

S.C.R.A - Exam  $\Rightarrow$  2013

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

T.B.C. : P-TSB-N-QIT

Test Booklet Series

TEST BOOKLET  
PHYSICAL SCIENCES  
PAPER—II



Time Allowed : Two Hours

Maximum Marks : 200

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/ discrepancy will render the Answer Sheet liable for rejection.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write anything else on the Test Booklet.
4. This Test Booklet contains **120** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.
5. You have to mark all your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *ONLY* the Answer Sheet. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**  
THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
  - (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0.33)** of the marks assigned to that question will be deducted as penalty.
  - (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
  - (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. The mass of a metal cube is 5.74 g and its volume is  $1.2 \text{ cm}^3$ . Then its density expressed up to appropriate significant figures will be
- (a)  $4.8 \text{ g cm}^{-3}$   
(b)  $4.78 \text{ g cm}^{-3}$   
(c)  $4.783 \text{ g cm}^{-3}$   
(d)  $5.0 \text{ g cm}^{-3}$
2. The displacement of a particle in simple harmonic motion in one time period is
- (a)  $A$   
(b)  $2A$   
(c)  $4A$   
(d)  $0$
- where  $A$  is the amplitude.
3. How will coefficient of friction change if the normal reaction is halved?
- (a) Doubled  
(b) Halved  
(c) Unchanged  
(d) Cannot be predicted
4. A car accelerates from rest to a speed of 10 m/s. Let the energy spent be  $E$ . If we accelerate the speed of the car from 10 m/s to 20 m/s, the energy spent will be
- (a)  $E$   
(b)  $2E$   
(c)  $3E$   
(d)  $4E$
5. A boy desires to hit a bird on the ground from a point at a horizontal distance of 100 m. If the gun can impart a velocity of 500 m/s to the bullet, at what height above the bird must he aim his gun in order to hit it ( $g = 10 \text{ m/s}^2$ )?
- (a) 10 cm  
(b) 20 cm  
(c) 50 cm  
(d) 100 cm
6. A car accelerates at  $5 \text{ m s}^{-2}$  and then retards to rest at  $3 \text{ m s}^{-2}$ . The maximum velocity of the car is 30 m/s. The distance covered by the car is
- (a) 150 m  
(b) 240 m  
(c) 300 m  
(d) 360 m

7. A bullet after firing from a gun goes through a plank of thickness  $h$  and changes its velocity from  $u$  to  $v$ . The force of resistance is proportional to square of velocity. The time of motion of the bullet in the plank is proportional to

- (a)  $(u - v)u^{-2}$
- (b)  $(u - v)v^{-2}$
- (c)  $(u - v)(uv)^{-1}$
- (d)  $(u^2 - v^2)(uv)^{-2}$

8. A satellite is shot vertically upward from the surface of the Earth of radius  $R$ . If  $v$  is the escape velocity from the surface of the Earth, then at what distance from the centre of the Earth will its speed be  $v/3$ ?

- (a)  $3R$
- (b)  $\sqrt{3}R$
- (c)  $2R/3$
- (d)  $9R$

9. A simple pendulum is taken at a place where its separation from the Earth's surface is equal to the radius of the Earth. Then the time period of small oscillations of the pendulum (with string length of 1.0 m) is given by

- (a) 1 s
  - (b) 2 s
  - (c) 4 s
  - (d) 0.5 s
- (Take  $g = \pi^2 \text{ m/s}^2$ )

10. A particle of mass  $m$  is at  $x = 0$  with velocity  $v = u$  in the  $x$ -direction at  $t = 0$ . It is subjected to a friction force  $-bv$ , where  $b$  is a positive constant. The position of the particle at  $t \rightarrow \infty$  is

- (a)  $mu/b$
- (b)  $u/mb$
- (c)  $2mu/b$
- (d)  $mu/2b$

11. A piece of ice of volume  $V \text{ m}^3$  and density  $900 \text{ kg/m}^3$  is dropped into water. What is the force (in newton) with which the ice should be pushed down so that it is totally under water ( $g = 10 \text{ m s}^{-2}$ )?

- (a)  $900V$
- (b)  $100V$
- (c)  $1900V$
- (d)  $1000V$

12. A body kept on a smooth inclined plane having inclination 1 in  $s$  will remain stationary relative to inclined plane if the body is given a horizontal acceleration equal to

- (a)  $\frac{g}{\sqrt{s^2 - 1}}$
- (b)  $\frac{gs}{\sqrt{s^2 - 1}}$
- (c)  $\frac{g\sqrt{s^2 - 1}}{s}$
- (d)  $g\sqrt{s^2 - 1}$

13. A body of mass  $m$  slides down a rough plane of inclination  $\alpha$ . If  $\mu$  is the coefficient of friction, then the acceleration of the body will be

- (a)  $g \sin \alpha$
- (b)  $\mu \cos \alpha$
- (c)  $g(\sin \alpha - \mu \cos \alpha)$
- (d)  $g(\cos \alpha - \mu \sin \alpha)$

14. A body floats with one-third volume outside when put in water and three-fourth of its volume outside when put in another liquid. The density of the liquid is

- (a)  $9/4 \text{ g cm}^{-3}$
- (b)  $8/3 \text{ g cm}^{-3}$
- (c)  $3/8 \text{ g cm}^{-3}$
- (d)  $4/9 \text{ g cm}^{-3}$

15. Radius of the Earth is twice that of the Mars and its weight is ten times the weight of the Mars. An object weighing 100 kg on the Earth will weigh how much on the Mars?

- (a) 50 kg
- (b) 40 kg
- (c) 30 kg
- (d) 20 kg

16. Which of the following are correct?

A static fluid implies that

1. there will not be any shear force acting in a fluid element
2. the individual molecules of a fluid element are not in motion
3. the fluid can be assumed to be a rigid body

Select the correct answer using the code given below.

- (a) 1, 2 and 3
- (b) 1 and 2 only
- (c) 2 and 3 only
- (d) 1 and 3 only

17. A planet with mass equal to eight times the mass of the Earth, has the same average density as the Earth. With  $g$  being the gravitational acceleration on the surface of the Earth, the gravitational acceleration on the surface of the planet is

- (a)  $8g$
- (b)  $4g$
- (c)  $\sqrt{8}g$
- (d)  $2g$

18. The pitch of a screw gauge is 0.5 mm. Its head scale contains 50 divisions. The least count of the screw gauge is

- (a) 0.0001 cm
- (b) 0.0025 cm
- (c) 0.01 cm
- (d) 0.001 cm

19. Water drops fall at regular intervals from a tap which is 5 m above the ground. The third drop leaves the tap at the instant the first drop touches the ground. How far above the ground is the second drop at that instant?

- (a) 2.5 m
- (b) 3.75 m
- (c) 4.0 m
- (d) 1.25 m

20. A body is acted upon by a force proportional to square of distance covered. If the distance covered is denoted by  $x$ , then work done by the force will be proportional to

- (a)  $x$
- (b)  $x^2$
- (c)  $x^3$
- (d)  $x^{-2}$

21. If the internal energy of an ideal gas decreases by the same amount as the work done by the system, then which of the following is/are correct?

1. The process must be adiabatic.
2. The process must be isothermal.
3. The temperature of the gas must decrease.

Select the correct answer using the code given below.

- (a) 1 only
- (b) 1 and 3
- (c) 2
- (d) 3 only

22. Which one of the following quantities is zero on an average for the molecules of an ideal gas in equilibrium?

- (a) Kinetic energy
- (b) Density
- (c) Speed
- (d) None of the above

23. A sample of gas with  $\gamma = 1.5$  is taken through an adiabatic process in which the volume is compressed from  $1600 \text{ cm}^3$  to  $400 \text{ cm}^3$ . If the initial pressure is 150 kPa, then the work done in the process is

- (a) -120 J
- (b) +120 J
- (c) -480 J
- (d) +480 J

24. The root-mean-square speed and average kinetic energy of the molecules of an ideal gas at absolute temperature  $T$  are respectively proportional to

- (a)  $T$  and  $T^{-1}$
- (b)  $\sqrt{T}$  and  $T$
- (c)  $T$  and  $T^2$
- (d)  $T^{-1}$  and  $T$



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25. A copper rod is joined to a steel rod in series. The rods have equal length and equal cross-sectional area. The free end of copper rod is kept at  $0\text{ }^{\circ}\text{C}$  and that of steel rod is kept at  $100\text{ }^{\circ}\text{C}$ . If the thermal conductivity of copper is eight times that of steel, what is the temperature (approximate) at the junction of the rods?
- (a)  $50\text{ }^{\circ}\text{C}$   
 (b)  $26\text{ }^{\circ}\text{C}$   
 (c)  $21\text{ }^{\circ}\text{C}$   
 (d)  $11\text{ }^{\circ}\text{C}$
26. A beam of light traveling with speed  $c$  in vacuum encounters a glass medium at an angle of incidence  $60^{\circ}$ . If the speed of light in the medium is  $\frac{c}{\sqrt{3}}$ , then the angle between the reflected and the refracted beams is
- (a)  $30^{\circ}$   
 (b)  $60^{\circ}$   
 (c)  $90^{\circ}$   
 (d)  $120^{\circ}$
27. An object is placed 10 cm from a lens. The size of the image is same as the size of the object. The power of the lens should be
- (a)  $+20\text{ D}$   
 (b)  $-20\text{ D}$   
 (c)  $+10\text{ D}$   
 (d)  $-10\text{ D}$
28. If the eye sees two objects located at different distances, then which one of the following does **not** change?
- (a) The radius of curvature of the eye lens  
 (b) The object distance from the eye lens  
 (c) The image distance from the eye lens  
 (d) The focal length of the eye lens
29. A monochromatic beam of light of wavelength  $\lambda$  and frequency  $\nu$  goes from vacuum to a medium of refractive index  $n$ . How do the wavelength and frequency of light change?
- (a) Wavelength becomes  $\frac{\lambda}{n}$  and frequency becomes  $n\nu$   
 (b) Wavelength becomes  $n\lambda$  and frequency becomes  $\frac{\nu}{n}$   
 (c) Wavelength and frequency do not change  
 (d) Wavelength becomes  $\frac{\lambda}{n}$  and frequency does not change
30. A concave mirror of focal length  $f$  produces a real image  $n$  times the size of the object. The distance of the object from the mirror is
- (a)  $(n-1)f$   
 (b)  $(n+1)f$   
 (c)  $(n+1)f/n$   
 (d)  $(n-1)f/n$

31. The optical power of a lens is 2.5 D. For a certain position of an object relative to the lens, a real doubly magnified image is formed on a screen. The object is now moved 0.1 m closer to the lens. What will be the magnification?
- (a) 8  
(b) 4  
(c) 2  
(d) 1
32. A glass tube 1.0 m length is filled with water. The water can be drained out slowly at the bottom of the tube. If a vibrating tuning fork of frequency 500 Hz is brought at the upper end of the tube, then what is the total number of resonances obtained? (Velocity of sound is  $300 \text{ m s}^{-1}$ )
- (a) 1  
(b) 2  
(c) 3  
(d) 4
33. A sample of oxygen at NTP has a volume  $V$  and a sample of hydrogen at NTP has a volume  $4V$ . Both the gases are mixed and the mixture is maintained at NTP. If the velocity of sound in hydrogen at NTP is  $1270 \text{ m/s}$ , then the velocity of sound in the mixture will be
- (a)  $317.5 \text{ m/s}$   
(b)  $635 \text{ m/s}$   
(c)  $830 \text{ m/s}$   
(d)  $950 \text{ m/s}$
34. An observer standing on the sea-coast finds that 48 ripples reach the surface per minute. If the wavelength of the ripples is 8 m, then the wave velocity is
- (a)  $4.8 \text{ m/s}$   
(b)  $6.4 \text{ m/s}$   
(c)  $8.4 \text{ m/s}$   
(d)  $12.4 \text{ m/s}$
35. A light ray is incident on a surface with angle of incidence  $60^\circ$ . The angle between the incident ray and the refracted ray is  $15^\circ$ . What is the refractive index (approximate) of the medium?
- (a) 1.225  
(b) 1.33  
(c) 1.5  
(d) 1.732
36. A cell of steady e.m.f. 2.5 V and internal resistance of  $0.5 \Omega$  delivers a current of 1.0 A to an external circuit. The useful work done per second is
- (a) 2.5 J  
(b) 2.0 J  
(c) 3.0 J  
(d) 0.5 J



**37.** A free proton and a free electron are placed in a uniform electric field. Which of the following statements are correct?

1. The magnitudes of electric forces acting on them will be equal.
2. Their accelerations will be different.
3. They will move in the same direction.

Select the correct answer using the code given below.

- (a) 1 and 2 only  
(b) 2 and 3 only  
(c) 1 and 3 only  
(d) 1, 2 and 3

**38.** When the separation between the charges is increased, the electric potential energy of the charges

- (a) increases  
(b) decreases  
(c) remains the same  
(d) may increase or decrease

**39.** The number of electrons to be removed from a metal surface to make it positive having positive charge  $1.0 \times 10^{-7}$  C will be

- (a)  $625 \times 10^9$   
(b)  $625 \times 10^{10}$   
(c)  $625 \times 10^{11}$   
(d)  $625 \times 10^{12}$

**40.** A uniform electric field  $10 \text{ NC}^{-1}$  exists in the vertically downward direction. What is the increase in the electric potential as one goes up through a height of 50 cm?

- (a) 50 V  
(b) 10 V  
(c) 5 V  
(d) 1 V

**41.** Consider the following statements :

If a charged particle at rest experiences no electromagnetic force, then

1. the electric field must be zero
2. the magnetic field must be zero
3. the electric field may or may not be zero
4. the magnetic field may or may not be zero

Select the correct answer using the code given below.

- (a) 1 and 4  
(b) 1 only  
(c) 1 and 2  
(d) 2 and 3

42. A metal wire loop is put in a uniform magnetic field and the plane of the loop is perpendicular to the magnetic field. An e.m.f. will be induced in the loop if

- (a) it moves in its plane
- (b) it is rotated about its axis
- (c) it is rotated about its diameter
- (d) it moves along the direction of the field

43. A copper rod of length 20 cm and cross-sectional area  $2 \text{ mm}^2$  is joined with a similar aluminium rod in series. What is the total resistance of the combination between the ends? (Resistivity of copper is  $1.7 \times 10^{-6} \Omega \text{ cm}$  and that of aluminium is  $2.6 \times 10^{-6} \Omega \text{ cm}$ )

- (a)  $4.3 \times 10^{-3} \Omega$
- (b)  $3.3 \times 10^{-3} \Omega$
- (c)  $2.1 \times 10^{-3} \Omega$
- (d)  $1.3 \times 10^{-3} \Omega$

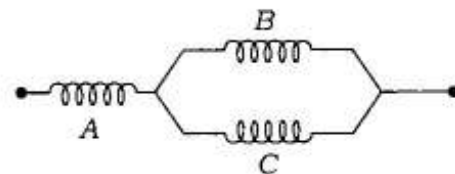
44. A steady d.c. current is flowing through a cylindrical conductor. Which of the following statements is/are correct?

1. The electric field at the axis of the conductor is zero.
2. The magnetic field at the axis of the conductor is zero.

Select the correct answer using the code given below.

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

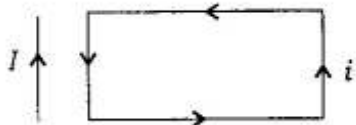
45.



Three identical long solenoids A, B and C are connected as shown in the figure above. The magnetic field due to current flow is 2.0 T at the centre of solenoid A. What is the magnetic field at the centre of solenoid C?

- (a) 2.0 T
- (b) 1.0 T
- (c) 0.5 T
- (d) 4.0 T

46.



A rectangular loop carrying a current  $i$  is situated near a long straight wire such that the wire is parallel to one of the sides of the loop and is in the plane of the loop. If a steady current  $I$  is established in the wire as shown in the figure above, then the loop will

- (a) rotate about an axis parallel to the wire
- (b) move away from the wire
- (c) move towards the wire
- (d) remain stationary

47. Current flows through a thick long straight wire such that the current density is uniform over the cross-section of the wire. The magnetic induction  $B$  inside the wire at a distance  $r$  from the axis is

- (a) proportional to  $r$
- (b) inversely proportional to  $r$
- (c) inversely proportional to  $r^2$
- (d) uniform throughout the cross-section of the wire

48. A magnetic needle lying parallel to the magnetic field requires  $W$  units of work to turn through  $60^\circ$ . The torque required to maintain the needle in this position is

- (a)  $\sqrt{3}W$
- (b)  $W/2$
- (c)  $\sqrt{3}W/2$
- (d) None of the above

49. What is the work done in carrying a charge  $q$  around a complete circle of radius  $r$  with charge  $Q$  at the centre?

- (a)  $\frac{qQ}{4\pi\epsilon_0} \left( \frac{1}{2\pi r} \right)$
- (b)  $\frac{qQ}{4\pi\epsilon_0} \left( \frac{1}{\pi r} \right)$
- (c)  $\frac{qQ}{4\pi\epsilon_0 r}$
- (d) 0

50. Consider three charges  $q$ ,  $-q$ ,  $q$  (in SI units) at the vertices of an equilateral triangle with side length  $b$ . The magnitude of electric field at the centroid of the triangle is

- (a)  $\frac{3q}{2\pi\epsilon_0 b^2}$
- (b)  $\frac{3q}{4\pi\epsilon_0 b^2}$
- (c)  $\frac{q}{2\pi\epsilon_0 b^2}$
- (d) 0

51. A 400 turns primary coil of an ideal transformer is connected to an alternating current power line of 120 V. A secondary coil of 100 turns is connected to a light bulb of  $60 \Omega$  resistance. The maximum current in the secondary would be

(a) 2 A

(b) 1 A

(c) 0.5 A

(d) 0.25 A

52. Two long wires each parallel to the z-axis and each carrying current  $I$ , are at  $(0, 0, 0)$  and  $(a, b, 0)$ . What is the force per unit length of each wire?

(a)  $\frac{\mu_0 I^2}{2\pi(a^2 + b^2)}$

(b)  $\frac{\mu_0 I^2}{2\pi(a^2 + b^2)^{\frac{3}{2}}}$

(c)  $\frac{\mu_0 I^2(a + b)}{2\pi(a^2 + b^2)}$

(d) None of the above

53. A heating coil transforms 100 J of electric energy into heat energy per second. The coil is cut into two halves and the two halves are joined in parallel to the same source. Now the energy transformed per second will be

(a) 25 J

(b) 50 J

(c) 100 J

(d) 400 J

54. In resistance box, the wire is doubled before winding to

(a) save space

(b) avoid induction

(c) avoid heating

(d) decrease the cost

55. Two free charges  $+Q$  and  $+4Q$  are placed at a distance  $x$  apart. The magnitude of third charge which makes the system in equilibrium is

(a)  $9Q/4$

(b)  $9Q$

(c)  $4Q/9$

(d)  $4Q$

**56.** A free neutron decays to a proton but a free proton does not decay to a neutron. This is because

- (a) neutron is a composite particle made of proton and electron whereas proton is a fundamental particle
- (b) neutron is an uncharged particle whereas proton is a charged particle
- (c) neutron has larger rest mass than proton
- (d) None of the above

**57.** The  $K_{\alpha}$  and  $K_{\beta}$  X-rays of molybdenum have wavelengths 0.71 Å and 0.63 Å respectively. Then the wavelength of  $L_{\alpha}$  of molybdenum will be

- (a) 0.66 Å
- (b) 0.55 Å
- (c) 5.59 Å
- (d) 10.55 Å

**58.** In a laboratory experiment on emission from atomic hydrogen in a discharge tube, only a small number of lines are observed whereas a large number of lines are present in the spectrum of a star. This is because in a laboratory

- (a) the amount of hydrogen taken is much smaller than that present in the star
- (b) the temperature of hydrogen is much smaller than that of star
- (c) the pressure of hydrogen is much smaller than that of star
- (d) the gravitational pull is much smaller than that in the star

**59.** The cutoff wavelength of X-rays coming from an X-ray tube depends on the

- (a) filament material
- (b) acceleration voltage
- (c) target material
- (d) temperature of the filament

**60.** Consider the alpha decay of  ${}^{212}\text{Bi} \rightarrow {}^{208}\text{Tl} + {}^4\text{He}$ . Taking the binding energy per nucleon to be approximately 8.00 MeV per nucleon for Bi, 8.05 MeV per nucleon for Tl and 7.1 MeV per nucleon for He, the energy released in the decay of one nucleus is approximately

- (a) 6.8 MeV
- (b) 3.6 MeV
- (c) 10.4 MeV
- (d) 14.0 MeV

61. The kinetic energy of an electron emitted when green light of wavelength 500 nm shines on sodium metal (work function = 2.3 eV) is [Planck's constant =  $6.6 \times 10^{-34}$  J s]

(a) 0.0175 eV

(b) 0.175 eV

(c) 1.75 eV

(d) 17.5 eV

62. The transition from  $n_i = 6$  to  $n_f = 2$  state in a hydrogen atom shows an emission in the region of the electromagnetic spectrum known as

(a) microwave

(b) infrared

(c) visible

(d) ultraviolet

63. The correct order for the number of radial nodes is

(a)  $4s > 5d > 3p > 3d$

(b)  $3p > 3d > 4s > 5d$

(c)  $5d > 4s > 3d > 3p$

(d)  $4s > 3p > 3d > 5d$

64. The correct order of ionization enthalpies is

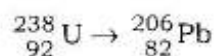
(a)  $O < N < B < Be < Li$

(b)  $Li < Be < B < N < O$

(c)  $Li < B < Be < O < N$

(d)  $Li < B < Be < N < O$

65. In the nuclear reaction



the number of  $\alpha$  and  $\beta$  particles emitted are

(a)  $8\alpha, 8\beta$                       (b)  $6\alpha, 4\beta$

(c)  $4\alpha, 3\beta$                       (d)  $8\alpha, 6\beta$

66. Consider the following statements in respect of internal energy ( $U$ ), pressure ( $P$ ) and temperature ( $T$ ):

1.  $U, P, T$  are intensive variables.
2.  $U, P, T$  are state functions.
3.  $U, P, T$  do not change during a reversible isothermal expansion of an ideal gas.
4.  $U, P, T$  do not change during a reversible isothermal expansion of a real gas.

How many statements are correct?

(a) Only one

(b) Only two

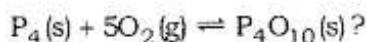
(c) Only three

(d) All

67. Which one of the following is **not** correct regarding isothermal expansion of an ideal gas?

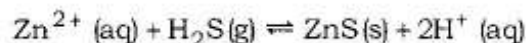
- (a) The work done reversibly is maximum
- (b) The heat exchanged reversibly is maximum
- (c) The work done is equal to the heat exchanged for a reversible process
- (d) The work done is not equal to the heat exchanged for an irreversible process

68. What is the equilibrium expression for the reaction



- (a)  $K_c = \frac{[\text{P}_4\text{O}_{10}]}{[\text{P}_4][\text{O}_2]^5}$
- (b)  $K_c = \frac{[\text{P}_4\text{O}_{10}]}{5[\text{P}_4][\text{O}_2]}$
- (c)  $K_c = [\text{O}_2]^5$
- (d)  $K_c = \frac{1}{[\text{O}_2]^5}$

69. Consider the reaction



Which one of the following does **not** shift the equilibrium to the right?

- (a) Increasing the pH
- (b) Removal of  $\text{H}^+$  ions
- (c) Increasing the pressure
- (d) Removal of  $\text{ZnS}(\text{s})$

70. Which concentration(s) can be calculated if the mole fraction and density of an aqueous solution of HCl are known?

1. Molality
2. Molarity
3. Percent by mass

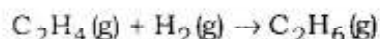
Select the correct answer using the code given below.

- (a) 1 only
- (b) 3 only
- (c) 1 and 2 only
- (d) 1, 2 and 3

71. The temperature in cold countries can go down to  $-10\text{ }^{\circ}\text{C}$ . Ethylene glycol is usually added to water as an antifreeze agent. The amount of  $\text{HOCH}_2\text{CH}_2\text{OH}$  that must be added so that the water in the car radiator (1.86 kg) does not freeze is (cryoscopic constant of water  $K_f = 1.86\text{ K kg mol}^{-1}$ )

- (a) 6.2 g
- (b) 62 g
- (c) 620 g
- (d) 6200 g

72. The enthalpies of formation of ethylene and ethane are  $52.3\text{ kJ mol}^{-1}$  and  $-84.6\text{ kJ mol}^{-1}$  respectively. The  $\Delta H^\circ$  for the reaction



in  $\text{kJ mol}^{-1}$  is

- (a)  $-32.3$
- (b)  $-136.9$
- (c)  $32.3$
- (d)  $136.9$

73. In which pair does the named substance have the same oxidation number?

- (a) Sulphur in  $\text{H}_2\text{S}_2\text{O}_7$  and  $\text{H}_2\text{SO}_4$
- (b) Mercury in  $\text{Hg}^{2+}$  and  $\text{Hg}_2^{2+}$
- (c) Oxygen in  $\text{Na}_2\text{O}_2$  and  $\text{H}_2\text{O}$
- (d) Cobalt in  $\text{Co}(\text{NH}_3)_6^{3+}$  and  $\text{Co}(\text{NO}_3)_2$

74. The half-life of  $^{14}\text{C}$  is 5570 years. How many years (approximate) will it take for 90% of a sample to decompose? ( $\log_{10} 2 = 0.3$ )

- (a) 5570 years
- (b) 11140 years
- (c) 18600 years
- (d) 50100 years

75. Consider the following statements in respect of covalent compounds :

1. They are bad conductors of electricity.
2. They are all liquids at room temperature.
3. They do not show isomerism.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 1 and 2
- (c) 1 and 3
- (d) 2 only



76. Consider the following ions :

1.  $\text{NH}_2^-$
2.  $\text{Cl}^-$
3.  $\text{ClO}_4^-$
4.  $\text{CH}_3\text{COO}^-$

What is the correct order of basic strength of the above ions?

- (a)  $4 > 1 > 2 > 3$
- (b)  $4 > 3 > 1 > 2$
- (c)  $1 > 4 > 2 > 3$
- (d)  $1 > 4 > 3 > 2$

77. Consider the following statements in respect of first-order chemical reactions :

1. Half-life period for a first-order reaction is independent of initial concentration.
2. The unit of rate constant of a first-order reaction is  $\text{sec}^{-1}$ .
3. The value of rate constant can be changed by changing the concentration unit.
4. The concentration of the reactants of a first-order reaction decreases linearly with time.

Which of the above statements are correct?

- (a) 2 and 3
- (b) 3 and 4
- (c) 1 and 4
- (d) 1 and 2

78. When sodium is dissolved in liquid ammonia, a solution of deep blue colour is obtained. The colour of the solution is due to

- (a) sodium ion
- (b) ammoniated electron
- (c) sodium amide
- (d) ammoniated sodium ion

79. The ionization constant of acetic acid is  $K_a = 10^{-5}$  at standard ambient temperature. The pH of a solution of 0.01 M acetic acid and 0.1 M sodium acetate is

- (a) 4
- (b) 5
- (c) 6
- (d) 7

80. A reaction obeys first-order kinetics. It takes 1 hour for the reactant to decay to one-eighth of its starting concentration. To decay to one-fourth of its starting concentration, it takes

- (a) 10 minutes
- (b) 20 minutes
- (c) 30 minutes
- (d) 40 minutes

81. Which one among the following is the correct structure of  $\text{H}_3\text{O}^+$ ?

- (a) T-shaped
- (b) Bent shape
- (c) Trigonal planar
- (d) Trigonal pyramidal

82. A sample of water contains 12 mg of  $\text{MgSO}_4$  (molecular weight = 120) per kg of water. The degree of hardness for this sample is

- (a) 1.0 ppm
- (b) 5.0 ppm
- (c) 10.0 ppm
- (d) 100.0 ppm

83. Consider the following statements for heavy water :

1. Pure heavy water is radioactive.
2. It is used as neutron moderator in nuclear fission reaction.
3. It is used as solvent in NMR spectroscopy.
4. Density of heavy water is less than that of ordinary water.

Which of the statements given above are correct?

- (a) 1 and 2 only
- (b) 1, 2, 3 and 4
- (c) 1, 3 and 4 only
- (d) 2 and 3 only

84. Milk of magnesia contains

- (a)  $\text{MgCO}_3$
- (b)  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
- (c)  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
- (d)  $\text{Mg}(\text{OH})_2$

85. Which one of the following compounds is having 2-electron 3-centered bond?

- (a)  $\text{NH}_3$
- (b)  $\text{B}_2\text{H}_6$
- (c)  $\text{BH}_4^-$
- (d)  $\text{H}_3\text{O}^+$

86. What will be the pH range of an aqueous solution of borax?

- (a)  $\text{pH} > 7$
- (b)  $\text{pH} < 7$
- (c)  $\text{pH} = 7$
- (d)  $\text{pH} \leq 7$

87. Consider the following statements :

1. Talc is magnesium silicate.
2. Lead shows allotropy.
3. Producer gas is a mixture of CO and O<sub>2</sub>.

Which of the statements given above is/are correct?

- (a) 1, 2 and 3  
(b) 1 and 3 only  
(c) 1 only  
(d) 2 and 3 only

88. Consider the following statements :

Statement I :

The dipole moment of NH<sub>3</sub> is greater than NF<sub>3</sub>.

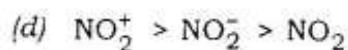
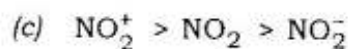
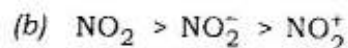
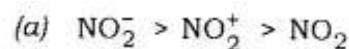
Statement II :

The electronegativity difference between nitrogen and fluorine is almost same as that between nitrogen and hydrogen.

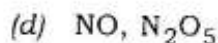
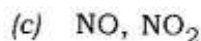
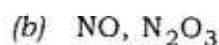
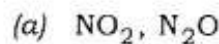
Which one of the following in respect of the above statements is correct?

- (a) Both the statements are correct and Statement II is the correct explanation for Statement I  
(b) Both the statements are correct but Statement II is not the correct explanation for Statement I  
(c) Statement I is correct but Statement II is incorrect  
(d) Statement I is incorrect but Statement II is correct

89. What is the correct order of O—N—O bond angles in the compounds NO<sub>2</sub><sup>-</sup>, NO<sub>2</sub><sup>+</sup>, NO<sub>2</sub>?



90. In Ostwald's process of manufacturing of HNO<sub>3</sub>, what are the two major nitrogen oxides formed in intermediate steps?



91. Consider the following statements :

Statement I :

The S—O bond distance in  $\text{SO}_2$  is intermediate between a single bond and a double bond.

Statement II :

The actual structure of  $\text{SO}_2$  is a resonance hybrid of multiple canonical forms.

Which one of the following in respect of the above statements is correct?

- (a) Both the statements are correct and Statement II is the correct explanation for Statement I
- (b) Both the statements are correct but Statement II is not the correct explanation for Statement I
- (c) Statement I is correct but Statement II is incorrect
- (d) Statement I is incorrect but Statement II is correct

92. A compound contains 28% of nitrogen and 72% of a metal. Three atoms of the metal combine with two atoms of nitrogen. The approximate atomic weight of the metal is

- (a) 12
- (b) 24
- (c) 36
- (d) 48

93. In the cyanide process of extraction of silver, the ore gives the extract containing

- (a) silver hydroxide
- (b) diamine silver(I) chloride
- (c) silver cyanide
- (d) None of the above

94. Which one of the following metals is extracted through electrolysis?

- (a) Silver
- (b) Iron
- (c) Zinc
- (d) Aluminium

95. The metal ion present in vitamin  $\text{B}_{12}$  is

- (a) Cu
- (b) Mg
- (c) Co
- (d) Fe

96. One of the bivalent metals of Group IIA forms a soluble sulphate and an insoluble hydroxide. But its hydroxide is soluble in solutions of strong alkalies. The metal is

(a) Ba

(b) Ca

(c) Mg

(d) Be

97.  $\text{PbCl}_2$  produces a yellow precipitate, when it is added to a solution of  $\text{K}_2\text{CrO}_4$ . But when  $\text{PbCl}_2$  is added to moderately concentrated HCl and the mixture is cooled

(a) no precipitate is formed

(b) white precipitate is formed

(c) yellow precipitate is formed

(d) light grey precipitate is formed

98. The oxide which is solid at room temperature is

(a)  $\text{N}_2\text{O}$

(b)  $\text{Br}_2\text{O}$

(c)  $\text{Cl}_2\text{O}$

(d)  $\text{SeO}_2$

99. The purpose of making alloys is to

1. increase the hardness of the metal

2. enhance tensile strength

3. increase corrosion resistance

Select the correct answer using the code given below.

(a) 1, 2 and 3

(b) 1 only

(c) 2 and 3 only

(d) 2 only

100. Which one of the following is used for drying of ammonia?

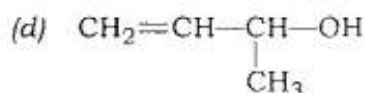
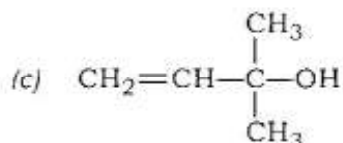
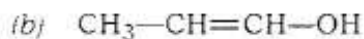
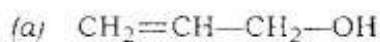
(a) 18 N  $\text{H}_2\text{SO}_4$

(b) CaO

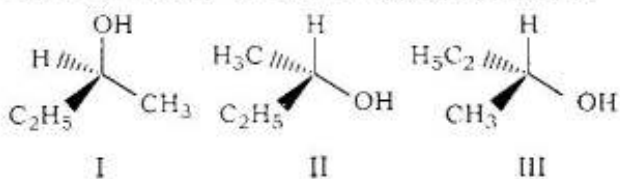
(c)  $\text{P}_2\text{O}_5$

(d) Oleum

101. In which one of the following compounds, hydroxyl group is attached to a vinyl carbon atom?



102. Consider the following compounds :



Which one of the following is correct in respect of the above compounds?

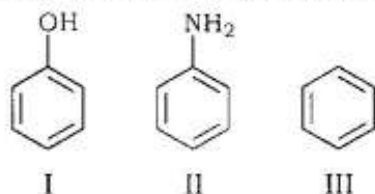
(a) I and II are enantiomers

(b) I and III are enantiomers

(c) II and III are identical

(d) I and III are identical

103. Consider the following compounds :



Which of the above compounds will react with bromine water to give tribromo substitution product?

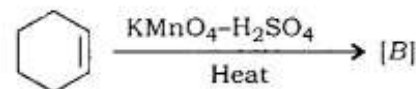
(a) I and III

(b) II only

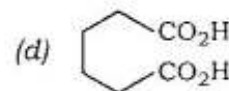
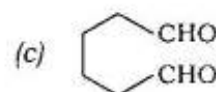
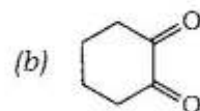
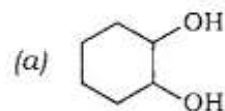
(c) I and II

(d) III only

104. Consider the following reaction :



What is the major product [B] of the reaction?



105. Which one of the following is **not** correct in respect of aromatic and aliphatic compounds?

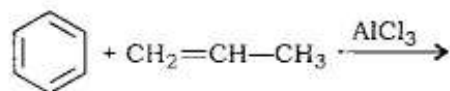
(a) Aliphatic amines are less basic than aromatic amines

(b) Alcohols are neutral while phenols are acidic in nature

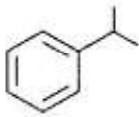
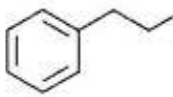
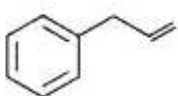
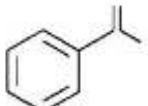
(c) Aliphatic compounds are generally poorer in carbon content than the aromatic ones

(d) Aliphatic compounds have open-chain structures while aromatic compounds are closed-chain structures

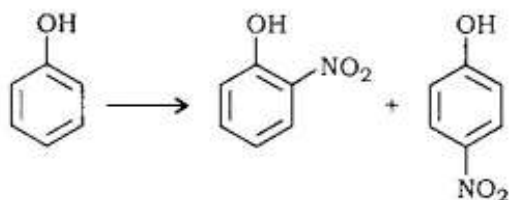
106. The major product of the following reaction



is

- (a) 
- (b) 
- (c) 
- (d) 

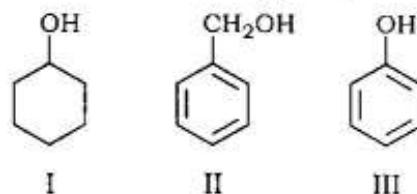
107. Consider the following reaction :



For carrying out the above reaction, which condition should be used?

- (a) Conc.  $\text{HNO}_3$  + conc.  $\text{H}_2\text{SO}_4$  + heat
- (b) Conc.  $\text{HNO}_3$  + conc.  $\text{H}_2\text{SO}_4$
- (c) Dilute  $\text{HNO}_3$
- (d) Conc.  $\text{HNO}_3$  only

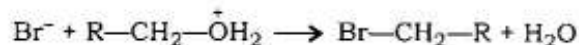
108. Consider the following compounds :



Which of the above compounds will react with sodium hydroxide solution at room temperature?

- (a) I, II and III
- (b) II and III only
- (c) III only
- (d) I and III only

109. Consider the following statements in respect of the reaction

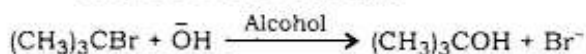


1.  $\text{Br}^-$  is a nucleophile and protonated alcohol is an electrophile.
2. It is nucleophilic displacement of water from protonated alcohol by  $\text{Br}^-$  nucleophile.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

110. Consider the following statements in respect of the reaction

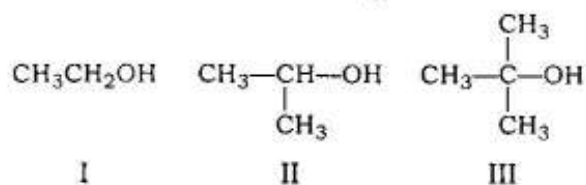


1. It is a nucleophilic substitution.
2. It is a two-step reaction.
3. The rate of the reaction depends only on the concentration of the alkyl halide.
4. It is an  $\text{S}_{\text{N}}2$  reaction.
5. Carbocation intermediate is formed in this reaction.

Which of the above statements are correct?

- (a) 1, 2, 3 and 5
- (b) 1, 2 and 5 only
- (c) 3 and 4 only
- (d) 2, 3 and 4

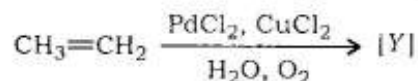
111. Consider the following alcohols :



On treating these with concentrated sulphuric acid at 413 K, which of the above will give the corresponding ether?

- (a) I, II and III
- (b) I and II only
- (c) I only
- (d) II and III only

112. Consider the following reaction :



What is the major product [Y] in the above reaction?

- (a)  $\text{CH}_3\text{CHO}$
- (b)  $\text{CH}_3\text{CO}_2\text{H}$
- (c)  $\text{CH}\equiv\text{CH}$
- (d)  $\text{CH}_3\text{CH}_2\text{OH}$

113. Benzoyl chloride can be converted to benzaldehyde by treatment with

- (a)  $\text{H}_2/\text{Pd}-\text{BaSO}_4$
- (b)  $\text{Zn}(\text{Hg})/\text{HCl}$
- (c) DIBAL-H
- (d)  $\text{Na}/\text{liq. NH}_3$

114. Direct nitration of aniline by using  $\text{HNO}_3/\text{H}_2\text{SO}_4$  at 288 K gives

- (a) a mixture of *ortho*-, *meta*- and *para*-nitroaniline
- (b) a mixture of *ortho*- and *para*-nitroaniline only
- (c) a mixture of *meta*- and *para*-nitroaniline only
- (d) a mixture of *meta*- and *ortho*-nitroaniline only

115. Which one of the following is a polyamide?

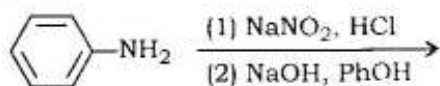
- (a) Teflon
- (b) Polyester
- (c) Polythene
- (d) Nylon



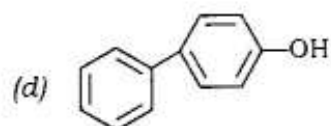
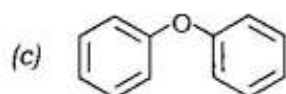
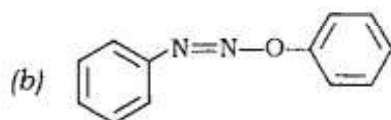
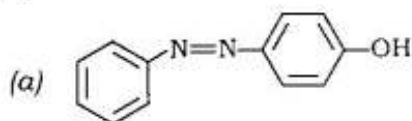
116. Which one of the following is water soluble?

- (a) Cellulose
- (b) Cholesterol
- (c) Vitamin D
- (d) Insulin

117. The major product of the following reaction



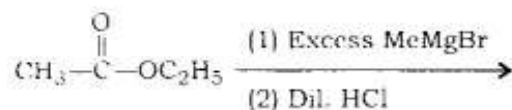
is



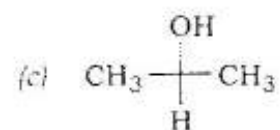
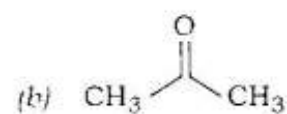
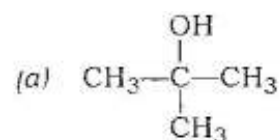
118. Addition of  $\text{Br}_2$  to 1-pentene would produce 1, 2-dibromopentane which is

- (a) meso
- (b) achiral
- (c) optically active
- (d) racemic

119. The major product of the following reaction

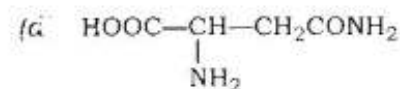
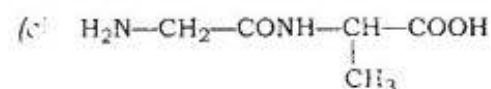
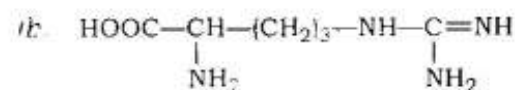
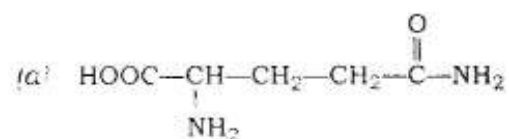


is



(d) None of the above

120. Which one of the following has peptide linkage?



**SPACE FOR ROUGH WORK**

**SPACE FOR ROUGH WORK**

**SPACE FOR ROUGH WORK**

**★ ★ ★**