No. of Printed Pages : **16**

SCIENCE OLYMPIAD 2011

07671

TIER-I TEST

(August 21, 2011)

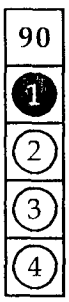
Total time : 3 hrs

Read the Following Instructions

1. Write only your Registration Number (Not your name) in the box provided in the OMR (Optical Marking Response) sheet.
2. Use only a H.B. pencil for darkening the circle, as your answers (to the Multiple Choice Questions) in the OMR sheet. Any erasing shall be done only with a soft eraser.
3. Do not mutilate/tear this OMR sheet.
4. Note that there are **eighty (80)** questions, each with four choices in this test paper, spread over **16 pages**. Question paper also has two blank sheets of paper for any rough work.
5. Select the correct answer for each question and shade only one appropriate box in the OMR sheet for the corresponding question.

   (eg.) Qn.No.90. Tiger has on its body,

   (1) Stripes; (2) black dots; (3) white dots; (4) none of the above



6. In the OMR sheet mark your chosen answer, **only** like • as shown above but not in any other form such as ⊗ ∅ ⊕ (In other words, the circle must be fully shaded).
7. Each **correct** answer carries **four** marks.
8. **One mark** will be **deducted** for every **incorrect** answer.
9. Use of calculators/log tables is prohibited.
10. Return the OMR sheet **alone** after you have completed the test.
11. Again check your registration number for its correctness.

GOOD LUCK!!!

1. The number of chromosomes in a human sperm is :
(1) 33 (2) 21 (3) 23 (4) 42

2. The form of sugar transported through phloem is :
(1) Glucose (2) Fructose (3) Sucrose (4) ribose

3. One of the following is **not** a viral disease :
(1) Poliomyelitis (2) Chicken pox (3) Rabies (4) Typhoid

4. The synthesis of DNA on RNA template is called :
(1) translation (2) transcription
(3) reverse transcription (4) transactivation

5. A goitrogen among the following is :
(1) thyroglobulin (2) prolactin (3) phlorizin (4) thiouracil

6. Maximum efficiency in usable energy is obtained during :
(1) aerobic respiration in amoeba (2) fermentation in yeast cell
(3) glycolysis in the liver cell (4) lactic acid formation in skeletal muscle

7. One of the following cells in our blood secretes histamine :
(1) eosinophils (2) basophils (3) lymphocytes (4) platelets

8. A non infectious disease among the following is :
(1) Malaria (2) Peptic ulcer
(3) Phenylketonuria (4) Cervical cancer

9. Which part of visible light is most effective in photosynthesis ?
(1) Red (2) Green (3) Blue (4) Violet

10. Down syndrome in humans is the result of trisomy of chromosome number :
(1) 21 (2) 18 (3) 13 (4) 22

11. The stem of the tropical grass bamboo, made almost of cellulose fiber, can grow at the rate of 30 cm/day. If each glucose unit is 4.5 Angstroms, the number of glucose units added per day would be approximately about :
(1) 3 billion (2) 2/3 billion (3) 1 billion (4) 1/4 billion

12. Which of the following combinations of chromosome number(N) and DNA content(C) is true for the diplotene stage of a mammalian oocyte ?

(1) 1N and 2C (2) 2N and 2C (3) 1N and 4C (4) 2N and 4C

13. Which of the following dyes is best suited for staining chromosomes ?

(1) Safranin (2) Methylene blue

(3) Carmine (4) Basic fuchsin

14. Metabolite transport across cell membrane occurs by various means as listed below. Which of them is **not** affected by inhibitors of cellular respiration ?

(1) Active transport (2) Facilitated diffusion

(3) Passive diffusion (4) Receptor mediated endocytosis

15. Glycogen is a homopolymer made of :

(1) Glucose units (2) Amino acids (3) Ribose units (4) Galactose units

16. The vitamin present in Rhodopsin is :

(1) Vitamin B (2) Vitamin C (3) Vitamin D (4) Vitamin A

17. Which of the following is oviparous ?

(1) Flying fox (2) Platypus (3) Elephant (4) Whale

18. Endosperm, a product of double fertilization in angiosperms is absent in the seeds of :

(1) Gram (2) Orchids (3) Maize (4) Castor

19. Life originated on earth probably about :

(1) 4.5 billion years ago (2) 1.0 billion years ago

(3) 3.5 billion years ago (4) 0.5 billion years ago

20. A piece of wood having no vessels(trachea) must be belonging to :

(1) Pine (2) Mango (3) Teak (4) Palm

21. A nugget of gold and quartz weighs 150 grams. The densities of gold, quartz and the nugget are determined to be 19.5, 2.75 and 6.5 g/cm^3 respectively. The mass of gold in the nugget is :

(1) 50 g (2) 140 g (3) 100.7 g (4) 75 g

22. Consider the two compounds benzene (C_6H_6) and acetylene (C_2H_2). The percentage composition of each element in both these compounds is :

(1) the same

(2) dependent on temperature

(3) higher in benzene than in acetylene

(4) lower in benzene than in acetylene

23. The ionic radii of sulphide (S^{2-}) and telluride (Te^{2-}) are 1.84 and 2.21Å respectively. The ionic radius of selenide (Se^{2-}) will be :

(1) greater than that of telluride (Te^{2-})

(2) smaller than that of sulphide (S^{2-})

(3) approximately the arithmetic average of sulphide (S^{2-}) and telluride (Te^{2-})

(4) equal to that of telluride.

24. CsCl crystallizes in a body centered configuration. The number of formula units and the coordination number of each type ion are :

(1) 4, 4 (2) 4, 8 (3) 1, 8 (4) 2, 8

25. The condition to be satisfied for the photoelectric emission of an electron from a clean metal surface is :

(1) the metal must be at a high temperature

(2) the energy of the photon striking the metal surface must be less than the kinetic energy of the emitted electron

(3) the energy of the photon striking the metal surface must be equal to the kinetic energy of the emitted electron

(4) the energy of the photon striking the metal surface must be greater than or equal to that of the kinetic energy emitted electron plus the binding energy holding the electron in the metal

26. Which of the following sets of quantum numbers is **not** allowed- for an electron in a hydrogen atom ?

(1) $n=5,\ l=2,\ m=0$ (2) $n=3,\ l=2,\ m=3$

(3) $n=4,\ l=3,\ m=-2$ (4) $n=2,\ l=1,\ m=1$

27. When an electron of charge e and mass m moves with a speed v around a nucleus of charge Ze, in a circular orbit of radius r the potential energy of the electron is given by :

(1) Ze^2/r (2) $-Ze^2/r$ (3) Ze^2/r^2 (4) Ze^2/mvr

28. Which of the following elements is expected to have the lowest ionization potential ?

(1) Sr (2) Xe (3) S (4) F

29. The molecule that has the highest percentage of ionic character among the following is :

(1) HI (2) HF (3) HCl (4) HBr

30. $C_2H_2Cl_2$ exhibits cis-trans isomerism. Which isomer will have a dipole moment ?

(1) trans isomer (2) cis isomer

(3) both isomers (4) neither of the isomers

31. The equilibrium constant for the following chemical reaction

$3A + 2B \rightleftharpoons 2C + D$ is :

(1) [C][D]/[A][B] (2) [2C][D]/[3A][2B]

(3) $[C]^2[D]/[A]^3[B]^2$ (4) $[C][D]^2/[A]^2[B]^3$

32. The mass numbers of hydrogen and helium are 1 and 4 respectively. The ratio of diffusion constant of He to that of H_2 molecule is :

(1) 2 (2) $\frac{1}{2}$ (3) $1/\sqrt{2}$ (4) $\frac{1}{4}$

33. The oxidation state of iron in $Fe_2(CO)_9$ is :

(1) 4.5 (2) 4 (3) 3 (4) 0

34. The specific heat of Platinum (At. Weight=195) is 0.0307 cal/g °C. The molar heat capacity of Pt is approximately :

(1) 6 cal/mol °C (2) 6300 cal/mol °C

(3) 12 cal/mol °C (4) 4.2 cal/mol °C

35. In the reaction $H_2O_2 + I_2 \rightarrow 2I^- + O_2 + 2H^+$

(1) both H_2O_2 and I_2 are oxidized

(2) both H_2O_2 and I_2 are reduced

(3) H_2O_2 is reduced and I_2 is oxidized

(4) H_2O_2 is oxidized and I_2 is reduced

36. Which among the following has the smallest ionic radius ?

(1) Li^+ (2) Be^{2+} (3) Mg^{2+} (4) Na^+

37. What percentage of the reactant will be left at the end of 30 hours for a first order reaction with a half-life of 5 hrs ?

(1) 25.00 (2) 12.50 (3) 6.25 (4) 1.56

38. Which of the following gases is most soluble in water at ambient conditions ?
(1) Helium (2) Hydrogen (3) Oxygen (4) Nitrogen

39. Which of the following organic compounds has the shortest carbon-carbon bond length ?
(1) C_2H_5OH (2) C_2H_6 (3) C_2H_4 (4) C_2H_2

40. The element that does not impart any color to Bunsen flame when held in it is :
(1) Be (2) Ca (3) Sr (4) Ba

41. Which of the following numbers is **not** irrational ?
(1) π (2) $\sqrt{2}$ (3) $\sqrt{3}$ (4) $\sqrt{4}$

42. The mean of four positive integers 10, 21, 32 and an unknown number is given to be 18. The unknown number has to be :
(1) greater than the mean (2) equal to the mean
(3) half of the mean (4) one third of the mean

43. The sum of the first n natural numbers is found to be 5151. Then the value of n is :
(1) 500 (2) 101 (3) 51 (4) 510

44. The last digit of 3^{2011} is (i.e., the units place) :
(1) 1 (2) 3 (3) 7 (4) 9

45. A cylinder has a radius of 5 cm and height of 8 cm. If another cylinder with a radius of 5/2 cm has the same surface area, then the height of that cylinder is :
(1) 47/2 cm (2) 16 cm (3) 64 cm (4) $\sqrt{8}$ cm

46. Five positive integers are in arithmetic progression and their sum is 35. Then :
(1) the first term has to be odd
(2) the second term has to be even
(3) the third term has to be a multiple of 5
(4) the last term has to be less than 10

47. If ax^2+bx+c is a quadratic polynomial where the coefficients a, b, c are positive integers then :
(1) no root can be an integer (2) no root can be imaginary
(3) both roots can be negative (4) both roots can be positive

48. When the polynomial x^3-3x^2+5x+k is divided by the polynomial x^2-1, the remainder is found to be $6x+1$. Then the value of k is :

(1) 4 (2) 0 (3) 1 (4) -2

49. From a point P outside a circle with centre O, it is found that the length of a tangent from P is 1 cm less than the length of OP. If the radius of the circle is 7 cm. find the length of OP

(1) 7 cm (2) 27 cm (3) 25 cm (4) 24 cm

50. A point (x, y) is equidistant from (3,6) and $(-3,4)$. It also lies on the line $x+y=1$. Then its distance from the origin is :

(1) 5 (2) 21 (3) 35 (4) $\sqrt{5}$

51. It is found that the volume of the frustum of a cone is two-thirds of the volume of the full cone. Then the two radii $r_1 < r_2$ should satisfy :

(1) $r_1=\frac{2}{3}r_2$ (2) $r_1^3=\frac{2}{3}r_2^3$ (3) $r_1^3=\frac{1}{3}r_2^3$ (4) $r_1^2=\frac{1}{2}r_2^2$

52. If $x^2+(k+1)xy+ky^2+x+y=0$ is the equation to a pair of parallel straight lines, then the value of k is :

(1) zero (2) 2 (3) -1 (4) 1

53. The statement "If a horse is black, then it is strong" is equivalent to :

(1) If a horse is strong, then it is black
(2) If a horse is not black, then it is not strong
(3) If a horse is not strong, then it is not black
(4) If a horse is weak, then it is white

54. In an isosceles triangle ABC with $AB=AC=10$ cm and $\angle B=30°$, then $BC=$

(1) 5 (2) $5\sqrt{3}$ (3) $10\sqrt{3}$ (4) $10\sqrt{2}$

55. The largest value of r for which x^2+x+r has a real root is :

(1) ½ (2) ¼ (3) 0 (4) 1

56. If the area of a triangle whose vertices are (0,0), (1,0) and (x, y) is 1, then :

(1) x has to be 1 (2) y has to be 2 (3) x has to be 2 (4) y has to be 1

57. The probability that a number strictly between 10 and 100 is divisible by 3 is :

(1) 1/3 (2) 30/89 (3) 31/90 (4) 1/30

58. The maximum value of $\sin\theta \cos\theta$ is :

(1) $\frac{1}{2}$ (2) 1 (3) 2 (4) $\sqrt{3}$

59. In a triangle ABC if the angles are in the ratio 1 : 1 : 2 then the triangle is :

(1) isosceles but not right angled (2) right angled but not isosceles

(3) right angled and isosceles (4) neither right angled nor isosceles

60. The area of a triangle whose sides are a, b, c is :

(1) $\frac{1}{4}\sqrt{(a+b+c)(a+b-c)(b+c-a)(c+a-b)}$

(2) $\frac{1}{2}(ab+bc+ca)$

(3) $(a+b+c)^2$

(4) $\sqrt{(a+b)(b+c)(c+a)(a+b+c)}$

61. A particle is moving in a circular orbit at a constant speed under the influence of a central force. Which of the following statements is correct ?

(1) The net force on the particle must be zero.

(2) The particle has no acceleration.

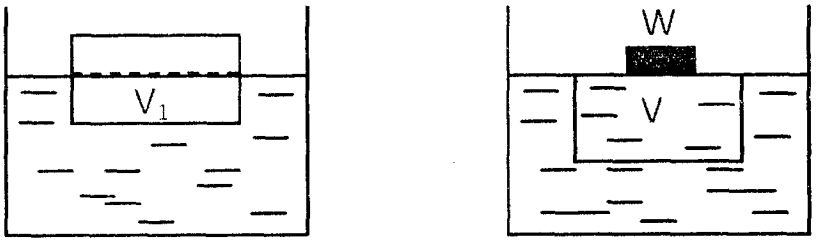
(3) There must also be a force on the particle that is always tangential to its path.

(4) The particle has an acceleration that is always directed towards the centre of its orbit.

62. Two cyclists A and B start from rest at a point O on a straight road. Cyclist A accelerates uniformly (acceleration = a) for a time T/2, and then decelerates uniformly (acceleration = $-$a) for a time T/2. Cyclist B accelerates uniformly (acceleration = a/2) for a time T. At time T, the distances covered by A and B are S_A and S_B, respectively. Then :

(1) $S_A = 2S_B$ (2) $S_A = S_B$ (3) $S_A = \frac{1}{2} S_B$ (4) $S_A = \frac{1}{4} S_B$

63. A brick-shaped block of wood (density d) of volume V is floating in water (density ρ). A volume V_1 of the block is submerged. A heavy paperweight (weight W) is placed on top of the block, so as to just submerge it fully.



If g is the acceleration due to gravity, then W is equal to :

(1) $d(V - V_1)\, g$ (2) $\rho(V - V_1)\, g$

(3) $(\rho - d)\,(V - V_1)\, g$ (4) $\rho V g$

64. A particle of mass m and charge q is moving in a circular orbit of radius r under the influence of a constant, uniform magnetic field of magnitude B. The time period of revolution of the particle is :

(1) independent of r (2) proportional to r

(3) proportional to r^2 (4) proportional to $1/r^2$

65. Continuing question (64), which of the following statements is correct ?

(1) The kinetic energy of the particle increases with time.

(2) The kinetic energy of the particle decreases with time.

(3) The radius r of the orbit decreases with time.

(4) The magnetic field does no work on the particle, even though it exerts a force on the particle.

66. A point charge q is rigidly fixed at each vertex of an equilateral triangle. A movable charge Q, placed at the centre of the triangle, is in :

(1) stable equilibrium for any value of $Q \neq 0$

(2) stable equilibrium only if q and Q have opposite signs

(3) stable equilibrium only if $Q = -3q$

(4) unstable equilibrium for any value of $Q \neq 0$.

67. Persons A, B, C and D are initially located at the four consecutive corners of a square of side L and centre O. At $t = 0$, they start walking at a constant speed v. The velocity of A is always directed towards the instantaneous position of B, that of B is directed towards C, that of C is directed towards D, and that of D is directed towards A. The four persons :

(1) will meet at O at time L / (4v)

(2) will meet at O at time L / v

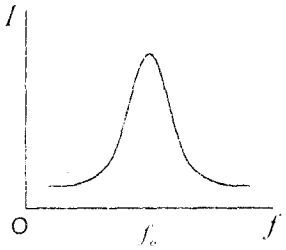
(3) will never meet at any finite time

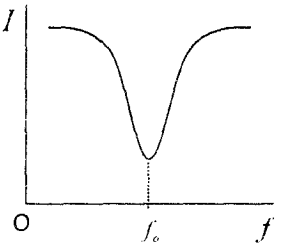
(4) move in paths that are arcs of circles

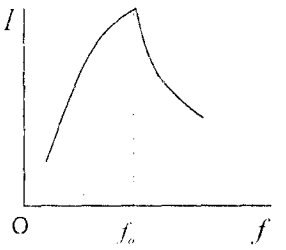
68. A beam of light comprises light of many frequencies. The intensity I of the light, as a formation of its frequency f, is found to be given by the formula

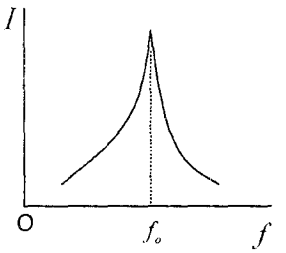
$I(f) = a/[\,b + (f - f_0)^2\,]$

where a, b and f_0 are positive constants. The graph of I versus f is best represented by

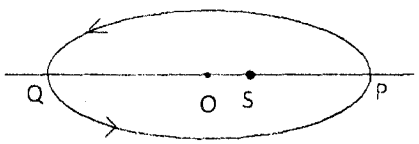
(1) 

(2) 

(3) 

(4) 

69. A planet moves around the sun S in an elliptical orbit as shown in the figure. P and Q are the closest and most distant points on its orbit. O is the centre of the ellipse.
Let OS = f and OP = a.

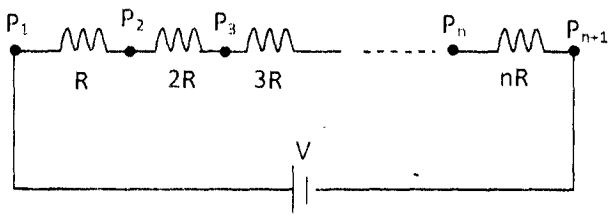


If v_p and v_q are the respective speeds of the planet at P and Q, then v_p/v_q is equal to

(1) a / f (2) f / a

(3) $(a-f) / (a+f)$ (4) $(a+f) / (a-f)$

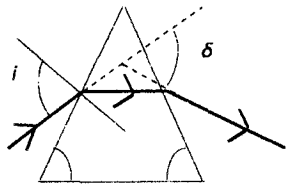
70. Resistances R, 2R, ..., nR are connected between the points P_1, P_2, ..., P_{n+1} as shown.



A battery of EMF V is used to close the circuit. The internal resistance of the battery is negligible compared to R. The voltage drop between the points P_1 and P_2 is :

(1) V/(n) (2) V/(n+1) (3) V/n(n−1) (4) 2V/n(n+1)

71. A ray of light falls on an isosceles glass prism and emerges from it on the other side as shown in the figure. As the angle of incidence i is increased, the angle of deviation δ of the ray



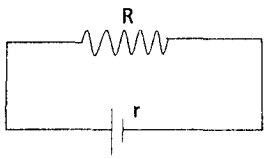
(1) decreases monotonically

(2) decreases to a minimum and then increases

(3) increases monotonically

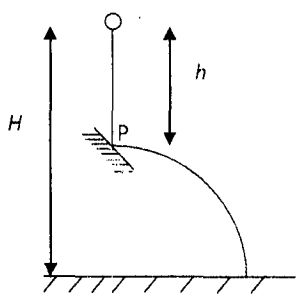
(4) increases to a maximum and then decreases

72. A resistance R is connected to a battery supplying a constant EMF $\mathcal{E}$, and a steady current flows through the circuit. The internal resistance of the battery is r. The power dissipated in the resistor R due to Ohmic heating is given by :



(1) $\mathcal{E}^2/R$ (2) $\mathcal{E}^2/(R+r)$ (3) $\mathcal{E}^2 r/(R+r)^2$ (4) $\mathcal{E}^2 R/(R+r)^2$

73. A ball is dropped from a height H above the ground. After dropping a distance h ($0 < h < H$), it hits an inclined plane at the point P, and bounces off the plane with a horizontal velocity. The total time it takes to hit the ground is :



(1) $\sqrt{2H/g}$ for any value of h (2) $\sqrt{2(H-h)/g}$

(3) maximum when $h = H/2$ (4) minimum when $h = H/2$

74. An object is weighed in a spring balance. When weighed at the North Pole and the equator, respectively, its weights are W_p and W_e. :

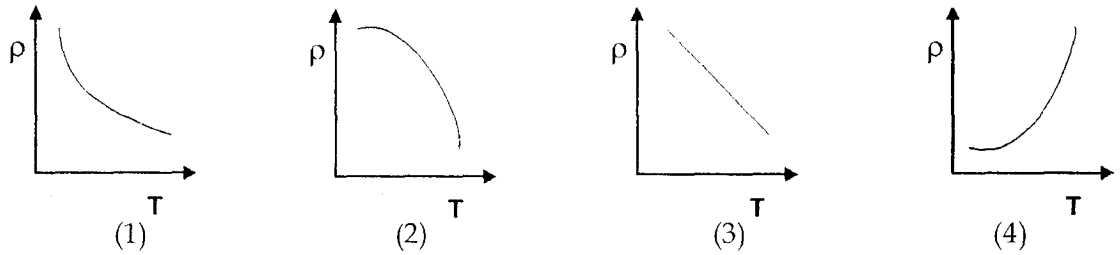
(1) $W_p > W_e$, solely because of the slight flattening of the earth at the poles.

(2) $W_p < W_e$ because of the centripetal acceleration due to the rotation of the earth.

(3) $W_p = W_e$ because the effect of the flattening at the poles is compensated by that of the centripetal acceleration due to the rotation of the earth.

(4) $W_p > W_e$, both because of the slight flattening of the earth at the poles and the centripetal acceleration at the equator due to the rotation of the earth.

75. A fixed amount of an ideal gas expands as its temperature is increased. The gas is maintained at constant pressure. Which graph best describes its density ρ as a function of its temperature T ?



(1) (2) (3) (4)

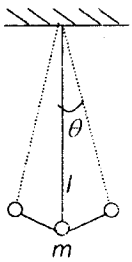
76. A coin lies at the bottom of a water tank. The depth of the water (refractive index = μ) is *h*. When viewed from above, roughly along the vertical direction, the apparent depth of the coin below the water surface is :

(1) h/μ (2) $h/\sqrt{\mu}$ (3) $h/\sqrt{1+\mu^2}$ (4) $h/(1+\mu)$

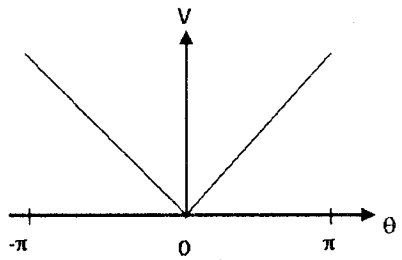
77. An ideal gas in a container of volume V is at a pressure P. The container is connected to a pump of volume v. At each complete stroke of the pump, the pressure in the container drops. Assuming that the temperature of the gas remains constant throughout, the pressure in the container after n strokes of the pump is given by :

(1) $P\left(\frac{V}{V+v}\right)^n$ (2) $P\left(\frac{V}{V-v}\right)^n$ (3) $P\left(\frac{V-v}{V}\right)^n$ (4) $P\left(\frac{V-v}{V+v}\right)^n$

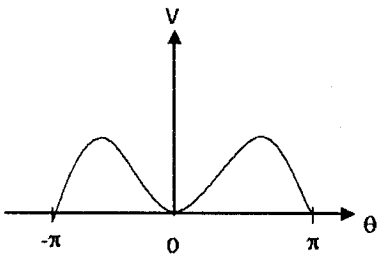
78. A pendulum consists of a light, massless rigid rod with a heavy bob of mass m attached to its lower end. The angular displacement of the rod from the vertical is denoted by θ. The potential energy $V(\theta)$ of the bob is taken to be zero when $\theta = 0$. The graph of $V(\theta)$ versus θ is :



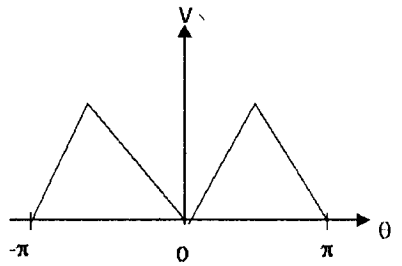
(1)



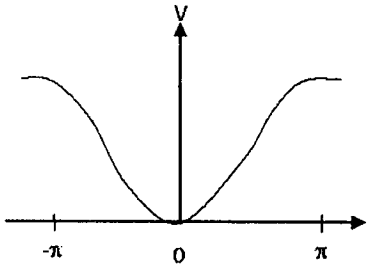
(2)



(3)



(4)



79. A travelling transverse wave of frequency f and wavelength l propagates along a string in the positive x direction. Which expression describes the displacement $u\ (x, t)$ of the string at the point x at time t ?

(1) $u(x,t) = A\cos 2\pi \left(ft - \frac{x}{l} \right)$

(2) $u(x,t) = A\cos 2\pi \left(fx - lt \right)$

(3) $u(x,t) = A\sin(2\pi ft)\ \cos \left(\frac{2\pi x}{l} \right)$

(4) $u(x,t) = A\cos 2\pi \left(\frac{x}{l} + ft \right)$

80. A stone is tied to one end of an inextensible string, and whirled around in a vertical circular path at a constant speed. Which of the following statements is correct ?

(1) The total energy of the stone varies with time.

(2) The tension of the string remains constant in time.

(3) The tension of the string varies with time.

(4) The acceleration of the stone vanishes except when the stone is at its highest or lowest point in its path.

- o 0 o -