



UNIFIED COUNCIL

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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 10

Question Paper Code : UN460

KEY

1. B	2. C	3. A	4. D	5. D	6. C	7. A	8. B	9. C	10. A
11. D	12. C	13. D	14. A	15. C	16. D	17. B	18. B	19. C	20. A
21. A	22. D	23. C	24. D	25. B	26. D	27. D	28. D	29. C	30. C
31. B	32. D	33. C	34. D	35. A	36. C	37. B	38. B	39. A	40. B
41. C	42. C	43. C	44. D	45. C	46. A	47. D	48. A	49. D	50. D
51. C	52. A	53. C	54. C	55. C	56. C	57. C	58. B	59. B	60. B

SOLUTIONS

MATHEMATICS

1: (B) Mid Point of AB

$$= \left(\frac{-6 + (-2)}{2}, \frac{5 + 3}{2} \right) = \left(\frac{a}{2}, 4 \right)$$

$$\therefore \frac{-8}{2} = \frac{a}{2}$$

$$\therefore a = -8$$

2: (C) Volume of frustrum = $\frac{1}{3}\pi h(R^2 + Rr + r^2)$

$$= \frac{1}{3} \times \frac{22}{7} \times 40 \text{cm} [28^2 + 28 \times 7 + 7^2] \text{cm}^3$$

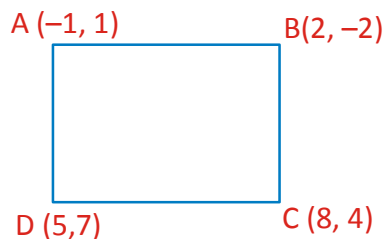
$$= \frac{1}{3} \times \frac{22}{7} \times 40 \text{cm} \times 49 [16 + 4 + 1] \text{cm}^3$$

$$= \frac{1}{3} \times \frac{22}{7} \times 40 \times 49 \times 21 \text{cm}^3$$

$$= 43120 \text{cm}^3$$

3: (A) Mid Point of AC = $\left(\frac{-1+8}{2}, \frac{1+4}{2} \right)$

$$= \left(\frac{7}{2}, \frac{5}{2} \right)$$



Mid point of BD

$$= \left(\frac{5+2}{2}, \frac{7+(-2)}{2} \right) = \left(\frac{7}{2}, \frac{5}{2} \right)$$

$$AC = \sqrt{[8 - (-1)]^2 + (4 - 1)^2} = \sqrt{9^2 + 3^2} = \sqrt{90}$$

$$BD = \sqrt{(5 - 2)^2 + (7 - (-2))^2} = \sqrt{90}$$

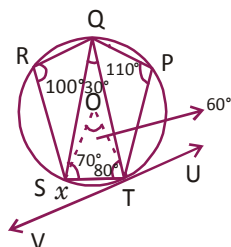
$$AB = \sqrt{[2 - (-1)]^2 + (-2 - 1)^2} = \sqrt{9 + 9} = \sqrt{18}$$

$$AD = \sqrt{[5 - (-1)]^2 + (7 - 1)^2} = \sqrt{36 + 36} = 6\sqrt{2}$$

Mid point of AC = Mid point of BD & AC = BD but AB ≠ AD

∴ ABCD is a rectangle

- 4: (D) Construction: - Join SQ. Join OS, OT.



QRST is a cyclic quadrilateral

$$\therefore \angle STQ = 180^\circ - \angle R = 80^\circ$$

QSTP is a cyclic quadrilateral

$$\therefore \angle QST = 180^\circ - 110^\circ = 70^\circ$$

$$\text{In } \Delta QST, 70^\circ + 80^\circ + \angle SQT = 180^\circ$$

$$\angle SQT = 30^\circ$$

$$\therefore \angle SOT = 2 \angle SQT = 60^\circ$$

$$\text{In } \Delta SOT, \angle SOT = 60^\circ \text{ \& } OS = OT \Rightarrow \angle OTS = 60^\circ$$

But $\angle OTV = 90^\circ$

[∵ A tangent is perpendicular to radius]

$$\therefore 60^\circ + x = 90^\circ$$

$$x = 90^\circ - 60^\circ = 30^\circ$$

- 5: (D) Let P(2, 5) divides the Join of A(8, 2) and B(-6, 9) in the ratio $m_1 : m_2$

$$\therefore P(2, 5) = \left(\frac{m_1(-6) + m_2 \times 8}{m_1 + m_2}, \frac{9m_1 + 2m_2}{m_1 + m_2} \right)$$

$$\therefore \frac{-6m_1 + 8m_2}{m_1 + m_2} = 2 \Rightarrow -6m_1 + 8m_2 = 2m_1 + 2m_2$$

$$-6m_1 - 2m_1 = 2m_2 - 8m_2$$

$$\cancel{8}m_1 = \cancel{6}m_2$$

$$\frac{m_1}{m_2} = \frac{6}{8} = \frac{3}{4}$$

$$\therefore m_1 : m_2 = 3 : 4$$

- 6: (C) Area of triangle is maximum \Rightarrow Base is maximum & height is also maximum

$$\therefore \text{Base} = 2r \text{ \& } \text{height} = r$$

$$\text{Maximum area} = \frac{1}{2} \times 2r \times r = r^2$$

- 7: (A) -2, 1, 3 are the zeros of the given curve

- 8: (B) Given $5m + 2n = 1$ and $(2k - 1)m + (k - 1)n = 2k + 1$ are inconsistent lines

$$\therefore \frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2} \Rightarrow \frac{5}{2k-1} = \frac{2}{k-1} \neq \frac{1}{2k+1}$$

$$\frac{5}{2k-1} = \frac{2}{k-1} \Rightarrow 5(k-1) = 2(2k-1)$$

$$5k - 5 = 4k - 2$$

$$5k - 4k = 5 - 2$$

$$k = 3$$

- 9: (C) Given $2\pi rh = 264 \text{ m}^2$ & $\pi r^2 h = 924 \text{ m}^3$

$$\therefore \frac{\cancel{\pi} r^2 \cancel{h}}{\cancel{2} \cancel{\pi} \cancel{r} \cancel{h}} = \frac{924 \cancel{\text{m}^3}}{264 \cancel{\text{m}^2}}$$

$$\therefore r = 7 \text{ m}$$

$$2 \times \frac{22}{7} \times \cancel{7} \times h = 264 \text{ m}^2$$

$$h = \frac{264 \cancel{132} \cancel{\text{m}^2}}{\cancel{2} \times \cancel{22} \cancel{7} \text{ m}} = 6 \text{ m}$$

∴ The ratio of height and diameter

$$= \cancel{6}^3 : \cancel{14}^7 = 3 : 7$$

10: (A) $2020 = 2^2 \times 5 \times 101$

$\therefore P = 2, q = 5 \text{ \& } r = 101$

$\therefore P + q + r = 2 + 5 + 101 = 108$

11: (D) Let the present age of son be x years

Let the Present age of father = x^2 years

Given $x^2 - 1 = 7(x - 1)$

$x^2 - 7x - 1 + 7 = 0$

$x^2 - 7x + 6 = 0$

$x = 6 \text{ (or) } -1$

$x = 6 \text{ Years}$

[$\therefore x = -1$ rejected because age is never negative]

12: (C) $165 = 11 \times 5 \times 3$

$605 = 11^2 \times 5$

$\therefore \text{LCM} = 11^2 \times 5 \times 3 = 1815$

$\therefore 99P + 330 = 1815$

$99P = 1815 - 330 = 1485$

$P = \frac{1485}{99} = 15$

13: (D) Given $\triangle ABC \sim \triangle DEF \Rightarrow$

$\frac{\triangle ABC}{\triangle DEF} = \frac{\text{Perimeter of } \triangle ABC}{\text{Perimeter of } \triangle DEF} = \frac{30\text{cm}}{18\text{cm}} = \frac{5}{3}$

$\therefore \frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle DEF} = \left(\frac{5}{3}\right)^2 = \frac{25}{9}$

14: (A) Given ABCD is a parallelogram

\therefore Mid point of AC = Mid point of BD

$\therefore \left(\frac{9+a}{2}, \frac{6+13}{2}\right) = \left(\frac{5+15}{2}, \frac{5+b}{2}\right)$

$\therefore \frac{9+a}{2} = \frac{20}{2} \text{ and } \frac{19}{2} = \frac{5+b}{2}$

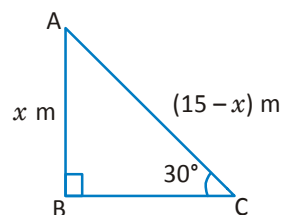
$a = 20 - 9 = 11$

$b = 19 - 5 = 14$

$\therefore a - b = 11 - 14 = 3$

15: (C) Given $AB + AC = 15 \text{ m}$

Let $AB = x \text{ m} \Rightarrow AC = (15 - x) \text{ m}$



$\sin 30^\circ = \frac{AB}{AC} = \frac{x}{(15-x)}$

$\frac{1}{2} = \frac{x}{(15-x)}$

$15 - x = 2x$

$15 = 3x$

$x = \frac{15}{3} = 5 \text{ mts}$

16: (D) Given $\sec \theta = \frac{a+b}{2\sqrt{ab}}$

$\therefore \tan^2 \theta = \sec^2 \theta - 1 = \left(\frac{a+b}{2\sqrt{ab}}\right)^2 - 1$

$= \frac{(a+b)^2 - 4ab}{4ab} = \frac{(a-b)^2}{4ab}$

$\therefore \tan \theta = \sqrt{\frac{(a-b)^2}{4ab}} = \frac{(a-b)}{2\sqrt{ab}}$

$\therefore \cot \theta = \frac{2\sqrt{ab}}{(a-b)}$

17: (B) Given $r = \frac{14\text{cm}}{2} = 7\text{cm}$

Area of shaded region

$= \frac{1}{2} \times \pi r^2 = \frac{1}{2} \times \frac{22}{7} \times \frac{22}{7} \times 7 \text{ cm}^2$

$= 77 \text{ cm}^2$

18: (B) Product of two numbers = LCM \times HCF

$k(a^2 - b^2) = \text{LCM} \times 1$

$\therefore \text{LCM} = k(a^2 - b^2)$

19: (C) Given $S_n = 5n^2 - 3n$
 $\therefore S_{n-1} = 5(n-1)^2 - 3(n-1) = 5(n^2 - 2n + 1) - 3n + 3$
 $= 5n^2 - 10n + 5 - 3n + 3$
 $= 5n^2 - 13n + 8$
 $a_n = S_n - S_{n-1} = (5n^2 - 3n) - (5n^2 - 13n + 8)$
 $= \cancel{5n^2} - 3n - \cancel{5n^2} + 13n - 8$
 $= 10n - 8$
 $\therefore a_{10} = 10 \times 10 - 8 = 92$

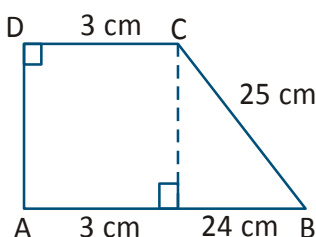
20: (A) $\angle C + \angle AOB = 180^\circ$
 $[\because \angle OAC = \angle OBC = 90^\circ]$
 $65^\circ + \angle AOB = 180^\circ$
 $\angle AOB = 180^\circ - 65^\circ = 115^\circ$

21: (A) Let the side of smaller square be x mts
 \therefore Let the side of larger square = $(x + 4)$ mts
 Given $(x + 4)^2 + x^2 = 208$
 $x^2 + 8x + 16 + x^2 = 208$
 $\cancel{x^2} + 4x + 8 = \cancel{208}^{104}$
 $x^2 + 4x + 8 - 104 = 0$
 $x^2 + 4x - 96 = 0$
 $x^2 + 12x - 8x - 96 = 0$
 $x(x + 12) - 8(x + 12) = 0$
 $(x + 12)(x - 8) = 0$

$\therefore x = 8$ m (or) $x = -12$ m which is rejected because length is never negative

\therefore Side of larger square = $x + 4$ m = 12 mts

22: (D) Construction :- Draw $CE \perp AB$
 In $\triangle BCE$, $\angle E = 90^\circ$
 $\therefore CE = \sqrt{CB^2 - EB^2}$
 $= \sqrt{(25\text{cm})^2 - (24\text{cm})^2} = \sqrt{(25+24)(25-24)\text{cm}}$
 $CE = 7$ cm



\therefore Area of trapezium ABCD
 $= \frac{1}{2} \times CE(AB + CD)$
 $= \frac{1}{2} \times 7\text{cm}(27\text{cm} + 3\text{cm})$
 $= \frac{1}{2} \times 7\text{cm} \times \cancel{30}^{15}\text{cm}$
 $= 105\text{ cm}^2$

23: (C) $\frac{\sqrt{\frac{1+\sin\theta}{1-\sin\theta}} + \sqrt{\frac{1-\sin\theta}{1+\sin\theta}}}{\sqrt{\frac{1+\sin\theta}{1-\sin\theta} \times \frac{1-\sin\theta}{1+\sin\theta}}} = \frac{(\sqrt{1+\sin\theta})^2 + (\sqrt{1-\sin\theta})^2}{\sqrt{1-\sin^2\theta}}$
 $= \frac{1 + \cancel{\sin\theta} + 1 - \cancel{\sin\theta}}{\sqrt{1-\sin^2\theta}}$
 $= \frac{2}{\sqrt{\cos^2\theta}}$
 $= \frac{2}{\cos\theta}$
 $= 2 \sec\theta$

24: (D) Given
 $\sqrt{(a+b-x)^2 + (b-a-y)^2} = \sqrt{(a-b-x)^2 + (a+b-y)^2}$
 Squaring on both sides
 $\cancel{a^2} + \cancel{b^2} + \cancel{x^2} + \cancel{2ab} - 2bx - \cancel{2ax} + \cancel{b^2} + \cancel{a^2} + \cancel{y^2} - \cancel{2ab} + 2ay - \cancel{2yb}$
 $= \cancel{a^2} + \cancel{b^2} + \cancel{x^2} - 2ab + 2bx - 2ax + \cancel{a^2} + \cancel{b^2} + \cancel{y^2} + 2ab - 2by - 2ay$
 $2ay + 2ay = 2bx + 2bx$
 $4ay = 4bx$
 $\therefore bx = ay$

25: (B) In $\triangle ABC$, AD , BE , CF are the medians
 $\therefore 3(AB^2 + BC^2 + CA^2) = 4(AD^2 + BE^2 + CF^2)$
 $\therefore 4(AD^2 + BE^2 + CF^2) = 3(12^2 + 16^2 + 20^2)$
 $4(AD^2 + BE^2 + CF^2) = 3(144 + 256 + 400)$
 $AD^2 + BE^2 + CF^2 = \frac{3 \times 800}{4} = 600\text{cm}^2$

PHYSICS

- 26: (D) $\downarrow I = \frac{V}{R \uparrow}$ $\uparrow R \propto \frac{1}{A \downarrow}$
- 27: (D) According to New Cartesian Sign Convention, the focal length of a concave mirror is negative as its focus is in front of the mirror on the left side. The focal length of a convex mirror is positive as its focus is behind the mirror on the right side.

28: (D) From $\mu = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin\frac{A}{2}}$

We can see that $\delta_m = 30^\circ$ for $\mu = \sqrt{2}$ and $A = 60^\circ$

Further, at minimum deviation,

$$r_1 = r_2 = \frac{A}{2} = 30^\circ$$

$$\therefore \sin i_1 = \mu \sin r_1 = (\sqrt{2}) \sin 30^\circ$$

$$= \frac{1}{\sqrt{2}} \quad i_1 = 45^\circ$$

- 29: (C) In order to obtain a magnification of -0.75 with a convex lens of focal length 8 cm, the object should be placed beyond 16 cm, i.e., beyond $2f$.
- 30: (C) When a soft iron bar is introduced into a current carrying solenoid, the magnetic field inside the solenoid will increase.
- 31: (B) Following is the increasing order of wavelengths of violet, yellow and red lights respectively

Violet – Shortest wavelength – $380 - 450$ nm

Yellow – $570 - 590$ nm

Red – Longest wavelength – $620 - 750$ nm

- 32: (D) Image formed of an object by a concave mirror is inverted, so magnification is negative.
As the object size is double, so magnification is $m = -2$
Object distance from concave mirror $u = -12$ cm

$$m = -\frac{v}{u}, -2 = \frac{v}{-12}, v = -24 \text{ cm}$$

Image is formed at 24 cm from the mirror in the same direction of object.

- 33: (C) Magnetic field due to a long current carrying conductor

$$B = \frac{\mu_0 I}{2\pi r} \text{ i.e., } B \propto \frac{1}{r}$$

- 34: (D) Stars are self luminous, small objects very far away from the earth. Planets are non-luminous, large objects nearer to the earth.

The continuously changing atmosphere refracts the light from the stars by different amounts from one moment to the next.

The continuously changing atmosphere is able to cause variations in the light coming from a point-sized star (due to refraction) because of which the star appears to be twinkling.

The continuously changing atmosphere is unable to cause variations in the light coming from a big sized planet (due to refraction) because of which the planet does not twinkle at all.

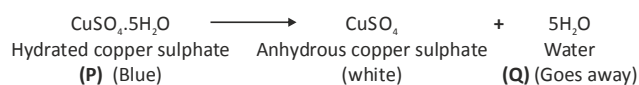
- 35: (A) Current = $\frac{\text{Potential difference}}{\text{Resistance}}$

$$I = \frac{V}{R} = \frac{10}{15} = 0.67 \text{ A}$$

CHEMISTRY

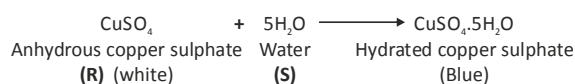
- 36: (C) An alloy is a mixture of a parent metal with another metal in low quantity.
- 37: (B) There was an increase in temperature due to the release of heat as exothermic reaction took place.
- 38: (B) The reaction between acid and base is not a redox reaction as there is no change in the oxidation state in each atom.

- 39: (A) Copper sulphate crystals ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) are blue in colour. When copper sulphate crystals are heated strongly, they lose all the water of crystallisation and form anhydrous copper sulphate (which is white):



Thus, on strong heating, blue copper sulphate crystals turn white (due to the loss of water of crystallisation)

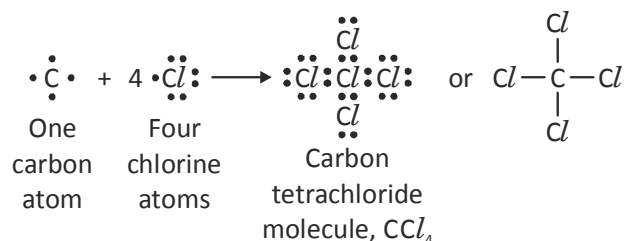
The dehydration of copper sulphate crystals is a reversible process. So, when water is added to anhydrous copper sulphate, it gets hydrated and turns blue due to the formation of hydrated copper sulphate :



Thus, anhydrous copper sulphate turns blue on adding water.

- 40: (B) The soil in a garden is acidic with a pH of 4.5 which is not suitable for growing daffodil plants. To reduce acidity of garden soil, lime can be added in dry or wet form to attain pH of 6.0 to 6.5 to favour growth of daffodil plants.
- 41: (C) The digestion of food i.e, breakdown of glucose is a decomposition reaction, while the others are combination reactions.
- 42: (C) A hard material X mined from the earth is COAL that is used as a fuel and for generation of electricity.
Y – A soft material wax is used as an artificial source of light to make CANDLE.
Z – A gaseous material obtained along with petroleum and used as a vehicular fuel is NATURAL GAS.
- 43: (C) Compound X hardens when mixed with a proper quantity of water is Plaster of Paris.
- 44: (D) Copper cannot react with any dilute acids.

- 45: (C) Carbon atom has 4 valence electrons, so it needs 4 more electrons to complete the 8-electron configuration of inert gas. Chlorine atom has 7 valence electrons, so it needs 1 more electron to achieve the eight-electron structure. The carbon atom shares its four valence electrons with four chlorine atoms to form carbon tetrachloride molecule :



All the atoms in the carbon tetrachloride molecule have a stable 8-electron inert gas configuration in their outermost shells. For example, C atom in CCl_4 has 8 electrons in its valence shell (4 its own and 4 shared)

BIOLOGY

46. (A) The plant produce more oxygen when there is more carbon dioxide concentration in water in bright light with warm temperature.
47. (D) Skin regulates body temperature and detects changes in the external environment. It acts as a protective barrier and functions as an excretory organ.
48. (A) Light energy first enters the food chain, which is absorbed by the producers (i.e. grass) found at the start of the food chain. Light energy is then converted to form chemical energy during photosynthesis.
49. (D) Pollen tube growing out from pollen tube carries male gamete move downwards the style to reach ovule.
50. (D) X - Anther; Y - Stigma; Z - Ovary.
51. (C) Pulmonary vein carries oxygenated blood from lungs.

52. (A) X is the Renal artery as it transports blood to the kidneys while Y is the Renal vein as it transports blood away from the kidneys. Z is the ureter as it transports urine down to the bladder for temporary storage.

53. (C) The digested food in the small intestine passes through the walls of the small intestine. The thin walls of the small intestine have many finger-like projections (villi) with many blood vessels to absorb the digested food into the bloodstream efficiently.

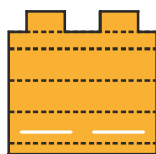
- The finger-like projections increase the surface area for absorption of food.
- The blood in the blood vessels carries the digested food to different parts of the body.

54. (C) Most of the water that enters the tubules via osmosis will be reabsorbed back at the proximal convoluted tubule and loop of Henle.

55. (C) Assuming that menstruation occurs from Day 1 to Day 5 of the menstrual cycle, ovulation should occur on Day 14. The closed date is 21st September.

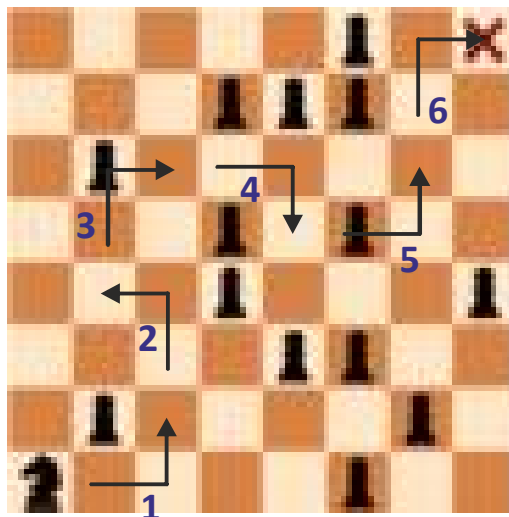
CRITICAL THINKING

56. (C) Option (C) does not form a triangular prism as shown in the question figure.



57: (C) The total force will be divided equally between the two springs that are arranged in parallel. Given we will assume a linear relationship between force and distance, since the force is divided in half, the distance moved will also be reduced by 50 percent. If the springs in series were moved by 10 cms, therefore, the springs in parallel will be moved only by 5 cms.

58: (B) 6



59: (B) In the given figure, one of the dots lies in the region common to the circle and the square only, another dot lies in the region common to all the three figures - the circle, the square and the triangle and the third dots lies in the region common to the circle and the triangle only.

In each of the alternatives (A), (C) and (D), there is no region common to the circle and the triangle only. Only figure (B) consists of all the three types of regions.

60: (B) In all the sets, the first digit represents the number of straight lines in the letters and the second digit represents the number of curved lines in the letters.

$\therefore \text{LAND} = 91$