ \text{Rs.} 2.75 = 784 \times 2.75 = 2156$.

Sum to be obtained from advertisement = $2882 - 2156 = \text{Rs. } 726$.

Henceforth, the given choice B is correct.

In which one of the following irrigation methods, the loss of water due to evaporation is negligible?

- A) Furrow irrigation
C) **Drip irrigation**
B) Sprinkler irrigation
D) Border irrigation

Solution:

In the **Drip Irrigation method**, the loss of water due to evaporation is negligible as it is a subsurface method of irrigation

Henceforth, the given choice C is correct.

Which one of the following methods can measure the chloride content in water?

- A) **Titration of the water with silver nitrate solution using potassium chromate as indicator**
B) Titration of the water with ammonium nitrate solution using potassium chromate as indicator

C) Titrating the water with sodium thiosulphate solution using potassium chromate as indicator

D) Titrating the water with potassium dichromate solution using potassium chromate as indicator

Solution:

Titration of the water with silver nitrate solution using potassium chromate as indicator is a standard method to measure the chloride content in water.

Henceforth, the given choice A is correct.

The three consecutive readings taken with a level instrument are 1.325m, 0.985 m, and 2.546 m. If the instrument was shifted after the first reading, then what would be the rise or fall of the last point?

A) 1.561 m, rise

B) 1.221 m, rise

C) 1.221 m, fall

D) 1.561 m, fall

Solution:

BS	IS	FS	RISE	FALL	REMARKS
0.985		1.325			Instrument Shifted
	2.546			1.561	

Henceforth, the given choice D is correct.

Bowditch rule is applicable _____.

A) where linear measurements are more precise than angular measurement

B) where linear and angular measurements are of equal precision

C) where angular measurements are more precise than linear measurement

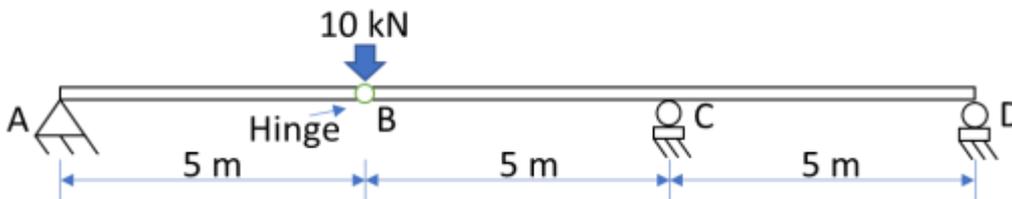
D) in all cases of traverse adjustments

Solution:

Bowditch rule is applicable only **where linear and angular measurements are of equal precision.**

Henceforth, the given choice B is correct.

What would be the vertical reaction at the roller support point C in the continuous beam loaded and supported as shown below?



- A) 10 kN (upward) B) 10 kN (downward)
C) **20 kN (upward)** D) 20 kN (downward)

Solution:

After carrying out the analysis of the beam for the given loading, the correct answer is **20 kN (upward)**.

Henceforth, the given choice C is correct.

Two steel columns P (length L and yield strength $f_y = 250$ MPa) and Q (length $2L$ and yield strength $f_y = 500$ MPa) have the same cross-sectional area and similar support end-conditions. In such a case scenario, what would the ratio of Euler's buckling load of column P to that of column Q?

- A) 0.50 B) 1.00
C) 2.00 D) **4.00**

Solution:

$$\text{Load P} / \text{Load Q} = (2L)^2 / L^2 = 4$$

Henceforth, the given choice D is correct.

As per IS: 800:2007, the cross-section in which the extreme fibre can reach the yield stress, but cannot develop the plastic moment of resistance due to failure by local buckling is classified as a _____.

- A) plastic section B) compact section

C) semi-compact section

D) slender section

Solution

IS 800: 2007 clause 1.3.85; **Semi-compact Section** — Cross-section, which can attain the yield moment, but not the plastic moment before failure by plate buckling.

Henceforth, the given choice C is correct.

In a steel plate with bolted connections, the rupture of the net section is a mode of failure under which one of the following?

A) Tension

B) Compression

C) Flexure

D) Shear

Solution:

Net section rupture has been asked in the question so **tension** will be the only answer. In flexure, net section will not rupture.

Henceforth, the given choice A is correct.

As per IS: 1077:1992, what is the minimum acceptable compressive strength of any class of burnt clay bricks in dry state?

A) 10 MPa

B) 7.5 MPa

C) 5 MPa

D) 3.5 MPa

Solution: As per the table 1 of IS: 1077 showing various classes of common burnt clay bricks, the minimum value is **3.5 MPa**.

Henceforth, the given choice D is correct.

Match list 1 and 2 and select the correct answer

List 1 (Type of cement)

(A) Portland Pozzolana Cements

(B) Portland Slag Cement

(C) Low Heat Portland Cement

(D) Rapid Hardening Portland Cement

List 2 (Property/characteristics)

1. Low rate of heat of hydration

2. Sulphate resistant

3. Has a lower content of C_3S and C_3A

4. Has a higher content of tricalcium C_3S

A) A-1, B-2, C-1, D-4

B) A-1, B-3, C-4, D-4

C) A-3, B-2, C-1, D-3

D) A-3, B-3, C-4, D-3

Solution:-

Irrelevant query. No misprinting in question. **The given choice A is correct.**

As per IRC:58-2015 guidelines for the design of plain jointed cement concrete pavements; what would be the number of allowable fatigue repetitions for a stress ratio corresponding to 0.30 using M40 grade of concrete having minimum flexural strength of 4.5 MPa?

A) Zero

B) 300000

C) 400000

D) Infinite

Solution: -

As per IRC: 58-2015, N is Infinite for stress ratio less than 0.45.

Henceforth, the given choice D is correct.

In time-cost optimization of a project using CPM networks, the total direct cost of the project is calculated for _____ of the project

A) all the activities

B) all activities along the critical path

C) the non-critical activities

D) all the events

Solution:-

The total direct cost of the project is calculated for **all the activities** of the project. Time duration of project is calculated only for critical activities.

Henceforth, the given choice A is correct.

What would be void ratio of soil if dry unit weight of soil and specific gravity of soil solid are 14.5 kN/m³ and 2.68, respectively?

A) 0.513

B) 0.613

C) 0.713

D) 0.813

Solution:

$$e = (2.68 * 9.81 / 14.5) - 1 = \mathbf{0.813}$$

Henceforth, the given choice D is correct.

A cylindrical soil sample of 5 cm diameter and 10 cm long is tested in a constant head permeability apparatus. A constant head of 60 cm is maintained during the test. After 100 seconds of testing a total volume of 1000 cm³ of water was collected. The experiment was conducted at 20⁰C. What would be the coefficient of permeability of soil in cm/sec?

A) 0.014

B) 0.084

C) 0.84

D) 1.0

Solution:

$$k = ((1000/100)*10*4) / (3.14*5*5*60) = \mathbf{0.084}$$

Henceforth, the given choice B is correct.

POST CODE: Junior Engineer (Mechanical/ Electrical) JEM

I QUERIES FOUND VALID AND THE CHANGES IN THE KEY OF THE QUESTION PAPER INCORPORATED

Which one amongst the following represents a group incentive plan?

- A) Bedaux plan
B) Hasley premium plan
C) Scanlon plan
D) Rowan plan

Solution:

The Scanlon plan is in the category of group incentive plans. The group incentive plan is preferred where the effective contribution of each worker cannot be actually measured or the output of a worker is related to output of others in the production.

The correct option is C i.e. Scanlon plan instead of B as given in answer key.

II QUERIES FOR QUESTION FOUND INVALID AND THE ANSWER KEY AS UPLOADED WAS FOUND TO BE CORRECT.

In a colony the ratio of school going children to non-school going children is 5: 4. If in the next year, the number of non-school going children increased by 20%, thus making the non-school going children number as 35400, then what is the new ratio of the school going children to the non-school going children?

- A) 3 : 2
B) 4 : 5
C) 7 : 3
D) 25 : 24

Solution:

Let the school going kids = $5x$

Non school going kid = $4x$

Non school going kid increase by 20% = $4x + \frac{4x \times 20}{100} = 4.8x$

Therefore, Required ratio = $5x : 4.8x = 25:24$

AB is a vertical pole with B at the ground level and A at the top. A man finds that the angle of elevation of point A from a certain point C is 60° . He moves away from the pole along the line BC to a point D such that CD is equal to 7m. If from D the angle of elevation of point A is 45° , then what would be the height of the pole?

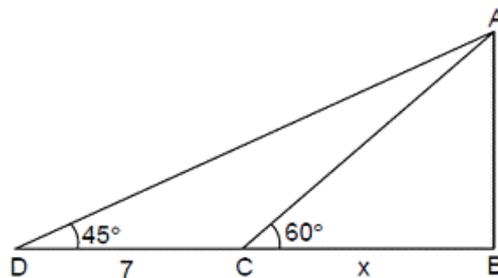
A) $\frac{7\sqrt{3}}{2}(\sqrt{3} - 1)$

B) $\frac{7\sqrt{3}}{2}\left(\frac{1}{\sqrt{3}+1}\right)$

C) $\frac{7\sqrt{3}}{2}\left(\frac{1}{\sqrt{3}-1}\right)$

D) $\frac{7\sqrt{3}}{2}(\sqrt{3} + 1)$

Solution:



$$\frac{AB}{BD} = \tan 45 = 1$$

$$\therefore AB = BD$$

$$BD = AB = 7 + x$$

$$\text{Also } AB = x \tan 60 = x\sqrt{3}$$

$$\therefore x\sqrt{3} = 7 + x$$

$$\text{or } x\sqrt{3} - x = 7$$

$$\text{or } x = \frac{7}{\sqrt{3} - 1}$$

$$\therefore AB = 7 + \frac{7}{\sqrt{3} - 1} = \frac{7(\sqrt{3} - 1) + 7}{\sqrt{3} - 1} = \frac{7\sqrt{3}}{\sqrt{3} - 1}$$

$$\text{or } AB = \frac{7\sqrt{3}}{\sqrt{3} - 1} \times \frac{\sqrt{3} + 1}{\sqrt{3} + 1} = \frac{7\sqrt{3}}{2}(\sqrt{3} + 1)$$

Henceforth, given option D is correct.

Norton's equivalent circuit consists of which one of the following source?

A) Ideal Current

B) Dependent Current

C) Practical Current

D) Controlled Current

Solution:

The Norton's equivalent circuit consists of an ideal current source with a Thevenin's impedance in parallel. This parallel impedance signifies the internal impedance of the current source. Together they constitute a Practical Current Source.

Henceforth, the given choice C is correct.

What can be the minimum value of power factor?

- A) -1
- B) 0
- C) $-\infty$
- D) 1

Solution:

The power factor angle (θ) that is the angle between the voltage and current varies from -90° to 90° . The power factor is given by $\cos(\theta)$. We also know that $\cos(-\theta)=\cos(\theta)$. So, the minimum value of power factor is 0.

Henceforth, the given choice B is correct.

In a p-n diode, the holes diffuse from p-region to n-region because _____.

- A) **there is higher concentration of holes in p-region**
- B) holes are positively charged
- C) holes are urged to move by the barrier potential
- D) the free electron in the n-region attracts the holes

Solution:

In a pn diode, on the p-side, holes are the majority carriers and electrons are the minority carriers. On the n-side, electrons are the majority carriers and holes are the minority carriers. So, the holes diffuse from p-region (higher concentration region) to n-region (lower concentration region).

Henceforth, the given choice A is correct.

Scott connections are used for _____ transformation.

- A) single phase to three phase
- B) three phase to single phase
- C) **two phase to three phase**
- D) single phase to two phase

Solution:

The Scott-T Connection is the method of connecting two single phase transformer to perform the 3-phase to 2-phase conversion and vice-versa. The two transformers are connected electrically but not magnetically. One of the transformers is called the main transformer, and the other is called the auxiliary or teaser transformer.

Henceforth, the given choice C is correct.

If the supply frequency is doubled maintaining a constant voltage, then what would be the effect on eddy current loss?

- A) No change
- B) Halved
- C) Doubled
- D) Four times

Solution:

The Eddy current losses are given by

$$P_e = K_e B_m^2 f^2 t^2 V$$

Though eddy current losses are proportional to square of supply frequency but an additional condition of constant voltage is specified in the question. Now, EMF equation of a transformer is given by

$$E = 4.44 f B_m N A$$

For voltage to remain constant, the product of f and B_m has to remain constant because for a given transformer, 4.44, N and A cannot vary.

Now, since $P_e \propto (f.B_m)^2$, and the term $(f.B_m)$ is constant. So, P_e remains constant.

Henceforth, the given choice A is correct.

If capacitor of single phase motor is short circuited, then the motor will _____.

- A) not start
- B) burn
- C) run in reverse direction
- D) run in same direction with reduced r.p.m.

Solution:

The capacitor of single phase motor helps in converting the single-phase power supply into two-phase supply which helps in making the motor self-starting by developing rotating magnetic field. If this capacitor is short circuited, it is equivalent to giving the power supply directly to the two machine winding i.e., starting winding and running winding. Since there is

no phase difference between the magnetic fluxes developed in the two windings, rotating torque will not develop. So, the motor will not start.

Henceforth, the given choice A is correct.

The mechanism of material removal in EDM process is _____.

- A) melting and evaporation B) melting and corrosion
C) erosion and cavitation D) cavitation and evaporation

Solution:

In EDM, a gap is maintained between the tool and the workpiece. Depending upon the applied potential difference and the gap between the tool and workpiece, an electric field would be established. As the electric field is established between the tool and the job, the free electrons on the tool are subjected to electrostatic forces. The “cold emitted” electrons are accelerated towards the job through the dielectric medium. As they gain velocity and energy, and start moving towards the job, there would be collisions between the electrons and dielectric molecules. Such collision may result in ionisation of the dielectric molecule depending upon the work function or ionisation energy of the dielectric molecule and the energy of the electron. Thus, as the electrons get accelerated, more positive ions and electrons would get generated due to collisions. This cyclic process would increase the concentration of electrons and ions in the dielectric medium between the tool and the job at the spark gap. The concentration would be so high that the matter existing in that channel could be characterised as “plasma”. The electrical resistance of such plasma channel would be very less. Thus all of a sudden, a large number of electrons will flow from the tool to the job and ions from the job to the tool. This is called avalanche motion of electrons. Such movement of electrons and ions can be visually seen as a spark. Thus the electrical energy is dissipated as the thermal energy of the spark. The high speed electrons then impinge on the job and ions on the tool. **The kinetic energy of the electrons and ions on impact with the surface of the job and tool respectively would be converted into thermal energy or heat flux.** Such intense localised heat flux leads to extreme instantaneous confined **rise in temperature which would be in excess of 10,000° C.** Such localised extreme rise in temperature leads to material removal. **Material removal occurs due to instant vaporisation of the material as well as due to melting.** The molten metal is not removed completely but only partially.

Generally the workpiece is made positive and the tool negative. Hence, the electrons strike the job leading to crater formation due to high temperature and melting and material removal. Similarly, the positive ions impinge on the tool leading to tool wear.

Moreover, Cavitation is not at all present in the mechanism. Therefore, option ‘C’ is automatically rule out.

Henceforth, the given choice A is correct.

Which of the following phases (or phase mixtures) in steels would NOT have been discovered/observed without time-temperature-transformation diagrams?

A) Bainite

B) Pearlite

C) Martensite

D) Ferrite

Solution:

Martensite cannot be the answer because it can also be observed on the 'Continuous Cooling Transformation diagram' (CCT diagram). Pearlite, ferrite, cementite, austenite etc. can be observed on iron-cementite diagram. Further, these phases (Pearlite, ferrite, cementite, austenite) and even martensite can be observed on the 'Continuous Cooling transformation' diagram. It can be noted that these cannot be show bainite. Bainite was discovered only because of time-temperature transformation diagram.

Henceforth, the given choice A is correct.