

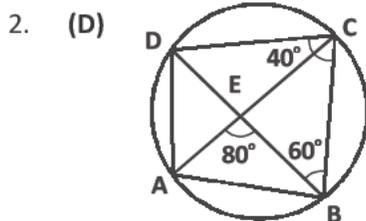
NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION - UN412

Solutions for Class : 9

Mathematics

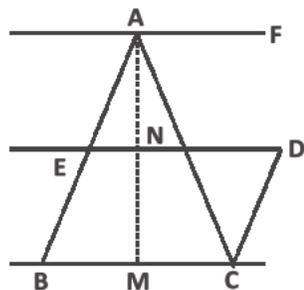
1. (D) Probability of getting 1 or 6 in a single toss
 $\frac{2}{6}$

Probability not getting = $1 - \frac{2}{6} = \frac{4}{6}$



In $\angle BCD$, $\angle BDC = 180^\circ - 40^\circ - 60^\circ = 80^\circ$
 $\angle DEC = \angle AEB = 80^\circ$
 \therefore In $\triangle DEC$, $\angle ECD = 180^\circ - 80^\circ - 80^\circ = 20^\circ$
 \therefore AC bisects $\angle BCD$.

3. (C) AF, ED and BC are parallel lines and AB, AC are transversals. As AE = EB, by Equal Intercepts Theorem, AN = NM. So, AM = 2NM.



Now, $\text{ar}(\triangle ABC) = \frac{1}{2} \times \text{base} \times \text{altitude}$

$$= \frac{1}{2} \times BC \times AM \quad \dots$$

- (i)
 $\text{ar}(\text{parallelogram BCDE})$
 $= \text{base} \times \text{altitude} = BC \times NM$
 ... (ii)

From (i) and (ii), $\frac{\text{ar}(\text{parallelogram BCDE})}{\text{ar}(\triangle ABC)}$

$$= \frac{BC \times NM}{\frac{1}{2} \times BC \times AM}$$

$$\therefore \frac{\text{ar}(\text{parallelogram BCDE})}{20 \text{ cm}^2} \times \frac{NM}{\frac{1}{2} \times 2NM} = 1$$

$$\therefore \text{ar}(\text{parallelogram BCDE}) = 20 \text{ cm}^2$$

4. (D) For $x = 0$ and $x = \frac{1}{3}$ (verify by substitution)

5. (A) The diagonals of a rectangle are equal in length and the rectangle being a parallelogram, its diagonals bisect each other.

$$\therefore AC = BD$$

$$\Rightarrow \frac{1}{2} AC = \frac{1}{2} BD$$

$$\Rightarrow OC = OD$$

$$\therefore \text{In } \triangle ODC, \angle ODC = \angle OCD = x^\circ$$

But $\angle ODC = \angle OBA = 30^\circ$

(Since $AB \parallel DC$).

$$\therefore x^\circ = 30^\circ$$

Now, $y^\circ = \angle AOB = \angle COD$ (opposite angles)

$$= 180^\circ - x^\circ - x^\circ \text{ (sum of three angles of } \triangle ODC \text{ is } 180^\circ)$$

$$= 180^\circ - 30^\circ - 30^\circ = 120^\circ$$

6. (D) $\angle NML = 180^\circ - 125^\circ = 55^\circ$

Since, $\overline{LN} = \overline{LM}$

$$\angle LNM = \angle NML = 55^\circ$$

$$\therefore \angle NLM = 180^\circ - 55^\circ - 55^\circ = 70^\circ$$

$$\angle KLN = 180^\circ - 90^\circ - 70^\circ = 20^\circ$$

$$\therefore \text{In } \triangle KLN, x^\circ = 180^\circ - 20^\circ - 90^\circ = 70^\circ$$

7. (D) $\frac{120}{x}$ of the planned distance.

8. (C) Area = $\sqrt{s(s-a)(s-b)(s-c)} = A$

where $s = \frac{a+b+c}{2}$ and a, b, c are sides of the triangle.

When the sides are increased by 200%, the sides become 3a, 3b and 3c.

$$s_1 = \frac{3a+3b+3c}{2} = 3 \times \frac{(a+b+c)}{2} = 3s$$

$$A_1 = \sqrt{s_1(s_1-3a)(s_1-3b)(s_1-3c)}$$

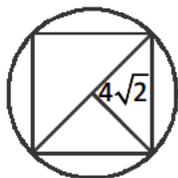
$$= \sqrt{3s \cdot 3(s-a) \cdot 3(s-b) \cdot 3(s-c)}$$

$$= 9\sqrt{s(s-a)(s-b)(s-c)} = 9A$$

$$\therefore \text{Increase in area} = 9A \quad A = 8A \text{ or } 800\%$$

9. (C) Edge of the cube = $a\sqrt{\frac{2}{3}} = 4\sqrt{2} \times \sqrt{\frac{2}{3}}$

$$= \frac{8}{\sqrt{3}} \text{ cm}$$



$$\therefore \text{Diagonal of the cube} = \sqrt{3} \text{ (edge)}$$

$$= \sqrt{3} \times \frac{8}{\sqrt{3}} = 8 \text{ cm}$$

10. (D) (5, 6), (6, 5) i.e.,

$$\text{The probability} = \frac{2}{36} = \frac{1}{18}$$

11. (C) $pq = 36$, since p and q are positive integers, hence 36 can be factorised as (36×1) and (18×2) , (12×3) , (9×4) , and (6×6) . Hence p, q can be 6, 6, 3, 12 = 9, (9, 4) = 5, 36 = 1 = 35, but it can NOT be 8.

12. (A) Since, $AB = BC \Rightarrow w^\circ = z^\circ$

$$BD \text{ bisects } AC \Rightarrow AD = DC \Rightarrow x^\circ = y^\circ$$

$$\therefore w^\circ = x^\circ \text{ is not possible.}$$

13. (C) $\sqrt{(2-0)^2 + (-1-0)^2} = \sqrt{5}$

$\Rightarrow (2, -1)$ is the nearest point.

14. (A) Since, in the list 5 appears 4 times and 6 appears 3 times.

So, the value of n can be any value other than 6 as mode of the given list is 5.

15. (D) $\frac{a_1}{a_2} = \frac{3}{12} = \frac{1}{4}$

$$\frac{b_1}{b_2} = \frac{-4}{-16} = \frac{1}{4}$$

$$\frac{c_1}{c_2} = \frac{5}{20} = \frac{1}{4}$$

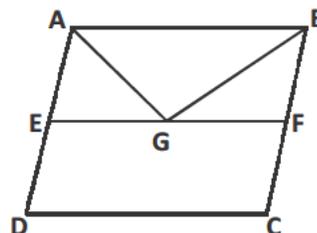
$$\text{Since, } \frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$

The given equations are coincident lines.

\therefore There are **more than two solutions**.

16. (C) $AB \parallel CD \parallel EF$

$$\Rightarrow \text{ar. } \triangle AGB = \frac{1}{2} \text{ ar. } \square \text{ AEFB}$$



(Since $\triangle AGB$ and \square gm AEFB are on the same base and between the same \parallel lines AB and EF).

$$\text{area } \triangle AGB = \frac{1}{4} \text{ ar. } \square \text{ ABCD} = \frac{S}{4}$$

17. (A) Area of rectangle = $xy = \beta$



$$\text{Area of parallelogram} = y \times h = \alpha$$

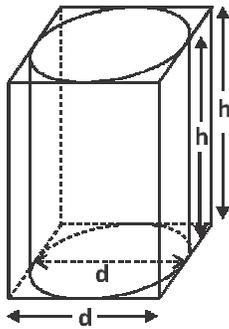
$$\text{Since, } h < x \Rightarrow y \times h < x \times y$$

$$\therefore \alpha < \beta$$

18. (C) $AP + PB = AB$



19. (B)



Hence, the dimensions of rectangular box is $d \times d \times h$.

\therefore Volume of rectangular box = d^2h

20. (B) Perimeter of quarter circle

$$= \frac{\pi r}{2} + r + r = \frac{\pi(6)}{2} + 6 + 6 = 3\pi + 12$$

Given, perimeter of rectangle = 14

length + width = $14 \div 2 = 7$

By trial and error method, $l = 4$, $b = 3$

\therefore Diagonal of rectangle

$$= \sqrt{l^2 + b^2} = \sqrt{16 + 9} = 5$$

Hence, perimeter of shaded region

$$= 3\pi + 12 - 7 + 5$$

$$= 3\pi + 10$$

21. (C) Since, $x + y + z = 0$

$$\Rightarrow x^2 + y^2 + z^2 + 2(xy + yz + zx) = 0$$

$$\therefore x^2 + y^2 + z^2 = 2(xy + yz + zx)$$

$$= 2[x(y + z) + yz]$$

$$= 2(x \times -x + yz)$$

$$\text{(Since, } x + y + z = 0\text{)}$$

$$= 2(x^2 - yz)$$

$$\therefore \frac{x^2 + y^2 + z^2}{x^2 - yz} = 2$$

22. (D) Of the given statements only (ii) and (iii) are true.

23. (C) A : Getting prime number

$$A = \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$$

$$n(A) = 9, n(S) = 25$$

\therefore Required probability

$$= P(A) = \frac{n(A)}{n(S)} = \frac{9}{25}$$

24. (C) $\angle FDG = \angle KCD$ (corresponding angles)

$$= \angle ECA \text{ (vertically opp. angles)}$$

$$\Rightarrow \angle ECA = 55^\circ$$

$$\angle EAC = 40^\circ \text{ (given)}$$

$$\therefore \angle E = 180^\circ - (55^\circ + 40^\circ) = 85^\circ$$

$$x^\circ = 85^\circ \text{ (corresponding angles)}$$

25. (D) $\angle B = \angle C$

$$\Rightarrow AB = AC$$

$$\angle CAD = 30^\circ$$

$$\therefore \angle CAD > \angle CDA$$

$$\Rightarrow CD > AC$$

(In a triangle, greater angle has longer side opposite to it)

$$\angle BAC = 180^\circ - 110^\circ = 70^\circ > \angle ABC$$

$$\Rightarrow BC > AB \text{ and } BC > AC$$

$$\therefore BC > CA \text{ and } CA < CD$$

Physics

26. (C) Initial kinetic energy = $\frac{1}{2}mv^2$

$$= \frac{1}{2}(2)(3)^2 = 9 \text{ J}$$

$$\text{Final kinetic energy} = \frac{1}{2}mv^2$$

$$= \frac{1}{2}(2)(7)^2 = 49 \text{ J}$$

$$\text{Increase in kinetic energy} = 49 \text{ J} - 9 \text{ J}$$

$$= 40 \text{ J}$$

27. (A) A cat that has become wet shakes its body from head to tail to shed the water from its coat by moving its head and tail on right and left sides respectively to make the water droplets to fall down. It is based on the concept of inertia of motion.

28. (B) Statements (A), (C) and (D) are not true of mass. Mass of an object is always constant whether it is on the earth, the moon or even in outer space.

29. (C) The momentum of a body is the product of its mass and velocity ($P = m \times v$). The momentum of four objects P, Q, R and S are calculated below.

$$\text{Object P} = \text{Mass} \times \text{velocity} =$$

$$0.3 \text{ kg} \times 5 \text{ m s}^{-1} = 1.5 \text{ kg m s}^{-1}$$

$$\text{Object Q} = \text{Mass} \times \text{velocity} =$$

$$0.6 \text{ kg} \times 2 \text{ m s}^{-1} = 1.2 \text{ kg m s}^{-1}$$

Object R = Mass \times velocity =

$$1.2 \text{ kg} \times 0.3 \text{ m s}^{-1} = 0.36 \text{ kg m s}^{-1}$$

Object S = Mass \times velocity =

$$1.5 \text{ kg} \times 1.8 \text{ m s}^{-1} = 2.7 \text{ kg m s}^{-1}$$

So, object 'R' has the lowest momentum.

30. (D) Car I is not moving, so it has no kinetic energy. Bus I has a bigger mass than car II, so bus I has more kinetic energy even though they are moving at the same speed. Bus II has the same mass as bus I, but it is moving at the fastest speed, so it has the most kinetic energy. Bus I and car II are moving at the same speed, but car II has less kinetic energy because it has a smaller mass.
31. (B) Velocity = $\frac{\text{Distance}}{\text{Time}} = \frac{100 \text{ m}}{20 \text{ s}} = 5 \text{ m s}^{-1}$
- Acceleration = $\frac{\text{Change in velocity}}{\text{Time interval}}$
- $$= \frac{5 - 0}{20} = 0.25 \text{ m s}^{-2}$$
32. (B) Time taken for sound to travel from the lightning to the observer = 2.5 s
- Speed of sound in air is approximately 330 m/s.
- Therefore, distance travelled by the sound = speed \times time
- $$= 330 \times 2.5 = 825 \text{ m}$$
33. (B) Pressure = Force / Area, the smaller the area, the greater the pressure.
34. (D) Statement (i), (ii) and (iii) are the safety measures, few are inbuilt in the vehicles and some are to be followed by passengers moving in various vehicles to reduce the negative effects of inertia.
35. (C) Potential energy is stored in the bow. To release an arrow from the bow, there is a change in the shape of stretched string of the bow. Hence, potential energy of the bow is converted to kinetic energy to stretch the string and release an arrow from it.
36. (A) The heaviest material copper has the greatest inertia.
37. (D) Power = work done \div time = force \times distance \div time. When the applied force on the weight is higher, the power used to do the work will increase.

Force = mass \times acceleration. When a higher force is applied, the weight will move at a higher acceleration. In other words, the object will move faster and thus the work can be completed in a shorter time.

The energy used to lift the weight comes from the boy. From the conservation of energy point of view, the faster the energy has gone to work, the faster will the energy of the boy be used up.

38. (D) The correct order of density of three substances P, Q, R from least to most dense is Q, P and R.

Density of a substance =

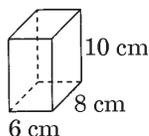
$$\frac{\text{Mass of substance}}{\text{Volume of substance}}$$

$$\text{Density of substance P} = \frac{65}{15} = 4.33 \dots\dots (2)$$

$$\text{Density of substance Q} = \frac{80}{20} = 4 \dots\dots (1)$$

$$\text{Density of substance R} = \frac{60}{12} = 5 \dots\dots (3)$$

39. (B) Point Q has the deepest water because ultrasound took the longest time to return back to the receiver on the ship.
40. (B) Work done is the product of the applied force and the distance moved by the object in the direction of the force. When the spaceship is cruising in space, although there is distance travelled but there is no force acting on it. As a result, no work is done.
41. (A) If an object moves with a constant speed along a circular path, then its velocity will not be constant because velocity changes in a specified direction. So, the object moving in a circular path has a variable velocity.
42. (C) The frequency will not change as the source is not being disturbed. Sound travels faster in water than in air as vibrations travel faster when the particles are closer together. According to the relationship $v = f\lambda$, when the frequency is constant, the speed increases and the wavelength will also increase.
43. (B) The smallest base area = $6 \times 8 = 48 \text{ cm}^2$
- Pressure = Force / Area
- $$= 24 / 48 = 0.5 \text{ N cm}^{-2}$$



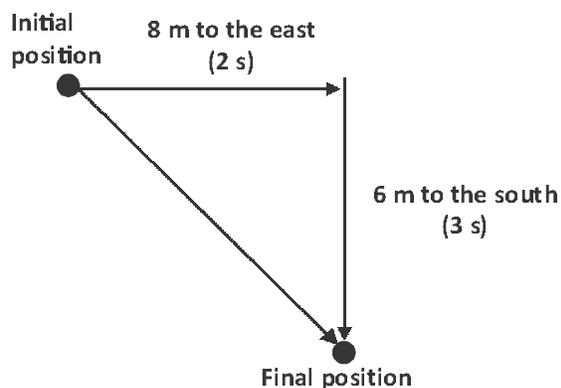
44. (D) Net force = Mass \times acceleration
45. (A) Work is force times displacement. Since, the girl does not displace at all from her initial point, the work done remains at zero. Common mistake occurs when we think that the work done by the girl depends on the distance travelled by her as she jumps.

Displacement is a different term with distance, and they are often used ambiguously. In this case, the initial and final position of the girl remains unchanged, which means she does not displace at all, i.e., her displacement is zero.

46. (D) Based on the fact that iron must have a higher density than feathers and the formula of "density = mass \div volume" and "weight = mass \times gravitational acceleration", a table of the situation is given below.

	Material	Density	Mass	Volume	Weight
Sack X	iron	high	2 kg	low	20 N
Sack Y	feathers	low	2kg	high	20 N

47. (B) Applied force opposing force
= Resultant force = ma
 $90 - 60 = 15a$; $a = 2 \text{ m s}^{-2}$
48. (D) When the speed of a truck changes in an irregular manner, then the velocity-time graph is a curved line.
49. (A) Distance is the total length travelled by the man whereas displacement is the position of the man as compared to his original position.



Total Distance = 8 m + 6 m = 14 m
Total time = 2 s + 3 s = 5 s

$$\text{Average speed} = \frac{\text{total distance}}{\text{total time}} = \frac{14 \text{ m}}{5 \text{ s}} = 2.8 \text{ m s}^{-1}$$

$$\text{Displacement} = \sqrt{8^2 + 6^2} = 10 \text{ m}$$

$$\text{Velocity} = \frac{\text{displacement}}{\text{time}} = \frac{10 \text{ m}}{5 \text{ s}} = 2.0 \text{ m s}^{-1}$$

50. (C) As radius is maximum at the equator, the value of 'g' will be minimum at the equator. Due to flattening of the earth at the poles, radius is minimum and 'g' is maximum at the poles. An object when weighed at the north pole will be the heaviest.

Chemistry

51. (C) Uranium-235 isotope is used as a fuel in the reactors of nuclear power plants for generating electricity.
52. (C) Mercury-ethanol is an immiscible liquid mixture. Hence, they can be separated by a separating funnel.
53. (C) Among the three states of matter, the rate of diffusion is very fast in gases. The particles in gases move very quickly in all directions. The rate of diffusion of a gas depends on its density. Lighter gases diffuse faster than heavier gases.

Nitrogen and carbon monoxide are a pair of gases which diffuse into the vacuum at the same speed due to their equal molecular weights.

$$\text{Nitrogen (N}_2\text{)} = 2 \times 14 = 28$$

$$\text{Carbon monoxide (CO)} = \text{Carbon } 12, \text{ Oxygen } 16 = 28$$

54. (C) Relative atomic mass of neon =

$$\frac{20 \times 90 + 21 \times 1 + 22 \times 9}{90 + 1 + 9} = 20.19$$

55. (C) The slow diffusion of perfume gas molecules which are moving very quickly occurs because the perfume molecules travel only short distances in straight lines before they are deflected in a new direction by collision with other gas molecules, in this case, of air and the perfume.

56. (B) Number of glucose molecules =

$$(\text{no. of moles}) \times (6.0 \times 10^{23})$$

$$= 0.8 \times 6.0 \times 10^{23}$$

$$= 4.8 \times 10^{23}$$

One glucose molecule contains 12 H atoms.

Hence, total number of H atoms
 $= 4.8 \times 10^{23} \times 12 = 57.6 \times 10^{23}$ atoms
 $= 5.76 \times 10^{24}$ atoms

57. (C) Soap solution is a colloid.
 Brass is a solution of zinc in copper, a solid in a solid metallic alloy.
 Milk of magnesia is a suspension of magnesium hydroxide in water.
 Copper sulphate dissolves in water, it is a true solution.

58. (A) The atomic number of the element = 7, which is nitrogen, N. The number of electrons in the particle = 10. Hence, the atom has gained 3 e⁻ to form a nitride ion = N³⁻.

59. (B) 60 g of KNO₃ dissolves in 100 g of water at 40 °C
 ? g of KNO₃ dissolves in 25 g of water at 40 °C

$$= \frac{60 \times 25}{100} = 15 \text{ g}$$

So, 15 g of KNO₃ dissolves in 25 g of water to produce a saturated solution at 40 °C.

60. (C) Chlorine atom has 7 electrons in its outermost shell. It needs 1 more electron to achieve the 8-electron configuration or octet. So, the chlorine atom gains (accepts) 1 electron to form a chloride ion, Cl⁻ having an inert gas electronic configuration of 2, 8, 8.

Cl	$\xrightarrow{+1 \text{ electron}}$	Cl^-
Chlorine atom		Chloride ion
Protons = 17 (+charge)		Protons = 17 (+charge)
Electrons = 17 (charge)		Electrons = 18 (charge)
Overall charge = 0		Overall charge = -1

61. (D) An atom gains or loses electrons when it becomes an ion. The number of protons before the gain/lose of electrons in an atom is same. Its atomic number remains the same as shown below.

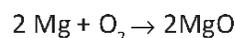
O	$\xrightarrow{+2 \text{ electrons}}$	O^{2-}
Oxygen atom		Oxide ion
Protons = 8		Protons = 8
Electrons = 8		Electrons = 10
Overall charge = 0		-2

62. (D) Condensation and freezing both involve the loss of heat energy by particles of a substance. However, the change of state from a gas to a liquid/solid involves the

larger change in volume as particles in gaseous state are far apart, and when they condense, they come very close together to form a liquid/solid.

63. (B) Element 'T' has 12 protons. It is magnesium, a metal

- (i) Magnesium reacts with oxygen to form an oxide MgO not MgO₂.



- (ii) Magnesium reacts with chlorine to form Magnesium chloride (Mg Cl₂)

- (iii) Magnesium forms a divalent ion with charge +2 (Mg²⁺) by losing 2 electrons.

- (iv) Magnesium is a metal.

64. (D) It has the highest nucleon number, indicating the largest number of neutrons, since the isotopes share the same number of protons. Carbon-12 has 6 neutrons and Carbon-13 has 7 neutrons and Carbon 14 has 8 neutrons.

65. (B) The melting point of pure substance 'X' is 1535 °C. It belongs to iron.

Melting point of ice is 0 °C

Melting point of copper is 1083 °C

Melting point of wax is 63 °C

66. (A) Ethanol is a compound made up of carbon, hydrogen and oxygen elements chemically bonded together - C₂H₅OH. Petrol is a mixture of C₅ - C₁₀ hydrocarbons (alkanes). Steel is an alloy made up of iron and 1-2% of carbon. Tap water has dissolved minerals, chloride and fluoride ions.

67. (D) Isotopes are the atoms of the same element having the same atomic number but different mass numbers. The number of protons and electrons are equal in an atom but the number of protons and neutrons inside the nucleus differ due to increase in the number of neutrons. The stability of an isotopic nucleus depends on its neutron-to-proton ratio.

68. (C) In the purification of water, some alum is added to the sedimentation tank. The heavy particles of dissolved alum deposit on the suspended clay particles in water. The suspended clay particles in water get clumped with alum particles, become heavy and settle down at the bottom of the sedimentation tank.

69. (C) (i) The electron structure of atom 'X' is magnesium. Its atomic number is 12 and mass number is 24.

Examrace