

Number of printed pages: 11

NEPAL SCIENCE OLYMPIAD - 2012



Tier - II Test

2nd February 2013

Time: 90 minutes
Total Mark: 100

Registration number:

S. No.:

Score:

INSTRUCTION

1. There are 100 questions: 20 Multiple Objective Choice Questions each with four answer choices and 5 Subjective Questions in this test paper in each disciplines except Maths, spread over 10 pages.
2. Select the correct answer for multiple objective question by shading your answer choice with HB pencil . E.g. If your choice is b among the choices then shade the b like: a)..... ● c) d)
3. Use **HB pencil** only for shading and answering the questions.
4. Each correct answer is scored one point.
5. 0.25 point is deducted for every incorrect answer.
6. Use of calculator and log tables is prohibited.

Physics

1. The dimension of $\frac{e^2}{\epsilon_0 hc}$ (ϵ_0 = permittivity of free space, e = charge of electron,

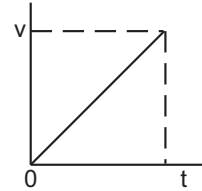
h = Planck's constant and c = speed of light) are

- a) $[M^{-1}L^{-3}T^4A^2]$ b) $[ML^3T^4A^{-2}]$ c) $[M^0L^0T^0A^0]$ d) $[M^{-1}L^{-3}T^2A]$

2. The error in the measurement of diameter of a sphere is 3%. Then
 a) The error in the measurement of surface area of sphere is $4\pi(3)^2$
 b) The error in the measurement of surface area of sphere is 6%
 c) The error in the measurement of radius of the sphere is 1.5%
 d) The error in the measurement of volume of the sphere is 9%

3. The velocity time graph of a body is shown in Fig. The slope of the line is 'm'. The distance traversed by the body in time t is

- a) $\frac{mv^2}{2T}$ b) $\frac{v^2}{2T}$
 c) $2mv^2$ d) $\frac{v^2}{2m}$



4. A stone is projected upwards with a velocity of 100 m/s. If $g = 10 \text{ m/s}^2$, then
 a) maximum height attained by it is 500m b) the total distance traversed by it is 100m
 c) the net displacement of stone is 500m d) the time of flight of stone is 20 s

5. In the product $P = \vec{a} \times (\vec{b} \times \vec{c})$ select the pairs of perpendicular vectors.

- a) \vec{a} and \vec{b} b) \vec{b} and \vec{c} c) \vec{a} and \vec{c} d) \vec{P} and \vec{a}

6. A ball rolls off the top of a stairway with a horizontal velocity of magnitude 1.8 m/s^2 . The steps are 0.20 m high and 0.20 m wide. Which step will the ball hit first?

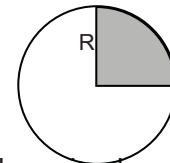
- a) first b) second c) third d) fourth

7. The apparent weight of a person in a lift is more than the actual weight, if the lift is

- a) accelerating upward b) accelerating downward
 c) moving with a constant velocity upward d) retarding downward

8. One quarter sector is cut from a uniform circular disc of radius R . This sector has a mass m . It is made to rotate about a line perpendicular to the plane passing through the centre C of the original disc. Its moment of inertia about the axis of rotation is

- a) $\frac{1}{2} mR^2$ b) $\frac{1}{4} mR^2$
 c) $\frac{1}{8} mR^2$ d) $2mR^2$



9. A particle is moving along a vertical circular path of radius r , when circular path is just completed

- a) the velocity at the highest position is \sqrt{rg}
 b) the velocity at highest position is zero
 c) the velocity at lowest position is $\sqrt{5rg}$
 d) the tension in the string at the lowest position is $5mg$

10. A man while running along a straight road leans a little in the forward direction. The angle between the vertical line and the line showing the man's centre of gravity with the point of support on the ground is β . The man will not slip if the coefficient of friction μ is such that

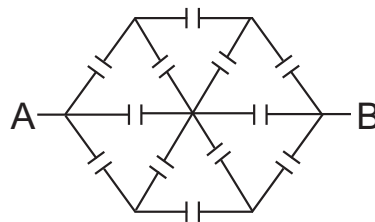
- a) $\mu > \tan \beta$ b) $\mu < \tan \beta$ c) $\mu > \tan^2 \beta$ d) $\mu < \tan^2 \beta$

11. No work is done by a force on an object if

- a) the force is always perpendicular to instantaneous velocity
 b) the force is always perpendicular to its acceleration
 c) the object remains stationary even though the force acts on the particle
 d) the object moves with constant velocity on account of the external force on it.

12. If the momentum of the particle increases by 100% , its kinetic energy increases by
 a) 100% b) 200% c) 300% d) 400%
13. Earth rotates about its axis with angular velocity ω . An object weighed by a spring balance gives the same reading at the equator and at a height h above the poles ($h \ll R$). By assuming the acceleration due to gravity to be same at the equator and at the poles without rotating earth, then the value of h is
 a) $\omega^2 R^2 / g$ b) $\omega^2 R^2 / 2g$ c) $2\omega^2 R^2 / g$ d) $(\overline{OgR}) / \omega$
14. Bulk modulus of water is $2 \times 10^9 \text{ N/m}^2$. The change in pressure required to increase the density of water by 0.1% is
 a) $2 \times 10^9 \text{ N/m}^2$ b) $2 \times 10^8 \text{ N/m}^2$ c) $2 \times 10^6 \text{ N/m}^2$ d) $2 \times 10^{12} \text{ N/m}^2$
15. The coefficient of volume expansion of mercury is 20 times the coefficient of linear expansion of glass. The fraction of volume of mercury that must be poured into a glass vessel so that volume above mercury may remain fixed at all temperature is
 a) 1/3 b) 3/20 c) 1/20 d) 7/20
16. If masses of all molecules of a gas are halved and their speed doubled, then the ratio of initial and final pressure is
 a) 2:1 b) 1:2 c) 4:1 d) 1:4
17. A gas mixture consists of 2 moles of oxygen and 4 moles of argon at temperature T . Neglecting all vibrational modes, the total energy of the system is
 a) $4RT$ b) $15RT$ c) $9RT$ d) $11RT$
18. When a glass prism of refracting angle 60° is immersed in a liquid, its angle of minimum deviation is 30° . The critical angle of glass with respect to liquid medium is
 a) 42° b) 45° c) 50° d) 52°
19. An astronomical telescope and a Galilean telescope use identical objective lenses. They have the same magnification in normal adjustment. If eye lens has focal length f_e , then which of the following statements true:
 a) the length of Galilean telescope and astronomical telescope are equal
 b) the length of astronomical telescope is greater than that of Galilean telescope by $2f_e$
 c) the length of Galilean telescope is greater than that of astronomical telescope by $2f_e$
 d) the lengths of two telescopes cannot be compared
20. The 12 capacitors each having capacitance C are connected as shown in Fig below. The effective capacitance between A and B is

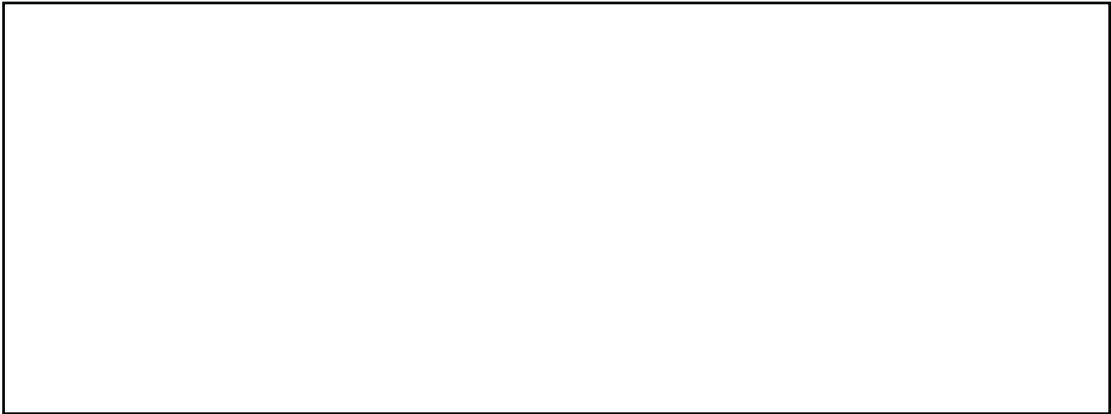
- a) $5C/4$ b) $8C$
 c) $8C/3$ d) $12C$



Subjective Questions

21. Can you use the equations of kinematics to find the height attained by an object projected upward with any velocity? Why?

22. When a wheel is rotated about its axle without sliding, how the frictional force acts on the wheel?



23. Does hydrogen balloon possess greater potential energy at higher altitude?



24. What is the net force on an electric dipole placed in a uniform electric field?



25. Why transformer cannot be used to change the value of dc voltage?



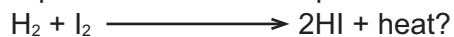
Chemistry

26. The metal used to recover copper from a solution of copper sulphate is
a) Na b) Ag c) Hg d) Fe
27. The number of d-electrons in Fe^{2+} ($z = 26$) is not equal to that of
a) p-electrons in Ne ($z = 10$) b) s-electrons in Mg ($z = 12$)
c) d-electrons in Fe ($z = 26$) d) p-electrons in Cl ($z = 17$)
28. The law which states that the amount of gas dissolved in a liquid is proportional to its partial pressure is
a) Dalton's law b) Gay Lussac's law c) Henry's law d) Raoult's law
29. The octane number of zero is assigned to
a) 2-methyl octane b) n-heptane c) iso-octane d) 3-methyl octane
30. What are the number of moles of CO_2 which contains 16 g of oxygen?
a) 0.5 mole b) 0.2 mole c) 0.4 mole d) 0.25 mole
31. The number of water molecules present in a drop of water (volume 0.0018 ml) at room temperature is
a) 1.568×10^3 b) 6.023×10^{19} c) 4.84×10^{17} d) 6.023×10^{23}
32. The graphite rods in the nuclear reactor
a) react with U to release energy b) produce neutrons
c) undergo combustion which triggers the nuclear fission
d) convert fast moving neutrons into thermal neutrons
33. Zone refining is used for the purification of
a) Au b) Ge c) Ag d) Cu
34. The molecule which has the highest percentage of ionic character among the following is
a) HI b) HF c) HCl d) HBr
35. The ionisation energy of hydrogen atom in the ground state is x KJ. The energy required for an electron to jump from 2nd orbit to 3rd orbit is
a) $5x/36$ b) $5x$ c) $7.2x$ d) $x/6$
36. The organic reaction represented by equation $\text{CH}_3\text{-CH=O} + \text{H}_2\text{NOH}$ gives $\text{CH}_3\text{-CH=NH} + \text{H}_2\text{O}$ is an example of
a) an addition reaction b) a condensation reaction
c) an oxidation reaction d) an elimination reaction
37. The number of waves made by an electron moving in an orbit having maximum magnetic quantum number is +3
a) 4 b) 5 c) 2 d) zero
38. Equal masses of oxygen, hydrogen and methane are kept under identical conditions. The ratio of the volumes of gases will be
a) 2 : 16 : 2 b) 2 : 16 : 1 c) 1 : 16 : 2 d) 1 : 1 : 1
39. The maximum number of covalent formed by nitrogen is
a) 1 b) 2 c) 3 d) 4
40. The formula $\text{C}_6\text{H}_5\text{-CO-CH}_3$ represents
a) Acetone b) Acetic acid c) Acetophenone d) Phenyl acetate
41. The main chemical constituent of the oil of cardamom which is responsible for flavour of this oil is
a) cineole b) engenol c) geraniol d) limonene
42. The high reactivity of fluorine is due to
a) its high electro negativity b) small size of fluorine atom
c) availability of d-orbitals d) strong F - F bond
43. The main chemical constituent of clay is
a) silicon oxide b) aluminium borosilicate c) zeolites d) aluminium silicate
44. The number of moles of solute present in 1 kg of a solvent is called its
a) molality b) molarity c) normality d) formality

45. The main use of salt in the diet is to
- a) make the taste of food better
 - b) produce in small amounts the HCl required for the digestion of food
 - c) ease the process of cooking
 - d) increase the solubility of food particles in water

Subjective Questions

46. What is the effect of the pressure and the temperature on the reaction:



47. The electronic configuration of Cr and Cu is exception to Aufbau Principle. Justify.

48. What will happen when copper coin is accidentally dropped into the silver nitrate solution?

49. Why anions are negatively charged and cations are positively charged?

62. What would have happen if there is self fertilization in earthworm all the time?

63. Why do animals have various types of adaptation? Give your opinion.

Botany

64. _____ splits at the anaphase of mitosis cell division.
a) Chromatid b) DNA molecule c) Centromere d) Chromomere
65. In nature, lightening is also a mean of nitrogen fixation. It fixes atmospheric free nitrogen to the soil in the form of _____
a) Nitrite b) Ammonium ion c) Nitric oxide d) Nitrate
66. Which is not an example of 'Symbiosis'?
a) Coralloid root b) Soil inhabiting Rhizobium
c) Lichen d) Mycorrhizal root
67. Insectivorous plants are _____
a) Autotrophs b) Heterotrophs c) Carnivores d) Omnivores
68. Bulk carbondioxide fixation occurs in _____
a) Crop lands b) Oceans
c) Tropical rainforests d) Temperate forests
69. Ovule in angiosperms is _____
a) Female gamete b) Female gametophyte
c) Megaspore d) Megasporangium
70. Amino acids usually exist in the form of zwitter ions. This means that they consist of _____
a) Basic NH_2 group and acidic COOH group
b) The basic NH_3 group and the acidic COO^- group
c) The basic COO^- group and the acidic NH_3 group
d) Positive ammonium $[\text{NH}_4]^+$ group and negative COO^- group
71. How many mitotic cell divisions are necessary for the formation of 512 parenchymatous cells?
a) 128 b) 64 c) 8 d) 9
72. All living organisms of an ecosystem is called _____
a) Community b) Biome c) Biota d) Ecotype

73. Intermediate meiosis is observed in
 a) Mucor b) Spirogyra c) Yersinia d) Marsilea

Subjective Questions

74. Apart from mitochondria and chloroplast, other cell organelles are not regarded 'semi-autonomous' in nature, why?

75. What is Kornberg enzyme?

Maths

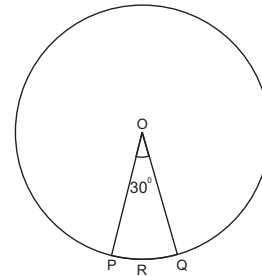
76. If $x < y < z$, $z = ky$, $x = 0$ and the average of the numbers are x , y and z is 3 times the median, what is the value of k ?
 a) -2 b) 5.5 c) 6 d) 8
77. A housing subdivision contains only two types of homes: ranchstyle homes and the town homes. There are twice as many town homes as ranchstyle homes. There are three times as many as town homes with pools than without pools. What is the probability that a home selected at random from the subdivision will be a town home with a pool?
 a) $1/2$ b) $1/6$ c) $1/4$ d) $1/3$
78. In a sequence, the first term $a_1 = -1$, second term $a_2 = 7$ and the third term $a_3 = -5$ and the $a_{n+3} = a_n$ for $n > 3$. Find the sum of the first seventy four terms of the sequence.
 a) 74 b) 34 c) 40 d) 30
79. At 1 pm, ship A leaves port travelling 15 miles / hr. Three hours later ship B leaves the same port in the same direction travelling 25 miles / hr. At what time does ship B pass ship A?
 a) 8:35 pm b) 9:15 pm c) 9 pm d) 8:30 pm
80. A train of length ' l ', travelling at a constant velocity passes a pole in t seconds. If the same train travelling at the same velocity passes a platform in $3t$ seconds then the length of the platform is
 a) $2l$ b) $1.5l$ c) $3l$ d) l
81. If \textcircled{d} denotes the area of a circle with diameter d , then which of the following is equal to $\textcircled{4} \cdot \textcircled{6}$?
 a) $\textcircled{12}$ b) $\textcircled{24}$ c) $\pi \textcircled{12}$ d) $\pi \textcircled{24}$
82. A circle is divided into five sectors with the sector angles a , $3a$, $3a + b$, $4a - 2b$ and $3b$ then the average of those angles in degree measure is ...
 a) 90° b) 65° c) 72° d) 80°

83. The value of $\frac{7^{10} + 7^9}{8} =$

- a) $\frac{7^7}{8}$ b) $\frac{7^{19}}{8}$ c) 7^8 d) 7^9

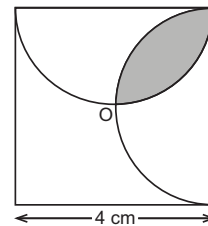
84. In the figure to the right, O is the center of the circle. If the area of the circle is 9π , then the perimeter of the sector PRQO is

- a) $\frac{\pi}{2} + 8$ b) $\frac{\pi}{2} + 6$
 c) $\frac{3\pi}{4} + 6$ d) $\frac{3\pi}{2} + 8$



85. In the figure, O is the midpoint of the diagonals of the square with the side 4 cm long. Two semi circles intersect at O. Find the area of the shaded part.

- a) $3\pi - 4$ b) $2\pi - 4$
 c) $3\pi + 4$ d) $\pi + 4$



86. In a bag containing identical marbles of two color: red and green; the red marbles are thrice the green marbles. One marble is drawn at random; the probability that it is of green color is

- a) 75% b) 25% c) $33\frac{1}{3}\%$ d) $67\frac{2}{3}\%$

87. "The moving power of mathematical invention is not reasoning but imagination"; It is said by

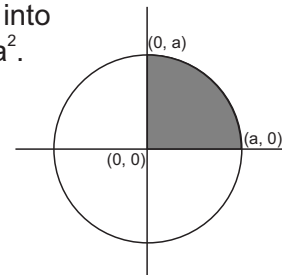
- a) A. Demorgan b) G. Polya c) W. R. Hamilton d) D. Hilbert

88. A function $f : \mathbb{N} \rightarrow \mathbb{N}$ defined by $f(x) = x^2 + 7$ is

- a) one - one and onto b) one - one and into
 c) many - one and onto d) many - one and into

89. Find the area enclosed by shaded part of the circle is $x^2 + y^2 = a^2$.

- a) $\frac{\pi a^2}{4}$ b) $\frac{\pi a^2}{2}$
 c) πa^2 d) $\frac{3\pi a^2}{4}$



90. $\int \frac{dx}{e^x + e^{-x}}$ is equal to

- a) $\tan^{-1}(e^x) + c$ b) $\tan^{-1}(e^{-x}) + c$ c) $\log(e^x - e^{-x}) + c$ d) $\log(e^x + e^{-x}) + c$

91. Area bounded by the curve $y = x^3$, the x axis and the ordinates $x = -2$ and $x = 1$ is

- a) -9 b) $-15/4$ c) $15/4$ d) $17/4$

92. Distance between the two planes $2x + 3y + 4z = 4$ and $4x + 6y + 8z = 12$ is

- a) 2 units b) $4/\sqrt{29}$ units c) 8 units d) $2/\sqrt{29}$ units

93. If a line makes angles α , β and γ with x - axis, y - axis and z - axis respectively in anti-clockwise direction then the value of $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma$ equal to

- a) $3/2$ b) 3 c) 2 d) $4/3$

94. The general solution of a differential equation $\frac{ydx - xdy}{y^2}$ is

- a) $xy = c$ b) $x = cy^2$ c) $y = cx$ d) $y = cx^2$

95. $\int \frac{dx}{2x - x^2}$ equals to

- a) $\sin^{-1}(2x - 1) + c$ b) $\sin^{-1}(x - 2) + c$ c) $\sin^{-1}(x - 1) + c$ d) $\frac{1}{2} \sin^{-1}(x - 1) + c$

96. $\frac{d}{dx} \left(\frac{a^x}{\log a} \right) =$
a) $\log a$ b) a^x c) $\log a^x$ d) $x \log a^x$
97. $\frac{2}{3!} + \frac{4}{5!} + \frac{6}{7!} + \frac{8}{9!} + \dots =$
a) e^{-1} b) $\frac{3e}{2}$ c) e^2 d) $e - 1$
98. The term independence of x in the expansion of $\left(\frac{3x^2}{2} - \frac{1}{3x} \right)^9$ is
a) 5th term b) 6th term c) 7th term d) 8th term
99. The value of $\sin^{-1} x + \cos^{-1} x$ is
a) $\frac{\pi}{2}$ b) $\frac{\pi}{3}$ c) $\frac{\pi}{4}$ d) 0
100. The function $f(x) = \frac{1}{x}$ is discontinuous in the interval
a) $[-1, 1]$ b) $[2, 3]$ c) $(0, \infty)$ d) $(-\infty, -1)$
-