

Test Booklet Code

ABC

No.: 5168499

This Booklet contains 20 pages.

G

Do not open this Test Booklet until you are asked to do so.

**Important Instructions :**

1. The Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on **side-1** and **side-2** carefully with **blue/black** ball point pen only.
2. The test is of **3 hours** duration and Test Booklet contains **180** questions. Each question carries **4** marks. For each correct response, the candidate will get **4** marks. For each incorrect response, **one mark** will be deducted from the total scores. The maximum marks are **720**.
3. Use **Blue/Black Ball Point Pen only** for writing particulars on this page/ marking responses.
4. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
5. **On completion of the test, the candidate must handover the Answer Sheet to the invigilator before leaving the Room/Hall. The candidates are allowed to take away this Test Booklet with them.**
6. The CODE for this Booklet is **G**. Make sure that the CODE printed on **Side-2** of the Answer Sheet is the same as that on this Booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your roll no. anywhere else except in the specified space in the Test Booklet/ Answer Sheet.
8. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
9. Each candidate must show on demand his/her Admission Card to the Invigilator.
10. No candidate, without special permission of the Superintendent or Invigilator, would leave his/her seat.
11. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign the Attendance Sheet twice. Cases where a candidate has not signed the Attendance Sheet second time will be deemed not to have handed over Answer Sheet and dealt with as an unfair means case.
12. Use of Electronic/Manual Calculator is prohibited.
13. The candidates are governed by all Rules and Regulations of the Board with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of the Board.
14. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
15. The candidates will write the Correct Test Booklet Code as given in the Test Booklet/ Answer Sheet in the Attendance Sheet.

SEAL

1. Leaves become modified into spines in:

- (1) *Milk thistle*
- (2) *Cycas*
- (3) *Pea*
- (4) *Cactus*

2. Vertical distribution of different species occupying different levels in a biotic community is known as:

- (1) Pyramid
- (2) Divergence
- (3) Stratification
- (4) Zonation

3. Transpiration and root pressure cause water to rise in plants by:

- (1) pushing and pulling it, respectively
- (2) pulling it upward
- (3) pulling and pushing it, respectively
- (4) pushing it upward

4. Gene regulation governing lactose operon of *E. coli* that involves the lac I gene product is:

- (1) Feedback inhibition because excess of  $\beta$ -galactosidase can switch off transcription
- (2) Positive and inducible because it can be induced by lactose
- (3) negative and inducible because repressor protein prevents transcription.
- (4) negative and repressible because repressor protein prevents transcription

5. High value of BOD (Biochemical Oxygen Demand) indicates that:

- (1) consumption of organic matter in the water is higher by the microbes
- (2) water is pure
- (3) water is highly polluted
- (4) water is less polluted

6. Which one of the following matches is correct?

(1) <i>Agaricus</i>	Parasitic fungus	Basidiomycetes
(2) <i>Phytophthora</i>	Aseptate mycelium	Basidiomycetes
(3) <i>Alternaria</i>	Sexual reproduction absent	Deuteromycetes
(4) <i>Mucor</i>	Reproduction by Conjugation	Ascomycetes

7. Which of these is **not** an important component of initiation of parturition in humans?

- (1) Release of prolactin
- (2) Increase in estrogen and progesterone ratio
- (3) Synthesis of prostaglandins
- (4) Release of oxytocin

8. A chemical signal that has both endocrine and neural roles is:

- (1) Cortisol
- (2) Melatonin
- (3) Calcitonin
- (4) Epinephrine

9. Match each disease with its correct type of vaccine:

- |                    |                        |
|--------------------|------------------------|
| (a) tuberculosis   | (i) harmless virus     |
| (b) whooping cough | (ii) inactivated toxin |
| (c) diphtheria     | (iii) killed bacteria  |
| (d) polio          | (iv) harmless bacteria |

- |           |       |       |       |
|-----------|-------|-------|-------|
| (a)       | (b)   | (c)   | (d)   |
| (1) (i)   | (ii)  | (iv)  | (iii) |
| (2) (ii)  | (i)   | (iii) | (iv)  |
| (3) (iii) | (ii)  | (iv)  | (i)   |
| (4) (iv)  | (iii) | (ii)  | (i)   |

10. Nuclear envelope is a derivative of:

- (1) Rough endoplasmic reticulum
- (2) Smooth endoplasmic reticulum
- (3) Membrane of Golgi complex
- (4) Microtubules

11. The crops engineered for glyphosate are resistant/tolerant to:

- (1) Herbicides
- (2) Fungi
- (3) Bacteria
- (4) Insects

12. Vascular bundles in monocotyledons are considered closed because:

- (1) Xylem is surrounded all around by phloem
- (2) A bundle sheath surrounds each bundle
- (3) Cambium is absent
- (4) There are no vessels with perforations

13. Read the following five statements (A to E) and select the option with **all correct** statements:

- (A) Mosses and Lichens are the first organisms to colonise a bare rock.
- (B) *Selaginella* is a homosporous pteridophyte.
- (C) Coralloid roots in *Cycas* have VAM.
- (D) Main plant body in bryophytes is gametophytic, whereas in pteridophytes it is sporophytic.
- (E) In gymnosperms, male and female gametophytes are present within sporangia located on sporophyte.

- (1) (B), (C) and (E)
- (2) (A), (C) and (D)
- (3) (B), (C) and (D)
- (4) (A), (D) and (E)

17. This nucleus is absent in :
- (1) *Volvox*
  - (2) *Anabaena*
  - (3) *Mucor*
  - (4) *Vaucheria*
18. Which one of the following statements is **not** true ?
- (1) Honey is made by bees by digesting pollen collected from flowers
  - (2) Pollen grains are rich in nutrients, and they are used in the form of tablets and syrups
  - (3) Pollen grains of some plants cause severe allergies and bronchial afflictions in some people
  - (4) The flowers pollinated by flies and bats secrete foul odour to attract them
19. Removal of proximal convoluted tubule from the nephron will result in :
- (1) No urine formation
  - (2) More diluted urine
  - (3) More concentrated urine
  - (4) No change in quality and quantity of urine
20. A gymnast is able to balance his body upside down even in the total darkness because of :
- (1) Organ of Corti
  - (2) Cochlea
  - (3) Vestibular apparatus
  - (4) Tectorial membrane
21. The hilum is a scar on the :
- (1) Seed, where micropyle was present
  - (2) Seed, where funicle was attached
  - (3) Fruit, where it was attached to pedicel
  - (4) Fruit, where style was present
22. Which one of the following is **correct** ?
- (1) Blood = Plasma + RBC + WBC + Platelets
  - (2) Plasma = Blood - Lymphocytes
  - (3) Serum = Blood + Fibrinogen
  - (4) Lymph = Plasma + RBC + WBC
23. The guts of cow and buffalo possess :
- (1) Cyanobacteria
  - (2) *Fucus* spp.
  - (3) *Chlorella* spp.
  - (4) Methanogens
24. Which one of the following may require pollinators, but is genetically similar to autogamy ?
- (1) Cleistogamy
  - (2) Geitonogamy
  - (3) Xenogamy
  - (4) Apogamy
25. In sea urchin DNA, which is double stranded, 17% of the bases were shown to be cytosine. The percentages of the other three bases expected to be present in this DNA are :
- (1) G 8.5%, A 50%, T 24.5%
  - (2) G 34%, A 24.5%, T 24.5%
  - (3) G 17%, A 16.5%, T 32.5%
  - (4) G 17%, A 33%, T 33%
26. Capacitation refers to changes in the :
- (1) sperm after fertilization
  - (2) sperm before fertilization
  - (3) ovum before fertilization
  - (4) ovum after fertilization
27. Which of the following had the smallest brain capacity ?
- (1) *Homo habilis*
  - (2) *Homo erectus*
  - (3) *Homo sapiens*
  - (4) *Homo neanderthalensis*
28. Which of the following viruses is **not** transferred through semen of an infected male ?
- (1) Ebola virus
  - (2) Hepatitis B virus
  - (3) Human immunodeficiency virus
  - (4) Chikungunya virus
29. A major characteristic of the monocot root is the presence of :
- (1) Cambium sandwiched between phloem and xylem along the radius
  - (2) Open vascular bundles
  - (3) Scattered vascular bundles
  - (4) Vasculature without cambium
30. Blood pressure in the mammalian aorta is maximum during :
- (1) Diastole of the right atrium
  - (2) Systole of the left atrium
  - (3) Diastole of the right ventricle
  - (4) Systole of the left ventricle
31. In Bt cotton, the Bt toxin present in plant tissue as pro-toxin is converted into active toxin due to :
- (1) presence of conversion factors in insect gut
  - (2) alkaline pH of the insect gut
  - (3) acidic pH of the insect gut
  - (4) action of gut micro-organisms

29. In an ecosystem the rate of production of organic matter during photosynthesis is termed as :
- (1) Net productivity
  - (2) Net primary productivity
  - (3) Gross primary productivity
  - (4) Secondary productivity
30. In a ring girdled plant :
- (1) Neither root nor shoot will die
  - (2) The shoot dies first
  - (3) The root dies first
  - (4) The shoot and root die together
31. Erythropoiesis starts in :
- (1) Red bone marrow
  - (2) Kidney
  - (3) Liver
  - (4) Spleen
32. Keel is the characteristic feature of flower of :
- (1) Tomato
  - (2) Tulip
  - (3) *Indigofera*
  - (4) *Aloe*
33. In which of the following gametophyte is not independent free living ?
- (1) *Pinus*
  - (2) *Funaria*
  - (3) *Marchantia*
  - (4) *Pteris*
34. The structures that are formed by stacking of organized flattened membranous sacs in the chloroplasts are :
- (1) Stroma
  - (2) Cristae
  - (3) Grana
  - (4) Stroma lamellae
35. Which of the following does not favour the formation of large quantities of dilute urine ?
- (1) Atrial-natriuretic factor
  - (2) Alcohol
  - (3) Caffeine
  - (4) Renin
36. DNA is not present in :
- (1) Mitochondria
  - (2) Chloroplast
  - (3) Ribosomes
  - (4) Nucleus

37. Which of the following are the important floral rewards to the animal pollinators ?
- (1) Protein pellicle and stigmatic exudates
  - (2) Colour and large size of flower
  - (3) Nectar and pollen grains
  - (4) Floral fragrance and calcium crystals
38. Which of the following represents the correct combination without any exception ?

	Characteristics	Class
<input checked="" type="checkbox"/> (1)	Body covered with feathers; skin moist and glandular; fore-limbs form wings; lungs with air sacs	Aves
<input checked="" type="checkbox"/> (2)	Mammary gland; hair on body; pinnae; two pairs of limbs	Mammalia
<input checked="" type="checkbox"/> (3)	Mouth ventral; gills without operculum; skin with placoid scales; persistent notochord	Chondrichthyes
<input checked="" type="checkbox"/> (4)	Suckling and circular mouth; jaws absent; integument without scales; paired appendages	Cyclostomata

39. Alleles are :
- (1) heterozygotes
  - (2) different phenotype
  - (3) true breeding homozygotes
  - (4) different molecular forms of a gene
40. Hysterectomy is surgical removal of :
- (1) Mammary glands
  - (2) Uterus
  - (3) Prostate gland
  - (4) Vas-deference
41. The UN Conference of Parties on climate change in the year 2011 was held in :
- (1) Qatar
  - (2) Poland
  - (3) South Africa
  - (4) Peru
42. HIV that causes AIDS, first starts destroying :
- (1) Thrombocytes
  - (2) B-Lymphocytes
  - (3) Leucocytes
  - (4) Helper T - Lymphocytes

Which one of the following statements is **wrong** ?

- (1) Mannitol is stored food in Rhodophyceae
- (2) Algin and carragen are products of algae
- (3) Agar-agar is obtained from *Gelidium* and *Gracilaria*
- (4) *Chlorella* and *Spirulina* are used as space food

44. Cryopreservation of gametes of threatened species in viable and fertile condition can be referred to as :

- (1) In situ cryo-conservation of biodiversity
- (2) In situ conservation of biodiversity
- (3) Advanced ex-situ conservation of biodiversity
- (4) In situ conservation by sacred groves

45. Select the **correct** matching in the following pairs :

- (1) Rough ER – Oxidation of fatty acids
- (2) Smooth ER – Oxidation of phospholipids
- (3) Smooth ER – Synthesis of lipids
- (4) Rough ER – Synthesis of glycogen

46. Secondary Succession takes place on/in :

- (1) Newly cooled lava
- (2) Bare rock
- (3) Degraded forest
- (4) Newly created pond

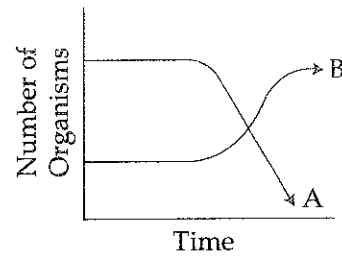
47. Which of the following is **not** a sexually transmitted disease ?

- (1) Encephalitis
- (2) Syphilis
- (3) Acquired Immuno Deficiency Syndrome (AIDS)
- (4) Trichomoniasis

48. The movement of a gene from one linkage group to another is called :

- (1) Crossing over
- (2) Inversion
- (3) Duplication
- (4) Translocation

49. The following graph depicts changes in two populations (A and B) of herbivores in a grassy field. A possible reason for these changes is that :



- (1) Population A consumed the members of population B
- (2) Both plant populations in this habitat decreased
- (3) Population B competed more successfully for food than population A
- (4) Population A produced more offspring than population B

50. Typical growth curve in plants is :

- (1) Parabolic
- (2) Sigmoid
- (3) Linear
- (4) Stair-steps shaped

51. Which one gives the most valid and recent explanation for stomatal movements ?

- (1) Guard cell photosynthesis
- (2) Transpiration
- (3) Potassium influx and efflux
- (4) Starch hydrolysis

52. Cytochromes are found in :

- (1) Lysosomes
- (2) Matrix of mitochondria
- (3) Outer wall of mitochondria
- (4) Cristae of mitochondria

53. Rachel Carson's famous book "Silent Spring" is related to :

- (1) Ecosystem management
- (2) Pesticide pollution
- (3) Noise pollution
- (4) Population explosion

54. Which of the following regions of the brain is incorrectly paired with its function ?

- (1) Cerebrum - calculation and contemplation ✓
- (2) Medulla oblongata - homeostatic control
- ~~(3)~~ Cerebellum - language comprehension
- (4) Corpus callosum - communication between the left and right cerebral cortices ✓

55. Which of the following characteristics is mainly responsible for diversification of insects on land ?

- (1) Eyes
- (2) Segmentation
- (3) Bilateral symmetry
- ~~(4)~~ Exoskeleton ✓

56. Sliding filament theory can be best explained as :

- ~~(1)~~ When myofilaments slide pass each other, Myosin filaments shorten while Actin filaments do not shorten ✓
- (2) When myofilaments slide pass each other Actin filaments shorten while Myosin filament do not shorten
- (3) Actin and Myosin filaments shorten and slide pass each other
- (4) Actin and Myosin filaments do not shorten but rather slide pass each other

57. Which one of the following is **not** an inclusion body found in prokaryotes ?

- ~~(1)~~ Polysome ✓
- (2) Phosphate granule
- (3) Cyanophycean granule
- (4) Glycogen granule

58. The mass of living material at a trophic level at a particular time is called :

- ~~(1)~~ Standing crop ✓
- (2) Gross primary productivity
- (3) Standing state
- (4) Net primary productivity

59. Select the correct option :

	I		II
(a)	Synapsis aligns homologous chromosomes	(i)	Anaphase-II
(b)	Synthesis of RNA and protein	(ii)	Zygotene
(c)	Action of enzyme recombinase	(iii)	G <sub>2</sub> -phase
(d)	Centromeres do not separate but chromatids move towards opposite poles	(iv)	Anaphase-I
		(v)	Pachytene

- (a) (b) (c) (d)
- ✓ (1) (ii) (iii) (iv) (v)
  - ✓ (2) (ii) (i) (iii) (iv)
  - ~~(3)~~ (ii) (iii) (v) (iv) ✓
  - (4) (i) (ii) (v) (iv)

60. Multiple alleles are present :

- (1) On non-sister chromatids
- (2) On different chromosomes
- (3) At different loci on the same chromosome
- ~~(4)~~ At the same locus of the chromosome ✓

61. Which of the following is **not** one of the prime health risks associated with greater UV radiation through the atmosphere due to depletion of stratospheric ozone ?

- ~~(1)~~ Increased liver cancer ✓
- (2) Increased skin cancer
- (3) Reduced Immune System
- (4) Damage to eyes

62. Which is the most common mechanism of genetic variation in the population of a sexually-reproducing organism ?

- ~~(1)~~ Recombination ✓
- (2) Transduction
- (3) Chromosomal aberrations
- (4) Genetic drift

63. Minerals known to be required in large amounts for plant growth include :

- (1) magnesium, sulphur, iron, zinc
- ~~(2)~~ phosphorus, potassium, sulphur, calcium ✓
- (3) calcium, magnesium, manganese, copper
- ✓ (4) potassium, phosphorus, selenium, boron

Perianth tissue is characteristic feature of :

- (1) Wet stigma
- (2) Hollow style
- (3) Solid style
- (4) Dry stigma

65. A man with blood group 'A' marries a woman with blood group 'B'. What are all the possible blood groups of their offsprings?

- (1) O only
- (2) A and B only
- (3) A, B and AB only
- (4) A, B, AB and O

66. Which of the following statements is **not correct**?

- (1) Acini are present in the pancreas and secrete carboxypeptidase
- (2) Brunner's glands are present in the submucosa of stomach and secrete pepsinogen
- (3) Goblet cells are present in the mucosa of intestine and secrete mucus
- (4) Oxyntic cells are present in the mucosa of stomach and secrete HCl.

67. Perigynous flowers are found in :

- (1) Rose
- (2) Guava
- (3) Cucumber
- (4) China rose

68. An abnormal human baby with 'XXX' sex chromosomes was born due to :

- (1) fusion of two sperms and one ovum
- (2) formation of abnormal sperms in the father
- (3) formation of abnormal ova in the mother
- (4) fusion of two ova and one sperm

69. What causes a green plant exposed to the light on only one side, to bend toward the source of light as it grows?

- (1) Auxin accumulates on the shaded side, stimulating greater cell elongation there.
- (2) Green plants need light to perform photosynthesis.
- (3) Green plants seek light because they are phototropic.
- (4) Light stimulates plant cells on the lighted side to grow faster.

70. The chromosomes in which centromere is situated close to one end are :

- (1) Sub-metacentric
- (2) Metacentric
- (3) Acrocentric
- (4) Telocentric

71. A technique of micropropagation is :

- (1) Embryo rescue
- (2) Somatic hybridization
- (3) Somatic embryogenesis
- (4) Protoplast fusion

72. A somatic cell that has just completed the S phase of its cell cycle, as compared to gamete of the same species, has :

- (1) four times the number of chromosomes and twice the amount of DNA
- (2) twice the number of chromosomes and twice the amount of DNA
- (3) same number of chromosomes but twice the amount of DNA
- (4) twice the number of chromosomes and four times the amount of DNA

73. Gastric juice of infants contains :

- (1) amylase, rennin, pepsinogen
- (2) maltase, pepsinogen, rennin
- (3) nuclease, pepsinogen, lipase
- (4) pepsinogen, lipase, rennin

74. Which of the following animals is **not** viviparous?

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

75.  $\oplus \otimes K_{(5)} C_{(5)} A_5 G_{(2)}$  is the floral formula of:

- (1) ~~Brassica~~  
 (2) ~~Allium~~  
 (3) ~~Sesbania~~  
 (4) ~~Petunia~~

76. In which of the following both pairs have correct combination?

- (1) *In situ* conservation : Tissue culture  
*Ex situ* conservation : Sacred groves  
 (2) *In situ* conservation : National Park  
*Ex situ* conservation : Botanical Garden  
 (3) *In situ* conservation : Cryopreservation  
*Ex situ* conservation : Wildlife Sanctuary  
 (4) *In situ* conservation : Seed Bank  
*Ex situ* conservation : National Park

77. Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services?

- (1) Research Committee on Genetic Manipulation  
 (2) Bio-safety committee  
 (3) Indian Council of Agricultural Research  
 (4) Genetic Engineering Approval Committee

78. Which of the following endoparasites of humans does show viviparity?

- (1) *Ascaris lumbricoides*  
 (2) *Ancylostoma duodenale*  
 (3) *Enterobius vermicularis*  
 (4) *Trichinella spiralis*

79. The terga, sterna and pleura of cockroach body are joined by:

- (1) Cartilage  
 (2) Cementing glue  
 (3) Muscular tissue  
 (4) Arthroial membrane

80. Most animals are tree dwellers in a:

- (1) tropical rain forest  
 (2) coniferous forest  
 (3) thorn woodland  
 (4) temperate deciduous forest

81. Which of the following enhances or induces fusion of protoplasts?

- (1) IAA and gibberellins  
 (2) Sodium chloride and potassium chloride  
 (3) Polyethylene glycol and sodium nitrate  
 (4) IAA and kinetin

82. Glenoid cavity articulates:

- (1) humerus with scapula  
 (2) clavicle with acromion  
 (3) scapula with acromion  
 (4) clavicle with scapula

83. A population will not exist in Hardy-Weinberg equilibrium if:

- (1) the population is large  
 (2) individuals mate selectively  
 (3) there are no mutations  
 (4) there is no migration

84. Male gametes are flagellated in:

- (1) *Spirogyra*  
 (2) *Polysiphonia*  
 (3) *Anabaena*  
 (4) *Ectocarpus*

85. When you hold your breath, which of the following gas changes in blood would first lead to the urge to breathe?

- (1) rising CO<sub>2</sub> and falling O<sub>2</sub> concentration  
 (2) falling O<sub>2</sub> concentration  
 (3) rising CO<sub>2</sub> concentration  
 (4) falling CO<sub>2</sub> concentration

86. Which of the following cells during gametogenesis is normally diploid?

- (1) Secondary polar body  
 (2) Primary polar body  
 (3) Spermatid  
 (4) Spermatogonia

87. In ginger vegetative propagation occurs through:

- (1) Runners  
 (2) Rhizome  
 (3) Offsets  
 (4) Bulbils

88. Which one of the following statements is incorrect?

- (1) The presence of the competitive inhibitor decreases the K<sub>m</sub> of the enzyme for the substrate.  
 (2) A competitive inhibitor reacts reversibly with the enzyme to form an enzyme-inhibitor complex.  
 (3) In competitive inhibition, the inhibitor molecule is not chemically changed by the enzyme.  
 (4) The competitive inhibitor does not affect the rate of breakdown of the enzyme-substrate complex.



$4vt - 2v = 0 \quad v^2 t^2 + 10000 = vt^2 - 2vt$   
 $t = \frac{2}{4v} = \frac{1}{2v}$

90. The organism *Entamoeba histolytica* feeds upon:
- (a) blood only
  - (b) erythrocytes, mucosa and submucosa of colon
  - (c) mucosa and submucosa of colon only
  - (d) food in intestine

$\frac{15}{24} = \frac{5}{8}$

91. How many pairs of contrasting characters in pea plants were studied by Mendel in his experiments?
- (a) Seven
  - (b) Five
  - (c) Six
  - (d) Eight

$4v^2 t = \frac{2v}{t}$   
 $t = \frac{1}{2v}$

91. A radiation of energy 'E' falls normally on a perfectly reflecting surface. The momentum transferred to the surface is (C = Velocity of light):

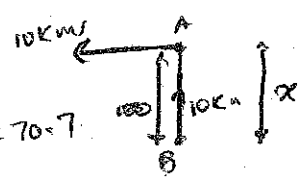
- (1)  $\frac{E}{C^2}$
- (2)  $\frac{E}{C}$
- (3)  $\frac{2E}{C}$
- (4)  $\frac{2E}{C^2}$



$x = \sqrt{t^2 + (100 - vt)^2}$   
 $2x \frac{dx}{dt} = 2vt - 2(100 - vt)(-v)$   
 $2x \frac{dx}{dt} = 2vt + 2(100 - vt)v$

92. A ship A is moving Westwards with a speed of  $10 \text{ km h}^{-1}$  and a ship B  $100 \text{ km}$  South of A, is moving Northwards with a speed of  $10 \text{ km h}^{-1}$ . The time after which the distance between them becomes shortest, is:

- (1)  $10\sqrt{2} \text{ h}$
- (2)  $0 \text{ h}$
- (3)  $5 \text{ h}$
- (4)  $5\sqrt{2} \text{ h}$



93. Three blocks A, B and C, of masses 4 kg, 2 kg and 1 kg respectively, are in contact on a frictionless surface, as shown. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is:



- (1) 18 N
- (2) 2 N
- (3) 6 N
- (4) 8 N

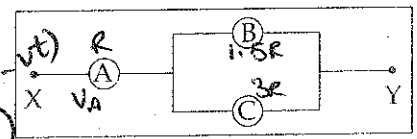
$a = 2$   
 $14 - N = 8$   
 $N = 6$   
 $2v^2 t^2 - 2vt$

94. The electric field in a certain region is acting radially outward and is given by  $E = Ar$ . A charge contained in a sphere of radius 'a' centred at the origin of the field, will be given by:

- (1)  $\epsilon_0 Aa^3$
- (2)  $4\pi\epsilon_0 Aa^2$
- (3)  $A\epsilon_0 a^2$
- (4)  $4\pi\epsilon_0 Aa^3$

$E = Ar = \frac{q}{\epsilon_0}$   
 $4\pi a^2 Aa = \frac{q}{\epsilon_0}$

95. A, B and C are voltmeters of resistance R, 1.5R and 3R respectively as shown in the figure. When some potential difference is applied between X and Y, the voltmeter readings are  $V_A$ ,  $V_B$  and  $V_C$  respectively. Then:



- (1)  $V_A \neq V_B \neq V_C$
- (2)  $V_A = V_B = V_C$
- (3)  $V_A \neq V_B = V_C$
- (4)  $V_A = V_B \neq V_C$

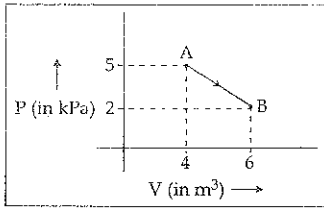
$\frac{2}{3R} + \frac{1}{3R}$

96. In a double slit experiment, the two slits are 1 mm apart and the screen is placed 1 m away. A monochromatic light of wavelength 500 nm is used. What will be the width of each slit for obtaining ten maxima of double slit within the central maximum of single slit pattern?

- (1) 0.02 mm
- (2) 0.2 mm
- (3) 0.1 mm
- (4) 0.5 mm

$d = 1 \text{ mm}$   
 $D = 1 \text{ m}$   
 $\frac{2}{10^{-3}} = \frac{10^3 d}{10^3}$

97. One mole of an ideal diatomic gas undergoes a transition from A to B along a path AB as shown in the figure,



The change in internal energy of the gas during the transition is :

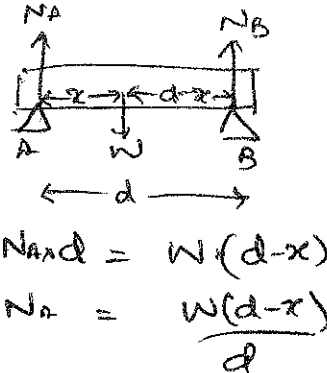
- (1) -12 kJ
- (2) 20 kJ
- (3) -20 kJ
- (4) 20 J

$$\Delta U = n C_v \Delta T = \frac{\Delta(PV)}{\gamma - 1}$$

$$= \frac{2 \times 5 - 6 \times 2}{2 - 1} = -8 \times 5 = -40 \text{ kJ}$$

98. A rod of weight  $W$  is supported by two parallel knife edges A and B and is in equilibrium in a horizontal position. The knives are at a distance  $d$  from each other. The centre of mass of the rod is at distance  $x$  from A. The normal reaction on A is :

- (1)  $\frac{W(d-x)}{d}$
- (2)  $\frac{Wx}{d}$
- (3)  $\frac{Wd}{x}$
- (4)  $\frac{W(d-x)}{x}$



99. Kepler's third law states that square of period of revolution ( $T$ ) of a planet around the sun, is proportional to third power of average distance  $r$  between sun and planet  
i.e.  $T^2 = Kr^3$   
here  $K$  is constant.

If the masses of sun and planet are  $M$  and  $m$  respectively then as per Newton's law of gravitation force of attraction between them is

$$F = \frac{GMm}{r^2}, \text{ here } G \text{ is gravitational constant}$$

The relation between  $G$  and  $K$  is described as :

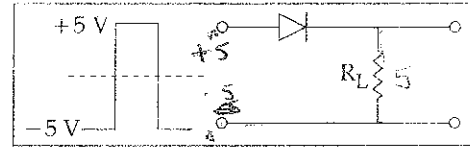
- (1)  $K = \frac{1}{G}$
- (2)  $GK = 4\pi^2$
- (3)  $GMK = 4\pi^2$
- (4)  $K = G$

$$T^2 = \frac{2\pi^2 r^3}{GM}$$

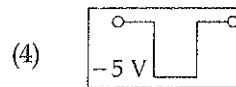
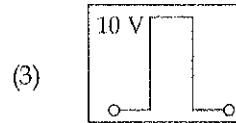
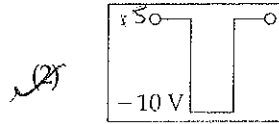
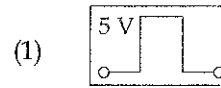
$$= \frac{2\pi^2 r^3 m}{GMm}$$

$$\Rightarrow \frac{4\pi^2}{GM} = K$$

100. If in a p-n junction, a square input signal of 10 V is applied, as shown,



then the output across  $R_L$  will be :



$$\frac{mv^2}{2} = \frac{GMm}{r^2}$$

101. Two particles of masses  $m_1, m_2$  move with initial velocities  $u_1$  and  $u_2$ . On collision, one of the particles get excited to higher level, after absorbing energy  $\epsilon$ . If final velocities of particles be  $v_1$  and  $v_2$  then we must have :

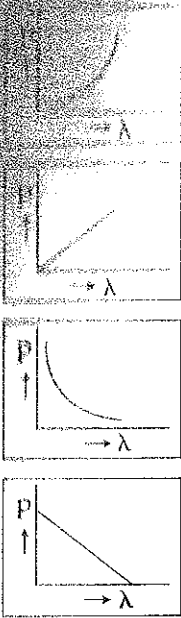
(1)  $\frac{1}{2}m_1^2 u_1^2 + \frac{1}{2}m_2^2 u_2^2 + \epsilon = \frac{1}{2}m_1^2 v_1^2 + \frac{1}{2}m_2^2 v_2^2$

(2)  $m_1^2 u_1 + m_2^2 u_2 + \epsilon = m_1^2 v_1 + m_2^2 v_2$

(3)  $\frac{1}{2}m_1 u_1^2 + \frac{1}{2}m_2 u_2^2 = \frac{1}{2}m_1 v_1^2 + \frac{1}{2}m_2 v_2^2 + \epsilon$

(4)  $\frac{1}{2}m_1 u_1^2 + \frac{1}{2}m_2 u_2^2 - \epsilon = \frac{1}{2}m_1 v_1^2 + \frac{1}{2}m_2 v_2^2$

The following figures represent the variation of pressure, momentum and the associated wavelength?



$45.4 \times 2.7 \times 10^{-3}$   
 $\frac{32}{2.7} = 11.85$   
 $\frac{3178}{9087} = 0.349$   
 $\frac{12258}{12258} = 1$   
 $B = \frac{P}{\Delta V/V}$   
 $\frac{\Delta V}{V} = PK$

103. The approximate depth of an ocean is 2700 m. The compressibility of water is  $45.4 \times 10^{-11} \text{ Pa}^{-1}$  and density of water is  $10^3 \text{ kg/m}^3$ . What fractional compression of water will be obtained at the bottom of the ocean?

- (1)  $1.4 \times 10^{-2}$
- (2)  $0.8 \times 10^{-2}$
- (3)  $1.0 \times 10^{-2}$
- (4)  $1.2 \times 10^{-2}$

$K = 45.4 \times 10^{-11}$   
 $P = 10^3 \times 2.7 \times 10^3 \times 10$   
 $= 2.7 \times 10^7$

104. The two ends of a metal rod are maintained at temperatures  $100^\circ\text{C}$  and  $110^\circ\text{C}$ . The rate of heat flow in the rod is found to be  $4.0 \text{ J/s}$ . If the ends are maintained at temperatures  $200^\circ\text{C}$  and  $210^\circ\text{C}$ , the rate of heat flow will be:

- (1)  $4.0 \text{ J/s}$
- (2)  $44.0 \text{ J/s}$
- (3)  $16.8 \text{ J/s}$
- (4)  $8.0 \text{ J/s}$

$\frac{4}{V} = \frac{10}{10}$   
 $\frac{dv}{dx} = -2n\beta^2 x^{2n-1}$

105. A particle of unit mass undergoes one-dimensional motion such that its velocity varies according to  $v(x) = \beta x^{-2n}$ , where  $\beta$  and  $n$  are constants and  $x$  is the position of the particle. The acceleration of the particle as a function of  $x$ , is given by:

- (1)  $-2n\beta^2 e^{-4n+1}$
- (2)  $-2n\beta^2 x^{-2n-1}$
- (3)  $-2n\beta^2 x^{-4n-1}$
- (4)  $-2\beta^2 x^{-2n+1}$

$\frac{dv}{dx} = \frac{\beta}{x^{2n}}$   
 $\frac{dv}{dt} = \frac{dv}{dx} \cdot \frac{dx}{dt} = \frac{\beta}{x^{2n}} \cdot \frac{\beta x^{-2n}}{v}$   
 $= \frac{\beta^2}{v x^{4n}}$   
 $= \frac{\beta^2}{v^{2n+1}}$

106. The refracting angle of a prism is  $A$ , and refractive index of the material of the prism is  $\cot(A/2)$ . The angle of minimum deviation is:

- (1)  $180^\circ + 2A$
- (2)  $180^\circ - 3A$
- (3)  $180^\circ - 2A$
- (4)  $90^\circ - A$

$\cot \frac{A}{2} = \frac{\sin(A + \delta/2)}{\sin \frac{A}{2}}$   
 $\frac{\sin(A + \delta/2)}{\sin \frac{A}{2}} = \cot \frac{A}{2} = \frac{\cos \frac{A}{2}}{\sin \frac{A}{2}}$   
 $\frac{\pi - A + \delta}{2} = \frac{A}{2}$

107. A particle is executing SHM along a straight line. Its velocities at distances  $x_1$  and  $x_2$  from the mean position are  $V_1$  and  $V_2$ , respectively. Its time period is:

- (1)  $2\pi \sqrt{\frac{V_1^2 - V_2^2}{x_1^2 - x_2^2}}$
- (2)  $2\pi \sqrt{\frac{x_1^2 + x_2^2}{V_1^2 + V_2^2}}$
- (3)  $2\pi \sqrt{\frac{x_2^2 - x_1^2}{V_1^2 - V_2^2}}$
- (4)  $2\pi \sqrt{\frac{V_1^2 + V_2^2}{x_1^2 + x_2^2}}$

$V_1 = \omega \sqrt{A^2 - x_1^2}$   
 $V_2 = \omega \sqrt{A^2 - x_2^2}$   
 $V_1^2 = \omega^2 A^2 - \omega^2 x_1^2$   
 $V_2^2 = \omega^2 A^2 - \omega^2 x_2^2$   
 $\omega^2 (x_2^2 - x_1^2) = V_2^2 - V_1^2$   
 $\frac{2\pi}{T} = \sqrt{\frac{V_1^2 - V_2^2}{x_2^2 - x_1^2}}$

108. Two similar springs P and Q have spring constants  $K_P$  and  $K_Q$ , such that  $K_P > K_Q$ . They are stretched, first by the same amount (case a), then by the same force (case b). The work done by the springs  $W_P$  and  $W_Q$  are related as, in case (a) and case (b), respectively:

- (1)  $W_P < W_Q; W_Q < W_P$
- (2)  $W_P = W_Q; W_P > W_Q$
- (3)  $W_P = W_Q; W_P = W_Q$
- (4)  $W_P > W_Q; W_Q > W_P$

$W = \frac{1}{2} \frac{F^2}{k}$

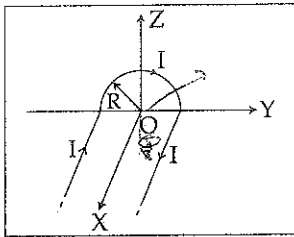
109. Consider 3<sup>rd</sup> orbit of  $\text{He}^+$  (Helium), using non-relativistic approach, the speed of electron in this orbit will be [given  $K = 9 \times 10^9$  constant,  $Z = 2$  and  $h$  (Planck's Constant)  $= 6.6 \times 10^{-34} \text{ J s}$ ]

- (1)  $3.0 \times 10^8 \text{ m/s}$
- (2)  $2.92 \times 10^6 \text{ m/s}$
- (3)  $1.46 \times 10^6 \text{ m/s}$
- (4)  $0.73 \times 10^6 \text{ m/s}$

$\frac{c}{137} \times \frac{Z}{n} = \frac{3 \times 10^8}{137} \times \frac{2}{3}$   
 $= \frac{200}{137} \times 10^6$

$\frac{1}{137} \times \frac{2}{3} \times 3 \times 10^8$   
 $= \frac{200}{137} \times 10^6$

110. A wire carrying current  $I$  has the shape as shown in adjoining figure. Linear parts of the wire are very long and parallel to X-axis while semicircular portion of radius  $R$  is lying in Y-Z plane. Magnetic field at point O is :



(1)  $\vec{B} = \frac{\mu_0}{4\pi} \frac{I}{R} (\pi \hat{i} - 2\hat{k})$

(2)  $\vec{B} = \frac{\mu_0}{4\pi} \frac{I}{R} (\pi \hat{i} + 2\hat{k})$

(3)  $\vec{B} = -\frac{\mu_0}{4\pi} \frac{I}{R} (\pi \hat{i} - 2\hat{k})$

(4)  $\vec{B} = -\frac{\mu_0}{4\pi} \frac{I}{R} (\pi \hat{i} + 2\hat{k})$

$\pi \frac{\mu_0 I}{4\pi R} (-\hat{i})$   
 $+ \left[ \frac{\mu_0 I}{4\pi R} \right] (-\hat{k})$   
 $-\frac{\mu_0 I}{4\pi R} [\pi \hat{i} + 2\hat{k}]$   
 $\frac{1}{8} = \frac{(1.5 - 1) \left(-\frac{1}{40}\right)}{(1.7)}$   
 $= -\frac{0.2}{1.7}$   
 $= \frac{17.5}{85}$

111. A particle of mass  $m$  is driven by a machine that delivers a constant power  $k$  watts. If the particle starts from rest the force on the particle at time  $t$  is :

(1)  $\frac{1}{2} \sqrt{mk} t^{-1/2}$

(2)  $\sqrt{\frac{mk}{2}} t^{-1/2}$

(3)  $\sqrt{mk} t^{-1/2}$

(4)  $\sqrt{2mk} t^{-1/2}$

$P = k$   
 $F \cdot v = k$   
 $m v dv = k dt$   
 $v^2 = \frac{2kt}{m}$   
 $a = \frac{1}{2} \frac{2k}{m} = \frac{k}{m}$

112. The fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of organ pipe open at both the ends is :

(1) 140 cm

(2) 80 cm

(3) 100 cm

(4) 120 cm

$\frac{3\lambda}{2l} = \frac{\lambda}{4 \times 20}$   
 $l = 120$

113. An electron moving in a circular orbit of radius  $r$  makes  $n$  rotations per second. The magnetic field produced at the centre has magnitude :

(1)  $\frac{\mu_0 n e}{2r}$

(2)  $\frac{\mu_0 n e}{2\pi r}$

(3) Zero

(4)  $\frac{\mu_0 n^2 e}{r}$

$\frac{\mu_0 i}{2r}$   
 $\frac{\mu_0 e n}{2r}$

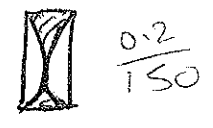
114. Two identical thin plano-convex glass lenses (refractive index 1.5) each having radius of curvature of 20 cm are placed with their convex surfaces in contact at the centre. The intervening space is filled with oil of refractive index 1.7. The focal length of the combination is :

(1) 50 cm

(2) -20 cm

(3) -25 cm

(4) -50 cm



115. On observing light from three different stars P, Q and R, it was found that intensity of violet colour is maximum in the spectrum of P, the intensity of green colour is maximum in the spectrum of R and the intensity of red colour is maximum in the spectrum of Q. If  $T_P$ ,  $T_Q$  and  $T_R$  are the respective absolute temperatures of P, Q and R, then it can be concluded from the above observations that :

(1)  $T_P < T_Q < T_R$

(2)  $T_P > T_Q > T_R$

(3)  $T_P > T_R > T_Q$

(4)  $T_P < T_R < T_Q$

$\lambda_Q > \lambda_R > \lambda_P$   
 $T_Q < T_R < T_P$

116. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be :

(1)  $[E^{-2} V^{-1} T^{-3}]$

(2)  $[E V^{-2} T^{-1}]$

(3)  $[E V^{-1} T^{-2}]$

(4)  $[E V^{-2} T^{-2}]$

$E = T^2 A$   
 $T = \frac{E}{V^2} T^{-2}$   
 $(L T^{-1})^2 L^2 T^2 T^{-2}$

117. A Carnot engine, having an efficiency of  $\eta = \frac{1}{10}$  as

heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is :

(1) 1 J

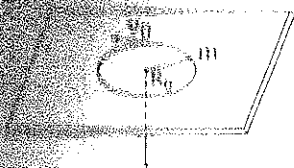
(2) 100 J

(3) 99 J

(4) 90 J

$\eta = \frac{Q_2 - Q_1}{Q_2} = \frac{W}{Q_2}$   
 $Q_2 = 100$

117. A particle of mass  $m$  moves in a circle on a smooth horizontal table with velocity  $v_0$  at a radius  $R_0$ . The mass is attached to a string which passes through a smooth hole in the plane as shown.



The tension in the string is increased gradually and finally  $m$  moves in a circle of radius  $\frac{R_0}{2}$ . The final value of the kinetic energy is:

- (1)  $\frac{1}{2} mv_0^2$
- (2)  $mv_0^2$
- (3)  $\frac{1}{4} mv_0^2$
- (4)  $2mv_0^2$

Handwritten notes for Q117:

$$T = \frac{mv_0^2}{R_0}$$

$$T = \frac{2T}{2}$$

$$\frac{v_0}{R_0} = \frac{2v}{\frac{R_0}{2}}$$

$$v = \frac{v_0}{2}$$

$$\frac{1}{2} m \left(\frac{v_0}{2}\right)^2 = \frac{1}{8} mv_0^2$$

119. For a parallel beam of monochromatic light of wavelength ' $\lambda$ ', diffraction is produced by a single slit whose width ' $a$ ' is of the order of the wavelength of the light. If ' $D$ ' is the distance of the screen from the slit, the width of the central maxima will be:

- (1)  $\frac{2Da}{\lambda}$
- (2)  $\frac{2D\lambda}{a}$
- (3)  $\frac{D\lambda}{a}$
- (4)  $\frac{Da}{\lambda}$

Handwritten notes for Q119:

$$\frac{1}{2} \times 10 \times 1000 = 960$$

120. A wind with speed 40 m/s blows parallel to the roof of a house. The area of the roof is 250 m<sup>2</sup>. Assuming that the pressure inside the house is atmospheric pressure, the force exerted by the wind on the roof and the direction of the force will be:

- ( $P_{\text{air}} = 1.2 \text{ kg/m}^3$ )
- (1)  $2.4 \times 10^5 \text{ N}$ , downwards
  - (2)  $4.8 \times 10^5 \text{ N}$ , downwards
  - (3)  $4.8 \times 10^5 \text{ N}$ , upwards
  - (4)  $2.4 \times 10^5 \text{ N}$ , upwards

Handwritten calculations for Q120:

$$960 \times 250 \times 10^2$$

$$\frac{96}{25} \times 2.4 \times 10^5$$

$$\frac{192}{2400}$$

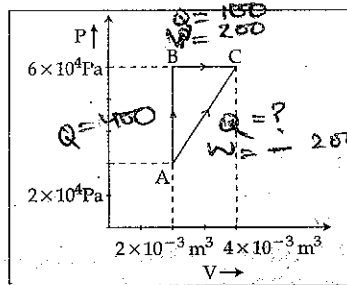
121. The ratio of the specific heats  $\frac{C_p}{C_v} = \gamma$  in terms of degrees of freedom ( $n$ ) is given by:

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

122. If radius of the  $^{27}_{13}\text{Al}$  nucleus is taken to be  $R_{\text{Al}}$  then the radius of  $^{125}_{53}\text{Te}$  nucleus is nearly:

- (1)  $\left(\frac{13}{53}\right)^{1/3} R_{\text{Al}}$
  - (2)  $\left(\frac{53}{13}\right)^{1/3} R_{\text{Al}}$
  - (3)  $\frac{5}{3} R_{\text{Al}}$
  - (4)  $\frac{3}{5} R_{\text{Al}}$
- Handwritten notes for Q122:
- $$R_{\text{Al}} = (27)^{1/3} R_0$$
- $$R_{\text{Te}} = (125)^{1/3} R_0$$
- $$\frac{R_{\text{Al}}}{R_{\text{Te}}} = \frac{3}{5}$$

123. Figure below shows two paths that may be taken by a gas to go from a state A to a state C.



In process AB, 400 J of heat is added to the system and in process BC, 100 J of heat is added to the system. The heat absorbed by the system in the process AC will be:

- (1) 300 J
- (2) 380 J
- (3) 500 J
- (4) 460 J

Handwritten calculations for Q123:

$$400 + 100 = 500$$

$$240 - 40$$

$\frac{1}{2}mv^2 = 100$   
 $G = 500$

$\Delta KE = \left[ \frac{x^2}{20} \right]_{20}^{30} = \frac{900}{14} - \frac{400}{20} = 45 - 20 = 25$

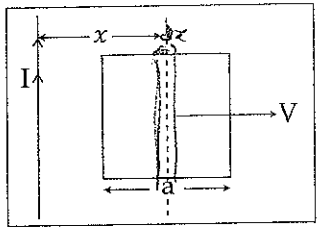
124. A block of mass 10 kg, moving in x direction with a constant speed of 10 ms<sup>-1</sup>, is subjected to a retarding force F = 0.1 x J/m during its travel from x = 20 m to 30 m. Its final KE will be:

- (1) 250 J
- (2) 475 J
- (3) 450 J
- (4) 275 J

$mv dv = - \frac{x}{10} dx$   
 $\int mv dv = \int \frac{-x dx}{10}$

125. A conducting square frame of side 'a' and a long straight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity 'V'. The emf induced in the frame will be proportional to:

$E = - \frac{d\phi}{dt}$



$\frac{\mu_0 I a dx}{2\pi x}$

$E = - \frac{dBA}{dt} = -B \frac{dA}{dt}$

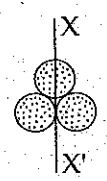
$\frac{d}{dt} \left( \frac{1}{(2x-a)(2x+a)} \right)$

- (1)  $\frac{1}{(2x-a)(2x+a)}$
- (2)  $\frac{1}{x^2}$
- (3)  $\frac{1}{(2x-a)^2}$
- (4)  $\frac{1}{(2x+a)^2}$

$m_2 T - \mu m_2 g = m_2 a$   
 $m_2 T - \mu m_1 m_2 g + m_1 T = 0$   
 $(m_1 + m_2) T = m_1 m_2 g (1 + \mu)$

126. Three identical spherical shells, each of mass m and radius r are placed as shown in figure. Consider an axis XX' which is touching to two shells and passing through diameter of third shell.

Moment of inertia of the system consisting of these three spherical shells about XX' axis is:

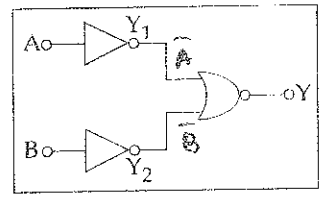


$= -B \frac{dA}{dt} = -Ba$

- (1) 4 mr<sup>2</sup>
- (2)  $\frac{11}{5} mr^2$
- (3) 3 mr<sup>2</sup>
- (4)  $\frac{16}{5} mr^2$

$2eV_0 = \frac{hc}{2\lambda}$   
 $eV_0$

127. Which logic gate is represented by the following combination of logic gates?



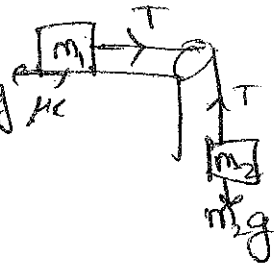
0	0	1
0	1	0
1	0	0
1	1	0

$\overline{A+B}$   
 $= A \cdot B$

- (1) NOR
- (2) OR
- (3) NAND
- (4) AND

128. A block A of mass m<sub>1</sub> rests on a horizontal table. A light string connected to it passes over a frictionless pulley at the edge of table and from its other end another block B of mass m<sub>2</sub> is suspended. The coefficient of kinetic friction between the block and the table is μ<sub>k</sub>. When the block A is sliding on the table, the tension in the string is:

- (1)  $\frac{m_1 m_2 (1 - \mu_k) g}{(m_1 + m_2)}$
- (2)  $\frac{(m_2 + \mu_k m_1) g}{(m_1 + m_2)}$
- (3)  $\frac{(m_2 - \mu_k m_1) g}{(m_1 + m_2)}$
- (4)  $\frac{m_1 m_2 (1 + \mu_k) g}{(m_1 + m_2)}$



129. A certain metallic surface is illuminated with monochromatic light of wavelength, λ. The stopping potential for photo-electric current for this light is 3V<sub>0</sub>. If the same surface is illuminated with light of wavelength 2λ, the stopping potential is V<sub>0</sub>. The threshold wavelength for this surface for photo-electric effect is:

- (1)  $\frac{\lambda}{6}$
- (2) 6λ
- (3) 4λ
- (4)  $\frac{\lambda}{4}$

$3eV_0 = \frac{hc}{2\lambda} - \phi$   
 $eV_0 = \frac{hc}{2\lambda} - \phi$   
 $\frac{eV_0}{2} = \frac{\phi}{2}$   
 $\phi = eV_0$

Two simple harmonic displacements represented by  $y_1 = a \sin(\omega t)$  and  $y_2 = b \cos(\omega t)$  are superimposed. The motion is:

- (1) simple harmonic with amplitude  $\frac{a+b}{2}$
- (2) not a simple harmonic
- (3) simple harmonic with amplitude  $\frac{a}{b}$
- (4) simple harmonic with amplitude  $\sqrt{a^2 + b^2}$

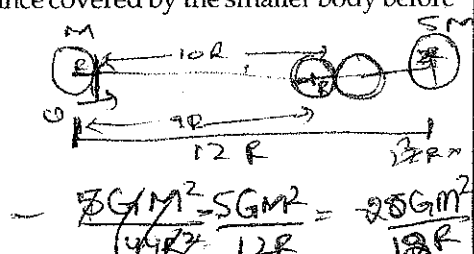
131. A potentiometer wire has length 4 m and resistance 8  $\Omega$ . The resistance that must be connected in series with the wire and an accumulator of e.m.f. 2V, so as to get a potential gradient 1 mV per cm on the wire is:

- (1) 48  $\Omega$
- (2) 32  $\Omega$
- (3) 40  $\Omega$
- (4) 44  $\Omega$

*Handwritten notes:*  
 1 mV per cm  
 0.1 V per m  
 0.4 V  
 1.6 V  
 $\frac{0.4}{8} = \frac{1.6}{R}$   
 $R = 32$

132. Two spherical bodies of mass M and 5M and radii R and 2R are released in free space with initial separation between their centres equal to 12R. If they attract each other due to gravitational force only, then the distance covered by the smaller body before collision is:

- (1) 1.5 R
- (2) 2.5 R
- (3) 4.5 R
- (4) 7.5 R



133. A resistance 'R' draws power 'P' when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedance of the circuit becomes 'Z', the power drawn will be:

- (1) P
- (2)  $P \left(\frac{R}{Z}\right)^2$
- (3)  $P \sqrt{\frac{R}{Z}}$
- (4)  $P \left(\frac{R}{Z}\right)$

*Handwritten notes:*  
 $P \cos \phi$   
 $\frac{P R}{Z}$   
 $\frac{15GM^2}{12R} = K$   
 $\frac{M(U_1^2 + U_2^2)}{2} = \frac{5GM^2}{24R}$   
 $MU_1 = 5MU_2$

134. Across a metallic conductor of non-uniform cross section a constant potential difference is applied. The quantity which remains constant along the conductor is:

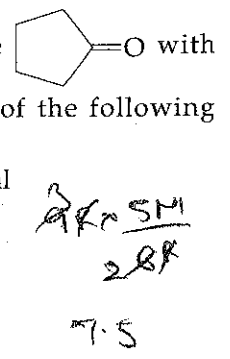
- (1) electric field
- (2) current density
- (3) current
- (4) drift velocity

135. A parallel plate air capacitor of capacitance C is connected to a cell of emf V and then disconnected from it. A dielectric slab of dielectric constant K, which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is incorrect?

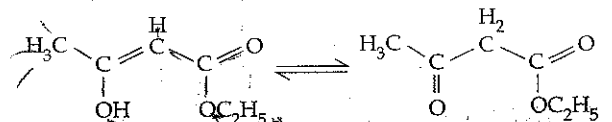
- (1) The charge on the capacitor is not conserved.
- (2) The potential difference between the plates decreases K times.
- (3) The energy stored in the capacitor decreases K times.
- (4) The change in energy stored is  $\frac{1}{2} CV^2 \left(\frac{1}{K} - 1\right)$ .

136. Treatment of cyclopentanone with methyl lithium gives which of the following species?  $C_5H_9Li$

- (1) Cyclopentanonyl biradical
- (2) Cyclopentanonyl anion
- (3) Cyclopentanonyl cation
- (4) Cyclopentanonyl radical



137. The enolic form of ethyl acetoacetate as below has:

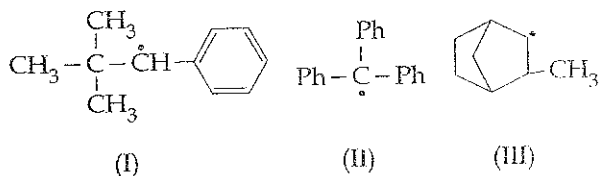


- (1) 9 sigma bonds and 1 pi - bond
- (2) 18 sigma bonds and 2 pi - bonds
- (3) 16 sigma bonds and 1 pi - bond
- (4) 9 sigma bonds and 2 pi - bonds

138. Biodegradable polymer which can be produced from glycine and aminocaproic acid is:

- (1) Nylon 6, 6
- (2) Nylon 2 - nylon 6
- (3) PHBV
- (4) Buna - N

139. Consider the following compounds

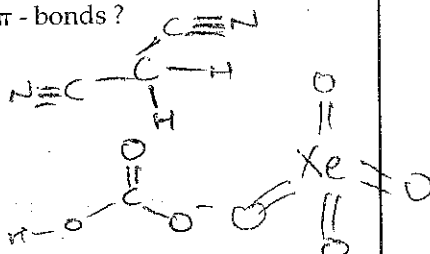


Hyperconjugation occurs in :

- (1) I and III  
 (2) I only  
 (3) II only  
 (4) III only

140. Which of the following species contains equal number of  $\sigma$ - and  $\pi$ -bonds?

- (1)  $\text{CH}_2(\text{CN})_2$   
 (2)  $\text{HCO}_3^-$   
 (3)  $\text{XeO}_4$   
 (4)  $(\text{CN})_2$



141. The correct bond order in the following species is :

- (1)  $\text{O}_2^- < \text{O}_2^+ < \text{O}_2^{2+}$   
 (2)  $\text{O}_2^{2+} < \text{O}_2^+ < \text{O}_2^-$   
 (3)  $\text{O}_2^{2+} < \text{O}_2^- < \text{O}_2^+$   
 (4)  $\text{O}_2^+ < \text{O}_2^- < \text{O}_2^{2+}$

142. The function of "Sodium pump" is a biological process operating in each and every cell of all animals. Which of the following biologically important ions is also a constituent of this pump?

- (1)  $\text{Fe}^{2+}$   
 (2)  $\text{Ca}^{2+}$   
 (3)  $\text{Mg}^{2+}$   
 (4)  $\text{K}^+$

143. Which of these statements about  $[\text{Co}(\text{CN})_6]^{3-}$  is true?

- (1)  $[\text{Co}(\text{CN})_6]^{3-}$  has no unpaired electrons and will be in a high-spin configuration.  
 (2)  $[\text{Co}(\text{CN})_6]^{3-}$  has no unpaired electrons and will be in a low-spin configuration.  
 (3)  $[\text{Co}(\text{CN})_6]^{3-}$  has four unpaired electrons and will be in a low-spin configuration.  
 (4)  $[\text{Co}(\text{CN})_6]^{3-}$  has four unpaired electrons and will be in a high-spin configuration.

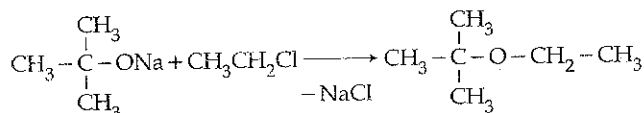
144. The activation energy of a reaction can be determined from the slope of which of the following graphs?

- (1)  $\frac{T}{\ln K}$  vs.  $\frac{1}{T}$   
 (2)  $\ln K$  vs.  $T$   
 (3)  $\frac{\ln K}{T}$  vs.  $T$   
 (4)  $\ln K$  vs.  $\frac{1}{T}$

$K = A e^{-E_a/RT}$   
 $\ln K = \ln A - \frac{E_a}{RT}$



145. The reaction



is called :

- (1) Gatterman-Koch reaction  
 (2) Williamson Synthesis  
 (3) Williamson continuous etherification process  
 (4) Etard reaction

146. Which one is not equal to zero for an ideal solution?

- (1)  $\Delta P = P_{\text{observed}} - P_{\text{Raoult}}$   
 (2)  $\Delta H_{\text{mix}}$   
 (3)  $\Delta S_{\text{mix}}$   
 (4)  $\Delta V_{\text{mix}}$

147. "Metals are usually not found as nitrates in their ores".

Out of the following two (a and b) reasons which is/are true for the above observation?

- (a) Metal nitrates are highly unstable.  
 (b) Metal nitrates are highly soluble in water.  
 (1) a is true but b is false  
 (2) a and b are true  
 (3) a and b are false  
 (4) a is false but b is true

148. An organic compound 'X' having molecular formula  $\text{C}_5\text{H}_{10}\text{O}$  yields phenyl hydrazone and gives negative response to the Iodoform test and Tollen's test. It produces n-pentane on reduction. 'X' could be:

- (1) n-amyl alcohol  
 (2) pentanal  
 (3) 2-pentanone  
 (4) 3-pentanone



150. Cobalt(III) chloride forms several octahedral complexes with ammonia. Which of the following will not give test for chloride ions with silver nitrate solution?

- (1)  $\text{CoCl}_3 \cdot 6\text{NH}_3$   
 (2)  $\text{CoCl}_3 \cdot 3\text{NH}_3$   $(\text{NH}_3)_3\text{CoCl}_3$   
 (3)  $\text{CoCl}_3 \cdot 4\text{NH}_3$   
 (4)  $\text{CoCl}_3 \cdot 5\text{NH}_3$

151. A mixture of gases contains  $\text{H}_2$  and  $\text{O}_2$  gases in the ratio of 1 : 4 (w/w). What is the molar ratio of the two gases in the mixture?

- (1) 2 : 1  
 (2) 1 : 4  
 (3) 4 : 1  $\frac{1}{2} : \frac{4}{32}$   
 (4) 16 : 1  $= \frac{1}{2} : \frac{1}{8}$

152. Which of the following is the most correct electron displacement for a nucleophilic reaction to take place?

- (1)  $\text{H}_3\text{C} \rightarrow \text{C} = \overset{\text{H}}{\underset{\text{H}}{\text{C}}} - \overset{\text{H}_2}{\text{C}} - \text{Cl}$   
 (2)  $\text{H}_3\text{C} \rightarrow \overset{\text{H}}{\text{C}} = \overset{\text{H}_2}{\text{C}} - \overset{\text{H}}{\text{C}} - \text{Cl}$   
 (3)  $\text{H}_3\text{C} \leftarrow \overset{\text{H}}{\text{C}} = \overset{\text{H}_2}{\text{C}} - \overset{\text{H}}{\text{C}} - \text{Cl}$   
 (4)  $\text{H}_3\text{C} \rightarrow \overset{\text{H}}{\text{C}} = \overset{\text{H}_2}{\text{C}} - \overset{\text{H}}{\text{C}} - \text{Cl}$
- Handwritten note:*  $\text{C} \leftarrow \text{H}_3\text{C} - \overset{\text{O}}{\text{C}} - \text{CH}_3$

153. The electrolytic reduction of nitrobenzene in strongly acidic medium produces:

- (1) Aniline  
 (2) p-Aminophenol  
 (3) Azoxybenzene  
 (4) Azobenzene
- Handwritten note:*  $\text{NO}_2$  and  $\text{SO}_2$  with a benzene ring diagram.

154. Nitrogen dioxide and sulphur dioxide have some properties in common. Which property is shown by one of these compounds, but not by the other?

- (1) is used as a food-preservative  
 (2) forms 'acid-rain'  
 (3) is a reducing agent  
 (4) is soluble in water

155. Which of the following statements is correct for a reversible process in a state of equilibrium?

- (1)  $\Delta G^\circ = 2.30 RT \log K$   
 (2)  $\Delta G = -2.30 RT \log K$   
 (3)  $\Delta G = 2.30 RT \log K$   
 (4)  $\Delta G^\circ = -2.30 RT \log K$

155. Which of the following pairs of ions are isoelectronic and isostructural?

- (1)  $\text{ClO}_3^-, \text{SO}_3^{2-}$   
 (2)  $\text{CO}_3^{2-}, \text{SO}_3^{2-}$   
 (3)  $\text{ClO}_3^-, \text{CO}_3^{2-}$   
 (4)  $\text{SO}_3^{2-}, \text{NO}_3^-$

156. The angular momentum of electron in 'd' orbital is equal to:

- (1)  $0 \hbar$   
 (2)  $\sqrt{6} \hbar$   
 (3)  $\sqrt{2} \hbar$   
 (4)  $2\sqrt{3} \hbar$
- Handwritten note:*  $\sqrt{2 \times 3}$

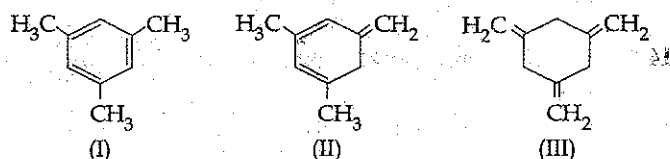
157. Which of the following options represents the correct bond order?

- (1)  $\text{O}_2^- < \text{O}_2 > \text{O}_2^+$   
 (2)  $\text{O}_2^- > \text{O}_2 > \text{O}_2^+$   
 (3)  $\text{O}_2^- < \text{O}_2 < \text{O}_2^+$   
 (4)  $\text{O}_2^- > \text{O}_2 < \text{O}_2^+$
- Handwritten note:*  $2\sqrt{2}$  and  $2.82$

158. Magnetic moment 2.84 B.M. is given by:

- (At. nos, Ni = 28, Ti = 22, Cr = 24, Co = 27)
- (1)  $\text{Co}^{2+}$   
 (2)  $\text{Ni}^{2+}$   
 (3)  $\text{Ti}^{3+}$   
 (4)  $\text{Cr}^{2+}$
- Handwritten note:*  $[\text{Ni}^{2+}]$  with a diagram of a d-orbital configuration.

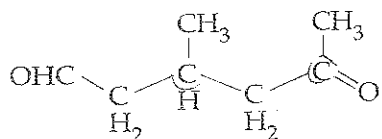
159. Given:



The enthalpy of hydrogenation of these compounds will be in the order as:

- (1) II > I > III  
 (2) I > II > III  
 (3) III > II > I  
 (4) II > III > I

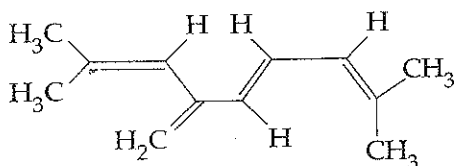
160. A single compound of the structure



is obtainable from ozonolysis of which of the following cyclic compounds?

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

161. The total number of  $\pi$  - bond electrons in the following structure is:



- (1) 16  
 (2) 4  
 (3) 8  
 (4) 12
162. The  $K_{sp}$  of  $Ag_2CrO_4$ ,  $AgCl$ ,  $AgBr$  and  $AgI$  are respectively,  $1.1 \times 10^{-12}$ ,  $1.8 \times 10^{-10}$ ,  $5.0 \times 10^{-13}$ ,  $8.3 \times 10^{-17}$ . Which one of the following salts will precipitate last if  $AgNO_3$  solution is added to the solution containing equal moles of  $NaCl$ ,  $NaBr$ ,  $NaI$  and  $Na_2CrO_4$ ?
- (1)  $Ag_2CrO_4$   
 (2)  $AgI$   
 (3)  $AgCl$   
 (4)  $AgBr$

163. When initial concentration of a reactant is doubled in a reaction, its half-life period is not affected. The order of the reaction is:

- (1) More than zero but less than first  
 (2) Zero  
 (3) First  
 (4) Second

164. Which of the following processes does not involve oxidation of iron?

- (1) Liberation of  $H_2$  from steam by iron at high temperature  
 (2) Rusting of iron sheets  
 (3) Decolourization of blue  $CuSO_4$  solution by iron  
 (4) Formation of  $Fe(CO)_5$  from Fe

165. Bithional is generally added to the soaps as an additive to function as a/an:

- (1) Antiseptic  
 (2) Softener  
 (3) Dryer  
 (4) Buffering agent

166. In which of the following compounds, the C - Cl bond ionisation shall give most stable carbonium ion?

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

167. A given metal crystallizes out with a cubic structure having edge length of 361 pm. If there are four metal atoms in one unit cell, what is the radius of one atom?

- (1) 108 pm  
 (2) 40 pm  
 (3) 127 pm  
 (4) 80 pm

168. The boiling point of 0.2 mol kg<sup>-1</sup> solution of X in water is greater than equimolar solution of Y in water. Which one of the following statements is true in this case?

- (1) Y is undergoing dissociation in water while X undergoes no change.  
 (2) X is undergoing dissociation in water.  
 (3) Molecular mass of X is greater than the molecular mass of Y.  
 (4) Molecular mass of X is less than the molecular mass of Y.

$\Delta T_b = i K_b m$   
 $\frac{\Delta T_b}{\Delta T_b} = \frac{i m}{m}$   
 $5 \times 10^{-3} = \frac{1 \times m}{1.5 m}$

$r = \frac{\sqrt{2}a}{4}$   
 $r = \frac{\sqrt{2} \times 361}{4} = 127.26$

In Duma's method for estimation of nitrogen, 0.25 g of an organic compound gave 40 mL of nitrogen collected at 300 K temperature and 725 mm pressure. If the aqueous tension at 300 K is 25 mm, the percentage of nitrogen in the compound is:

- (1) 15.76  
 (2) 17.36  
 (3) 18.20  
 (4) 16.76

$$\frac{725 \times 40}{300} = \frac{700 \times V}{300}$$

$$V = 290$$

170. The species Ar,  $K^+$  and  $Ca^{2+}$  contain the same number of electrons. In which order do their radii increase?

- (1)  $K^+ < Ar < Ca^{2+}$   
 (2)  $Ar < K^+ < Ca^{2+}$   
 (3)  $Ca^{2+} < Ar < K^+$   
 (4)  $Ca^{2+} < K^+ < Ar$

$$\frac{725 \times V}{300} = \frac{700 \times 40}{29}$$

171. Because of lanthanoid contraction, which of the following pairs of elements have nearly same atomic radii? (Numbers in the parenthesis are atomic numbers).

- (1) Zr (40) and Ta (73)  
 (2) Ti (22) and Zr (40)  
 (3) Zr (40) and Nb (41)  
 (4) Zr (40) and Hf (72)

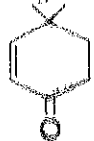
$$\frac{725 \times 20}{29} = \frac{700 \times V}{29}$$

172. The number of d-electrons in  $Fe^{2+}$  ( $Z=26$ ) is not equal to the number of electrons in which one of the following?

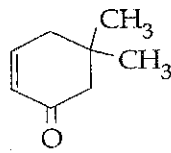
- (1) p-electrons in Ne ( $Z=10$ )  
 (2) s-electrons in Mg ( $Z=12$ )  
 (3) p-electrons in Cl ( $Z=17$ )  
 (4) d-electrons in Fe ( $Z=26$ )

$$1s^2 2s^2 2p^6 3s^2 3p^5$$

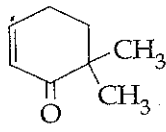
173. Given:



(I)



(II)



(III)

Which of the given compounds can exhibit tautomerism?

- (1) I, II and III  
 (2) I and II  
 (3) I and III  
 (4) II and III

$$\frac{725 \times 40}{3} = V$$

$$V = \frac{116}{3}$$

174. Which one of the following electrolytes has the same value of van't Hoff's factor ( $i$ ) as that of  $Al_2(SO_4)_3$  (if all are 100% ionised)?

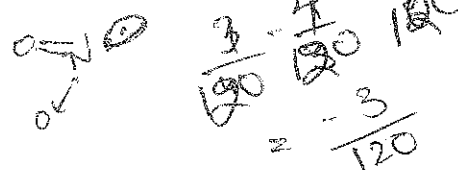
- (1)  $K_4[Fe(CN)_6]$  5  
 (2)  $K_2SO_4$  3  
 (3)  $K_3[Fe(CN)_6]$  4  
 (4)  $Al(NO_3)_3$  4

$$\frac{725 \times 40}{3} = \frac{700 \times V}{3}$$

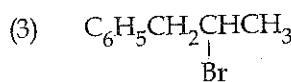
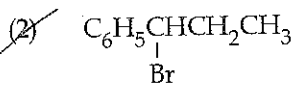
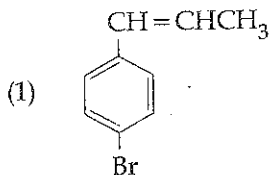
$$V = \frac{29000}{250}$$

175. Maximum bond angle at nitrogen is present in which of the following?

- (1)  $NO_3^-$   
 (2)  $NO_2$   
 (3)  $NO_2^-$   
 (4)  $NO_2^+$



176. The reaction of  $C_6H_5CH=CHCH_3$  with HBr produces:



177. Which property of colloidal solution is independent of charge on the colloidal particles?

- (1) Tyndall effect  
 (2) Coagulation  
 (3) Electrophoresis  
 (4) Electro-osmosis

178. Solubility of the alkaline earth's metal sulphates in water decreases in the sequence:

- (1)  $Ba > Mg > Sr > Ca$   
 (2)  $Mg > Ca > Sr > Ba$   
 (3)  $Ca > Sr > Ba > Mg$   
 (4)  $Sr > Ca > Mg > Ba$

179. A device that converts energy of combustion of fuels like hydrogen and methane, directly into electrical energy is known as:

- (1) Ni-Cd cell  
 (2) Fuel Cell  
 (3) Electrolytic Cell  
 (4) Dynamo

180. If the value of an equilibrium constant for a particular reaction is  $1.6 \times 10^{12}$ , then at equilibrium the system will contain:

- (1) similar amounts of reactants and products.  
 (2) all reactants.  
 (3) mostly reactants.  
 (4) mostly products.