

# M.Sc in Forensic Science

2171

16P/302/6

Question Booklet No.....

(To be filled up by the candidate by blue/black ball-point pen)

Roll No.

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Roll No.

(Write the digits in words) .....

Code No (472)

Serial No. of OMR Answer Sheet .....

(2016)

Day and Date .....

(Signature of Invigilator)

## INSTRUCTIONS TO CANDIDATES

(Use only **blue/black ball-point pen** in the space above and on both sides of the Answer Sheet)

1. Within 30 minutes of the issue of the Question Booklet, check the Question Booklet to ensure that it contains all the pages in correct sequence and that no page/question is missing. In case of faulty Question Booklet bring it to the notice of the Superintendent/Invigilators immediately to obtain a fresh Question Booklet.
2. Do not bring any loose paper, written or blank, inside the Examination Hall *except the Admit Card without its envelope*.
3. A separate Answer Sheet is given. *It should not be folded or mutilated. A second Answer Sheet shall not be provided. Only the Answer Sheet will be evaluated.*
4. Write your *Roll Number and Serial Number of the Answer Sheet by pen* in the space provided above.
5. **On the front page of the Answer Sheet, write by pen your Roll Number in the space provided at the top, and by darkening the circles at the bottom. Also, wherever applicable, write the Question Booklet Number and the Set Number in appropriate places.**
6. No overwriting is allowed in the entries of Roll No., Question Booklet No. and Set No. (if any) on OMR sheet and also Roll No. and OMR Sheet No. on the Question Booklet.
7. Any change in the aforesaid entries is to be verified by the invigilator, otherwise it will be taken as unfair means.
8. Each question in this Booklet is followed by four alternative answers. *For each question, you are to record the correct option on the Answer Sheet by darkening the appropriate circle in the corresponding row of the Answer Sheet, by ball-point pen as mentioned in the guidelines given on the first page of the Answer Sheet.*
9. For each question, darken only one circle on the Answer Sheet. If you darken more than one circle or darken a circle partially, the answer will be treated as incorrect.
10. *Note that the answer once filled in ink cannot be changed.* If you *do not wish to attempt* a question, leave all the circles in the corresponding row blank (such question will be awarded zero mark).
11. For rough work, use the inner back page of the title cover and the blank page at the end of this Booklet.
12. Deposit *only the OMR Answer Sheet* at the end of the Test.
13. You are not permitted to leave the Examination Hall until the end of the Test.
14. If a candidate attempts to use any form of unfair means, he/she shall be liable to such punishment as the University may determine and impose on him/her.

[उपर्युक्त निर्देश हिन्दी में अन्तिम आवरण-पृष्ठ पर दिये गए हैं]

[No. of Printed Pages : 48+2



16P/302/6

**No. of Questions : 240**

**No. of Questions to be attempted : 120**

**Time : 2 Hours**

**Full Marks : 360**

- Note :**
- (1) Attempt as many questions as you can. Each question carries **3** marks. **One** mark will be deducted for each incorrect answer. Zero mark will be awarded for each unattempted question.
  - (2) If more than one alternative answers seem to be approximate to the correct answer, choose the closest one.
  - (3) This question paper contains **two** Sections, viz : **Section—A** and **Section—B**. Details of **Section—A** and **Section—B** are as follows :
    - (a) **Section—A** contains **60** questions from General Sciences and **20** questions of General Nature.
    - (b) **Section—B** contains **four** sub-sections namely : **Biology, Chemistry, Physics** and **Mathematics** with **40** questions in each. The candidate has to select **only one** of the four sub-sections of **Section—B**.

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**SECTION—A**

1. The application of Science to Law describes
  - (1) Civil Science
  - (2) Social Science
  - (3) Forensic Science
  - (4) Judiciary Science
  
2. The examination of body fluids and organs for drugs and poisons is a function belonging to
  - (1) serology unit
  - (2) chemical unit
  - (3) ballistics unit
  - (4) toxicology unit
  
3. A cognizable offence or case is defined as the one which an officer in-charge of a police station may investigate
  - (1) with the order of a Magistrate but cannot arrest without warrant
  - (2) with the order of a Magistrate and can arrest with warrant
  - (3) without the order of a Magistrate and affect arrest without warrant
  - (4) without the order of a Magistrate and affect arrest with warrant
  
4. A system of identification of individual by measurements of parts of the body is called
  - (1) Anthropometry
  - (2) Anthropology
  - (3) Optometry
  - (4) Arthrology
  
5. Serum is
  - (1) the liquid that separates from the whole blood fluid
  - (2) the liquid that separates from the blood when a clot is formed
  - (3) the liquid that separates from the blood when no clot is formed
  - (4) the RBC separated from the blood

6. X-chromosome is
- (1) the male hormones (2) the female hormones  
(3) the male sex chromosome (4) the female sex chromosome
7. Haemoglobin is a
- (1) red blood cell protein responsible for transporting iron in the bloodstream and the red colouring of blood  
(2) red blood cell protein responsible for transporting oxygen in the bloodstream and the red colouring of blood  
(3) red blood cell protein responsible for the maintenance of water in the bloodstream and the red colouring of blood  
(4) red blood cell protein responsible for transporting vitamins in the bloodstream and the red colouring of blood
8. The minimum temperature at which a liquid fuel will produce enough vapour to burn is called
- (1) melting point (2) flash point  
(3) boiling point (4) critical temperature
9. Tropospheric region in which we live has an altitude of
- (1) 0-50 km (2) 0-85 km (3) 0-11 km (4) 0-500 km
10. Which one is not a stimulants?
- (1) Cocaine (2) Opium  
(3) Amphetamine (4) Methamphetamine

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- 11.** Black powder is normally a mixture of potassium nitrate, carbon and sulfur in the ratio as  
(1) 10/15/75      (2) 75/15/10      (3) 15/75/10      (4) 15/10/75
- 12.** Boric acid belongs to which category?  
(1) Antiseptic      (2) Antibiotics      (3) Antipyretic      (4) Anaesthetics
- 13.** Refrigeration helps in food preservation by  
(1) killing the germs  
(2) sealing the food with the layer of ice  
(3) greatly reducing the rate of biochemical reactions  
(4) destroying enzymatic action
- 14.** Aqueous solution of sodium acetate is  
(1) acidic      (2) basic      (3) neutral      (4) moderate acidic
- 15.** Which one is not an asphyxial death?  
(1) Hanging      (2) Strangulation  
(3) Drowning      (4) Electrocution
- 16.** The only real guide to establish an approximate time of death is  
(1) body cooling rate      (2) body warming rate  
(3) skin drying rate      (4) fouling smells from the body

17. The individuality of the fingerprint
- (1) changes throughout the life
  - (2) never changes though scars may disturb it
  - (3) depends on the living style
  - (4) changes by deep cuts
18. Odontology is related to the study of
- (1) bones
  - (2) teeth
  - (3) skin
  - (4) blood
19. Wound involving splitting or tearing of the whole skin and deeper bruising is called
- (1) abrasion
  - (2) bruise
  - (3) laceration
  - (4) incised wound
20. Which one of the following is a tranquilliser?
- (1) Valium
  - (2) Mandrax
  - (3) Heroin
  - (4) Aspirin
21. Ballistics means
- (1) the study of injuries and wound
  - (2) the study of forensic medicine
  - (3) the study of live and dead human remains
  - (4) the study of firearms and ammunition
22. Which of the following bacteria is found in Ganges water?
- (1) Coliform bacteria
  - (2) Streptococcus bacteria
  - (3) Staphylococcus bacteria
  - (4) Diplococcus bacteria

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29. Copper obtained from copper pyrite is called blister copper. Gas responsible for the formation of blister is  
(1)  $\text{CO}_2$                       (2)  $\text{CO}$                       (3)  $\text{NO}_2$                       (4)  $\text{SO}_2$
30. Which of the following is a sulfide ore?  
(1) Bauxite                      (2) Haematite                      (3) Cuprite                      (4) Iron pyrites
31. Metal, which is a constituent of haemoglobin, is  
(1) Cu                      (2) Al                      (3) Zn                      (4) Fe
32. Which of the following is used for making insulation of electric wires?  
(1) Bakelite                      (2) Isoprene                      (3) Neoprene                      (4) Thiokol
33. Which of the following compounds belong to the same homologous series?  
(1)  $\text{C}_2\text{H}_6\text{O}_2$  and  $\text{C}_2\text{H}_6\text{O}$                       (2)  $\text{C}_6\text{H}_6\text{O}_2$  and  $\text{CH}_4\text{O}$   
(3)  $\text{C}_2\text{H}_6\text{O}$  and  $\text{CH}_4\text{O}$                       (4)  $\text{C}_2\text{H}_6\text{O}$  and  $\text{C}_2\text{H}_6$
34. A cart of mass 500 kg is pulled by a horse and acceleration produced in it is  $4 \text{ m/sec}^2$ . The force extended by the horse is  
(1) 2000 N                      (2) 2000 kg wt                      (3) 2000 dyne                      (4) 200 N
35. The process of separating dissolved salt from water is  
(1) loading                      (2) unloading  
(3) distillation                      (4) demineralization

36. The acid present in an ant sting is  
(1) ethanoic acid (2) methanoic acid  
(3) citric acid (4) tartaric acid
37. In moving from outermost shell to innermost shell, the energy of shells  
(1) increases (2) decreases  
(3) remains same (4) cannot be predicted
38. A body of mass 2 kg is thrown up vertically with a kinetic energy of 490 J. The height at which the kinetic energy of the body becomes half of the initial value is  
(1) 10 m (2) 12.5 m (3) 25 m (4) 50 m
39. For  $n = 5$ , total number of electrons will be  
(1) 32 (2) 50 (3) 48 (4) 68
40. If the diameter of the Earth becomes two times its present value and its mass remains unchanged, then the weight of an object on the surface of the Earth becomes  
(1) one-eighth (2) one-fourth (3) half (4) remains same
41. How many isomers of  $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{3+}$  may exist?  
(1) 2 (2) 3 (3) 4 (4) 5
42. A body moving in a circle travels distance which is directly proportional to time. The body travels with  
(1) zero velocity (2) constant speed  
(3) uniform velocity (4) constant acceleration

43. A 1000 W heater is used everyday for 30 minutes. The heater will consume units of electrical energy in 30 days
- (1) 45 units      (2) 90 units      (3) 30 units      (4) 60 units
44. Which colour component of white light is deviated the most through a prism?
- (1) Red      (2) Yellow      (3) Blue      (4) Violet
45. The direction of force acting on a current-carrying conductor placed in magnetic field is determined by
- (1) right-hand thumb rule      (2) cork screw rule  
(3) Fleming's right-hand rule      (4) Fleming's left-hand rule
46. A magnetic field line is
- (1) the path along which a free north pole tends to move  
(2) the path along which a free ion particle tends to move  
(3) the path along which a magnetic needle tends to move  
(4) the path along which a line is traced
47. There is no atmosphere on the moon because
- (1) it is close to the Earth  
(2) it revolves around the Earth  
(3) its acceleration due to gravity is low  
(4) its acceleration due to gravity is high

48. Which part of the eye is adjustable in accordance with the light conditions?  
(1) Iris                      (2) Retina                      (3) Pupil                      (4) Lens
49. Deficiency of vitamin C causes  
(1) rickets                      (2) beriberi                      (3) scurvy                      (4) night blindness
50. If a wave of wavelength  $\lambda$  is travelling in a medium with velocity  $v$ , then its frequency is  
(1)  $v/\lambda$                       (2)  $v\lambda$                       (3)  $\lambda/v$                       (4)  $1/v\lambda$
51. The focal length of a plane mirror is  
(1) positive                      (2) negative                      (3) zero                      (4) infinity
52.  $\text{CO}_2$  in atmospheric air amounts to about  
(1) 0.03%                      (2) 0.003%                      (3) 0.3%                      (4) 3%
53. C, BASIC, COBOL and Java are examples of the language of  
(1) low-level                      (2) computer  
(3) system programming                      (4) high-level
54. The space in your computer that loads and works with data is called  
(1) cache memory                      (2) CPU  
(3) megabyte                      (4) RAM memory

55. Which is not a green gas?
- (1) Methane (2) Chlorofluorocarbons  
(3) Nitrous oxide (4) SO<sub>2</sub>
56. El Nino phenomenon is
- (1) warming of the waters of Eastern Pacific  
(2) warming of the waters of Western Pacific  
(3) cooling of the waters of Eastern Pacific  
(4) cooling of the waters of Western Pacific
57. A population of organisms genetically similar obtained from the same individual by vegetative propagation is known as
- (1) offspring (2) clone (3) stocks (4) scions
58. The substitute of petroleum could be
- (1) butanol (2) methanol (3) ethanol (4) acetone
59. Biogas (Gobar gas) consists of
- (1) methane (2) CO<sub>2</sub>  
(3) traces of H<sub>2</sub>, H<sub>2</sub>S and N<sub>2</sub> (4) All of these
60. The Minamata disease in Japan was caused through pollution of water by
- (1) cyanide (2) mercury  
(3) lead (4) methyl isocyanate

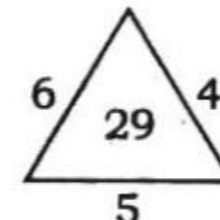
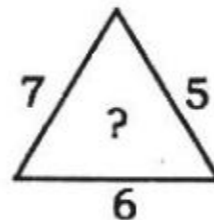
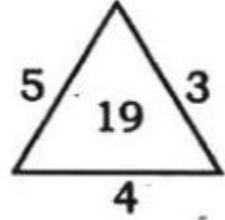
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61. If  $(a + b) : (a - b) = 5 : 3$ , then  $(a^2 + b^2) : (a^2 - b^2) = ?$
- (1) 17:15            (2) 25:9            (3) 4:1            (4) 16:1
62. The mean of 50 observations was 36. It was found later that an observation 48 was wrongly taken as 84 and observation 32 was wrongly taken as 23. The corrected new mean is
- (1) 35.46            (2) 35.64            (3) 36.44            (4) 36.54
63. If FAITH is written as KELVI, then how CLOUD can be written as
- (1) HEWRP            (2) HPERW            (3) HPRWE            (4) HPWRE
64. Daya has a brother Anil. Daya is son of Chandra. Biman is Chandra's father. In terms of relationship, what is Anil of Biman?
- (1) Grand-uncle    (2) Grandson        (3) Son-in-law        (4) Brother
65. Substitute the correct set of symbols in place of  $\bullet$  in the following equation :
- $$65 \bullet 40 \bullet 11 \bullet 36$$
- (1)  $- + =$             (2)  $\times \div =$             (3)  $+ + =$             (4)  $+ \times =$
66. A boy takes 20 minutes to reach the school at the speed of 12 km/hr. If he wants to reach the school in 15 minutes, the speed should be
- (1) 15 km/hr        (2) 16 km/hr        (3) 18 km/hr        (4) 19 km/hr

67. Find the missing number



- (1) 25                      (2) 47                      (3) 37                      (4) 41

68. How many times in a day (i.e., 24 hours) the hands of the clock are in a straight line but not together?

- (1) 24                      (2) 22                      (3) 12                      (4) 11

**Directions** (Question No. 69 to 71) : In each question below are two statements followed by two conclusions number I and II. You have to take the two statements to be true even if they seem to be at variance from commonly known facts and then decide which of the given conclusions logically follows from the given statements disregarding commonly known facts. Given answers are :

- (1) if only conclusion I follows  
 (2) if only conclusion II follows  
 (3) if either conclusion I or II follows  
 (4) if neither conclusion I nor II follows

69. Statements : No holiday is vacation  
 Some vacations are trips

Conclusions : (I) No trip is holiday  
 (II) Some holidays are definitely not trips

Answer :

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

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- 70.** Statements : Some kites are birds  
 No kite is an aeroplane  
 Conclusions : (I) All aeroplanes are birds  
 (II) Some birds are definitely not kites

Answer :

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

- 71.** Statements : All metals are plastics  
 All plastics are fibres  
 Conclusions : (I) At least some fibres are metals  
 (II) Some metals are not fibres

Answer :

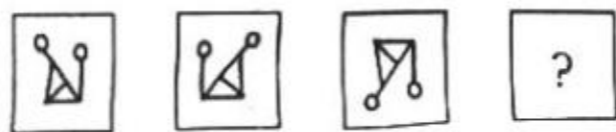
- (1) (2) (3) (4)

- 72.** In how many different ways can the letters of the word 'STORE' be arranged?  
 (1) 24 (2) 720 (3) 120 (4) 140

- 73.** If  $23 \times 5 = 27$  and  $13 \times 8 = 20$ , then  $29 \times 6 = ?$   
 (1) 33 (2) 34 (3) 36 (4) 174

- 74.** Select the missing figure from the given responses

Question Figures :



Answer Figures :





**Directions** (Question No. **75** to **79**) : Select the related letters/word/number from the given alternatives.

**75.** Hard : Soft :: ?

(1) Blue : Red

(2) Bold : Successful

(3) Beautiful : Ugly

(4) Kind : Helpful

**76.** Sphere : Cube : Circle : ?

(1) Round

(2) Square

(3) Ring

(4) Oval

**77.** Wood : Table :: ? : Knife

(1) Fork

(2) Chair

(3) Steel

(4) Saw

**78.** JLN : SQO :: PRT : ?

(1) UYW

(2) UTV

(3) YWU

(4) VUT

**79.** 36 : 64 :: ? : 81

(1) 49

(2) 64

(3) 100

(4) 121

**80.** A car covers 232 km in 4 hours. The average speed of a bike is 50% more than the average speed of the car. How much distance will the bike cover in 6 hours?

(1) 524 km

(2) 528 km

(3) ~~522 km~~

(4) 526 km

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85. How many carbon atoms are present in oleic acid?  
 (1) 16 carbons, with one double bond  
 (2) 18 carbons, with one double bond  
 (3) 18 carbons, with three double bond  
 (4) 20 carbons, with one double bond
86. Gynobasic style is found in family  
 (1) Leguminosae (2) Acanthaceae (3) Solanaceae (4) Lamiaceae
87. Semi-autonomous organelle is  
 (1) elaioplast (2) peroxisome (3) chloroplast (4) leucoplast
88. Plectostele is found in  
 (1) *Lycopodium serratum* (2) *Lycopodium clavatum*  
 (3) *Lycopodium cernuum* (4) *Lycopodium annotinum*
89. Dinoflagellates are related to  
 (1) Prokaryotes (2) Mesokaryotes (3) Eukaryotes (4) Archaeobacteria
90. Fire algae belong to  
 (1) Pyrrophyta (2) Xanthophyta (3) Rhodophyta (4) Cyanophyta
91. Which plant and its part contain the alkaloid vincristine and vinblastine?  
 (1) *Adhatoda vasica* (2) *Rauwolfia serpentina*  
 (3) *Catharanthus roseus* (4) *Selaginella*

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92. A food chain starting from a large autotroph and ending successively in smaller sized organism

- (1) grazing food chain (2) detritus food chain  
(3) parasitic food chain (4) autotrophic food chain

93. Which of the following is primarily concerned with reduction in emission of greenhouse gases?

- (1) Kyoto protocol (2) IPCC  
(3) CBD (4) Montreal protocol

94. Woronin bodies are found in

- (1) Bryophyta (2) Basidiomycotina  
(3) Myxomycotina (4) Ascomycotina

95. Excess of nitrates in drinking water causes

- (1) Minamata disease (2) Itai-itai disease  
(3) methaemoglobinaemia (4) osteomalacia

96. Water can move through apoplast in most of the root tissues, except the cells of

- (1) epidermis (2) endodermis (3) pericycle (4) cortex

97. Which of the following was an Indian Paleobotanist?

- (1) Acharya J. C. Bose (2) S. R. Bose  
(3) P. Agarkar (4) Birbal Sahni

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- 98.** Ecology is the study of reciprocal relationship between
- (1) animals and plants                      (2) animals and man  
(3) organisms and man                      (4) organisms and environment
- 99.** Living organisms can be best studied by
- (1) *electron microscope*                      (2) phase contrast microscope  
(3) compound microscope                      (4) inverted microscope
- 100.** The enzyme which maintains the chromosome from being shortened with each round of replication is
- (1) telomerase                      (2) helicase  
(3) reverse transcriptase                      (4) topoisomerase
- 101.** If 0.1 M solutions of sodium dihydrogen phosphate and disodium hydrogen phosphate are mixed together in equal proportions, what is the pH of the mixture if the  $pK_a$ -values of orthophosphoric acid ( $H_3PO_4$ ) are 2.0, 6.8, 12.0
- (1) 2.0                      (2) 4.4                      (3) 6.8                      (4) 9.4
- 102.** The oxygen dissociation curve of normal adult haemoglobin is most effectively shifted to the right by which of the following?
- (1) Cooperative binding of oxygen  
(2) Increased pH  
(3) Increased 2,3-bisphosphoglycerate  
(4) Decreased  $CO_2$



107. Which of the following compounds is a gratuitous inducer of  $\beta$ -galactosidase in *E. coli* ?
- (1) Allolactose (2) Isopropylthiogalactoside  
(3) Glucose (4) Lactose
108. The removal of two-carbon units from a fatty acyl coenzyme A involves four sequential reactions. Which of the following best describes the reaction sequence?
- (1) Dehydrogenation, hydration, dehydrogenation, cleavage  
(2) Oxidation, dehydration, oxidation, cleavage  
(3) Hydrogenation, dehydration, hydrogenation, cleavage  
(4) Reduction, hydration, dehydrogenation, cleavage
109. Which of the following is incorrectly paired?
- (1) Tympanic membrane : manubrium of malleus  
(2) Helicotrema : apex of cochlea  
(3) Foot plate of stapes : oval window  
(4) Otolith : semicircular canal
110. Maximum absorption of short chain fatty acids produced by bacteria occurs in the
- (1) duodenum (2) colon (3) jejunum (4) ileum
111. On the summit of Mt. Everest, where barometric pressure is about 250 mm Hg, the partial pressure of  $O_2$  is about
- (1) 0.5 mm Hg (2) 5 mm Hg (3) 50 mm Hg (4) 100 mm Hg

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117. Larva of *Obelia* is

- (1) amphiblastula (2) scyphistoma  
(3) planula (4) parenchymula

118. Infective stage of plasmodium in man is

- (1) trophozoite (2) ookinete (3) sporozoite (4) schizont

119. Microfilariae refer to

- (1) female *Wuchereria bancrofti*  
(2) male *Wuchereria bancrofti*  
(3) living embryo of *Wuchereria bancrofti*  
(4) embryo set free in water by female mosquito

120. Which of the following vitamins would most likely become deficient in a person who develops a completely carnivorous life style?

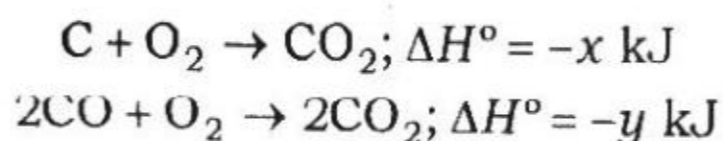
- (1) Thiamine (2) Niacin (3) Cobalamin (4) Vitamin C

## SECTION—B

## CHEMISTRY

121. What is the time (in sec) required for depositing all the silver present in 125 mL of 1 M  $\text{AgNO}_3$  solution by passing a current of 241.25 A? ( $1 F = 96500 C$ )
- (1) 10                      (2) 50                      (3) 100                      (4) 1000

122. Given that



The heat of formation of carbon monoxide will be

- (1)  $(y - 2x)/2$       (2)  $y + 2x$               (3)  $2x - y$               (4)  $(2x - y)/2$
123. Ethylene glycol is used as an anti-freeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it from freezing at  $-6^\circ\text{C}$  will be ( $K_f = 1.86 \text{ K kg mol}^{-1}$  and molar mass of ethylene glycol =  $62 \text{ g mol}^{-1}$ )
- (1) 600 g              (2) 800 g              (3) 200 g              (4) 400 g
124. 9.2 g  $\text{N}_2\text{O}_4$  is heated in a 1 L vessel till equilibrium state is established  $\text{N}_2\text{O}_4(g) = 2\text{NO}_2(g)$ . In equilibrium state 50%  $\text{N}_2\text{O}_4$  was dissociated. Given molecular weight of  $\text{N}_2\text{O}_4 = 93 \text{ g/mol}$ . Equilibrium constant will be
- (1) 0.1              (2) 0.4              (3) 0.2              (4) 0.3
125. A mixture of ethyl alcohol and propyl alcohol has a vapour pressure of 290 mm at 300 K. The vapour pressure of propyl alcohol is 200 mm. If the mole fraction of ethyl alcohol is 0.6, its vapour pressure (in mm) at the same temperature will be
- (1) 350              (2) 300              (3) 700              (4) 360

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126. The number of atoms present in 100 g of a f.c.c. crystal with density  $d = 10 \text{ g/cm}^3$  and cell edge equal to 100 p.m. are

- (1)  $1 \times 10^{25}$       (2)  $2 \times 10^{25}$       (3)  $3 \times 10^{25}$       (4)  $4 \times 10^{25}$

127. Work done during isothermal expansion of one mole of an ideal gas from 10 atm to 1 atm at 300 K is

- (1) 5744.1 J      (2) 7544.1 J      (3) 4574.1 J      (4) 4754.1 J

128. Most probable speed, average speed and root mean square speed are related as

- (1) 1 : 1.128 : 1.224      (2) 1 : 1.128 : 1.424  
 (3) 1 : 2.128 : 1.224      (4) 1 : 1.428 : 1.442

129. If the masses of an electron and 1 hydrogen atom are 1.008655 a.m.u. and 1.007825 a.m.u., respectively, and 1 a.m.u. = 931.5 MeV, the binding energy per nucleon in He atom  ${}^4\text{He}_2$  of mass 4.00260 a.m.u. is

- (1) 5.7740 MeV      (2) 4.7750 MeV      (3) 7.4750 MeV      (4) 7.0745 MeV

130. The degree of hydrolysis of a salt of weak acid and weak base is given by the expression

(1)  $\alpha = \sqrt{\frac{K_w \cdot K_b}{K_a}}$

(2)  $\alpha = \sqrt{\frac{K_w \cdot K_a}{K_b}}$

(3)  $\alpha = \sqrt{\frac{K_w}{K_a \cdot K_b}}$

(4)  $\alpha = \sqrt{K_w \cdot K_a \cdot K_b}$

(184)

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(P.T.O.)

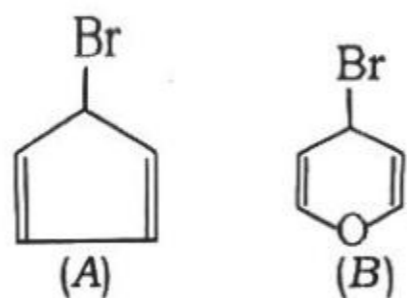
131. Phenol can be converted to salicylic acid by using

- (1)  $\text{CHCl}_3$  in presence of alkali followed by oxidation
- (2)  $\text{CCl}_4$  in alkali
- (3)  $\text{CO}_2$  and alkali under pressure
- (4) All of the above

132. Which one of the following pairs represents a set of electrophiles?

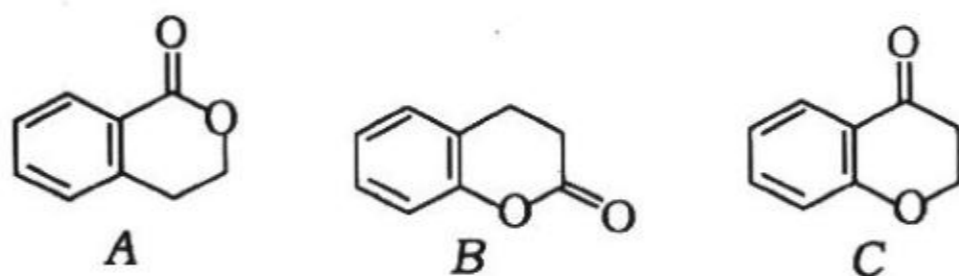
- |   |  |
|---|--|
| (1) $\text{Br}^\oplus$ and $\text{CCl}_2$ | (2) $\text{H}^\oplus$ and $\text{H}_2\text{O}$ |
| (3) $\text{BF}_3$ and $\text{NH}_3$       | (4) $\text{H}^\oplus$ and $\text{AlCl}_3$      |

133. Considering the rate of solvolysis of the compound A and B under  $\text{S}_\text{N}1$  reaction condition, which one of the following state is true?



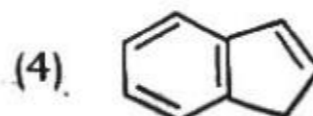
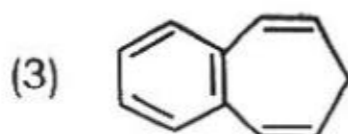
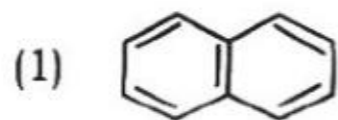
- (1) Compound A reacts with faster rate than B
- (2) Compound B reacts with faster rate than A
- (3) Both A and B reacts at the same rate
- (4) None of A as well B reacts

134. The order of increasing rate of reaction with  $\text{Br}_2 / \text{FeBr}_3$  of the following compounds A, B and C, will be

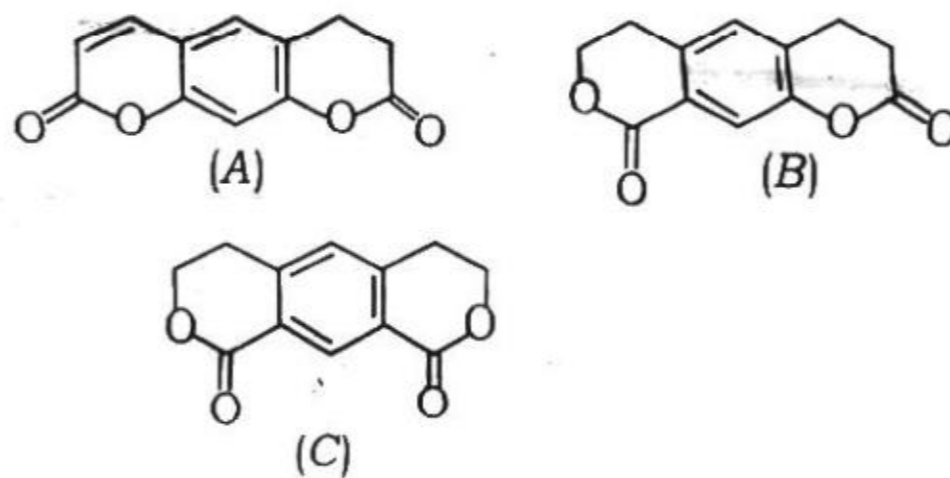


- (1)  $A < C < B$       (2)  $A < B < C$       (3)  $C < A < B$       (4)  $C < B < A$

135. Among the following hydrocarbons 'A—D', which one is the strongest acid?



136. For the nitration of the following compounds A-C under mixed acid condition, the increasing order for the rate of reaction is

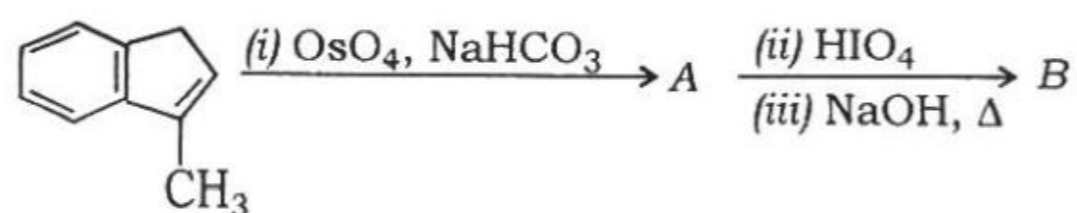


- (1)  $A < B < C$       (2)  $B < A < C$   
 (3)  $C < A < B$       (4)  $C < B < A$

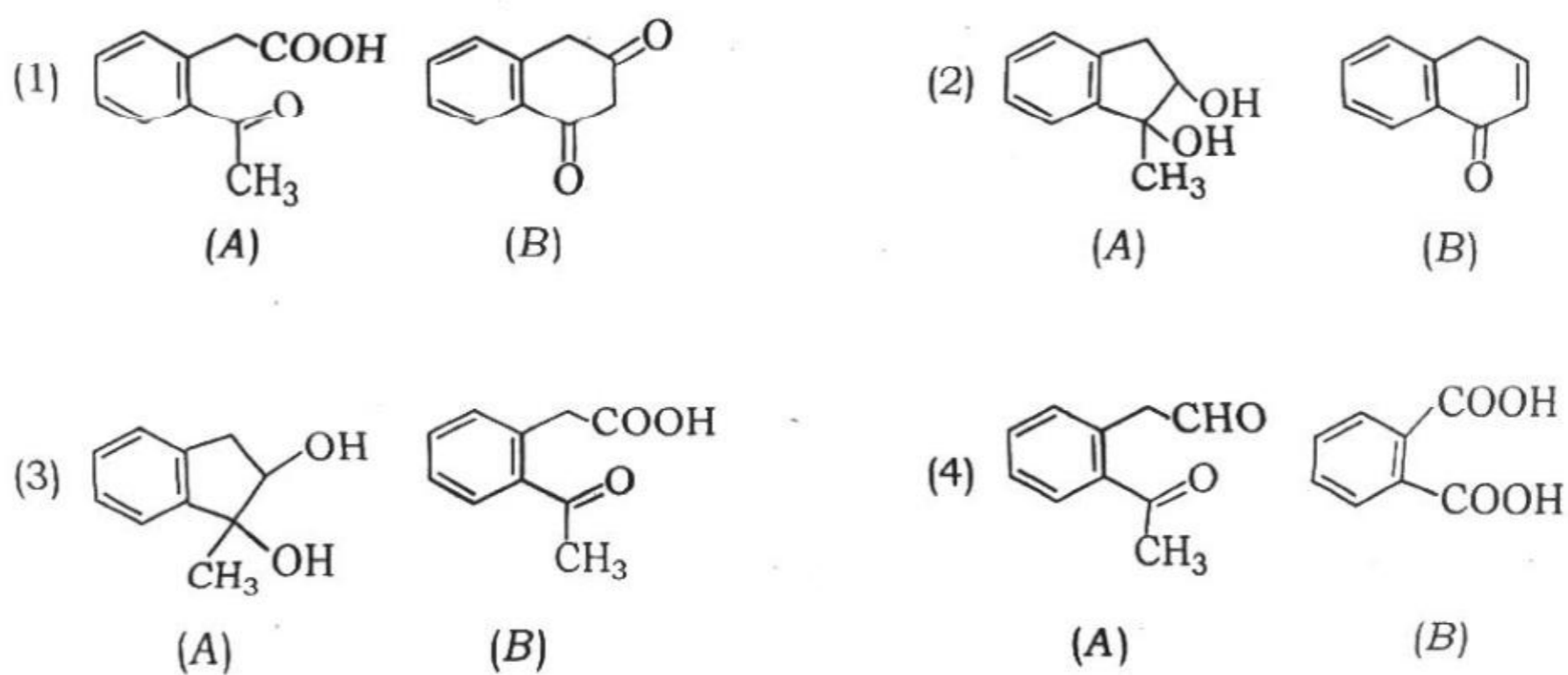
(184)

(P.T.O.)

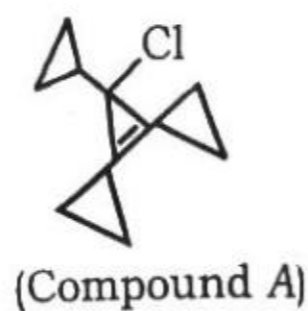
137. In the following reaction sequence :



Compound A and B are



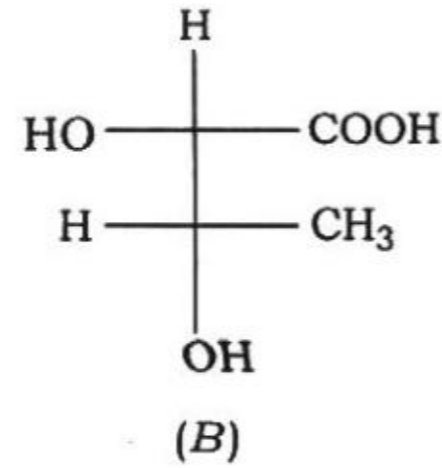
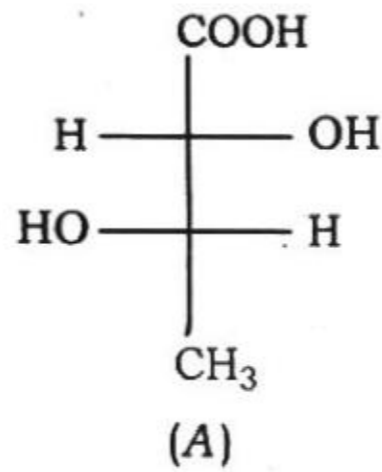
138. In the following compound A chlorine may be liberated easily in the form of



- (1)  $\text{Cl}^-$       (2)  $\text{Cl}^+$       (3)  $\text{Cl}^{+2}$       (4)  $\text{Cl}^\cdot$

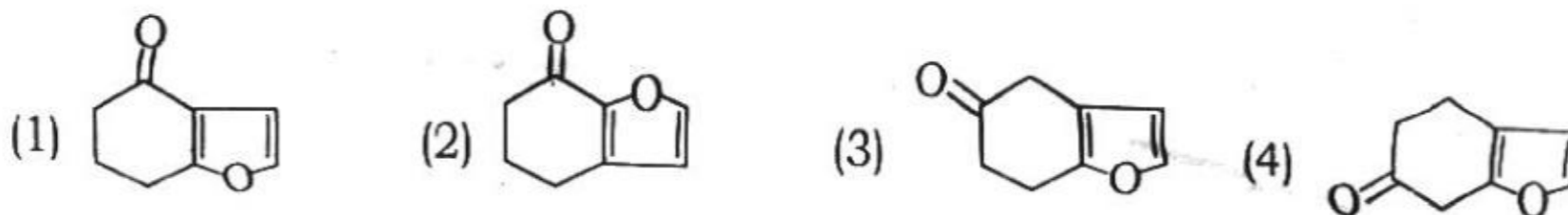
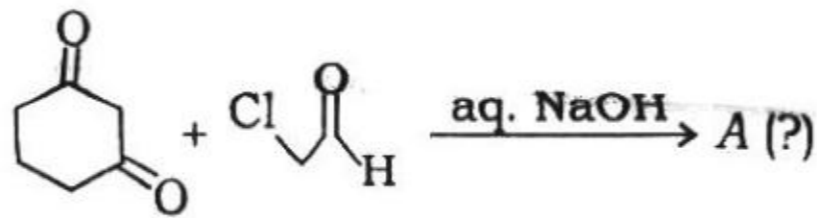
(184)

139. Compound A and B are



- (1) enantiomers (2) diastereomers  
 (3) epimers (4) identical

140. In the following reaction, the major product is



141. Gases responsible for acid rain are

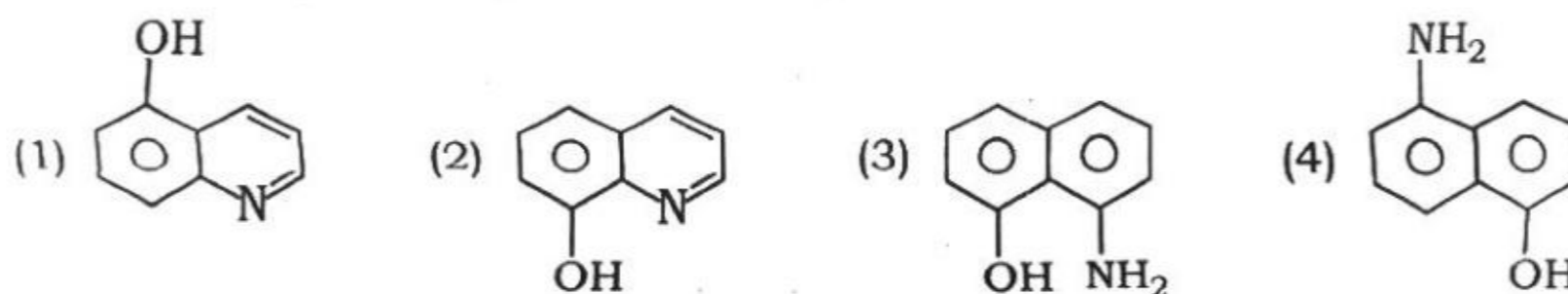
- (1)  $\text{CO}_x$  and  $\text{NO}_x$  (2)  $\text{NO}_x$  and  $\text{SO}_x$   
 (3) hydrocarbon and  $\text{CO}_x$  (4)  $\text{CO} + \text{CO}_2$

(184)

142. The criteria for selection of a pH indicator is

- (1)  $\text{pH} = \text{p}K_a \pm 1$                       (2)  $\text{pH} = 1 + \frac{1}{K_a}$   
 (3)  $\text{pH} = \text{p}K_a$                               (4)  $\text{pH} = K_a \pm 1$

143. Which of the following is the correct structure of oxine?



144. The salt of a weak base is

- (1) neutral              (2) strong acid      (3) strong base      (4) weak acid

145. The expression for standard deviation is

(1)  $S = \sqrt{\frac{\sum (\bar{x} - x_i)^2}{N-1}}$                       (2)  $S = \sqrt{\frac{\sum (x_i - \bar{x})^2}{N-1}}$   
 (3)  $S = \frac{\sum (x_i - \bar{x})^2}{N+1}$                       (4)  $S = \frac{\sum (\bar{x} - x_i)^2}{N-1}$

146. The amount 'ppm' is

- (1) mg/mL              (2)  $\mu\text{g/mL}$               (3) ng/mL              (4) g/mL

147. How many millilitres of 0.25 M solution of  $\text{H}_2\text{SO}_4$  will react with 10 mL of a 0.25 M solution of NaOH?

- (1) 0.5 mL              (2) 50.0 mL              (3) 0.05 mL              (4) 5.0 mL

(184)





154. In oxyhaemoglobin iron has

- (1) octahedral coordination and is paramagnetic
- (2) octahedral coordination and is diamagnetic
- (3) square pyramidal and is paramagnetic
- (4) square pyramidal and is diamagnetic

155. Shape of  $N(SiH_3)_3$  is

- (1) trigonal pyramidal
- (2) trigonal planar
- (3) V-shape
- (4) distorted tetrahedral

156. Stability of  $MO_2^+$  ions increases in the order

- (1)  $UO_2^+ < NpO_2^+ < PuO_2^+ < AmO_2^+$
- (2)  $NpO_2^{2+} < PuO_2^+ < UO_2^+ < AmO_2^+$
- (3)  $AmO_2^+ < UO_2^+ < NpO_2^+ < PuO_2^+$
- (4)  $UO_2^+ > NpO_2^+ > PuO_2^+ > AmO_2^+$

157. Yellow colour of  $K_2CrO_4$  is due to

- (1) *d-d* transition
- (2) intraligand transition
- (3) ligand to metal charge transfer transition
- (4) metal to ligand charge transfer transition

158. Element with atomic number 110 is

- (1) Ru
- (2) Ds
- (3) Re
- (4) Mt

(184)



**SECTION—B****PHYSICS**

- 161.** An object starts from rest at the origin and moves along the  $x$ -axis with a constant acceleration of  $4 \text{ m/s}^2$ . Its average velocity as it goes from  $x = 2 \text{ m}$  to  $x = 8 \text{ m}$  is
- (1)  $1 \text{ m/s}$       (2)  $2 \text{ m/s}$       (3)  $3 \text{ m/s}$       (4)  $6 \text{ m/s}$
- 162.** When the temperature of a copper penny is increased by  $100^\circ\text{C}$ , its diameter increases by  $0.17\%$ . The area of one of its faces increases by
- (1)  $0.17\%$       (2)  $0.34\%$       (3)  $0.51\%$       (4)  $0.13\%$
- 163.** A small object has charge  $Q$ . Charge  $q$  is removed from it and placed on a second small object. The two objects are placed  $1 \text{ m}$  apart. For the force that each object exerts on the other to be a maximum,  $q$  should be
- (1)  $2Q$       (2)  $Q$       (3)  $Q/2$       (4)  $Q/4$
- 164.** The reactance in ohms of a  $35 \mu\text{F}$  capacitor connected to a  $400 \text{ Hz}$  generator is
- (1)  $0$       (2)  $0.014$       (3)  $0.088$       (4)  $11$
- 165.** The purpose of Millikan's oil-drop experiment was to determine
- (1) the mass of an electron  
(2) the charge of an electron  
(3) the ratio of charge to mass for an electron  
(4) the sign of the charge on an electron

- 166.** Suppose  $A = BC$ , where  $A$  has the dimension  $L/M$  and  $C$  has the dimension  $L/T$ . Then  $B$  has the dimension
- (1)  $T/M$                       (2)  $L^2/TM$                       (3)  $TM/L^2$                       (4)  $L^2T/M$
- 167.** The index of refraction of a certain glass is 1.50. The sine of the critical angle for total internal reflection at a glass-air interface is
- (1) 0.50                      (2) 0.67                      (3) 0.75                      (4) 1.00
- 168.** According to relativity theory, a particle of mass  $m$  with a momentum of  $2mc$  has a speed of
- (1)  $2c$                       (2)  $4c$                       (3)  $c$                       (4)  $0.89c$
- 169.** The shimmering or wavy lines that can often be seen near the ground on a hot day are due to
- (1) Brownian movement                      (2) reflection  
(3) refraction                      (4) diffraction
- 170.** A boy on the edge of a vertical cliff 20 m high throws a stone horizontally outward with a speed of 20 m/s. It strikes the ground at what horizontal distance from the foot of the cliff? Use  $g = 10 \text{ m/s}^2$
- (1) 10 m                      (2) 40 m                      (3) 50 m                      (4)  $50\sqrt{5}$  m
- 171.** An inelastic collision is one in which
- (1) momentum is not conserved but kinetic energy is conserved  
(2) total mass is not conserved but momentum is conserved  
(3) neither kinetic energy nor momentum is conserved  
(4) momentum is conserved but kinetic energy is not conserved

(184)

172. If the kinetic energy of a particle is equal to its rest energy, then its speed must be  
(1)  $0.25c$             (2)  $0.50c$             (3)  $0.87c$             (4)  $c$
173. The frequency of light beam A is twice that of light beam B. The ratio  $E_A/E_B$  of photon energies is  
(1)  $1/2$             (2)  $1/4$             (3)  $1$             (4)  $2$
174. The quantum number  $n$  is most closely associated with what property of the electron in a hydrogen atom?  
(1) Energy            (2) Orbital angular momentum  
(3) Spin angular momentum            (4) Magnetic moment
175. A Laser must be pumped to achieve  
(1) a metastable state            (2) fast response  
(3) stimulated emission            (4) population inversion
176. A 5 kg concrete block is lowered with a downward acceleration of  $2.8 \text{ m/s}^2$  by means of a rope. The force of the block on the rope is  
(1) 14 N, up            (2) 14 N, down            (3) 35 N, up            (4) 35 N, down
177. The force exerted by a uniform electric field on a dipole is  
(1) parallel to the dipole moment  
(2) perpendicular to the dipole moment  
(3) parallel to the electric field  
(4) None of the above

178. An electron is accelerated from rest through a potential difference  $V$ . Its final speed is proportional to
- (1)  $V$                       (2)  $V^2$                       (3)  $\sqrt{V}$                       (4)  $1/V$
179. The r.m.s. speed of an oxygen molecule at  $0^\circ\text{C}$  is  $460\text{ m/s}$ . If the molar mass of oxygen is  $32\text{ g}$  and that of helium is  $4\text{ g}$ , then the r.m.s. speed of a helium molecule at  $0^\circ\text{C}$  is
- (1)  $230\text{ m/s}$               (2)  $326\text{ m/s}$               (3)  $650\text{ m/s}$               (4)  $1300\text{ m/s}$
180. The Stern-Gerlach experiment makes use of
- (1) a strong uniform magnetic field  
(2) a strong non-uniform magnetic field  
(3) a strong uniform electric field  
(4) a strong non-uniform electric field
181. A single force acts on a particle situated on the positive  $x$ -axis. The torque about the origin is in the negative  $z$ -direction. The force might be
- (1) in the positive  $y$ -direction              (2) in the negative  $y$ -direction  
(3) in the positive  $x$ -direction              (4) in the negative  $x$ -direction
182. A shearing force of  $50\text{ N}$  is applied to an aluminium rod with a length of  $10\text{ m}$ , a cross-sectional area of  $1.0 \times 10^{-5}\text{ m}^2$ , and a shear modulus of  $2.5 \times 10^{10}\text{ N/m}^2$ . As a result the rod is sheared through a distance of
- (1) zero                      (2)  $1.9\text{ mm}$                       (3)  $1.9\text{ cm}$                       (4)  $19\text{ cm}$

(184)

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(P.T.O.)

- 183.** A stationary source generates 5.0 Hz water waves whose speed is 2.0 m/s. A boat is approaching the source at 10 m/s. The frequency of these waves, as observed by a person in the boat, is
- (1) 5.0 Hz      (2) 15 Hz      (3) 20 Hz      (4) 30 Hz
- 184.** An object moves around a circle. If the radius is doubled keeping the speed same, then the magnitude of the centripetal force must be
- (1) twice      (2) half      (3) four times      (4) one-fourth
- 185.** An ideal gas has molar specific heat  $C_p$  at constant pressure. When the temperature of  $n$  moles is increased by  $\Delta T$  the increase in the internal energy is
- (1)  $nC_p \Delta T$       (2)  $n(C_p + R) \Delta T$   
(3)  $n(C_p - R) \Delta T$       (4)  $n(2C_p + R) \Delta T$
- 186.** A slow (quasi-static) process is not reversible if
- (1) the temperature changes  
(2) energy is absorbed or emitted as heat  
(3) work is done on the system  
(4) friction is present
- 187.** Two plane mirrors make an angle of  $120^\circ$  with each other. The maximum number of images of an object placed between them is
- (1) one      (2) two      (3) three      (4) four
- 188.** Let  $M$  denote the mass of Earth and let  $R$  denote its radius. The ratio  $g/G$  at Earth's surface is
- (1)  $R^2/M$       (2)  $M/R^2$       (3)  $MR^2$       (4)  $M/R$

(184)



189. One mole of an ideal gas expands reversibly and isothermally at temperature  $T$  until its volume is doubled. The change of entropy of this gas for this process is  
(1)  $R \ln 2$                       (2)  $(\ln 2)/T$                       (3) 0                      (4)  $RT \ln 2$
190. 10 C of charge is placed on a spherical conducting shell. A particle with a charge of  $-3$  C is placed at the centre of the cavity. The net charge on the outer surface of the shell is  
(1)  $-7$  C                      (2)  $-3$  C                      (3) 0 C                      (4)  $+7$  C
191. In a Young's double-slit experiment, light of wavelength 500 nm illuminates two slits that are separated by 1 mm. The separation between adjacent bright fringes on a screen 5 m from the slits is  
(1) 0.10 cm                      (2) 0.25 cm                      (3) 0.50 cm                      (4) 1.0 cm
192. Radioactive  $^{90}\text{Sr}$  has a half-life of 30 years. What percent of a sample of  $^{90}\text{Sr}$  will remain after 60 years?  
(1) 0%                      (2) 25%                      (3) 50%                      (4) 75%
193. A concave mirror forms a real image that is twice the size of the object. If the object is 20 cm from the mirror, the radius of curvature of the mirror must be about  
(1) 13 cm                      (2) 20 cm                      (3) 27 cm                      (4) 40 cm
194. A battery with an e.m.f. of 12 V and an internal resistance of  $1 \Omega$  is used to charge a battery with an e.m.f. of 10 V and an internal resistance of  $1 \Omega$ . The current in the circuit is  
(1) 1 A                      (2) 2 A                      (3) 4 A                      (4) 11 A

(184)

- 195.** In a metal at 0 K, the Fermi energy is
- (1) the highest energy of any electron
  - (2) the lowest energy of any electron
  - (3) the mean thermal energy of the electrons
  - (4) the energy of the top of the valence band
- 196.** Which one of the following is not needed in a nuclear fission reactor?
- (1) Moderator      (2) Fuel      (3) Coolant      (4) Accelerator
- 197.** Iron, rather than copper, is used in the core of transformers because iron
- (1) can withstand a higher temperature
  - (2) has a greater resistivity
  - (3) has a very high permeability
  - (4) makes a good permanent magnet
- 198.** When you stand in front of a plane mirror, your image is
- (1) real, erect and smaller than you
  - (2) real, erect and the same size as you
  - (3) virtual, erect and smaller than you
  - (4) virtual, erect and the same size as you

- 199.** In a photoelectric effect experiment the stopping potential is
- (1) the energy required to remove an electron from the sample
  - (2) the kinetic energy of the most energetic electron ejected
  - (3) the potential energy of the most energetic electron ejected
  - (4) the electric potential that causes the electron current to vanish
- 200.** A femtometre is
- |                             |                  |
|-----------------------------|------------------|
| (1) larger than $10^{-9}$ m | (2) $10^{-9}$ m  |
| (3) $10^{-12}$ m            | (4) $10^{-15}$ m |

**SECTION—B**  
**MATHEMATICS**

- 201.** A transformation  $w = \alpha z + \beta$ , where  $\alpha$  and  $\beta$  are complex constants, is the resultant of
- (1) magnification and translation
  - (2) magnification, rotation and translation
  - (3) rotation and translation
  - (4) None of these
- 202.** The number of poles of the function  $f(z) = \tan \frac{1}{z}$  is
- (1) 1
  - (2) 2
  - (3) 0
  - (4) None of these
- 203.** The value of  $\int_0^{\infty} \frac{\sin t}{t} dt$  is
- (1)  $\pi$
  - (2)  $\frac{\pi}{2}$
  - (3)  $\frac{\pi}{3}$
  - (4)  $\frac{\pi}{4}$
- 204.** The function  $f(z) = \sqrt{|xy|}$ , where  $z = x + iy$  is
- (1) analytic function at  $z = 0$
  - (2) not analytic at  $z = 0$
  - (3)  $f'(z)$  exists at  $z = 0$
  - (4) None of these
- 205.** The value of  $\left(\frac{\Delta^2}{E}\right) e^x \cdot \frac{Ee^x}{\Delta^2 e^x}$  is
- (1)  $e^{2x}$
  - (2)  $e^{\frac{x}{2}}$
  - (3)  $e^x$
  - (4) None of these

- 206.** If  $\Delta^n (1-x)(1-2x)(1-3x) = -36$ , then the value of  $n$  is  
 (1) 6 (2) 3 (3) 2 (4) 36
- 207.** In the trapezoidal rule, we assume that the function  $f(x)$  is a polynomial of degree  
 (1) one (2) two (3) three (4) four
- 208.** The general solution of linear difference equation  $(E^2 - 2E - 8)y_k = 0$  is  
 (1)  $y_k = c_1(-2)^k + c_2 4^k$  (2)  $y_k = c_1 2^k + c_2 4^k$   
 (3)  $y_k = c_1(-2)^k + c_2(-4)^k$  (4)  $y_k = c_1 2^k + c_2(-4)^k$
- 209.** Range of the sequence  $\{-1, 1, -1, 1, \dots\}$  defined by  
 (1)  $\{-1\}$  (2)  $\{-1, 1\}$  (3) real numbers (4) None of these
- 210.** The perpendicular distance of any point  $p(x, y, z)$  from the  $z$ -axis is given by  
 (1)  $\frac{z}{\sqrt{x^2 + y^2 + z^2}}$  (2)  $\sqrt{x^2 + y^2}$   
 (3) 1 (4)  $z$
- 211.** The planes  $bx - ay = n$ ,  $cy - bz = l$  and  $az - cx = m$  intersect in a line if  
 (1)  $a + b + c = 0$  (2)  $a = b = c$   
 (3)  $al + bm + cn = 0$  (4)  $l + m + n = 0$

**212.** Let  $F(x, y, z, t) = 0$  be a homogeneous equation of second degree representing a cone. Then the coordinates of its vertex satisfy

- (1)  $\frac{\partial F}{\partial x} = 0, \frac{\partial F}{\partial y} = 0, \frac{\partial F}{\partial z} = 0, \frac{\partial F}{\partial t} \neq 0$       (2)  $\frac{\partial F}{\partial x} = 0, \frac{\partial F}{\partial y} = 0, \frac{\partial F}{\partial z} = 0, \frac{\partial F}{\partial t} = 0$   
 (3)  $\frac{\partial F}{\partial x} = 0, \frac{\partial F}{\partial y} = 0, \frac{\partial F}{\partial z} = 0$       (4) None of these

**213.** The equation of right circular cone with vertex  $(0, 0, 0)$  and axis along z-axis and semi-vertical angle  $\theta$  is

- (1)  $x^2 + y^2 = z^2 \tan^2 \theta$       (2)  $x^2 + y^2 = z^2 \sin^2 \theta$   
 (3)  $x^2 + y^2 = z^2 \cot^2 \theta$       (4)  $x^2 + y^2 = z^2 \cos^2 \theta$

**214.** The radius of the curvature at the origin for the curve  $r = a \sin n\theta$  is given by

- (1)  $2na$       (2)  $\frac{na}{2}$       (3)  $\frac{2n}{a}$       (4)  $n^2 a^2$

**215.** The circular asymptote of the curve  $r = f(\theta)$  is given by

- (1)  $r = \lim_{\theta \rightarrow 0} f(\theta)$       (2)  $r = \lim_{\theta \rightarrow \infty} f(\theta)$   
 (3)  $\theta = \lim_{r \rightarrow 0} f(r)$       (4) None of these

**216.** How many asymptotes of the curve  $r = \frac{a}{(1 - \cos \theta)}$  has?

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

**217.**  $\int_0^{\frac{\pi}{2}} \sin^n x dx$  and  $\int_0^{\frac{\pi}{2}} \cos^n x dx$  are

- (1) always equal      (2) equal only in some particular cases  
 (3) never equal      (4) None of these

218.  $\lim_{n \rightarrow \infty} \left[ \tan \frac{\pi}{2n} \tan \frac{2\pi}{2n} \dots \tan \frac{n\pi}{2n} \right]^{\frac{1}{n}}$  is equal to  
 (1) 0 (2) 1 (3)  $e$  (4)  $e^{-1}$
219.  $\int_0^{\frac{\pi}{2}} \int_0^{\sin \theta} r \, d\theta \, dr$  is given by  
 (1)  $\int_0^{\frac{\pi}{2}} \frac{\sin^2 \theta}{2} \, d\theta$  (2)  $\int_0^{\sin \theta} \frac{\pi}{2} r \, dr$   
 (3)  $\int_0^{\frac{\pi}{2}} (1 - \cos 2\theta) \, d\theta$  (4) None of these
220. The initial value problem  $\frac{dy}{dx} = x, y(0) = 1$  has  
 (1) only one solution (2) two solutions  
 (3) no solutions (4) an infinite number of solutions
221. The general solution of the differential equation  $(y - px)(p - 1) = p$  is given by  
 (1)  $y = \sqrt{cx + \frac{c}{c-1}}$  (2)  $y^2 = 4cx$   
 (3)  $y = cx + \frac{c}{c+1}$  (4)  $(y - cx)(c - 1) = c$
222. If  $A$  is a  $3 \times 3$  matrix with  $\det(A) = 3$ , then  $\det(\text{adj } A)$  is  
 (1) 3 (2) 9 (3) 27 (4) 81
223. If  $A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 2a & 2b & -1 \end{pmatrix}$ , then  $A^2$  is  
 (1) null matrix (2) unit matrix (3)  $A$  (4)  $-A$

(184)

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(P.T.O.)

224. The inverse of the matrix  $A = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}$  is
- (1)  $\begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$       (2)  $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}$       (3)  $-A$       (4) None of these
225. If  $A = \begin{pmatrix} 4 & 2 \\ -1 & 1 \end{pmatrix}$ , then  $(A - 2I)(A - 3I)$  is
- (1) identity matrix      (2) null matrix  
(3) nil potent matrix      (4) None of these
226. The virtual work done by the tension of an extensible string is
- (1) zero      (2) -ve  
(3) +ve      (4) Both zero and +ve
227. Tension at any point of the catenary is
- (1)  $wx$       (2)  $wy$       (3)  $wc$       (4)  $w\psi$
228. A uniform string hangs freely under gravity. The mass per unit length is proportional to
- (1)  $\sec^2 \psi$       (2)  $\cos^2 \psi$       (3)  $\sec^2 \psi / \rho$       (4)  $\tan^2 \psi$
229. The equation of catenary of uniform strength is
- (1)  $y = a \log \sec(x/a)$       (2)  $y = \log \sec(x/a)$   
(3)  $y = \log \cos(x/a)$       (4)  $y = a \log \cos(x/a)$



- 230.** If a particle moves along a circle of radius  $r$  with centre at pole, then its radial acceleration is  
 (1)  $r^2 \theta$                       (2)  $-r\dot{\theta}^2$                       (3)  $\ddot{r} + r\dot{\theta}^2$                       (4)  $r\dot{\theta}^2$
- 231.** A particle slides down the outside of a smooth vertical circle of radius  $a$ , starting from the rest at the highest point. It will leave the circle after descending vertically a distance equal to  
 (1)  $a/3$                       (2)  $2a/3$                       (3)  $a/2$                       (4)  $a/4$
- 232.** In order to rise above the horizontal diameter of a vertical circle, the velocity of a projection  $u$  of a heavy particle tied to a light inextensible string of length  $a$  will be related to the length of the string as  
 (1)  $u^2 \geq 2ag$                       (2)  $u^2 < 2ag$                       (3)  $u^2 > 2ag$                       (4)  $u^2 \leq 2ag$
- 233.** The series  $\sum \frac{1}{n^p}$  is convergent if  
 (1)  $p < 1$                       (2)  $p = 1$                       (3)  $p = \infty$                       (4)  $p > 1$
- 234.** In an inner product space  $V(F)$  is  
 (1)  $|(a, b)| = \|a\| + \|b\|$                       (2)  $|(a, b)| \leq \|a\| \cdot \|b\|$   
 (3)  $|(a, b)| = \|a\| \cdot \|b\|$                       (4)  $|(a, b)| \leq \|a\| + \|b\|$
- 235.** The Christoffel's symbols are  
 (1) tensor quantities                      (2) not tensor quantities  
 (3) covariant tensors                      (4) contravariant tensors

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**236.** The number of Serret-Frenet formulae is/are

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

**237.** The Riemannian metric is

- (1)  $ds^2 = ng_{ij} dx^i dx^j$                       (2)  $ds^2 = [ij, k] dx^i dx^j$   
 (3)  $ds^2 = g_{ij} dx^i dx^j$                       (4)  $ds^2 = \{ j^i k \} dx^i dx^j$

**238.** The value of  $L \left\{ \frac{\sin at}{t} \right\}$  is equal to

- (1)  $\sin^{-1} (a/p)$                       (2)  $\cos^{-1} (a/p)$   
 (3)  $\tan^{-1} (a/p)$                       (4)  $\cot^{-1} (a/p)$

**239.** The function  $f(z) = |z|^2$  is

- (1) differentiable everywhere                      (2) differentiable nowhere  
 (3) differentiable at the origin only                      (4) differentiable at  $z=0$  and  $z=1$

**240.** The necessary condition that surface  $z = f(x, y)$  should represent a developable surface is

- (1)  $r^2 t^2 = s^2$                       (2)  $rt - s^2 < 0$   
 (3)  $rt - s^2 > 0$                       (4)  $rt = s^2$

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## अभ्यर्थियों के लिए निर्देश

(इस पुस्तिका के प्रथम आवरण-पृष्ठ पर तथा उत्तर-पत्र के दोनों पृष्ठों पर केवल नीली या काली बाल-प्वाइंट पेन से ही लिखें)

1. प्रश्न पुस्तिका मिलने के 10 मिनट के अन्दर ही देख लें कि प्रश्नपत्र में सभी पृष्ठ मौजूद हैं और कोई प्रश्न छूटा नहीं है। पुस्तिका दोषयुक्त पाये जाने पर इसकी सूचना तत्काल कक्ष-निरीक्षक को देकर सम्पूर्ण प्रश्नपत्र की दूसरी पुस्तिका प्राप्त कर लें।
2. परीक्षा भवन में लिफाफा रहित प्रवेश-पत्र के अतिरिक्त, लिखा या सादा कोई भी खुला कागज साथ में न लायें।
3. उत्तर-पत्र अलग से दिया गया है। इसे न तो मोड़ें और न ही विकृत करें। दूसरा उत्तर-पत्र नहीं दिया जायेगा, केवल उत्तर-पत्र का ही मूल्यांकन किया जायेगा।
4. अपना अनुक्रमांक तथा उत्तर-पत्र का क्रमांक प्रथम आवरण-पृष्ठ पर पेन से निर्धारित स्थान पर लिखें।
5. उत्तर-पत्र के प्रथम पृष्ठ पर पेन से अपना अनुक्रमांक निर्धारित स्थान पर लिखें तथा नीचे दिये वृत्तों को गाढ़ा कर दें। जहाँ-जहाँ आवश्यक हो वहाँ प्रश्न-पुस्तिका का क्रमांक तथा सेट का नम्बर उचित स्थानों पर लिखें।
6. ओ० एम० आर० पत्र पर अनुक्रमांक संख्या, प्रश्न-पुस्तिका संख्या व सेट संख्या (यदि कोई हो) तथा प्रश्न-पुस्तिका पर अनुक्रमांक सं० और ओ० एम० आर० पत्र सं० की प्रविष्टियों में उपरिलेखन की अनुमति नहीं है।
7. उपर्युक्त प्रविष्टियों में कोई भी परिवर्तन कक्ष निरीक्षक द्वारा प्रमाणित होना चाहिये अन्यथा यह एक अनुचित साधन का प्रयोग माना जायेगा।
8. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार वैकल्पिक उत्तर दिये गये हैं। प्रत्येक प्रश्न के वैकल्पिक उत्तर के लिये आपको उत्तर-पत्र की सम्बन्धित पंक्ति के सामने दिये गये वृत्त को उत्तर-पत्र के प्रथम पृष्ठ पर दिये गये निर्देशों के अनुसार पेन से गाढ़ा करना है।
9. प्रत्येक प्रश्न के उत्तर के लिये केवल एक ही वृत्त को गाढ़ा करें। एक से अधिक वृत्तों को गाढ़ा करने पर अथवा एक वृत्त को अपूर्ण भरने पर वह उत्तर गलत माना जायेगा।
10. ध्यान दें कि एक बार स्याही द्वारा अंकित उत्तर बदला नहीं जा सकता है। यदि आप किसी प्रश्न का उत्तर नहीं देना चाहते हैं, तो सम्बन्धित पंक्ति के सामने दिये गये सभी वृत्तों को खाली छोड़ दें। ऐसे प्रश्नों पर शून्य अंक दिये जायेंगे।
11. रफ़ कार्य के लिये प्रश्न-पुस्तिका के मुखपृष्ठ के अन्दर वाले पृष्ठ तथा अंतिम पृष्ठ का प्रयोग करें।
12. परीक्षा के उपरान्त केवल ओ०एम०आर० उत्तर-पत्र परीक्षा भवन में जमा कर दें।
13. परीक्षा समाप्त होने से पहले परीक्षा भवन से बाहर जाने की अनुमति नहीं होगी।
14. यदि कोई अभ्यर्थी परीक्षा में अनुचित साधनों का प्रयोग करता है, तो वह विश्वविद्यालय द्वारा निर्धारित दंड का/की, भागी होगा/होगी।