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STATE LEVEL SCIENCE TALENT SEARCH EXAMINATION - CODE: UCS-717
SOLUTIONS FOR CLASS : 10
Mathematics

1. (A) $\frac{4}{3}\pi r^3 = 4\pi r^2$
 $\Rightarrow r = 3$
 Volume of cylinder = $\pi r^2 h = 54\pi$
2. (B) 400 cm²
3. (D)
 $9x^2 + \frac{3}{4}x\sqrt{2} = 0$ is given quadratic equation.
 $(3x)^2 + 2(3x)\left(\frac{\sqrt{2}}{8}\right) = 0$
 on L.H.S. Let $a = 3x$; $b = \frac{\sqrt{2}}{8}$
 LHS becomes $a^2 + 2ab$
 If we add $b^2 = \left(\frac{\sqrt{2}}{8}\right)^2 = \frac{2}{64} = \frac{1}{32}$ on both sides
 LHS will be $a^2 + 2ab + b^2$
 $\Rightarrow (a + b)^2 \rightarrow$ which is square of $a + b$
 Hence, $b^2 = \frac{1}{32}$ should be added.
4. (C) Let a man start from O. First, the man goes 18 m due east and reaches A. Then he goes 24 m due north reaching B. Now, in $\triangle ABO$
 $OA = 18$ m, $AB = 24$ m.
 $OB^2 = OA^2 + AB^2$
 (By Pythagoras Theorem)
 $= (18)^2 + (24)^2 = 324 + 576$
 $OB^2 = 900$ m, $OB = \sqrt{900}$ m
 $\Rightarrow OB = 30$ m
 Hence, the man is at a distance of 30 m from the starting point.

5. (B) As per the data in question,
 $2^m - 2^n = 56$ is satisfied
 when $m = 6$ and $n = 3$
6. (C) Given interior angles a polygon form an A.P.
 Least angle = 120° = first term of A.P. (a)
 common difference = 5° = d.
 AP will be $120^\circ, 125^\circ, 130^\circ, \dots$
 sum of n terms (angles)

$$= \frac{n}{2}[2a + (n-1)d]$$

$$= \frac{n}{2}[2.120^\circ + (n-1)5^\circ]$$

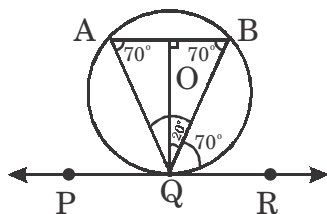
$$= \frac{n}{2}[240 + 5n - 5] = \frac{n}{2}[5n + 235]$$

$$= \frac{5n^2 + 235n}{2} \quad \text{--- (1)}$$
 If a polygon has 'n' sides then sum of n angles = $(2n - 4) \times 90^\circ$ --- (2)
 from (1) & (2) $\frac{5n^2 + 235n}{2} = (2n - 4) \times 90^\circ$
 $\Rightarrow 5n^2 + 235n = (2n - 4) \times 180^\circ$
 $\Rightarrow \cancel{5} (n^2 + 47n) = (2n - 4) \times \cancel{180}^{\circ 36}$
 $\Rightarrow n^2 + 47n = 72n - 144$
 $\Rightarrow n^2 + 47n - 72n + 144 = 0$
 $\Rightarrow n^2 - 25n + 144 = 0$
 $\Rightarrow n^2 - 16n - 9n + 144 = 0$
 $\Rightarrow n(n-16) - 9(n-16) = 0$
 $\Rightarrow (n-16)(n-9) = 0$
 $\therefore n = 16$ or $n = 9$.
 $+_{16} = +_{16} = a + 15d = 120^\circ + 15(5^\circ)$
 $= 120^\circ + 75^\circ = 195^\circ > 180^\circ$
 So, $n = 16$ (should not be taken)
 Hence, $n = 9$ sides.

7. (B) As we know that $\sin \theta = \cos (90 - \theta)$ but reason is not the explanation for assertion.
8. (D) $a_1x + b_1y + c_1 = 0$
 $a_2x + b_2y + c_2 = 0$
 these two linear equations become dependent only when

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$

9. (B) for $x \geq 0$ and $y \geq 0$, $\sqrt{xy} = \frac{x+y}{2}$
 $\Rightarrow xy = \frac{x+2xy+y^2}{4}$
 $\Rightarrow x^2 - 2xy + y^2 = 0$ or $(x-y)^2 = 0$
 $\Rightarrow x = y$
10. (B) PQR is the tangent at 'Q'



Let QB be the chord through the point of contact of the tangent.

$\therefore$ by alternate segment theorem

$$\angle BQR = \angle BAQ = 70^\circ$$

We have $OQ \perp PR$ ($\square$ radius $\perp$ tangent at the point of contact by a theorem)(1)

$$\therefore \angle OQR = 90^\circ \Rightarrow \angle OQB + \angle BQR = 90^\circ$$

$$\Rightarrow \angle OQB = 70^\circ = 90^\circ \text{ (given } \angle BQR = 70^\circ \text{)}$$

$$\Rightarrow \angle OQB = 90^\circ - 70^\circ = 20^\circ$$

Given $AB \parallel PR$, from (1) $\Rightarrow SQ \perp PR$

$\therefore SQ$ is also $\perp AB$

Now, In $\triangle BSQ$, $\angle S = 90^\circ$, $\angle BQS = 20^\circ$

$$\therefore \angle SQB = 70^\circ \quad \dots \text{ why?}$$

Hence, from $\triangle ABQ$,

it is clear to say that $\angle AQB = 40^\circ$.

11. (A) Since, $A \subset B = A$
 $\Rightarrow A \subset B$
 $A \cap B = A$
12. (B) Use area of the triangle formula when its three vertices are given and

$$\Delta = \frac{1}{2} |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)| = 0$$

13. (C)

14. (D) $\left(\frac{-b}{a}\right)$, we have $\alpha + \beta + \gamma = \frac{-b}{a}$

$$\text{So, } 0 + 0 + \gamma = \frac{-b}{a} \Rightarrow \gamma = -\frac{b}{a}$$

15. (C) In $\triangle ABC$, $\angle C = 3 \angle B = (\angle A + \angle B) \dots (1)$
 In $\triangle ABC$, sum of $3 \angle s = 180^\circ$

$$\text{i.e., } \angle A + \angle B + \angle C = 180^\circ$$

$$2[\angle A + \angle B] + 2 \angle C = 2 \times 180^\circ$$

(multiply by '2')

$$\text{from (1) } 2(\angle A + \angle B) = \angle C$$

$$\therefore \angle C + 2 \angle C = 360^\circ \Rightarrow 3 \angle C = 360^\circ$$

$$\Rightarrow \angle C = \frac{360^\circ}{3} = 120^\circ$$

from (1), we also have $3 \angle B = \angle C$

$$\Rightarrow \angle B = \frac{1}{3} \angle C = \frac{1}{3} \times 120^\circ$$

$$\therefore \angle B = 40^\circ$$

16. (B) In a G.P. $t_{p+q} = m \Rightarrow ar^{p+q-1} = m$

$$t_{p-q} = n \Rightarrow ar^{p-q-1} = n$$

are given

$$t_p = ar^{p-1} = ? \dots \text{ this is required}$$

Let we multiply m & n

$$a \cdot r^{p+q-1} \times ar^{p-q-1} = m \times n$$

$$a^2 \cdot r^{p+q-1+p-q-1} = mn$$

$$a^2 \cdot r^{2p-2} = mn$$

$$(ar^{p-1})^2 = mn \Rightarrow ar^{p-1} = \sqrt{mn}$$

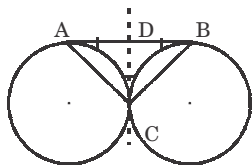
ar^{p-1} = indicates ' p^{th} ' term of G.P.

Hence required t_p of GP is $\sqrt{mn}$

17. (D) $AP = \frac{1}{2} AB$

$$\Rightarrow \frac{BP}{AP} = \frac{1}{3} \text{ from this we can conclude the correct option is (D).}$$

18. (C)



Two circles are touching at 'C' externally.
AB is the direct common tangent of two circles. Draw a transverse common tangent CD through 'C', which cuts AB at D.

$$DA = DC \quad DB = DC$$

by a theorem lengths of two tangents drawn from an external point of a circle are equal.

$$\therefore DA = DB \Rightarrow CD \text{ bisects } AB$$

$$\text{In } \triangle ADC, DA = DC \Rightarrow \angle ACD = \angle CAD$$

$$\text{In } \triangle BDC, DB = DC \Rightarrow \angle BCD = \angle CBD$$

$$\angle ACD + \angle BCD = \angle CAD + \angle CBD$$

$$\Rightarrow \angle ACB = \angle CAD + \angle CBD$$

$$\Rightarrow 2 \angle ACB = \angle ACB + \angle CAD + \angle CBD$$

$$(\square \text{ Add } \angle ACB)$$

$$\Rightarrow 2 \angle ACB = 180^\circ \text{ [on RHS, In } \triangle ABC, \text{ sum of } 3 \angle \text{s)]}$$

$$\Rightarrow \angle ACB = 180^\circ / 2 = 90^\circ$$

19. (C) x is odd $\Rightarrow x^2$ also becomes oddy is odd $\Rightarrow y^2$ also becomes odd $\Rightarrow x^2 + y^2$ becomes even

Let $x^2 + y^2 = 2m$ is always divisible by 1 and 2, but not by 4.

20. (A) A (1, 5) and B (4, 6) are given

$$\text{slope of } AB = \frac{6-5}{4-1} = \frac{1}{3}$$

$$\text{slope of line } \perp \text{ to } AB = -3$$

$$\left[\begin{array}{l} l_1 \perp l_2 \\ \Rightarrow m_1 \times m_2 = -1 \end{array} \right]$$

one point on $\perp$ line = mid -point of AB

$$= \left(\frac{5}{2}, \frac{11}{2} \right)$$

let another point on $\perp$ line which lies on y-axis be (0, k)

Now we have two points $\left(\frac{5}{2}, \frac{11}{2} \right)$ and (0, k)

which lie on $\perp$ bisector line and its slope = -3

$$\therefore \frac{k - \frac{11}{2}}{0 - \frac{5}{2}} = -3 \Rightarrow \frac{k - \frac{11}{2}}{-\frac{5}{2}} = -3$$

$$\Rightarrow k - \frac{11}{2} = -3 \times -\frac{5}{2}$$

$$\Rightarrow k - \frac{11}{2} = \frac{15}{2} \Rightarrow k = \frac{15}{2} + \frac{11}{2} = \frac{26}{2} = 13$$

$$\therefore \text{Required point} = (0, 13)$$

21. (B) If radius = R_1 , area = πR_1^2

$$\text{If radius} = R_2, \text{ area} = \pi R_2^2$$

$$\text{If radius} = R, \text{ area} = \pi R^2$$

$$\text{Given } \pi R_1^2 + \pi R_2^2 = \pi R^2$$

$$\boxed{R_1^2 + R_2^2 = R^2}$$

22. (C)

$$23. \text{ (C) } S_n = 2n^2 - 7n \Rightarrow S_{n-1} = 2(n-1)^2 - 7(n-1) \\ = 2n^2 - 4n + 2 - 7n + 7$$

$$S_{n-1} = 2n^2 - 11n + 9$$

$$\therefore t_n = S_n - S_{n-1} \quad \text{formula}$$

$$t_n = 2n^2 - 7n - 2n^2 + 11n - 9 = 4n - 9$$

$$t_{n-1} = 4(n-1) - 9 = 4n - 4 - 9 = 4n - 13$$

$$d = t_n - t_{n-1} = (4n - 9) - (4n - 13) \\ = 4n - 9 - 4n + 13 = 4$$

24. (B)

25. (B) Substitute $\frac{1}{b} = \frac{a}{2}$ and $\frac{1}{a} = \frac{b}{2}$

$$\left(a - \frac{a}{2} \right) + \left(b - \frac{b}{2} \right)$$

$$= \frac{a}{2} + \frac{b}{2} = \frac{a+b}{2}$$

Physical Science

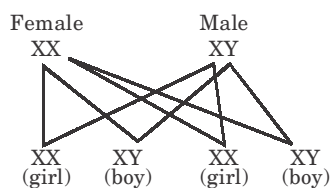
26. (B) The focal length of the concave lens is considered negative.
- $$\text{Focal length} = -50 \text{ cm} = -\frac{50}{100} \text{ m} = -0.5 \text{ m}$$
- $$P = \frac{1}{-0.5}, P = \frac{1 \times 10}{5} = -2 \text{ D}$$
27. (A) HNO_3 is used to produce explosives like nitroglycerine, dynamite, T.N.T. etc.
28. (D) When the object is placed at C of a concave mirror, the distance between a real object and its real image is zero.
29. (A) Ionic compounds possess high melting points and non-directional bonds.
30. (B) Electrical energy $E = P \times t$
Power of fan $P = 50 \text{ W}$
$$= \frac{50}{1000} = 0.05 \text{ kW}$$

Time in hours $= 20 \times 30 \text{ days} = 600 \text{ h}$
 $E = P \times t = 0.05 \times 600 = 30 \text{ kWh}$
 $1 \text{ kWh} = \text{Rs. } 2 = 30 \times 2 = \text{Rs. } 60$
31. (C) Decomposition of calcium carbonate is balanced.
32. (D) A convex lens has two foci. The two foci of a convex lens are at equal distances from the optical centre, one on either side of the lens. Since, all the light rays actually pass through the principal focus of a convex lens, it has real focus. Like a convex lens, a concave lens also has two foci, one on each side of the concave lens. If the parallel rays fall on the concave lens from the right side, then they will appear to diverge from a point F' . Thus, F' is the second focus of the concave lens. Since, the light rays do not actually pass through the focus of a concave lens, it has a virtual focus. The principal focus real or virtual of a lens always lies on the principal axis.
33. (D) White light produces emission spectrum that is continuous.
34. (C) Lenz's law states that the direction of the induced current is such that it always opposes the cause (motion of conductor) that produced it.
35. (B) Let the given ratio of atomic weights of X, Y, Z be $5x, 11x, 17x$ respectively.
Sum of extreme elements $(5x + 17x) = 176$ (given)
$$22x = 176, x = \frac{176}{22} = 8$$

 $\therefore$ At wt. of
 $X = 5 \times 8 = 40,$
 $Y = 11 \times 8 = 88,$
 $Z = 17 \times 8 = 136$
36. (A) The correct matching is: a-3, b-1, c-4, d-2
(i) The blue colour of the sky – Scattering of light.
(ii) The glittering of diamond – Total internal reflection.
(iii) The formation of rainbow – Dispersion of light.
(iv) The visibility of sun for some time even after sunset – Refraction of light.
37. (A) H_2SO_4 is used in lead storage batteries.
38. (B) $f = \frac{R}{2} = \frac{30}{2} = 15 \text{ cm}$
39. (C) $\text{K}^+ \text{C} \equiv \text{N}$ contains both ionic and covalent bonds.
40. (B) When the temperature of a pure metallic conductor is increased, the resistance of the conductor also increases.
41. (C) A chemical reaction must follow the law of conservation of mass.
42. (B) The speed of light is higher in a rarer medium than in a denser medium.
43. (D) No. of orbitals in a subshell $= (2l + 1)$
 $\therefore$ Maximum no. of electrons in a subshell $= 2(2l + 1) = 4l + 2.$
44. (D) The given three ways increase the rate of change of magnetic flux linking the circuit.
45. (D) $Z = 34$; E.C. = 2, 8, 18, 6. Therefore, the element belongs to VI A group or 16th group and since it has four shells it belongs to 4th period.

Biology

46. (B) Increase in ghrelin levels gives sensation of hunger and motivation to consume food. Ghrelin is secreted from the walls of stomach.
47. (C) 2, 5, 4, 3, 1
The reflex arc first start with the stimulation of the receptor (sense organ). This generates a nerve impulse in the sensory neuron which synapses with a relay neurone found within the central nervous system. The relay neuron then synapses to motor neuron which is responsible for the stimulation of the effector (muscle/gland).
48. (C) 2 describes asexual reproduction, 3 describes growth and development of an individual organism and 4 describes tissue repair. All three processes require the production of new cells that are genetically identical to one another and the parent cell(s). Hence, they undergo mitosis.
49. (C) The downward movement of food is blocked. Roots do not receive food and die first.
50. (A) In humans always male are responsible for sex determination because they possess both X and Y sex chromosome and females possess only X chromosome. Thus at the time of fertilisation if the male contributes chromosome X the sex of the child would be a girl and if he contributes Y chromosome the sex of the child would be boy. In both these cases female will contributed only X chromosome in such a way.



Thus, for the determination of sex always males are responsible.

51. (A) The adrenal gland is found as a cap above both kidneys and it secretes adrenaline (also known as epinephrine).
52. (D) Nephron is the structural unit of kidney. It filters the blood by removing nitrogenous wastes.
53. (B) Dendrites of one nerve cell connect to the other or to the axons of the other nerve cell through connections is called as a synapse. It is a functional region between two neurons, where information from the neuron is transmitted or relayed to other neuron.
54. (A) Potato, ginger and sugarcane reproduce by stem.
55. (C) Euglena is a protist. It shows mixotrophic nutrition. It is an autotroph as it contains chloroplast to synthesise its own food and also feeds on insects.

Critical Thinking

56. Del
57. (B)
58. (A)
59. (D)
60. (A) Blood vessel that carries blood from the lungs to the heart is oxygen rich or oxygenated. In the given bar graph bar W shows high oxygen content hence it can be assumed that the sample of blood is taken or drawn from a blood vessel that carries blood from the lungs to the heart.