

# PUNJAB PUBLIC SERVICE COMMISSION

Objective Type Test (March-2023) for Recruitment to the post of SOs (Ballistics, Documents, Photography, Audio/Voice), SAs (Ballistics, Photography, Audio/Voice) in the Department of Home Affairs & Justice Govt. of Punjab

READ INSTRUCTIONS BEFORE FILLING ANY DETAILS OR ATTEMPTING TO ANSWER THE QUESTIONS.

Total Questions: 120  
Time Allowed: 2 Hours

Candidate's Name \_\_\_\_\_

Father's Name \_\_\_\_\_

Date of Birth          
DD MM YYYY

OMR Response Sheet No. \_\_\_\_\_

Roll No. \_\_\_\_\_

Candidate's Signature (Please sign in the box)

Question  
Booklet Set

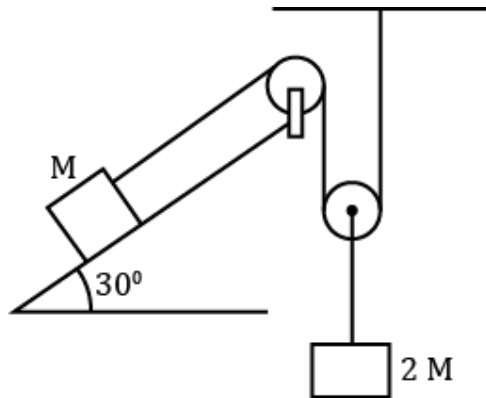
A

Booklet Series No.

## INSTRUCTIONS

1. The candidate shall NOT open this booklet till the time told to do so by the Invigilation Staff. However, in the meantime, the candidate can read these instructions carefully and subsequently fill the appropriate columns given above in CAPITAL letters. The candidate may also fill the relevant boxes out of 1 to 9 of the Optical Mark Reader (OMR) response sheet, supplied separately.
2. Use only blue or black **ball point pen** to fill the relevant columns on this page as well as in OMR sheet. Use of Ink pen or any other pen is not allowed.
3. The candidate shall be liable for any adverse effect if the information given above is wrong or illegible or incomplete.
4. Each candidate is required to attempt 120 questions in 120 minutes, except for orthopedically/visually impaired candidates, who would be given 40 extra minutes, for marking correct responses on the OMR sheet.
5. The question paper booklet has 23 pages.
6. The candidates, when allowed to open the question paper booklet, must first check the entire booklet to confirm that the booklet has complete number of pages, the pages printed correctly and there are no blank pages. In case there is any such error in the question paper booklet then the candidate should IMMEDIATELY bring this fact to the notice of the Invigilation Staff and obtain a new booklet of the same series as given earlier.
7. The serial number of the new Question booklet if issued for some reason should be entered in the relevant column of the OMR. The Invigilation Staff must make necessary corrections in their record regarding the change in the serial no. of Question booklet.
8. The paper consists of total 480 Marks. Each question shall carry 4 marks. There are four options for each question and the candidate has to mark the MOST APPROPRIATE answer on the OMR response sheet.
9. There is negative marking (1 mark for each question) for questions wrongly answered by the candidate.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidate **MUST READ INSTRUCTIONS BEHIND THE OMR SHEET** before answering the questions and check that two carbon copies attached to the OMR sheet are intact.

- Find the acceleration of the block of mass  $M$  in the situation shown in the figure. All the surfaces are frictionless and the pulley and the string are light.



- $g$
  - $\frac{g}{2}$
  - $\frac{g}{3}$
  - $\frac{g}{5}$
- A pendulum bob has a speed of  $3 \text{ m/s}$  at its lowest position. The pendulum is  $0.5 \text{ m}$  long. Then the speed of the pendulum bob, when it makes an angle of  $60^\circ$  with the vertical is: (Take  $g=10 \text{ m/s}^2$ )
    - $1 \text{ m/s}$
    - $2 \text{ m/s}$
    - $3 \text{ m/s}$
    - $4 \text{ m/s}$
  - A force  $F = (0.5x + 10)$  acts on a particle in the  $x$  direction, where  $F$  is in Newton and  $x$  is in meter. The work done by the force during the displacement of the particle from  $x = 0$  to  $x = 2$  meter is
    - $9 \text{ J}$
    - $15 \text{ J}$
    - $21 \text{ J}$
    - $36 \text{ J}$
  - The image formed by an objective of a compound microscope is
    - virtual and diminished
    - real and diminished
    - real and enlarged
    - virtual and enlarged

5. What is the limit of resolution of a telescope objective having a diameter of 200 cm, if it has to detect light of wavelength 500 nm coming from a distant star?
- a)  $152.5 \times 10^{-9}$  radian
  - b)  $305 \times 10^{-9}$  radian
  - c)  $510 \times 10^{-9}$  radian
  - d)  $610.5 \times 10^{-9}$  radian
6. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then focal length of the lens
- a) becomes zero
  - b) becomes infinite
  - c) remains unchanged
  - d) becomes small but non zero
7. When an inverter is placed between both inputs of an S–R flipflop, it becomes
- a) J–K flip-flop
  - b) D flip-flop
  - c) T flip-flop
  - d) Master slave flip-flop
8. Which of the following is D to A conversion technique?
- a) Successive approximation
  - b) Weighted resistor technique
  - c) Dual slope technique
  - d) Single slope technique
9. Consider two objects A and B, each of mass 1 kg. A is dropped from rest from the roof of a tall building, while B is projected horizontally with an initial velocity 10 m/s from the same roof. It is found that A reaches the ground after 3 seconds. Neglecting air resistance and assuming no obstructions, after how much time will B hit the ground?
- a) Less than 3 s
  - b) 3 s
  - c) More than 3 s but less than 4.5 s
  - d) 4.5 s or more
10. A billiard ball hits a rigid wall at an angle of  $45^\circ$  to the normal and is reflected at  $45^\circ$  on the other side of the normal without any change in speed. The direction of the force exerted by the ball on the wall is
- a) Along the initial direction of motion of the ball
  - b) Along the final direction of motion of the ball
  - c) Along the normal
  - d) Tangent to the wall

11. A bullet of mass 20 g is fired by a gun of mass 7.5 kg. If the muzzle speed of the bullet is 180 m/s, the recoil speed of the gun is
- a) 0.60 m/s
  - b) 0.48 m/s
  - c) 0.36 m/s
  - d) 0.24 m/s
12. A block of mass 5 kg rests on a wooden board which is initially placed horizontally on the floor. One end of the board is now slowly raised, keeping the other end fixed on the ground. When the board is at an angle of 30 degrees to the horizontal, the block *just* begins to slide. The coefficient of static friction between the block and the board is
- a) 0.50
  - b) 0.58
  - c) 0.73
  - d) 0.97
13. The driver of a fast-moving car applied emergency brakes, as a result of which the car skidded (underwent sliding motion) for 200 m before coming to a stop. Assuming that the car decelerated uniformly, and given that the coefficient of kinetic friction is 0.60, how fast was the car going (in km per hour) when the brakes were applied (approx.)?
- a) 292
  - b) 212
  - c) 175
  - d) 136
14. Which of the following statements is *not* true for a plane electromagnetic wave in vacuum?
- a) The electric and magnetic vectors oscillate in perpendicular planes
  - b) If the strength of the electric field is given, the strength of the magnetic field is known
  - c) The propagation direction is at right angles to both electric and magnetic fields
  - d) The energy transported by the wave falls off as the square of the distance
15. Microwave ovens use electromagnetic radiation for warming food. A typical wavelength used is around
- a) 1.2 mm
  - b) 12 mm
  - c) 1.2 cm
  - d) 12 cm

16. To examine powder burns in a gunshot wound, the most useful technique is likely to be
- a) X-ray imaging
  - b) UV photography
  - c) Visible light photography
  - d) IR photography
17. To obtain a photograph of a fingerprint on a drinking glass, the most useful lighting technique is likely to be
- a) Direct reflective lighting
  - b) 45 degree lighting
  - c) Transmission lighting
  - d) Small spot lights
18. A ray of light is incident on a slab of transparent material at an angle of 60 degrees. The refracted ray inside the slab makes an angle of 30 degrees to the normal. The refractive index of the slab's material is
- a) 1.33
  - b) 1.60
  - c) 1.73
  - d) 1.86
19. A mirage is formed by total internal reflection when
- a) The optical density of air near the ground increases with height and there are strong air currents
  - b) The optical density of air near the ground increases with height and there are no strong air currents
  - c) The optical density of air near the ground decreases with height and there are strong air currents
  - d) The optical density of air near the ground decreases with height and there are no strong air currents
20. Light from a point source in air falls on a convex spherical glass surface of radius of curvature 20 cm and refractive index 1.5. If the distance of the light source from the glass surface is 100 cm, the image is located at
- a) 43 cm from the surface, in the direction of incident light
  - b) 43 cm from the surface, opposite to the direction of incident light
  - c) 100 cm from the surface, in the direction of incident light
  - d) 100 cm from the surface, opposite to the direction of incident light
21. A thin convex lens has a focal length of 20 cm. When it is placed in contact with another lens, the combination focuses parallel rays at a distance 5 cm from the second lens. The second lens is
- a) Convex and of focal length 6.67 cm
  - b) Convex and of focal length 5.00 cm
  - c) Concave and of focal length -6.67 cm
  - d) Concave and of focal length -5.00 cm

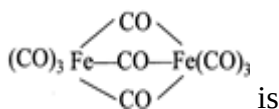
22. Circularly polarized light can be obtained by passing linearly polarized light through a
- a) half-wave plate
  - b) quarter-wave plate
  - c) pinhole aperture
  - d) right-angled prism
23. Unpolarized light of intensity  $I_0$  falls on a polaroid. The emerging light then passes through a second polaroid. The axes of the two polaroids are at  $45^\circ$  with respect to each other. The light emerging from the second polaroid has intensity
- a)  $I_0$
  - b)  $I_0/2$
  - c)  $I_0/4$
  - d) Zero
24. An UV-visible spectrophotometer typically works over the wavelength range
- a) 20 nm – 570 nm
  - b) 190 nm – 900 nm
  - c) 600 nm – 2  $\mu\text{m}$
  - d) 1 – 9  $\mu\text{m}$
25. What is the muzzle velocity of 5.56 INSAS rifle?
- a) 700 m/s
  - b) 800 m/s
  - c) 900 m/s
  - d) 1000 m/s
26. Which of the following laser produces output in the infrared region?
- a) Ruby
  - b)  $\text{CO}_2$
  - c) He-Ne
  - d) Rhodamine
27. Sound waves of wavelength 68 cm travelling in air hit a water surface and continue to propagate in water. If the speeds of sound in air and water are 340 m/s and 1490 m/s respectively, the wavelength of the sound waves in water is approximately
- a) 200 cm
  - b) 30 cm
  - c) 100 cm
  - d) 300 cm

28. The equation  $y = A \sin (40 z - 60 t)$ , where the coordinates  $y, z$  are measured in metres and the time is in seconds, represents a progressive wave travelling in the
- positive  $z$  direction with speed 1.50 m/s
  - negative  $z$  direction with speed 1.50 m/s
  - positive  $z$  direction with speed 0.67 m/s
  - negative  $z$  direction with speed 0.67 m/s
29. The superposition of two waves, each of amplitude  $a$  and wavelength  $\lambda$ , travelling in opposite directions, results in
- A travelling wave of wavelength  $\lambda/2$
  - A travelling wave of wavelength  $2\lambda$
  - A standing wave of wavelength  $\lambda$
  - No wave
30. Two strings A and B, when plucked together, produce 5 beats per second. When the tension in string A is reduced a little, the beat frequency becomes 3 per second. If the original frequency of A was 256 Hz, the frequency of B is
- 251 Hz
  - 253 Hz
  - 259 Hz
  - 261 Hz
31. The type of biasing which is most likely to be useful for linear operation of a transistor with good thermal stability is
- Fixed bias
  - Fixed bias with emitter resistor
  - Collector to base bias
  - Voltage divider bias
32. Compared to a bipolar junction transistor (BJT), a field-effect transistor (FET) is characterized by
- Higher gain and higher thermal stability
  - Higher gain and lower thermal stability
  - Lower gain and higher thermal stability
  - Lower gain and lower thermal stability
33. A given MOSFET is ON when the gate-source voltage is zero, and is turned OFF by applying +3 V to the gate. The device is of type
- Enhancement mode, n-channel
  - Enhancement mode, p-channel
  - Depletion mode, n-channel
  - Depletion mode, p-channel

34. Which class of amplifiers give the most faithful reproduction of audio signals?
- A
  - B
  - AB
  - C
35. The LED revolution is said to have been completed with the development of bright LEDs of which of the following colour, for which the Nobel Prize in Physics was awarded in 2014?
- Infra-red
  - Red
  - Green
  - Blue
36. The open-loop gain of a real op-amp varies with frequency  $f$  as
- $1/\sqrt{f}$
  - $1/f$
  - $1/f\sqrt{f}$
  - $1/f^2$
37. An op-amp is used as an inverting amplifier by applying the input signal through a resistor  $R_1$  to the inverting input terminal and connecting a feedback resistor  $R_2$  between output and input. The magnitude of the gain is
- $R_1/R_2$
  - $R_2/R_1$
  - $1 + R_1/R_2$
  - $1 + R_2/R_1$
38. A digital circuit made out of 4 flip-flops shows the following sequence of states:  $0100 \rightarrow 0010 \rightarrow 0001 \rightarrow 1000$ . The circuit is a
- Ripple counter
  - Johnson counter
  - Decade counter
  - Ring counter
39. A sine wave is applied to one input terminal of a comparator, while the other input terminal is grounded. The output is
- A sine wave
  - A square wave
  - A triangular wave
  - Zero
40. The ballistic coefficient (BC) is a measure of a projectile's ability to overcome air resistance. If " $m$ " is the mass of a bullet, " $A$ " its cross-sectional area and " $d$ " the drag coefficient, BC is given by
- $m d A$
  - $m d / A$
  - $m A / d$
  - $m / A d$



41. Three key components of an automated ballistics identification system are the Signature Extraction Unit, Data Storage Unit, and Correlation Server. The fourth key component is
- Ballistic scanner, which captures images of bullets and cartridge cases
  - High-speed camera, which takes photographs of bullets in flight
  - Ballistic trajectory calculator for a bullet after it leaves the gun
  - Propellant and cartridge design unit
42. A 5 molar solution of  $\text{H}_2\text{SO}_4$  is diluted from 1 L to 10L. Then the normality of the solution is
- 0.25 N
  - 1N
  - 2 N
  - 7 N
43. The molarity of pure water is
- 18 M
  - 50.0 M
  - 55.6 M
  - 100 M
44. For the reaction between  $\text{KMnO}_4$  and  $\text{H}_2\text{O}_2$ , the number of electrons transferred per mole of  $\text{H}_2\text{O}_2$  are
- One
  - Two
  - Three
  - Four
45. The IUPAC name of the following compound is:
- $$(\text{CH}_3)_2\text{CH}-\text{CH}_2\text{CH}=\text{CH}-\text{CH}=\text{CH}-\text{CH}(\text{CH}_3)(\text{C}_2\text{H}_5)$$
- 1,1,7,7-tetramethyl-2,5-octadiene
  - 2,8-dimethyl-3,6-decadiene
  - 1,5-di-isopropyl-1,4-hexadiene
  - 2,8-dimethyl-4,6-decadiene



46. The correct name of

is

- tri- $\mu$ - carbonyl bis (tricarbonyl) iron (0)
- hexacarbonyl iron (III) $\mu$ -tricarbonyl ferrate (0)
- tricarbonyl iron (0) $\mu$ -tricarbonyl iron (0) tricarbonyl
- nonacarbonyl iron

47. Which of the following statement is INCORRECT for aromatic compounds?
- a) Aromatic compounds are cyclic and planar
  - b) In aromatic compounds all carbon atoms are either  $sp^2$  or  $sp$  hybridized
  - c) Aromatic compounds follow Huckel's rule
  - d) Aromatic compounds contains  $(4n+2)$  number of pi-bonds  
(where;  $n=0,1,2,3,4,5,\dots$ )
48. Oxidation number of Fe in  $Fe_3O_4$  is
- a)  $5/4$
  - b)  $4/5$
  - c)  $3/2$
  - d)  $8/3$
49. Which of the following depends upon temperature?
- a) Mole fraction
  - b) Weight percentage of solute
  - c) Molarity
  - d) Molality
50. How many liters of water must be added to 1L of an aqueous solution of HCl having  $pH = 1$  to create an aqueous solution with a  $pH$  of 2?
- a) 0.1L
  - b) 0.9 L
  - c) 2.0 L
  - d) 9.0 L
51. India's first self-governing Forensic Science Laboratory was established in which of the following states?
- a) Kolkata
  - b) Chennai
  - c) Delhi
  - d) Hyderabad
52. Who among the following undertook the study of fingerprints for the purpose of personal identification?
- a) Landsteiner
  - b) Galton
  - c) Locard
  - d) Osborn

53. The length of tyre skid marks depends on which of the following?

- i. Speed of vehicle,
- ii. Friction of road
- iii. Wheel base
- iv. Ground clearance

Choose the correct option

- a) i and iii only
- b) ii and iv only
- c) i and ii only
- d) iii and iv only

54. Restoration of erased chassis number is carried out using

- a) Marquis reagent
- b) Dragendorff's reagent
- c) Fry's reagent
- d) Sulphanilic Acid only

55. Ratio of  $\text{KNO}_3$ , Sulphur and Charcoal in black powder is

- a) 75:15:10
- b) 75:10:15
- c) 65:15:20
- d) 65:20:15

56. Which out of the following is true for LG shots of 12 bore shotgun cartridge?

- a) 9.14mm (6 shots)
- b) 9.04 mm (8 shots)
- c) 9.14 mm (8 shots)
- d) 9.04 mm (6 shots)

57. Front curved part of a bullet is termed as

- a) Obturation
- b) Ogive
- c) Bullet cone
- d) Wad

58. Ballistite is a propellant which can be categorized into

- a) Single base
- b) Double base
- c) Triple base
- d) Black powder

59. Arrange the following in sequential order and choose the correct option

- i. Overshot wad
- ii. Base wad
- iii. Propellant powder
- iv. Air cushion wad

- a) i, iv, iii, ii
- b) i, iii, iv, ii
- c) i, ii, iv, iii
- d) i, iii, ii, iv

60. If,  $m$ = ballistics coefficient,  $n$ =mass of projectile,  $o$ =diameter of projectile and  $p$ =form factor, then which of the following is true?

- a)  $m=n/o^2p$
- b)  $n=m/ o^2p$
- c)  $p=m/ o^2n$
- d)  $p=n/ o^2m$

61. Which of the following is not a method of collection of GSR from hands of shooter?

- a) Nitric acid swab
- b) Acetic acid swab
- c)  $H_2O_2$  swab
- d) Molten wax

62. Harrison and Gilroy test is used to determine the presence of which of the following element?

- i. Lead
- ii. Barium
- iii. Copper
- iv. Antimony
- v. Mercury

Choose the correct option

- a) ii, iii and v only
- b) i, ii and iv only
- c) iii, iv and v only
- d) i, ii, iii and iv

63. Rifling is incorporated in a barrel of firearm

- a) To increase range and accuracy
- b) To decrease range and accuracy
- c) To increase range and decrease accuracy
- d) To decrease range and increase accuracy

64. Which of the following is a class characteristic of a fired bullet?
- Land marks
  - Groove marks
  - Calibre
  - Twist of rifling
- Choose the correct option
- iii and iv only
  - i and ii only
  - ii and iii only
  - i and iv only
65. Which of the following is used in the priming composition?
- Lead nitrate
  - Mercury azide
  - lead azide
  - mercury nitrate
66. The angle between the direction of propagation of projectile and the axis of projectile is known as:
- Nutation
  - Percussion
  - Yaw
  - Precession
67. Which of the following is true for Berdan type of primer?
- Anvil is part of primer cup
  - Anvil is part of cartridge case
  - Does not contain anvil
  - Anvil is part of base wad
68. High ISO number is used in photography for which of the following condition?
- To achieve shallow depth of field
  - To achieve motion blur
  - To freeze the motion
  - To increase the exposure
69. Signatures on old cheques, deeds and old application forms are example of which of the following?
- Admitted signature
  - Requested signature
  - Holographic signature
  - Irrelevant signature
70. Which of the following is best suitable for restoration of indented writings?
- ESDA
  - Comparison microscope
  - Stereo zoom microscope
  - AAS

71. Which is most appropriate for stabilizing charred documents?
- a) Acetone
  - b) Canada balsam adhesive
  - c) Poly Vinyl acetate
  - d) Fevicol
72. Which of the following is an example of Soft nose bullet cartridge?
- a) 8 mm/.315"
  - b) 9 mm/0.38"
  - c) 7.65 mm/0.32"
  - d) 12 Bore
73. Which of the following reagent is used for detection of Barium?
- a) Rubeanic Acid
  - b) Sodium Rhodizonate
  - c) Sulphanilic Acid
  - d) Alpha Naphthylamine
74. Bullet of AK 47 is categorized under
- a) Incendiary Bullet
  - b) Rifled slug
  - c) Spitzer bullet
  - d) Streamline bullet
75. In whose presence seizure of physical evidences should be done by the Investigation officer?
- a) At least two independent witness
  - b) At least two dependent witness
  - c) At most two independent witness
  - d) At most two dependent witness
76. Sawn-off shotgun refers to which of the following?
- a) Shotgun having single barrel
  - b) Shotgun having double barrel
  - c) Shotgun having shorter barrel than regular
  - d) Shotgun having larger barrel than regular
77. Which of the following is NOT a part of walker test?
- a) Alpha Naphthylamine
  - b) Sulphanilic acid
  - c) Glacial acetic acid
  - d) Rubeanic acid

78. As per which section of law, report by officers of mint is considered as evidence in the Indian court of law?

- a) Section 291, CrPC
- b) Section 292, CrPC
- c) Section 291, IPC
- d) Section 292, IPC

79. Examination-in- chief is defined under which section of Indian law?

- a) Section 137, CrPC
- b) Section 138, CrPC
- c) Section 137, IEA
- d) Section 138, IEA

80. Section 293 of CrPC does not apply on which of the following government scientific expert?

- a) Assistant Professor, National Forensic Sciences University
- b) Director, Haffkine Institute, Mumbai
- c) Director, Central Forensic Science Laboratory
- d) Director, Central Bureau of Investigation

81. Match List I with List II and select the correct option

| List-I (Exhibit) |          | List-II (Analytical Division of FSL) |           |
|------------------|----------|--------------------------------------|-----------|
| i.               | Glass    | m                                    | Ballistic |
| ii.              | Hair     | n                                    | Biology   |
| iii.             | MDMA     | o                                    | Narcotics |
| iv.              | Revolver | p                                    | Physics   |

- a) i- p, ii-n, iii-o, iv- m
- b) i-m, ii-n, iii-o, iv-p
- c) i-p, ii-o, iii-n, iv-m
- d) i-p, ii-o, iii-m, iv-n

82. What would be the sequence of firing in chronological order?

- i. formation of firing pin mark
- ii. pulling of trigger
- iii. expansion of propellant gases
- iv. projection of bullet
- v. falling of hammer

Choose the correct option

- a) i-ii-iii-iv-v
- b) ii-v-i-iii-iv
- c) ii-v-iv-i-iii
- d) i-ii-v-iii-iv

83. VSC is an instrument used for examination of

- a) Tool marks
- b) Foot prints
- c) Questioned documents
- d) Firearms

84. What does the term IBIS stand for?

- a) Integrated ballistics Identification system
- b) Integrated blood identification system
- c) Interoperable blood Identification system
- d) Interoperable ballistics identification system

85. Principle of exchange was given by

- a) Lombroso
- b) Locard
- c) Landsteiner
- d) Goddard

86. Which among the following occurs first, in terms of trial in court?

- a) Charge formation
- b) Cross examination
- c) Examination-in-chief
- d) Re-examination

87. Iron gallotinate ink is also known as

- a) Blue ink
- b) Red Ink
- c) Gel Ink
- d) Black Ink

88. SLR in camera stands for

- a) Single lens Recorder
- b) Short lens recorder
- c) Single lens reflex
- d) Short lens reflex

89. Opinion of digital signature certificate issuing authority is considered as a relevant fact as per which section of the Indian Law?

- a) Section 47, IEA
- b) Section 47a , IEA
- c) Section 45, IEA
- d) Section 45a, IEA



90. Which of the following aperture setting will give higher exposure considering ISO and shutter speed constant in manual mode in SLR camera?

- a) f/22
- b) f/11
- c) f/2.8
- d) f/1.4

91. Punishment for criminal conspiracy is dealt in

- a) Section 120 IPC
- b) Section 120A IPC
- c) Section 120B IPC
- d) Section 120C IPC

92. Which section of Indian law deals with the punishment for counterfeiting of currency notes?

- a) Section 489D IPC
- b) Section 473 IPC
- c) Section 489A IPC
- d) Section 477A IPC

93. Bertillonage is associated with which of the following?

- a) Somatoscopy
- b) Photogrammetry
- c) Anthropometry
- d) Dactyloscopy

94. Cordite is which type of propellant?

- a) Single base smokeless
- b) Double base smokeless
- c) Triple base smokeless
- d) Semi smokeless

95. Police inquest is conducted under which of the following section of Indian law?

- a) 174 CrPC
- b) 176 CrPC
- c) 174 IPC
- d) 176 IPC

96. Which of the following is true for proof cartridges?

- a) It produces 10% more pressure
- b) It produces 25% more pressure
- c) It produces 15% more pressure
- d) It produces 20% more pressure

97. Derringers are firearms which possess

- a) Multiple magazines
- b) Choked barrel
- c) Shortened barrel
- d) Multiple barrel

98. Which of the following place does NOT have a Central Detective Training School?

- a) Kolkata
- b) Hyderabad
- c) Bhopal
- d) Chandigarh

99. Document is defined in which section of IPC?

- a) 29
- b) 29A
- c) 30
- d) 30A

100. Cheating is defined in which section of IPC?

- a) 410
- b) 412
- c) 412A
- d) 415

101. In the following question, different alphabets stand for various symbols as indicated below:

|             |                |                   |             |
|-------------|----------------|-------------------|-------------|
| Addition: P | Subtraction: Q | Multiplication: R | Division: S |
| Equal to: T | Less than: U   | Greater than: Z   |             |

Out of the four alternatives given below, which one is correct according to the above letter symbols?

- a) 10R2U2S2R10S2
- b) 3P2T2S1R3Q1
- c) 2Z1R2S1P1R1
- d) 16Z8R3P1R2Q2

102. A number when subtracted by  $\frac{1}{7}$  of itself gives the same value as the sum of all the angles of a triangle. What is the number?

- a) 224
- b) 210
- c) 140
- d) 350

103. In a certain code ENGLISH is written as FMHKJRI. How is OCTOBER written in that code?

- a) PBUNCDS
- b) PBUCNSD
- c) BPUNCSD
- d) PBUCNDS

104. There is a family of 6 persons A, B, C, D, E and F. There are two married couples in the family. The family members are lawyer, teacher, salesman, engineer, accountant and doctor. D, the salesman is married to the lady teacher. The doctor is married to the lawyer. F, the accountant is the son of B and brother of E. C, the lawyer is the daughter-in-law of A. E is the unmarried engineer. A is the grandmother of F. How is E related to F?
- Brother
  - Sister
  - Cannot be established
  - None of these
105. A and B together can do a piece of work in 12 days and B and C finish the same work together in 16 days. After A has worked on it for 5 days and B for 7 days, C finishes it in 13 days. In how many days will C alone be able to finish the work?
- 16
  - 24
  - 36
  - 48
106. Find value of x, y and z in the given series and then establish relation among them.
- 102, 107, 117, 134, (x);
  - 130, 115, 135, 110, (y);
  - (z), 80, 120, 300, 1050;
- $x > y = z$
  - $y < x = z$
  - $x = y = z$
  - $y > x > z$
107. A vessel contains 400 liters of acid A and 80 liters of acid B. If \_\_\_\_\_ liters of mixture is taken out from the vessel and \_\_\_\_\_ liters of acid B are added to the remaining mixture, then the final amount of acid A in the vessel becomes 250 liters more than the amount of acid B in it.
- Which of the following integral values given in the options are possible in the blanks in same order?
- (72, 22)
  - (60, 30)
  - (84, 24)
  - (48, 38)
  - (36, 48)
- 2 & 4 only
  - 1 & 5 only
  - 2, 4 & 5 only
  - 1, 2 & 4 only

108. Consider two Statements and a Question:

Statement-1: The last day of the month is Thursday

Statement-2: The third Saturday of the month was the eighteenth day

Question: What day is the fourteenth day of the given month?

Which one of the following is correct in respect of the Statements and the Question?

- a) Statement-1 alone is sufficient to answer the Question
- b) Statement-2 alone is sufficient to answer the Question
- c) Both Statement-1 and Statement-2 are required to answer the Question
- d) Neither Statement-1 alone nor Statement-2 alone is sufficient to answer the Question

109. What is the probability of getting a sum of less than 11 after throwing a dice twice?

- a)  $\frac{3}{12}$
- b)  $\frac{25}{36}$
- c)  $\frac{11}{18}$
- d)  $\frac{33}{36}$

110. The percentage profit earned by selling a table for Rs. 11520 is equal to the percentage loss incurred by selling the same table for Rs. 7680. At what price should the article be sold to make 40% profit?

- a) Rs. 11520
- b) Rs. 12800
- c) Rs. 13440
- d) Rs. 10800

111. Recently, scientists observed the merger of two 'black holes' billions of light years away from the Earth. What is the significance of these observations?

- a) Existence of 'black holes' was confirmed
- b) Higgs Bosons particles were detected
- c) 'Gravitational Waves' were detected
- d) Einstein's Special Theory of Relativity was proved

112. Why do Step index Single mode fibers are used in long distance communication? Select the correct answer(s).

- 1. Low signal loss in single mode fiber
  - 2. No modal dispersion in single mode fiber
  - 3. Single mode fiber has high modal dispersion
  - 4. Refractive index of single mode fiber gradually changes, this will help in long distance communication.
- a) 1 and 3 only
  - b) 1 and 2 only
  - c) 2 and 4 only
  - d) 3 and 4 only

113. The energy band gap of a semiconductor

- a) Increases with increase in T
- b) Decreases with increase in T
- c) Does not vary with change in T
- d) Changes as a function of T & H

114. Which act led to the Jallianwala Bagh incident?

- a) Defence of India Act
- b) Rowlatt Act
- c) Government of India Act
- d) Official secrets Act

115. Who among the following is the famous architect of pre-independence Punjab who prepared the architectural design of Khalsa College?

- a) John Lockwood Kipling
- b) Bhai Ram Singh
- c) Sir Ganga Ram
- d) Bhai Jodh Singh

116. Match the following collections with its poets

**List I**

- 1. Mohan Singh
- 2. Surjit Patar
- 3. Shiv Batalavi
- 4. Amrita Pritam

**Code**

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

**List II**

- i. *Hawa Vich Likhe Harf*
- ii. *Lajwanti*
- iii. *Saave Pattar*
- iv. *Amrit Lehran*

117. Which of the following is the first multi-wavelength satellite to detect extreme ultraviolet light emanating from a galaxy 9.3 billion light years from Earth?

- a) SCATSAT-1
- b) INSAT-3DR
- c) CARTOSAT-2
- d) ASTROSAT

118. The term "golden rice" refers to rice varieties that have been genetically modified to address which of the following vitamin deficiencies?

- a) Vitamin D
- b) Vitamin A
- c) Vitamin K
- d) Vitamin B

119. Provisions of single citizenship in Indian Constitution are borrowed from which of the following constitution?

- a) US Constitution
- b) British Constitution
- c) Canadian Constitution
- d) Weimar Constitution of Germany

120. Which Indian documentary short has won an Oscar at the 95th Academy Awards?

- a) The Elephant Whisperers
- b) The House That Ananda Built
- c) An Encounter With Faces
- d) RRR

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**SPACE FOR ROUGH WORK**

# PUNJAB PUBLIC SERVICE COMMISSION

Objective Type Test (March-2023) for Recruitment to the post of SOs (Ballistics, Documents, Photography, Audio/Voice), SAs (Ballistics, Photography, Audio/Voice) in the Department of Home Affairs & Justice Govt. of Punjab

READ INSTRUCTIONS BEFORE FILLING ANY DETAILS OR ATTEMPTING TO ANSWER THE QUESTIONS.

Total Questions: 120  
Time Allowed: 2 Hours

Candidate's Name \_\_\_\_\_

Father's Name \_\_\_\_\_

Date of Birth          
DD MM YYYY

OMR Response Sheet No. \_\_\_\_\_

Roll No. \_\_\_\_\_

Candidate's Signature (Please sign in the box)

Question  
Booklet Set

**B**

Booklet Series No.

## INSTRUCTIONS

1. The candidate shall NOT open this booklet till the time told to do so by the Invigilation Staff. However, in the meantime, the candidate can read these instructions carefully and subsequently fill the appropriate columns given above in CAPITAL letters. The candidate may also fill the relevant boxes out of 1 to 9 of the Optical Mark Reader (OMR) response sheet, supplied separately.
2. Use only blue or black **ball point pen** to fill the relevant columns on this page as well as in OMR sheet. Use of Ink pen or any other pen is not allowed.
3. The candidate shall be liable for any adverse effect if the information given above is wrong or illegible or incomplete.
4. Each candidate is required to attempt 120 questions in 120 minutes, except for orthopedically/visually impaired candidates, who would be given 40 extra minutes, for marking correct responses on the OMR sheet.
5. The question paper booklet has 23 pages.
6. The candidates, when allowed to open the question paper booklet, must first check the entire booklet to confirm that the booklet has complete number of pages, the pages printed correctly and there are no blank pages. In case there is any such error in the question paper booklet then the candidate should IMMEDIATELY bring this fact to the notice of the Invigilation Staff and obtain a new booklet of the same series as given earlier.
7. The serial number of the new Question booklet if issued for some reason should be entered in the relevant column of the OMR. The Invigilation Staff must make necessary corrections in their record regarding the change in the serial no. of Question booklet.
8. The paper consists of total 480 Marks. Each question shall carry 4 marks. There are four options for each question and the candidate has to mark the MOST APPROPRIATE answer on the OMR response sheet.
9. There is negative marking (1 mark for each question) for questions wrongly answered by the candidate.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidate **MUST READ INSTRUCTIONS BEHIND THE OMR SHEET** before answering the questions and check that two carbon copies attached to the OMR sheet are intact.



1. Which of the following is D to A conversion technique?
  - a) Successive approximation
  - b) Weighted resistor technique
  - c) Dual slope technique
  - d) Single slope technique
2. Consider two objects A and B, each of mass 1 kg. A is dropped from rest from the roof of a tall building, while B is projected horizontally with an initial velocity 10 m/s from the same roof. It is found that A reaches the ground after 3 seconds. Neglecting air resistance and assuming no obstructions, after how much time will B hit the ground?
  - a) Less than 3 s
  - b) 3 s
  - c) More than 3 s but less than 4.5 s
  - d) 4.5 s or more
3. A billiard ball hits a rigid wall at an angle of  $45^\circ$  to the normal and is reflected at  $45^\circ$  on the other side of the normal without any change in speed. The direction of the force exerted by the ball on the wall is
  - a) Along the initial direction of motion of the ball
  - b) Along the final direction of motion of the ball
  - c) Along the normal
  - d) Tangent to the wall
4. A bullet of mass 20 g is fired by a gun of mass 7.5 kg. If the muzzle speed of the bullet is 180 m/s, the recoil speed of the gun is
  - a) 0.60 m/s
  - b) 0.48 m/s
  - c) 0.36 m/s
  - d) 0.24 m/s
5. A block of mass 5 kg rests on a wooden board which is initially placed horizontally on the floor. One end of the board is now slowly raised, keeping the other end fixed on the ground. When the board is at an angle of 30 degrees to the horizontal, the block *just* begins to slide. The coefficient of static friction between the block and the board is
  - a) 0.50
  - b) 0.58
  - c) 0.73
  - d) 0.97

6. The driver of a fast-moving car applied emergency brakes, as a result of which the car skidded (underwent sliding motion) for 200 m before coming to a stop. Assuming that the car decelerated uniformly, and given that the coefficient of kinetic friction is 0.60, how fast was the car going (in km per hour) when the brakes were applied (approx.)?
- a) 292
  - b) 212
  - c) 175
  - d) 136
7. Which of the following statements is *not* true for a plane electromagnetic wave in vacuum?
- a) The electric and magnetic vectors oscillate in perpendicular planes
  - b) If the strength of the electric field is given, the strength of the magnetic field is known
  - c) The propagation direction is at right angles to both electric and magnetic fields
  - d) The energy transported by the wave falls off as the square of the distance
8. Microwave ovens use electromagnetic radiation for warming food. A typical wavelength used is around
- a) 1.2 mm
  - b) 12 mm
  - c) 1.2 cm
  - d) 12 cm
9. To examine powder burns in a gunshot wound, the most useful technique is likely to be
- a) X-ray imaging
  - b) UV photography
  - c) Visible light photography
  - d) IR photography
10. To obtain a photograph of a fingerprint on a drinking glass, the most useful lighting technique is likely to be
- a) Direct reflective lighting
  - b) 45 degree lighting
  - c) Transmission lighting
  - d) Small spot lights
11. A ray of light is incident on a slab of transparent material at an angle of 60 degrees. The refracted ray inside the slab makes an angle of 30 degrees to the normal. The refractive index of the slab's material is
- a) 1.33
  - b) 1.60
  - c) 1.73
  - d) 1.86

12. A mirage is formed by total internal reflection when
- a) The optical density of air near the ground increases with height and there are strong air currents
  - b) The optical density of air near the ground increases with height and there are no strong air currents
  - c) The optical density of air near the ground decreases with height and there are strong air currents
  - d) The optical density of air near the ground decreases with height and there are no strong air currents
13. Light from a point source in air falls on a convex spherical glass surface of radius of curvature 20 cm and refractive index 1.5. If the distance of the light source from the glass surface is 100 cm, the image is located at
- a) 43 cm from the surface, in the direction of incident light
  - b) 43 cm from the surface, opposite to the direction of incident light
  - c) 100 cm from the surface, in the direction of incident light
  - d) 100 cm from the surface, opposite to the direction of incident light
14. A thin convex lens has a focal length of 20 cm. When it is placed in contact with another lens, the combination focuses parallel rays at a distance 5 cm from the second lens. The second lens is
- a) Convex and of focal length 6.67 cm
  - b) Convex and of focal length 5.00 cm
  - c) Concave and of focal length -6.67 cm
  - d) Concave and of focal length -5.00 cm
15. Circularly polarized light can be obtained by passing linearly polarized light through a
- a) half-wave plate
  - b) quarter-wave plate
  - c) pinhole aperture
  - d) right-angled prism
16. Unpolarized light of intensity  $I_0$  falls on a polaroid. The emerging light then passes through a second polaroid. The axes of the two polaroids are at  $45^\circ$  with respect to each other. The light emerging from the second polaroid has intensity
- a)  $I_0$
  - b)  $I_0/2$
  - c)  $I_0/4$
  - d) Zero
17. An UV-visible spectrophotometer typically works over the wavelength range
- a) 20 nm – 570 nm
  - b) 190 nm – 900 nm
  - c) 600 nm – 2  $\mu\text{m}$
  - d) 1 – 9  $\mu\text{m}$

18. What is the muzzle velocity of 5.56 INSAS rifle?
- a) 700 m/s
  - b) 800 m/s
  - c) 900 m/s
  - d) 1000 m/s
19. Which of the following laser produces output in the infrared region?
- a) Ruby
  - b) CO<sub>2</sub>
  - c) He-Ne
  - d) Rhodamine
20. Sound waves of wavelength 68 cm travelling in air hit a water surface and continue to propagate in water. If the speeds of sound in air and water are 340 m/s and 1490 m/s respectively, the wavelength of the sound waves in water is approximately
- a) 200 cm
  - b) 30 cm
  - c) 100 cm
  - d) 300 cm
21. The equation  $y = A \sin (40 z - 60 t)$ , where the coordinates  $y, z$  are measured in metres and the time is in seconds, represents a progressive wave travelling in the
- a) positive  $z$  direction with speed 1.50 m/s
  - b) negative  $z$  direction with speed 1.50 m/s
  - c) positive  $z$  direction with speed 0.67 m/s
  - d) negative  $z$  direction with speed 0.67 m/s
22. The superposition of two waves, each of amplitude  $a$  and wavelength  $\lambda$ , travelling in opposite directions, results in
- a) A travelling wave of wavelength  $\lambda/2$
  - b) A travelling wave of wavelength  $2\lambda$
  - c) A standing wave of wavelength  $\lambda$
  - d) No wave
23. Two strings A and B, when plucked together, produce 5 beats per second. When the tension in string A is reduced a little, the beat frequency becomes 3 per second. If the original frequency of A was 256 Hz, the frequency of B is
- a) 251 Hz
  - b) 253 Hz
  - c) 259 Hz
  - d) 261 Hz

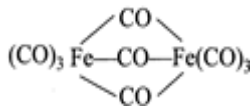
24. The type of biasing which is most likely to be useful for linear operation of a transistor with good thermal stability is
- Fixed bias
  - Fixed bias with emitter resistor
  - Collector to base bias
  - Voltage divider bias
25. Compared to a bipolar junction transistor (BJT), a field-effect transistor (FET) is characterized by
- Higher gain and higher thermal stability
  - Higher gain and lower thermal stability
  - Lower gain and higher thermal stability
  - Lower gain and lower thermal stability
26. A given MOSFET is ON when the gate-source voltage is zero, and is turned OFF by applying +3 V to the gate. The device is of type
- Enhancement mode, n-channel
  - Enhancement mode, p-channel
  - Depletion mode, n-channel
  - Depletion mode, p-channel
27. Which class of amplifiers give the most faithful reproduction of audio signals?
- A
  - B
  - AB
  - C
28. The LED revolution is said to have been completed with the development of bright LEDs of which of the following colour, for which the Nobel Prize in Physics was awarded in 2014?
- Infra-red
  - Red
  - Green
  - Blue
29. The open-loop gain of a real op-amp varies with frequency  $f$  as
- $1/\sqrt{f}$
  - $1/f$
  - $1/f\sqrt{f}$
  - $1/f^2$
30. An op-amp is used as an inverting amplifier by applying the input signal through a resistor  $R_1$  to the inverting input terminal and connecting a feedback resistor  $R_2$  between output and input. The magnitude of the gain is
- $R_1/R_2$
  - $R_2/R_1$
  - $1 + R_1/R_2$
  - $1 + R_2/R_1$

31. A digital circuit made out of 4 flip-flops shows the following sequence of states:  
 $0100 \rightarrow 0010 \rightarrow 0001 \rightarrow 1000$ . The circuit is a
- Ripple counter
  - Johnson counter
  - Decade counter
  - Ring counter
32. A sine wave is applied to one input terminal of a comparator, while the other input terminal is grounded. The output is
- A sine wave
  - A square wave
  - A triangular wave
  - Zero
33. The ballistic coefficient (BC) is a measure of a projectile's ability to overcome air resistance. If "m" is the mass of a bullet, "A" its cross-sectional area and "d" the drag coefficient, BC is given by
- $m d A$
  - $m d / A$
  - $m A / d$
  - $m / A d$
34. Three key components of an automated ballistics identification system are the Signature Extraction Unit, Data Storage Unit, and Correlation Server. The fourth key component is
- Ballistic scanner, which captures images of bullets and cartridge cases
  - High-speed camera, which takes photographs of bullets in flight
  - Ballistic trajectory calculator for a bullet after it leaves the gun
  - Propellant and cartridge design unit
35. A 5 molar solution of  $H_2SO_4$  is diluted from 1 L to 10L. Then the normality of the solution is
- 0.25 N
  - 1N
  - 2 N
  - 7 N
36. The molarity of pure water is
- 18 M
  - 50.0 M
  - 55.6 M
  - 100 M
37. For the reaction between  $KMnO_4$  and  $H_2O_2$ , the number of electrons transferred per mole of  $H_2O_2$  are
- One
  - Two
  - Three
  - Four

38. The IUPAC name of the following compound is:



- a) 1,1,7,7-tetramethyl-2,5-octadiene
- b) 2,8-dimethyl-3,6-decadiene
- c) 1,5-di-isopropyl-1,4-hexadiene
- d) 2,8-dimethyl-4,6-decadiene



39. The correct name of \_\_\_\_\_ is

- a) tri- $\mu$ - carbonyl bis (tricarbonyl) iron (0)
- b) hexacarbonyl iron (III) $\mu$ -tricarbonyl ferrate (0)
- c) tricarbonyl iron (0) $\mu$ -tricarbonyl iron (0) tricarbonyl
- d) nonacarbonyl iron

40. Which of the following statement is INCORRECT for aromatic compounds?

- a) Aromatic compounds are cyclic and planar
- b) In aromatic compounds all carbon atoms are either  $sp^2$  or  $sp$  hybridized
- c) Aromatic compounds follow Huckel's rule
- d) Aromatic compounds contains  $(4n+2)$  number of pi-bonds (where;  $n=0,1,2,3,4,5,\dots$ )

41. Oxidation number of Fe in  $\text{Fe}_3\text{O}_4$  is

- a)  $5/4$
- b)  $4/5$
- c)  $3/2$
- d)  $8/3$

42. Which of the following depends upon temperature?

- a) Mole fraction
- b) Weight percentage of solute
- c) Molarity
- d) Molality

43. How many liters of water must be added to 1L of an aqueous solution of HCl having  $\text{pH} = 1$  to create an aqueous solution with a  $\text{pH}$  of 2?

- a) 0.1L
- b) 0.9 L
- c) 2.0 L
- d) 9.0 L

44. India's first self-governing Forensic Science Laboratory was established in which of the following states?
- a) Kolkata
  - b) Chennai
  - c) Delhi
  - d) Hyderabad
45. Who among the following undertook the study of fingerprints for the purpose of personal identification?
- a) Landsteiner
  - b) Galton
  - c) Locard
  - d) Osborn
46. The length of tyre skid marks depends on which of the following?
- i. Speed of vehicle,
  - ii. Friction of road
  - iii. Wheel base
  - iv. Ground clearance
- Choose the correct option
- a) i and iii only
  - b) ii and iv only
  - c) i and ii only
  - d) iii and iv only
47. Restoration of erased chassis number is carried out using
- a) Marquis reagent
  - b) Dragendorff's reagent
  - c) Fry's reagent
  - d) Sulphanilic Acid only
48. Ratio of  $\text{KNO}_3$ , Sulphur and Charcoal in black powder is
- a) 75:15:10
  - b) 75:10:15
  - c) 65:15:20
  - d) 65:20:15
49. Which out of the following is true for LG shots of 12 bore shotgun cartridge?
- a) 9.14mm (6 shots)
  - b) 9.04 mm (8 shots)
  - c) 9.14 mm (8 shots)
  - d) 9.04 mm (6 shots)



50. Front curved part of a bullet is termed as
- Obturation
  - Ogive
  - Bullet cone
  - Wad
51. Ballistite is a propellant which can be categorized into
- Single base
  - Double base
  - Triple base
  - Black powder
52. Arrange the following in sequential order and choose the correct option
- Overshot wad
  - Base wad
  - Propellant powder
  - Air cushion wad
- i, iv, iii, ii
  - i, iii, iv, ii
  - i, ii, iv, iii
  - i, iii, ii, iv
53. If,  $m$ = ballistics coefficient,  $n$ =mass of projectile,  $o$ =diameter of projectile and  $p$ =form factor, then which of the following is true?
- $m=n/o^2p$
  - $n=m/ o^2p$
  - $p=m/ o^2n$
  - $p=n/ o^2m$
54. Which of the following is not a method of collection of GSR from hands of shooter?
- Nitric acid swab
  - Acetic acid swab
  - $H_2O_2$  swab
  - Molten wax
55. Harrison and Gilroy test is used to determine the presence of which of the following element?
- Lead
  - Barium
  - Copper
  - Antimony
  - Mercury
- Choose the correct option
- ii, iii and v only
  - i, ii and iv only
  - iii, iv and v only
  - i, ii, iii and iv

56. Rifling is incorporated in a barrel of firearm
- To increase range and accuracy
  - To decrease range and accuracy
  - To increase range and decrease accuracy
  - To decrease range and increase accuracy
57. Which of the following is a class characteristic of a fired bullet?
- Land marks
  - Groove marks
  - Calibre
  - Twist of rifling
- Choose the correct option
- iii and iv only
  - i and ii only
  - ii and iii only
  - i and iv only
58. Which of the following is used in the priming composition?
- Lead nitrate
  - Mercury azide
  - lead azide
  - mercury nitrate
59. The angle between the direction of propagation of projectile and the axis of projectile is known as:
- Nutation
  - Percussion
  - Yaw
  - Precession
60. Which of the following is true for Berdan type of primer?
- Anvil is part of primer cup
  - Anvil is part of cartridge case
  - Does not contain anvil
  - Anvil is part of base wad
61. High ISO number is used in photography for which of the following condition?
- To achieve shallow depth of field
  - To achieve motion blur
  - To freeze the motion
  - To increase the exposure
62. Signatures on old cheques, deeds and old application forms are example of which of the following?
- Admitted signature
  - Requested signature
  - Holographic signature
  - Irrelevant signature

63. Which of the following is best suitable for restoration of indented writings?
- a) ESDA
  - b) Comparison microscope
  - c) Stereo zoom microscope
  - d) AAS
64. Which is most appropriate for stabilizing charred documents?
- a) Acetone
  - b) Canada balsam adhesive
  - c) Poly Vinyl acetate
  - d) Fevicol
65. Which of the following is an example of Soft nose bullet cartridge?
- a) 8 mm/.315"
  - b) 9 mm/0.38"
  - c) 7.65 mm/0.32"
  - d) 12 Bore
66. Which of the following reagent is used for detection of Barium?
- a) Rubeanic Acid
  - b) Sodium Rhodizonate
  - c) Sulphanilic Acid
  - d) Alpha Naphthylamine
67. Bullet of AK 47 is categorized under
- a) Incendiary Bullet
  - b) Rifled slug
  - c) Spitzer bullet
  - d) Streamline bullet
68. In whose presence seizure of physical evidences should be done by the Investigation officer?
- a) At least two independent witness
  - b) At least two dependent witness
  - c) At most two independent witness
  - d) At most two dependent witness
69. Sawn-off shotgun refers to which of the following?
- a) Shotgun having single barrel
  - b) Shotgun having double barrel
  - c) Shotgun having shorter barrel than regular
  - d) Shotgun having larger barrel than regular

70. Which of the following is NOT a part of walker test?
- Alpha Naphthylamine
  - Sulphanilic acid
  - Glacial acetic acid
  - Rubeanic acid
71. As per which section of law, report by officers of mint is considered as evidence in the Indian court of law?
- Section 291, CrPC
  - Section 292, CrPC
  - Section 291, IPC
  - Section 292, IPC
72. Examination-in- chief is defined under which section of Indian law?
- Section 137, CrPC
  - Section 138, CrPC
  - Section 137, IEA
  - Section 138, IEA
73. Section 293 of CrPC does not apply on which of the following government scientific expert?
- Assistant Professor, National Forensic Sciences University
  - Director, Haffkeine Institute, Mumbai
  - Director, Central Forensic Science Laboratory
  - Director, Central Bureau of Investigation
74. Match List I with List II and select the correct option

| List-I (Exhibit) |          | List-II (Analytical Division of FSL) |           |
|------------------|----------|--------------------------------------|-----------|
| i.               | Glass    | m                                    | Ballistic |
| ii.              | Hair     | n                                    | Biology   |
| iii.             | MDMA     | o                                    | Narcotics |
| iv.              | Revolver | p                                    | Physics   |

- i- p, ii-n, iii-o, iv- m
- i-m, ii-n, iii-o, iv-p
- i-p, ii-o, iii-n, iv-m
- i-p, ii-o, iii-m, iv-n

75. What would be the sequence of firing in chronological order?

- i. formation of firing pin mark
- ii. pulling of trigger
- iii. expansion of propellant gases
- iv. projection of bullet
- v. falling of hammer

Choose the correct option

- a) i-ii-iii-iv-v
- b) ii-v-i-iii-iv
- c) ii-v-iv-i-iii
- d) i-ii-v-iii-iv

76. VSC is an instrument used for examination of

- a) Tool marks
- b) Foot prints
- c) Questioned documents
- d) Firearms

77. What does the term IBIS stand for?

- a) Integrated ballistics Identification system
- b) Integrated blood identification system
- c) Interoperable blood Identification system
- d) Interoperable ballistics identification system

78. Principle of exchange was given by

- a) Lombroso
- b) Locard
- c) Landsteiner
- d) Goddard

79. Which among the following occurs first, in terms of trial in court?

- a) Charge formation
- b) Cross examination
- c) Examination-in-chief
- d) Re-examination

80. Iron gallotinate ink is also known as

- a) Blue ink
- b) Red Ink
- c) Gel Ink
- d) Black Ink

81. SLR in camera stands for

- a) Single lens Recorder
- b) Short lens recorder
- c) Single lens reflex
- d) Short lens reflex

82. Opinion of digital signature certificate issuing authority is considered as a relevant fact as per which section of the Indian Law?

- a) Section 47, IEA
- b) Section 47a , IEA
- c) Section 45, IEA
- d) Section 45a, IEA

83. Which of the following aperture setting will give higher exposure considering ISO and shutter speed constant in manual mode in SLR camera?

- a) f/22
- b) f/11
- c) f/2.8
- d) f/1.4

84. Punishment for criminal conspiracy is dealt in

- a) Section 120 IPC
- b) Section 120A IPC
- c) Section 120B IPC
- d) Section 120C IPC

85. Which section of Indian law deals with the punishment for counterfeiting of currency notes?

- a) Section 489D IPC
- b) Section 473 IPC
- c) Section 489A IPC
- d) Section 477A IPC

86. Bertillonage is associated with which of the following?

- a) Somatoscopy
- b) Photogrammetry
- c) Anthropometry
- d) Dactyloscopy

87. Cordite is which type of propellant?

- a) Single base smokeless
- b) Double base smokeless
- c) Triple base smokeless
- d) Semi smokeless

88. Police inquest is conducted under which of the following section of Indian law?

- a) 174 CrPC
- b) 176 CrPC
- c) 174 IPC
- d) 176 IPC

89. Which of the following is true for proof cartridges?

- a) It produces 10% more pressure
- b) It produces 25% more pressure
- c) It produces 15% more pressure
- d) It produces 20% more pressure

90. Derringers are firearms which possess

- a) Multiple magazines
- b) Choked barrel
- c) Shortened barrel
- d) Multiple barrel

91. Which of the following place does NOT have a Central Detective Training School?

- a) Kolkata
- b) Hyderabad
- c) Bhopal
- d) Chandigarh

92. Document is defined in which section of IPC?

- a) 29
- b) 29A
- c) 30
- d) 30A

93. Cheating is defined in which section of IPC?

- a) 410
- b) 412
- c) 412A
- d) 415

94. In the following question, different alphabets stand for various symbols as indicated below:

|             |                |                   |             |
|-------------|----------------|-------------------|-------------|
| Addition: P | Subtraction: Q | Multiplication: R | Division: S |
| Equal to: T | Less than: U   | Greater than: Z   |             |

Out of the four alternatives given below, which one is correct according to the above letter symbols?

- a) 10R2U2S2R10S2
- b) 3P2T2S1R3Q1
- c) 2Z1R2S1P1R1
- d) 16Z8R3P1R2Q2

95. A number when subtracted by  $\frac{1}{7}$  of itself gives the same value as the sum of all the angles of a triangle. What is the number?
- 224
  - 210
  - 140
  - 350
96. In a certain code ENGLISH is written as FMHKJRI. How is OCTOBER written in that code?
- PBUNCDS
  - PBUCNSD
  - BPUNCSD
  - PBUCNDS
97. There is a family of 6 persons A, B, C, D, E and F. There are two married couples in the family. The family members are lawyer, teacher, salesman, engineer, accountant and doctor. D, the salesman is married to the lady teacher. The doctor is married to the lawyer. F, the accountant is the son of B and brother of E. C, the lawyer is the daughter-in-law of A. E is the unmarried engineer. A is the grandmother of F. How is E related to F?
- Brother
  - Sister
  - Cannot be established
  - None of these
98. A and B together can do a piece of work in 12 days and B and C finish the same work together in 16 days. After A has worked on it for 5 days and B for 7 days, C finishes it in 13 days. In how many days will C alone be able to finish the work?
- 16
  - 24
  - 36
  - 48
99. Find value of x, y and z in the given series and then establish relation among them.
- 102, 107, 117, 134, (x);
  - 130, 115, 135, 110, (y);
  - (z), 80, 120, 300, 1050;
- $x > y = z$
  - $y < x = z$
  - $x = y = z$
  - $y > x > z$



100. A vessel contains 400 liters of acid A and 80 liters of acid B. If \_\_\_\_\_ liters of mixture is taken out from the vessel and \_\_\_\_\_ liters of acid B are added to the remaining mixture, then the final amount of acid A in the vessel becomes 250 liters more than the amount of acid B in it.

Which of the following integral values given in the options are possible in the blanks in same order?

- 1) (72, 22)
- 2) (60, 30)
- 3) (84, 24)
- 4) (48, 38)
- 5) (36, 48)

- a) 2 & 4 only
- b) 1 & 5 only
- c) 2, 4 & 5 only
- d) 1, 2 & 4 only

101. Consider two Statements and a Question:

Statement-1: The last day of the month is Thursday

Statement-2: The third Saturday of the month was the eighteenth day

Question: What day is the fourteenth day of the given month?

Which one of the following is correct in respect of the Statements and the Question?

- a) Statement-1 alone is sufficient to answer the Question
- b) Statement-2 alone is sufficient to answer the Question
- c) Both Statement-1 and Statement-2 are required to answer the Question
- d) Neither Statement-1 alone nor Statement-2 alone is sufficient to answer the Question

102. What is the probability of getting a sum of less than 11 after throwing a dice twice?

- a)  $\frac{3}{12}$
- b)  $\frac{25}{36}$
- c)  $\frac{11}{18}$
- d)  $\frac{33}{36}$

103. The percentage profit earned by selling a table for Rs. 11520 is equal to the percentage loss incurred by selling the same table for Rs. 7680. At what price should the article be sold to make 40% profit?

- a) Rs. 11520
- b) Rs. 12800
- c) Rs. 13440
- d) Rs. 10800

104. Recently, scientists observed the merger of two 'black holes' billions of light years away from the Earth. What is the significance of these observations?

- a) Existence of 'black holes' was confirmed
- b) Higgs Bosons particles were detected
- c) 'Gravitational Waves' were detected
- d) Einstein's Special Theory of Relativity was proved

105. Why do Step index Single mode fibers are used in long distance communication? Select the correct answer(s).

- 1. Low signal loss in single mode fiber
- 2. No modal dispersion in single mode fiber
- 3. Single mode fiber has high modal dispersion
- 4. Refractive index of single mode fiber gradually changes, this will help in long distance communication.

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

106. The energy band gap of a semiconductor

- a) Increases with increase in T
- b) Decreases with increase in T
- c) Does not vary with change in T
- d) Changes as a function of T & H

107. Which act led to the Jallianwala Bagh incident?

- a) Defence of India Act
- b) Rowlatt Act
- c) Government of India Act
- d) Official secrets Act

108. Who among the following is the famous architect of pre-independence Punjab who prepared the architectural design of Khalsa College?

- a) John Lockwood Kipling
- b) Bhai Ram Singh
- c) Sir Ganga Ram
- d) Bhai Jodh Singh

109. Match the following collections with its poets

**List I**

1. Mohan Singh
2. Surjit Patar
3. Shiv Batalavi
4. Amrita Pritam

**List II**

- i. *Hawa Vich Likhe Harf*
- ii. *Lajwanti*
- iii. *Saave Pattar*
- iv. *Amrit Lehran*

Code

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

110. Which of the following is the first multi-wavelength satellite to detect extreme ultraviolet light emanating from a galaxy 9.3 billion light years from Earth?

- a) SCATSAT-1
- b) INSAT-3DR
- c) CARTOSAT-2
- d) ASTROSAT

111. The term "golden rice" refers to rice varieties that have been genetically modified to address which of the following vitamin deficiencies?

- a) Vitamin D
- b) Vitamin A
- c) Vitamin K
- d) Vitamin B

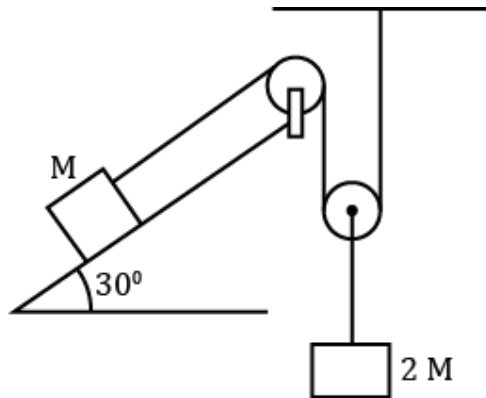
112. Provisions of single citizenship in Indian Constitution are borrowed from which of the following constitution?

- a) US Constitution
- b) British Constitution
- c) Canadian Constitution
- d) Weimar Constitution of Germany

113. Which Indian documentary short has won an Oscar at the 95th Academy Awards?

- a) The Elephant Whisperers
- b) The House That Ananda Built
- c) An Encounter With Faces
- d) RRR

114. Find the acceleration of the block of mass  $M$  in the situation shown in the figure. All the surfaces are frictionless and the pulley and the string are light.



- a)  $g$
- b)  $\frac{g}{2}$
- c)  $\frac{g}{3}$
- d)  $\frac{g}{5}$
115. A pendulum bob has a speed of  $3 \text{ m/s}$  at its lowest position. The pendulum is  $0.5 \text{ m}$  long. Then the speed of the pendulum bob, when it makes an angle of  $60^\circ$  with the vertical is: (Take  $g=10 \text{ m/s}^2$ )
- a)  $1 \text{ m/s}$
- b)  $2 \text{ m/s}$
- c)  $3 \text{ m/s}$
- d)  $4 \text{ m/s}$
116. A force  $F = (0.5x + 10)$  acts on a particle in the  $x$  direction, where  $F$  is in Newton and  $x$  is in meter. The work done by the force during the displacement of the particle from  $x = 0$  to  $x = 2$  meter is
- a)  $9 \text{ J}$
- b)  $15 \text{ J}$
- c)  $21 \text{ J}$
- d)  $36 \text{ J}$
117. The image formed by an objective of a compound microscope is
- a) virtual and diminished
- b) real and diminished
- c) real and enlarged
- d) virtual and enlarged

118. What is the limit of resolution of a telescope objective having a diameter of 200 cm, if it has to detect light of wavelength 500 nm coming from a distant star?
- a)  $152.5 \times 10^{-9}$  radian
  - b)  $305 \times 10^{-9}$  radian
  - c)  $510 \times 10^{-9}$  radian
  - d)  $610.5 \times 10^{-9}$  radian
119. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then focal length of the lens
- a) becomes zero
  - b) becomes infinite
  - c) remains unchanged
  - d) becomes small but non zero
120. When an inverter is placed between both inputs of an S–R flipflop, it becomes
- a) J–K flip-flop
  - b) D flip-flop
  - c) T flip-flop
  - d) Master slave flip-flop

\*\*\*\*\*

**SPACE FOR ROUGH WORK**

# PUNJAB PUBLIC SERVICE COMMISSION

Objective Type Test (March-2023) for Recruitment to the post of SOs (Ballistics, Documents, Photography, Audio/Voice), SAs (Ballistics, Photography, Audio/Voice) in the Department of Home Affairs & Justice Govt. of Punjab

READ INSTRUCTIONS BEFORE FILLING ANY DETAILS OR ATTEMPTING TO ANSWER THE QUESTIONS.

Total Questions: 120  
Time Allowed: 2 Hours

Candidate's Name \_\_\_\_\_

Father's Name \_\_\_\_\_

Date of Birth          
DD MM YYYY

OMR Response Sheet No. \_\_\_\_\_

Roll No. \_\_\_\_\_

Candidate's Signature (Please sign in the box)

Question  
Booklet Set

C

Booklet Series No.

## INSTRUCTIONS

1. The candidate shall NOT open this booklet till the time told to do so by the Invigilation Staff. However, in the meantime, the candidate can read these instructions carefully and subsequently fill the appropriate columns given above in CAPITAL letters. The candidate may also fill the relevant boxes out of 1 to 9 of the Optical Mark Reader (OMR) response sheet, supplied separately.
2. Use only blue or black **ball point pen** to fill the relevant columns on this page as well as in OMR sheet. Use of Ink pen or any other pen is not allowed.
3. The candidate shall be liable for any adverse effect if the information given above is wrong or illegible or incomplete.
4. Each candidate is required to attempt 120 questions in 120 minutes, except for orthopedically/visually impaired candidates, who would be given 40 extra minutes, for marking correct responses on the OMR sheet.
5. The question paper booklet has 23 pages.
6. The candidates, when allowed to open the question paper booklet, must first check the entire booklet to confirm that the booklet has complete number of pages, the pages printed correctly and there are no blank pages. In case there is any such error in the question paper booklet then the candidate should IMMEDIATELY bring this fact to the notice of the Invigilation Staff and obtain a new booklet of the same series as given earlier.
7. The serial number of the new Question booklet if issued for some reason should be entered in the relevant column of the OMR. The Invigilation Staff must make necessary corrections in their record regarding the change in the serial no. of Question booklet.
8. The paper consists of total 480 Marks. Each question shall carry 4 marks. There are four options for each question and the candidate has to mark the MOST APPROPRIATE answer on the OMR response sheet.
9. There is negative marking (1 mark for each question) for questions wrongly answered by the candidate.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidate **MUST READ INSTRUCTIONS BEHIND THE OMR SHEET** before answering the questions and check that two carbon copies attached to the OMR sheet are intact.

1. Microwave ovens use electromagnetic radiation for warming food. A typical wavelength used is around
  - a) 1.2 mm
  - b) 12 mm
  - c) 1.2 cm
  - d) 12 cm
2. To examine powder burns in a gunshot wound, the most useful technique is likely to be
  - a) X-ray imaging
  - b) UV photography
  - c) Visible light photography
  - d) IR photography
3. To obtain a photograph of a fingerprint on a drinking glass, the most useful lighting technique is likely to be
  - a) Direct reflective lighting
  - b) 45 degree lighting
  - c) Transmission lighting
  - d) Small spot lights
4. A ray of light is incident on a slab of transparent material at an angle of 60 degrees. The refracted ray inside the slab makes an angle of 30 degrees to the normal. The refractive index of the slab's material is
  - a) 1.33
  - b) 1.60
  - c) 1.73
  - d) 1.86
5. A mirage is formed by total internal reflection when
  - a) The optical density of air near the ground increases with height and there are strong air currents
  - b) The optical density of air near the ground increases with height and there are no strong air currents
  - c) The optical density of air near the ground decreases with height and there are strong air currents
  - d) The optical density of air near the ground decreases with height and there are no strong air currents
6. Light from a point source in air falls on a convex spherical glass surface of radius of curvature 20 cm and refractive index 1.5. If the distance of the light source from the glass surface is 100 cm, the image is located at
  - a) 43 cm from the surface, in the direction of incident light
  - b) 43 cm from the surface, opposite to the direction of incident light
  - c) 100 cm from the surface, in the direction of incident light
  - d) 100 cm from the surface, opposite to the direction of incident light

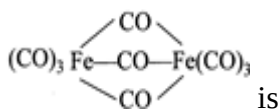


7. A thin convex lens has a focal length of 20 cm. When it is placed in contact with another lens, the combination focuses parallel rays at a distance 5 cm from the second lens. The second lens is
- Convex and of focal length 6.67 cm
  - Convex and of focal length 5.00 cm
  - Concave and of focal length -6.67 cm
  - Concave and of focal length -5.00 cm
8. Circularly polarized light can be obtained by passing linearly polarized light through a
- half-wave plate
  - quarter-wave plate
  - pinhole aperture
  - right-angled prism
9. Unpolarized light of intensity  $I_0$  falls on a polaroid. The emerging light then passes through a second polaroid. The axes of the two polaroids are at  $45^\circ$  with respect to each other. The light emerging from the second polaroid has intensity
- $I_0$
  - $I_0/2$
  - $I_0/4$
  - Zero
10. An UV-visible spectrophotometer typically works over the wavelength range
- 20 nm – 570 nm
  - 190 nm – 900 nm
  - 600 nm – 2  $\mu\text{m}$
  - 1 – 9  $\mu\text{m}$
11. What is the muzzle velocity of 5.56 INSAS rifle?
- 700 m/s
  - 800 m/s
  - 900 m/s
  - 1000 m/s
12. Which of the following laser produces output in the infrared region?
- Ruby
  - $\text{CO}_2$
  - He-Ne
  - Rhodamine
13. Sound waves of wavelength 68 cm travelling in air hit a water surface and continue to propagate in water. If the speeds of sound in air and water are 340 m/s and 1490 m/s respectively, the wavelength of the sound waves in water is approximately
- 200 cm
  - 30 cm
  - 100 cm
  - 300 cm

14. The equation  $y = A \sin (40 z - 60 t)$ , where the coordinates  $y, z$  are measured in metres and the time is in seconds, represents a progressive wave travelling in the
- positive  $z$  direction with speed 1.50 m/s
  - negative  $z$  direction with speed 1.50 m/s
  - positive  $z$  direction with speed 0.67 m/s
  - negative  $z$  direction with speed 0.67 m/s
15. The superposition of two waves, each of amplitude  $a$  and wavelength  $\lambda$ , travelling in opposite directions, results in
- A travelling wave of wavelength  $\lambda/2$
  - A travelling wave of wavelength  $2\lambda$
  - A standing wave of wavelength  $\lambda$
  - No wave
16. Two strings A and B, when plucked together, produce 5 beats per second. When the tension in string A is reduced a little, the beat frequency becomes 3 per second. If the original frequency of A was 256 Hz, the frequency of B is
- 251 Hz
  - 253 Hz
  - 259 Hz
  - 261 Hz
17. The type of biasing which is most likely to be useful for linear operation of a transistor with good thermal stability is
- Fixed bias
  - Fixed bias with emitter resistor
  - Collector to base bias
  - Voltage divider bias
18. Compared to a bipolar junction transistor (BJT), a field-effect transistor (FET) is characterized by
- Higher gain and higher thermal stability
  - Higher gain and lower thermal stability
  - Lower gain and higher thermal stability
  - Lower gain and lower thermal stability
19. A given MOSFET is ON when the gate-source voltage is zero, and is turned OFF by applying +3 V to the gate. The device is of type
- Enhancement mode, n-channel
  - Enhancement mode, p-channel
  - Depletion mode, n-channel
  - Depletion mode, p-channel

20. Which class of amplifiers give the most faithful reproduction of audio signals?
- A
  - B
  - AB
  - C
21. The LED revolution is said to have been completed with the development of bright LEDs of which of the following colour, for which the Nobel Prize in Physics was awarded in 2014?
- Infra-red
  - Red
  - Green
  - Blue
22. The open-loop gain of a real op-amp varies with frequency  $f$  as
- $1/\sqrt{f}$
  - $1/f$
  - $1/f\sqrt{f}$
  - $1/f^2$
23. An op-amp is used as an inverting amplifier by applying the input signal through a resistor  $R_1$  to the inverting input terminal and connecting a feedback resistor  $R_2$  between output and input. The magnitude of the gain is
- $R_1/R_2$
  - $R_2/R_1$
  - $1 + R_1/R_2$
  - $1 + R_2/R_1$
24. A digital circuit made out of 4 flip-flops shows the following sequence of states:  $0100 \rightarrow 0010 \rightarrow 0001 \rightarrow 1000$ . The circuit is a
- Ripple counter
  - Johnson counter
  - Decade counter
  - Ring counter
25. A sine wave is applied to one input terminal of a comparator, while the other input terminal is grounded. The output is
- A sine wave
  - A square wave
  - A triangular wave
  - Zero
26. The ballistic coefficient (BC) is a measure of a projectile's ability to overcome air resistance. If "m" is the mass of a bullet, "A" its cross-sectional area and "d" the drag coefficient, BC is given by
- $m d A$
  - $m d / A$
  - $m A / d$
  - $m / A d$

27. Three key components of an automated ballistics identification system are the Signature Extraction Unit, Data Storage Unit, and Correlation Server. The fourth key component is
- Ballistic scanner, which captures images of bullets and cartridge cases
  - High-speed camera, which takes photographs of bullets in flight
  - Ballistic trajectory calculator for a bullet after it leaves the gun
  - Propellant and cartridge design unit
28. A 5 molar solution of  $\text{H}_2\text{SO}_4$  is diluted from 1 L to 10L. Then the normality of the solution is
- 0.25 N
  - 1N
  - 2 N
  - 7 N
29. The molarity of pure water is
- 18 M
  - 50.0 M
  - 55.6 M
  - 100 M
30. For the reaction between  $\text{KMnO}_4$  and  $\text{H}_2\text{O}_2$ , the number of electrons transferred per mole of  $\text{H}_2\text{O}_2$  are
- One
  - Two
  - Three
  - Four
31. The IUPAC name of the following compound is:
- $$(\text{CH}_3)_2\text{CH}-\text{CH}_2\text{CH}=\text{CH}-\text{CH}=\text{CH}-\text{CH}(\text{CH}_3)(\text{C}_2\text{H}_5)$$
- 1,1,7,7-tetramethyl-2,5-octadiene
  - 2,8-dimethyl-3,6-decadiene
  - 1,5-di-isopropyl-1,4-hexadiene
  - 2,8-dimethyl-4,6-decadiene



32. The correct name of is
- tri- $\mu$ - carbonyl bis (tricarbonyl) iron (0)
  - hexacarbonyl iron (III) $\mu$ -tricarbonyl ferrate (0)
  - tricarbonyl iron (0) $\mu$ -tricarbonyl iron (0) tricarbonyl
  - nonacarbonyl iron

33. Which of the following statement is INCORRECT for aromatic compounds?
- a) Aromatic compounds are cyclic and planar
  - b) In aromatic compounds all carbon atoms are either  $sp^2$  or  $sp$  hybridized
  - c) Aromatic compounds follow Huckel's rule
  - d) Aromatic compounds contains  $(4n+2)$  number of pi-bonds  
(where;  $n=0,1,2,3,4,5,\dots$ )
34. Oxidation number of Fe in  $Fe_3O_4$  is
- a)  $5/4$
  - b)  $4/5$
  - c)  $3/2$
  - d)  $8/3$
35. Which of the following depends upon temperature?
- a) Mole fraction
  - b) Weight percentage of solute
  - c) Molarity
  - d) Molality
36. How many liters of water must be added to 1L of an aqueous solution of HCl having  $pH = 1$  to create an aqueous solution with a  $pH$  of 2?
- a) 0.1L
  - b) 0.9 L
  - c) 2.0 L
  - d) 9.0 L
37. India's first self-governing Forensic Science Laboratory was established in which of the following states?
- a) Kolkata
  - b) Chennai
  - c) Delhi
  - d) Hyderabad
38. Who among the following undertook the study of fingerprints for the purpose of personal identification?
- a) Landsteiner
  - b) Galton
  - c) Locard
  - d) Osborn

39. The length of tyre skid marks depends on which of the following?

- i. Speed of vehicle,
- ii. Friction of road
- iii. Wheel base
- iv. Ground clearance

Choose the correct option

- a) i and iii only
- b) ii and iv only
- c) i and ii only
- d) iii and iv only

40. Restoration of erased chassis number is carried out using

- a) Marquis reagent
- b) Dragendorff's reagent
- c) Fry's reagent
- d) Sulphanilic Acid only

41. Ratio of  $\text{KNO}_3$ , Sulphur and Charcoal in black powder is

- a) 75:15:10
- b) 75:10:15
- c) 65:15:20
- d) 65:20:15

42. Which out of the following is true for LG shots of 12 bore shotgun cartridge?

- a) 9.14mm (6 shots)
- b) 9.04 mm (8 shots)
- c) 9.14 mm (8 shots)
- d) 9.04 mm (6 shots)

43. Front curved part of a bullet is termed as

- a) Obturation
- b) Ogive
- c) Bullet cone
- d) Wad

44. Ballistite is a propellant which can be categorized into

- a) Single base
- b) Double base
- c) Triple base
- d) Black powder

45. Arrange the following in sequential order and choose the correct option

- i. Overshot wad
- ii. Base wad
- iii. Propellant powder
- iv. Air cushion wad

- a) i, iv, iii, ii
- b) i, iii, iv, ii
- c) i, ii, iv, iii
- d) i, iii, ii, iv

46. If,  $m$ = ballistics coefficient,  $n$ =mass of projectile,  $o$ =diameter of projectile and  $p$ =form factor, then which of the following is true?

- a)  $m=n/o^2p$
- b)  $n=m/ o^2p$
- c)  $p=m/ o^2n$
- d)  $p=n/ o^2m$

47. Which of the following is not a method of collection of GSR from hands of shooter?

- a) Nitric acid swab
- b) Acetic acid swab
- c)  $H_2O_2$  swab
- d) Molten wax

48. Harrison and Gilroy test is used to determine the presence of which of the following element?

- i. Lead
- ii. Barium
- iii. Copper
- iv. Antimony
- v. Mercury

Choose the correct option

- a) ii, iii and v only
- b) i, ii and iv only
- c) iii, iv and v only
- d) i, ii, iii and iv

49. Rifling is incorporated in a barrel of firearm

- a) To increase range and accuracy
- b) To decrease range and accuracy
- c) To increase range and decrease accuracy
- d) To decrease range and increase accuracy

50. Which of the following is a class characteristic of a fired bullet?
- i. Land marks
  - ii. Groove marks
  - iii. Calibre
  - iv. Twist of rifling
- Choose the correct option
- a) iii and iv only
  - b) i and ii only
  - c) ii and iii only
  - d) i and iv only
51. Which of the following is used in the priming composition?
- a) Lead nitrate
  - b) Mercury azide
  - c) lead azide
  - d) mercury nitrate
52. The angle between the direction of propagation of projectile and the axis of projectile is known as:
- a) Nutation
  - b) Percussion
  - c) Yaw
  - d) Precession
53. Which of the following is true for Berdan type of primer?
- a) Anvil is part of primer cup
  - b) Anvil is part of cartridge case
  - c) Does not contain anvil
  - d) Anvil is part of base wad
54. High ISO number is used in photography for which of the following condition?
- a) To achieve shallow depth of field
  - b) To achieve motion blur
  - c) To freeze the motion
  - d) To increase the exposure
55. Signatures on old cheques, deeds and old application forms are example of which of the following?
- a) Admitted signature
  - b) Requested signature
  - c) Holographic signature
  - d) Irrelevant signature
56. Which of the following is best suitable for restoration of indented writings?
- a) ESDA
  - b) Comparison microscope
  - c) Stereo zoom microscope
  - d) AAS



57. Which is most appropriate for stabilizing charred documents?
- a) Acetone
  - b) Canada balsam adhesive
  - c) Poly Vinyl acetate
  - d) Fevicol
58. Which of the following is an example of Soft nose bullet cartridge?
- a) 8 mm/.315"
  - b) 9 mm/0.38"
  - c) 7.65 mm/0.32"
  - d) 12 Bore
59. Which of the following reagent is used for detection of Barium?
- a) Rubeanic Acid
  - b) Sodium Rhodizonate
  - c) Sulphanilic Acid
  - d) Alpha Naphthylamine
60. Bullet of AK 47 is categorized under
- a) Incendiary Bullet
  - b) Rifled slug
  - c) Spitzer bullet
  - d) Streamline bullet
61. In whose presence seizure of physical evidences should be done by the Investigation officer?
- a) At least two independent witness
  - b) At least two dependent witness
  - c) At most two independent witness
  - d) At most two dependent witness
62. Sawn-off shotgun refers to which of the following?
- a) Shotgun having single barrel
  - b) Shotgun having double barrel
  - c) Shotgun having shorter barrel than regular
  - d) Shotgun having larger barrel than regular
63. Which of the following is NOT a part of walker test?
- a) Alpha Naphthylamine
  - b) Sulphanilic acid
  - c) Glacial acetic acid
  - d) Rubeanic acid

64. As per which section of law, report by officers of mint is considered as evidence in the Indian court of law?

- a) Section 291, CrPC
- b) Section 292, CrPC
- c) Section 291, IPC
- d) Section 292, IPC

65. Examination-in- chief is defined under which section of Indian law?

- a) Section 137, CrPC
- b) Section 138, CrPC
- c) Section 137, IEA
- d) Section 138, IEA

66. Section 293 of CrPC does not apply on which of the following government scientific expert?

- a) Assistant Professor, National Forensic Sciences University
- b) Director, Haffkeine Institute, Mumbai
- c) Director, Central Forensic Science Laboratory
- d) Director, Central Bureau of Investigation

67. Match List I with List II and select the correct option

| List-I (Exhibit) |          | List-II (Analytical Division of FSL) |           |
|------------------|----------|--------------------------------------|-----------|
| i.               | Glass    | m                                    | Ballistic |
| ii.              | Hair     | n                                    | Biology   |
| iii.             | MDMA     | o                                    | Narcotics |
| iv.              | Revolver | p                                    | Physics   |

- a) i- p, ii-n, iii-o, iv- m
- b) i-m, ii-n, iii-o, iv-p
- c) i-p, ii-o, iii-n, iv-m
- d) i-p, ii-o, iii-m, iv-n

68. What would be the sequence of firing in chronological order?

- i. formation of firing pin mark
- ii. pulling of trigger
- iii. expansion of propellant gases
- iv. projection of bullet
- v. falling of hammer

Choose the correct option

- a) i-ii-iii-iv-v
- b) ii-v-i-iii-iv
- c) ii-v-iv-i-iii
- d) i-ii-v-iii-iv

69. VSC is an instrument used for examination of
- a) Tool marks
  - b) Foot prints
  - c) Questioned documents
  - d) Firearms
70. What does the term IBIS stand for?
- a) Integrated ballistics Identification system
  - b) Integrated blood identification system
  - c) Interoperable blood Identification system
  - d) Interoperable ballistics identification system
71. Principle of exchange was given by
- a) Lombroso
  - b) Locard
  - c) Landsteiner
  - d) Goddard
72. Which among the following occurs first, in terms of trial in court?
- a) Charge formation
  - b) Cross examination
  - c) Examination-in-chief
  - d) Re-examination
73. Iron gallotinate ink is also known as
- a) Blue ink
  - b) Red Ink
  - c) Gel Ink
  - d) Black Ink
74. SLR in camera stands for
- a) Single lens Recorder
  - b) Short lens recorder
  - c) Single lens reflex
  - d) Short lens reflex
75. Opinion of digital signature certificate issuing authority is considered as a relevant fact as per which section of the Indian Law?
- a) Section 47, IEA
  - b) Section 47a , IEA
  - c) Section 45, IEA
  - d) Section 45a, IEA

76. Which of the following aperture setting will give higher exposure considering ISO and shutter speed constant in manual mode in SLR camera?

- a) f/22
- b) f/11
- c) f/2.8
- d) f/1.4

77. Punishment for criminal conspiracy is dealt in

- a) Section 120 IPC
- b) Section 120A IPC
- c) Section 120B IPC
- d) Section 120C IPC

78. Which section of Indian law deals with the punishment for counterfeiting of currency notes?

- a) Section 489D IPC
- b) Section 473 IPC
- c) Section 489A IPC
- d) Section 477A IPC

79. Bertillonage is associated with which of the following?

- a) Somatoscopy
- b) Photogrammetry
- c) Anthropometry
- d) Dactyloscopy

80. Cordite is which type of propellant?

- a) Single base smokeless
- b) Double base smokeless
- c) Triple base smokeless
- d) Semi smokeless

81. Police inquest is conducted under which of the following section of Indian law?

- a) 174 CrPC
- b) 176 CrPC
- c) 174 IPC
- d) 176 IPC

82. Which of the following is true for proof cartridges?

- a) It produces 10% more pressure
- b) It produces 25% more pressure
- c) It produces 15% more pressure
- d) It produces 20% more pressure

83. Derringers are firearms which possess

- a) Multiple magazines
- b) Choked barrel
- c) Shortened barrel
- d) Multiple barrel

84. Which of the following place does NOT have a Central Detective Training School?

- a) Kolkata
- b) Hyderabad
- c) Bhopal
- d) Chandigarh

85. Document is defined in which section of IPC?

- a) 29
- b) 29A
- c) 30
- d) 30A

86. Cheating is defined in which section of IPC?

- a) 410
- b) 412
- c) 412A
- d) 415

87. In the following question, different alphabets stand for various symbols as indicated below:

|             |                |                   |             |
|-------------|----------------|-------------------|-------------|
| Addition: P | Subtraction: Q | Multiplication: R | Division: S |
| Equal to: T | Less than: U   | Greater than: Z   |             |

Out of the four alternatives given below, which one is correct according to the above letter symbols?

- a) 10R2U2S2R10S2
- b) 3P2T2S1R3Q1
- c) 2Z1R2S1P1R1
- d) 16Z8R3P1R2Q2

88. A number when subtracted by  $\frac{1}{7}$  of itself gives the same value as the sum of all the angles of a triangle. What is the number?

- a) 224
- b) 210
- c) 140
- d) 350

89. In a certain code ENGLISH is written as FMHKJRI. How is OCTOBER written in that code?

- a) PBUNCDS
- b) PBUCNSD
- c) BPUNCSD
- d) PBUCNDS

90. There is a family of 6 persons A, B, C, D, E and F. There are two married couples in the family. The family members are lawyer, teacher, salesman, engineer, accountant and doctor. D, the salesman is married to the lady teacher. The doctor is married to the lawyer. F, the accountant is the son of B and brother of E. C, the lawyer is the daughter-in-law of A. E is the unmarried engineer. A is the grandmother of F. How is E related to F?
- Brother
  - Sister
  - Cannot be established
  - None of these
91. A and B together can do a piece of work in 12 days and B and C finish the same work together in 16 days. After A has worked on it for 5 days and B for 7 days, C finishes it in 13 days. In how many days will C alone be able to finish the work?
- 16
  - 24
  - 36
  - 48
92. Find value of x, y and z in the given series and then establish relation among them.
- 102, 107, 117, 134, (x);
  - 130, 115, 135, 110, (y);
  - (z), 80, 120, 300, 1050;
- $x > y = z$
  - $y < x = z$
  - $x = y = z$
  - $y > x > z$
93. A vessel contains 400 liters of acid A and 80 liters of acid B. If \_\_\_\_\_ liters of mixture is taken out from the vessel and \_\_\_\_\_ liters of acid B are added to the remaining mixture, then the final amount of acid A in the vessel becomes 250 liters more than the amount of acid B in it.
- Which of the following integral values given in the options are possible in the blanks in same order?
- (72, 22)
  - (60, 30)
  - (84, 24)
  - (48, 38)
  - (36, 48)
- 2 & 4 only
  - 1 & 5 only
  - 2, 4 & 5 only
  - 1, 2 & 4 only

94. Consider two Statements and a Question:

Statement-1: The last day of the month is Thursday

Statement-2: The third Saturday of the month was the eighteenth day

Question: What day is the fourteenth day of the given month?

Which one of the following is correct in respect of the Statements and the Question?

- a) Statement-1 alone is sufficient to answer the Question
- b) Statement-2 alone is sufficient to answer the Question
- c) Both Statement-1 and Statement-2 are required to answer the Question
- d) Neither Statement-1 alone nor Statement-2 alone is sufficient to answer the Question

95. What is the probability of getting a sum of less than 11 after throwing a dice twice?

- a)  $\frac{3}{12}$
- b)  $\frac{25}{36}$
- c)  $\frac{11}{18}$
- d)  $\frac{33}{36}$

96. The percentage profit earned by selling a table for Rs. 11520 is equal to the percentage loss incurred by selling the same table for Rs. 7680. At what price should the article be sold to make 40% profit?

- a) Rs. 11520
- b) Rs. 12800
- c) Rs. 13440
- d) Rs. 10800

97. Recently, scientists observed the merger of two 'black holes' billions of light years away from the Earth. What is the significance of these observations?

- a) Existence of 'black holes' was confirmed
- b) Higgs Bosons particles were detected
- c) 'Gravitational Waves' were detected
- d) Einstein's Special Theory of Relativity was proved

98. Why do Step index Single mode fibers are used in long distance communication? Select the correct answer(s).

- 1. Low signal loss in single mode fiber
  - 2. No modal dispersion in single mode fiber
  - 3. Single mode fiber has high modal dispersion
  - 4. Refractive index of single mode fiber gradually changes, this will help in long distance communication.
- a) 1 and 3 only
  - b) 1 and 2 only
  - c) 2 and 4 only
  - d) 3 and 4 only

99. The energy band gap of a semiconductor

- a) Increases with increase in T
- b) Decreases with increase in T
- c) Does not vary with change in T
- d) Changes as a function of T & H

100. Which act led to the Jallianwala Bagh incident?

- a) Defence of India Act
- b) Rowlatt Act
- c) Government of India Act
- d) Official secrets Act

101. Who among the following is the famous architect of pre-independence Punjab who prepared the architectural design of Khalsa College?

- a) John Lockwood Kipling
- b) Bhai Ram Singh
- c) Sir Ganga Ram
- d) Bhai Jodh Singh

102. Match the following collections with its poets

**List I**

- 1. Mohan Singh
- 2. Surjit Patar
- 3. Shiv Batalavi
- 4. Amrita Pritam

**Code**

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

**List II**

- i. *Hawa Vich Likhe Harf*
- ii. *Lajwanti*
- iii. *Saave Pattar*
- iv *Amrit Lehran*

103. Which of the following is the first multi-wavelength satellite to detect extreme ultraviolet light emanating from a galaxy 9.3 billion light years from Earth?

- a) SCATSAT-1
- b) INSAT-3DR
- c) CARTOSAT-2
- d) ASTROSAT

104. The term "golden rice" refers to rice varieties that have been genetically modified to address which of the following vitamin deficiencies?

- a) Vitamin D
- b) Vitamin A
- c) Vitamin K
- d) Vitamin B



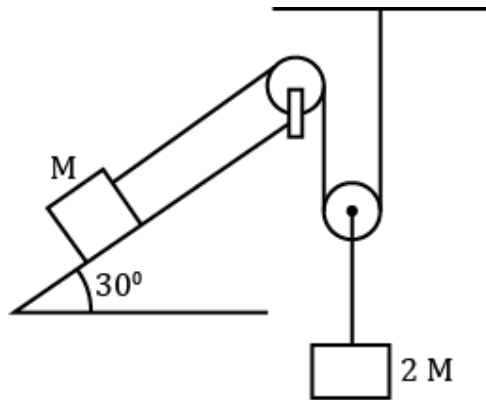
105. Provisions of single citizenship in Indian Constitution are borrowed from which of the following constitution?

- a) US Constitution
- b) British Constitution
- c) Canadian Constitution
- d) Weimar Constitution of Germany

106. Which Indian documentary short has won an Oscar at the 95th Academy Awards?

- a) The Elephant Whisperers
- b) The House That Ananda Built
- c) An Encounter With Faces
- d) RRR

107. Find the acceleration of the block of mass  $M$  in the situation shown in the figure. All the surfaces are frictionless and the pulley and the string are light.



- a)  $g$
- b)  $\frac{g}{2}$
- c)  $\frac{g}{3}$
- d)  $\frac{g}{5}$

108. A pendulum bob has a speed of  $3 \text{ m/s}$  at its lowest position. The pendulum is  $0.5 \text{ m}$  long. Then the speed of the pendulum bob, when it makes an angle of  $60^\circ$  with the vertical is: (Take  $g=10 \text{ m/s}^2$ )

- a)  $1 \text{ m/s}$
- b)  $2 \text{ m/s}$
- c)  $3 \text{ m/s}$
- d)  $4 \text{ m/s}$

109. A force  $F = (0.5x + 10)$  acts on a particle in the  $x$  direction, where  $F$  is in Newton and  $x$  is in meter. The work done by the force during the displacement of the particle from  $x = 0$  to  $x = 2$  meter is
- a) 9J
  - b) 15J
  - c) 21J
  - d) 36J
110. The image formed by an objective of a compound microscope is
- a) virtual and diminished
  - b) real and diminished
  - c) real and enlarged
  - d) virtual and enlarged
111. What is the limit of resolution of a telescope objective having a diameter of 200 cm, if it has to detect light of wavelength 500 nm coming from a distant star?
- a)  $152.5 \times 10^{-9}$  radian
  - b)  $305 \times 10^{-9}$  radian
  - c)  $510 \times 10^{-9}$  radian
  - d)  $610.5 \times 10^{-9}$  radian
112. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then focal length of the lens
- a) becomes zero
  - b) becomes infinite
  - c) remains unchanged
  - d) becomes small but non zero
113. When an inverter is placed between both inputs of an S–R flipflop, it becomes
- a) J–K flip-flop
  - b) D flip-flop
  - c) T flip-flop
  - d) Master slave flip-flop
114. Which of the following is D to A conversion technique?
- a) Successive approximation
  - b) Weighted resistor technique
  - c) Dual slope technique
  - d) Single slope technique

115. Consider two objects A and B, each of mass 1 kg. A is dropped from rest from the roof of a tall building, while B is projected horizontally with an initial velocity 10 m/s from the same roof. It is found that A reaches the ground after 3 seconds. Neglecting air resistance and assuming no obstructions, after how much time will B hit the ground?
- a) Less than 3 s
  - b) 3 s
  - c) More than 3 s but less than 4.5 s
  - d) 4.5 s or more
116. A billiard ball hits a rigid wall at an angle of  $45^\circ$  to the normal and is reflected at  $45^\circ$  on the other side of the normal without any change in speed. The direction of the force exerted by the ball on the wall is
- a) Along the initial direction of motion of the ball
  - b) Along the final direction of motion of the ball
  - c) Along the normal
  - d) Tangent to the wall
117. A bullet of mass 20 g is fired by a gun of mass 7.5 kg. If the muzzle speed of the bullet is 180 m/s, the recoil speed of the gun is
- a) 0.60 m/s
  - b) 0.48 m/s
  - c) 0.36 m/s
  - d) 0.24 m/s
118. A block of mass 5 kg rests on a wooden board which is initially placed horizontally on the floor. One end of the board is now slowly raised, keeping the other end fixed on the ground. When the board is at an angle of 30 degrees to the horizontal, the block *just* begins to slide. The coefficient of static friction between the block and the board is
- a) 0.50
  - b) 0.58
  - c) 0.73
  - d) 0.97

119. The driver of a fast-moving car applied emergency brakes, as a result of which the car skidded (underwent sliding motion) for 200 m before coming to a stop. Assuming that the car decelerated uniformly, and given that the coefficient of kinetic friction is 0.60, how fast was the car going (in km per hour) when the brakes were applied (approx.)?
- a) 292
  - b) 212
  - c) 175
  - d) 136
120. Which of the following statements is *not* true for a plane electromagnetic wave in vacuum?
- a) The electric and magnetic vectors oscillate in perpendicular planes
  - b) If the strength of the electric field is given, the strength of the magnetic field is known
  - c) The propagation direction is at right angles to both electric and magnetic fields
  - d) The energy transported by the wave falls off as the square of the distance

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**SPACE FOR ROUGH WORK**

# PUNJAB PUBLIC SERVICE COMMISSION

Objective Type Test (March-2023) for Recruitment to the post of SOs (Ballistics, Documents, Photography, Audio/Voice), SAs (Ballistics, Photography, Audio/Voice) in the Department of Home Affairs & Justice Govt. of Punjab

READ INSTRUCTIONS BEFORE FILLING ANY DETAILS OR ATTEMPTING TO ANSWER THE QUESTIONS.

Total Questions: 120  
Time Allowed: 2 Hours

Candidate's Name \_\_\_\_\_

Father's Name \_\_\_\_\_

Date of Birth          
DD MM YYYY

OMR Response Sheet No. \_\_\_\_\_

Roll No. \_\_\_\_\_

Candidate's Signature (Please sign in the box)

Question  
Booklet Set

D

Booklet Series No.

## INSTRUCTIONS

1. The candidate shall NOT open this booklet till the time told to do so by the Invigilation Staff. However, in the meantime, the candidate can read these instructions carefully and subsequently fill the appropriate columns given above in CAPITAL letters. The candidate may also fill the relevant boxes out of 1 to 9 of the Optical Mark Reader (OMR) response sheet, supplied separately.
2. Use only blue or black **ball point pen** to fill the relevant columns on this page as well as in OMR sheet. Use of Ink pen or any other pen is not allowed.
3. The candidate shall be liable for any adverse effect if the information given above is wrong or illegible or incomplete.
4. Each candidate is required to attempt 120 questions in 120 minutes, except for orthopedically/visually impaired candidates, who would be given 40 extra minutes, for marking correct responses on the OMR sheet.
5. The question paper booklet has 23 pages.
6. The candidates, when allowed to open the question paper booklet, must first check the entire booklet to confirm that the booklet has complete number of pages, the pages printed correctly and there are no blank pages. In case there is any such error in the question paper booklet then the candidate should IMMEDIATELY bring this fact to the notice of the Invigilation Staff and obtain a new booklet of the same series as given earlier.
7. The serial number of the new Question booklet if issued for some reason should be entered in the relevant column of the OMR. The Invigilation Staff must make necessary corrections in their record regarding the change in the serial no. of Question booklet.
8. The paper consists of total 480 Marks. Each question shall carry 4 marks. There are four options for each question and the candidate has to mark the MOST APPROPRIATE answer on the OMR response sheet.
9. There is negative marking (1 mark for each question) for questions wrongly answered by the candidate.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidate **MUST READ INSTRUCTIONS BEHIND THE OMR SHEET** before answering the questions and check that two carbon copies attached to the OMR sheet are intact.

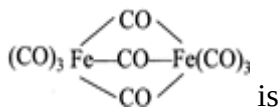
1. Circularly polarized light can be obtained by passing linearly polarized light through a
  - a) half-wave plate
  - b) quarter-wave plate
  - c) pinhole aperture
  - d) right-angled prism
2. Unpolarized light of intensity  $I_0$  falls on a polaroid. The emerging light then passes through a second polaroid. The axes of the two polaroids are at  $45^\circ$  with respect to each other. The light emerging from the second polaroid has intensity
  - a)  $I_0$
  - b)  $I_0/2$
  - c)  $I_0/4$
  - d) Zero
3. An UV-visible spectrophotometer typically works over the wavelength range
  - a) 20 nm – 570 nm
  - b) 190 nm – 900 nm
  - c) 600 nm – 2  $\mu\text{m}$
  - d) 1 – 9  $\mu\text{m}$
4. What is the muzzle velocity of 5.56 INSAS rifle?
  - a) 700 m/s
  - b) 800 m/s
  - c) 900 m/s
  - d) 1000 m/s
5. Which of the following laser produces output in the infrared region?
  - a) Ruby
  - b)  $\text{CO}_2$
  - c) He-Ne
  - d) Rhodamine
6. Sound waves of wavelength 68 cm travelling in air hit a water surface and continue to propagate in water. If the speeds of sound in air and water are 340 m/s and 1490 m/s respectively, the wavelength of the sound waves in water is approximately
  - a) 200 cm
  - b) 30 cm
  - c) 100 cm
  - d) 300 cm

7. The equation  $y = A \sin (40 z - 60 t)$ , where the coordinates  $y, z$  are measured in metres and the time is in seconds, represents a progressive wave travelling in the
- positive  $z$  direction with speed 1.50 m/s
  - negative  $z$  direction with speed 1.50 m/s
  - positive  $z$  direction with speed 0.67 m/s
  - negative  $z$  direction with speed 0.67 m/s
8. The superposition of two waves, each of amplitude  $a$  and wavelength  $\lambda$ , travelling in opposite directions, results in
- A travelling wave of wavelength  $\lambda/2$
  - A travelling wave of wavelength  $2\lambda$
  - A standing wave of wavelength  $\lambda$
  - No wave
9. Two strings A and B, when plucked together, produce 5 beats per second. When the tension in string A is reduced a little, the beat frequency becomes 3 per second. If the original frequency of A was 256 Hz, the frequency of B is
- 251 Hz
  - 253 Hz
  - 259 Hz
  - 261 Hz
10. The type of biasing which is most likely to be useful for linear operation of a transistor with good thermal stability is
- Fixed bias
  - Fixed bias with emitter resistor
  - Collector to base bias
  - Voltage divider bias
11. Compared to a bipolar junction transistor (BJT), a field-effect transistor (FET) is characterized by
- Higher gain and higher thermal stability
  - Higher gain and lower thermal stability
  - Lower gain and higher thermal stability
  - Lower gain and lower thermal stability
12. A given MOSFET is ON when the gate-source voltage is zero, and is turned OFF by applying +3 V to the gate. The device is of type
- Enhancement mode, n-channel
  - Enhancement mode, p-channel
  - Depletion mode, n-channel
  - Depletion mode, p-channel



13. Which class of amplifiers give the most faithful reproduction of audio signals?
- A
  - B
  - AB
  - C
14. The LED revolution is said to have been completed with the development of bright LEDs of which of the following colour, for which the Nobel Prize in Physics was awarded in 2014?
- Infra-red
  - Red
  - Green
  - Blue
15. The open-loop gain of a real op-amp varies with frequency  $f$  as
- $1/\sqrt{f}$
  - $1/f$
  - $1/f\sqrt{f}$
  - $1/f^2$
16. An op-amp is used as an inverting amplifier by applying the input signal through a resistor  $R_1$  to the inverting input terminal and connecting a feedback resistor  $R_2$  between output and input. The magnitude of the gain is
- $R_1/R_2$
  - $R_2/R_1$
  - $1 + R_1/R_2$
  - $1 + R_2/R_1$
17. A digital circuit made out of 4 flip-flops shows the following sequence of states:  $0100 \rightarrow 0010 \rightarrow 0001 \rightarrow 1000$ . The circuit is a
- Ripple counter
  - Johnson counter
  - Decade counter
  - Ring counter
18. A sine wave is applied to one input terminal of a comparator, while the other input terminal is grounded. The output is
- A sine wave
  - A square wave
  - A triangular wave
  - Zero
19. The ballistic coefficient (BC) is a measure of a projectile's ability to overcome air resistance. If " $m$ " is the mass of a bullet, " $A$ " its cross-sectional area and " $d$ " the drag coefficient, BC is given by
- $m d A$
  - $m d / A$
  - $m A / d$
  - $m / A d$

20. Three key components of an automated ballistics identification system are the Signature Extraction Unit, Data Storage Unit, and Correlation Server. The fourth key component is
- Ballistic scanner, which captures images of bullets and cartridge cases
  - High-speed camera, which takes photographs of bullets in flight
  - Ballistic trajectory calculator for a bullet after it leaves the gun
  - Propellant and cartridge design unit
21. A 5 molar solution of  $\text{H}_2\text{SO}_4$  is diluted from 1 L to 10L. Then the normality of the solution is
- 0.25 N
  - 1N
  - 2 N
  - 7 N
22. The molarity of pure water is
- 18 M
  - 50.0 M
  - 55.6 M
  - 100 M
23. For the reaction between  $\text{KMnO}_4$  and  $\text{H}_2\text{O}_2$ , the number of electrons transferred per mole of  $\text{H}_2\text{O}_2$  are
- One
  - Two
  - Three
  - Four
24. The IUPAC name of the following compound is:
- $$(\text{CH}_3)_2\text{CH}-\text{CH}_2\text{CH}=\text{CH}-\text{CH}=\text{CH}-\text{CH}(\text{CH}_3)(\text{C}_2\text{H}_5)$$
- 1,1,7,7-tetramethyl-2,5-octadiene
  - 2,8-dimethyl-3,6-decadiene
  - 1,5-di-isopropyl-1,4-hexadiene
  - 2,8-dimethyl-4,6-decadiene



25. The correct name of

is

- tri- $\mu$ - carbonyl bis (tricarbonyl) iron (0)
- hexacarbonyl iron (III) $\mu$ -tricarbonyl ferrate (0)
- tricarbonyl iron (0) $\mu$ -tricarbonyl iron (0) tricarbonyl
- nonacarbonyl iron

26. Which of the following statement is INCORRECT for aromatic compounds?
- a) Aromatic compounds are cyclic and planar
  - b) In aromatic compounds all carbon atoms are either  $sp^2$  or  $sp$  hybridized
  - c) Aromatic compounds follow Huckel's rule
  - d) Aromatic compounds contains  $(4n+2)$  number of pi-bonds  
(where;  $n=0,1,2,3,4,5,\dots$ )
27. Oxidation number of Fe in  $Fe_3O_4$  is
- a)  $5/4$
  - b)  $4/5$
  - c)  $3/2$
  - d)  $8/3$
28. Which of the following depends upon temperature?
- a) Mole fraction
  - b) Weight percentage of solute
  - c) Molarity
  - d) Molality
29. How many liters of water must be added to 1L of an aqueous solution of HCl having  $pH = 1$  to create an aqueous solution with a  $pH$  of 2?
- a) 0.1L
  - b) 0.9 L
  - c) 2.0 L
  - d) 9.0 L
30. India's first self-governing Forensic Science Laboratory was established in which of the following states?
- a) Kolkata
  - b) Chennai
  - c) Delhi
  - d) Hyderabad
31. Who among the following undertook the study of fingerprints for the purpose of personal identification?
- a) Landsteiner
  - b) Galton
  - c) Locard
  - d) Osborn

32. The length of tyre skid marks depends on which of the following?

- i. Speed of vehicle,
- ii. Friction of road
- iii. Wheel base
- iv. Ground clearance

Choose the correct option

- a) i and iii only
- b) ii and iv only
- c) i and ii only
- d) iii and iv only

33. Restoration of erased chassis number is carried out using

- a) Marquis reagent
- b) Dragendorff's reagent
- c) Fry's reagent
- d) Sulphanilic Acid only

34. Ratio of  $\text{KNO}_3$ , Sulphur and Charcoal in black powder is

- a) 75:15:10
- b) 75:10:15
- c) 65:15:20
- d) 65:20:15

35. Which out of the following is true for LG shots of 12 bore shotgun cartridge?

- a) 9.14mm (6 shots)
- b) 9.04 mm (8 shots)
- c) 9.14 mm (8 shots)
- d) 9.04 mm (6 shots)

36. Front curved part of a bullet is termed as

- a) Obturation
- b) Ogive
- c) Bullet cone
- d) Wad

37. Ballistite is a propellant which can be categorized into

- a) Single base
- b) Double base
- c) Triple base
- d) Black powder

38. Arrange the following in sequential order and choose the correct option

- i. Overshot wad
- ii. Base wad
- iii. Propellant powder
- iv. Air cushion wad

- a) i, iv, iii, ii
- b) i, iii, iv, ii
- c) i, ii, iv, iii
- d) i, iii, ii, iv

39. If,  $m$ = ballistics coefficient,  $n$ =mass of projectile,  $o$ =diameter of projectile and  $p$ =form factor, then which of the following is true?

- a)  $m=n/o^2p$
- b)  $n=m/ o^2p$
- c)  $p=m/ o^2n$
- d)  $p=n/ o^2m$

40. Which of the following is not a method of collection of GSR from hands of shooter?

- a) Nitric acid swab
- b) Acetic acid swab
- c)  $H_2O_2$  swab
- d) Molten wax

41. Harrison and Gilroy test is used to determine the presence of which of the following element?

- i. Lead
- ii. Barium
- iii. Copper
- iv. Antimony
- v. Mercury

Choose the correct option

- a) ii, iii and v only
- b) i, ii and iv only
- c) iii, iv and v only
- d) i, ii, iii and iv

42. Rifling is incorporated in a barrel of firearm

- a) To increase range and accuracy
- b) To decrease range and accuracy
- c) To increase range and decrease accuracy
- d) To decrease range and increase accuracy

43. Which of the following is a class characteristic of a fired bullet?
- i. Land marks
  - ii. Groove marks
  - iii. Calibre
  - iv. Twist of rifling
- Choose the correct option
- a) iii and iv only
  - b) i and ii only
  - c) ii and iii only
  - d) i and iv only
44. Which of the following is used in the priming composition?
- a) Lead nitrate
  - b) Mercury azide
  - c) lead azide
  - d) mercury nitrate
45. The angle between the direction of propagation of projectile and the axis of projectile is known as:
- a) Nutation
  - b) Percussion
  - c) Yaw
  - d) Precession
46. Which of the following is true for Berdan type of primer?
- a) Anvil is part of primer cup
  - b) Anvil is part of cartridge case
  - c) Does not contain anvil
  - d) Anvil is part of base wad
47. High ISO number is used in photography for which of the following condition?
- a) To achieve shallow depth of field
  - b) To achieve motion blur
  - c) To freeze the motion
  - d) To increase the exposure
48. Signatures on old cheques, deeds and old application forms are example of which of the following?
- a) Admitted signature
  - b) Requested signature
  - c) Holographic signature
  - d) Irrelevant signature
49. Which of the following is best suitable for restoration of indented writings?
- a) ESDA
  - b) Comparison microscope
  - c) Stereo zoom microscope
  - d) AAS

50. Which is most appropriate for stabilizing charred documents?
- a) Acetone
  - b) Canada balsam adhesive
  - c) Poly Vinyl acetate
  - d) Fevicol
51. Which of the following is an example of Soft nose bullet cartridge?
- a) 8 mm/.315"
  - b) 9 mm/0.38"
  - c) 7.65 mm/0.32"
  - d) 12 Bore
52. Which of the following reagent is used for detection of Barium?
- a) Rubeanic Acid
  - b) Sodium Rhodizonate
  - c) Sulphanilic Acid
  - d) Alpha Naphthylamine
53. Bullet of AK 47 is categorized under
- a) Incendiary Bullet
  - b) Rifled slug
  - c) Spitzer bullet
  - d) Streamline bullet
54. In whose presence seizure of physical evidences should be done by the Investigation officer?
- a) At least two independent witness
  - b) At least two dependent witness
  - c) At most two independent witness
  - d) At most two dependent witness
55. Sawn-off shotgun refers to which of the following?
- a) Shotgun having single barrel
  - b) Shotgun having double barrel
  - c) Shotgun having shorter barrel than regular
  - d) Shotgun having larger barrel than regular
56. Which of the following is NOT a part of walker test?
- a) Alpha Naphthylamine
  - b) Sulphanilic acid
  - c) Glacial acetic acid
  - d) Rubeanic acid

57. As per which section of law, report by officers of mint is considered as evidence in the Indian court of law?

- a) Section 291, CrPC
- b) Section 292, CrPC
- c) Section 291, IPC
- d) Section 292, IPC

58. Examination-in- chief is defined under which section of Indian law?

- a) Section 137, CrPC
- b) Section 138, CrPC
- c) Section 137, IEA
- d) Section 138, IEA

59. Section 293 of CrPC does not apply on which of the following government scientific expert?

- a) Assistant Professor, National Forensic Sciences University
- b) Director, Haffkine Institute, Mumbai
- c) Director, Central Forensic Science Laboratory
- d) Director, Central Bureau of Investigation

60. Match List I with List II and select the correct option

| List-I (Exhibit) |          | List-II (Analytical Division of FSL) |           |
|------------------|----------|--------------------------------------|-----------|
| i.               | Glass    | m                                    | Ballistic |
| ii.              | Hair     | n                                    | Biology   |
| iii.             | MDMA     | o                                    | Narcotics |
| iv.              | Revolver | p                                    | Physics   |

- a) i- p, ii-n, iii-o, iv- m
- b) i-m, ii-n, iii-o, iv-p
- c) i-p, ii-o, iii-n, iv-m
- d) i-p, ii-o, iii-m, iv-n

61. What would be the sequence of firing in chronological order?

- i. formation of firing pin mark
- ii. pulling of trigger
- iii. expansion of propellant gases
- iv. projection of bullet
- v. falling of hammer

Choose the correct option

- a) i-ii-iii-iv-v
- b) ii-v-i-iii-iv
- c) ii-v-iv-i-iii
- d) i-ii-v-iii-iv



62. VSC is an instrument used for examination of

- a) Tool marks
- b) Foot prints
- c) Questioned documents
- d) Firearms

63. What does the term IBIS stand for?

- a) Integrated ballistics Identification system
- b) Integrated blood identification system
- c) Interoperable blood Identification system
- d) Interoperable ballistics identification system

64. Principle of exchange was given by

- a) Lombroso
- b) Locard
- c) Landsteiner
- d) Goddard

65. Which among the following occurs first, in terms of trial in court?

- a) Charge formation
- b) Cross examination
- c) Examination-in-chief
- d) Re-examination

66. Iron gallotinate ink is also known as

- a) Blue ink
- b) Red Ink
- c) Gel Ink
- d) Black Ink

67. SLR in camera stands for

- a) Single lens Recorder
- b) Short lens recorder
- c) Single lens reflex
- d) Short lens reflex

68. Opinion of digital signature certificate issuing authority is considered as a relevant fact as per which section of the Indian Law?

- a) Section 47, IEA
- b) Section 47a , IEA
- c) Section 45, IEA
- d) Section 45a, IEA

69. Which of the following aperture setting will give higher exposure considering ISO and shutter speed constant in manual mode in SLR camera?

- a) f/22
- b) f/11
- c) f/2.8
- d) f/1.4

70. Punishment for criminal conspiracy is dealt in

- a) Section 120 IPC
- b) Section 120A IPC
- c) Section 120B IPC
- d) Section 120C IPC

71. Which section of Indian law deals with the punishment for counterfeiting of currency notes?

- a) Section 489D IPC
- b) Section 473 IPC
- c) Section 489A IPC
- d) Section 477A IPC

72. Bertillonage is associated with which of the following?

- a) Somatoscopy
- b) Photogrammetry
- c) Anthropometry
- d) Dactyloscopy

73. Cordite is which type of propellant?

- a) Single base smokeless
- b) Double base smokeless
- c) Triple base smokeless
- d) Semi smokeless

74. Police inquest is conducted under which of the following section of Indian law?

- a) 174 CrPC
- b) 176 CrPC
- c) 174 IPC
- d) 176 IPC

75. Which of the following is true for proof cartridges?

- a) It produces 10% more pressure
- b) It produces 25% more pressure
- c) It produces 15% more pressure
- d) It produces 20% more pressure

76. Derringers are firearms which possess

- a) Multiple magazines
- b) Choked barrel
- c) Shortened barrel
- d) Multiple barrel

77. Which of the following place does NOT have a Central Detective Training School?

- a) Kolkata
- b) Hyderabad
- c) Bhopal
- d) Chandigarh

78. Document is defined in which section of IPC?

- a) 29
- b) 29A
- c) 30
- d) 30A

79. Cheating is defined in which section of IPC?

- a) 410
- b) 412
- c) 412A
- d) 415

80. In the following question, different alphabets stand for various symbols as indicated below:

|             |                |                   |             |
|-------------|----------------|-------------------|-------------|
| Addition: P | Subtraction: Q | Multiplication: R | Division: S |
| Equal to: T | Less than: U   | Greater than: Z   |             |

Out of the four alternatives given below, which one is correct according to the above letter symbols?

- a) 10R2U2S2R10S2
- b) 3P2T2S1R3Q1
- c) 2Z1R2S1P1R1
- d) 16Z8R3P1R2Q2

81. A number when subtracted by  $\frac{1}{7}$  of itself gives the same value as the sum of all the angles of a triangle. What is the number?

- a) 224
- b) 210
- c) 140
- d) 350

82. In a certain code ENGLISH is written as FMHKJRI. How is OCTOBER written in that code?

- a) PBUNCDS
- b) PBUCNSD
- c) BPUNCSD
- d) PBUCNDS

83. There is a family of 6 persons A, B, C, D, E and F. There are two married couples in the family. The family members are lawyer, teacher, salesman, engineer, accountant and doctor. D, the salesman is married to the lady teacher. The doctor is married to the lawyer. F, the accountant is the son of B and brother of E. C, the lawyer is the daughter-in-law of A. E is the unmarried engineer. A is the grandmother of F. How is E related to F?
- Brother
  - Sister
  - Cannot be established
  - None of these
84. A and B together can do a piece of work in 12 days and B and C finish the same work together in 16 days. After A has worked on it for 5 days and B for 7 days, C finishes it in 13 days. In how many days will C alone be able to finish the work?
- 16
  - 24
  - 36
  - 48
85. Find value of x, y and z in the given series and then establish relation among them.
- 102, 107, 117, 134, (x);
  - 130, 115, 135, 110, (y);
  - (z), 80, 120, 300, 1050;
- $x > y = z$
  - $y < x = z$
  - $x = y = z$
  - $y > x > z$
86. A vessel contains 400 liters of acid A and 80 liters of acid B. If \_\_\_\_\_ liters of mixture is taken out from the vessel and \_\_\_\_\_ liters of acid B are added to the remaining mixture, then the final amount of acid A in the vessel becomes 250 liters more than the amount of acid B in it.
- Which of the following integral values given in the options are possible in the blanks in same order?
- (72, 22)
  - (60, 30)
  - (84, 24)
  - (48, 38)
  - (36, 48)
- 2 & 4 only
  - 1 & 5 only
  - 2, 4 & 5 only
  - 1, 2 & 4 only

87. Consider two Statements and a Question:

Statement-1: The last day of the month is Thursday

Statement-2: The third Saturday of the month was the eighteenth day

Question: What day is the fourteenth day of the given month?

Which one of the following is correct in respect of the Statements and the Question?

- a) Statement-1 alone is sufficient to answer the Question
- b) Statement-2 alone is sufficient to answer the Question
- c) Both Statement-1 and Statement-2 are required to answer the Question
- d) Neither Statement-1 alone nor Statement-2 alone is sufficient to answer the Question

88. What is the probability of getting a sum of less than 11 after throwing a dice twice?

- a)  $\frac{3}{12}$
- b)  $\frac{25}{36}$
- c)  $\frac{11}{18}$
- d)  $\frac{33}{36}$

89. The percentage profit earned by selling a table for Rs. 11520 is equal to the percentage loss incurred by selling the same table for Rs. 7680. At what price should the article be sold to make 40% profit?

- a) Rs. 11520
- b) Rs. 12800
- c) Rs. 13440
- d) Rs. 10800

90. Recently, scientists observed the merger of two 'black holes' billions of light years away from the Earth. What is the significance of these observations?

- a) Existence of 'black holes' was confirmed
- b) Higgs Bosons particles were detected
- c) 'Gravitational Waves' were detected
- d) Einstein's Special Theory of Relativity was proved

91. Why do Step index Single mode fibers are used in long distance communication? Select the correct answer(s).

- 1. Low signal loss in single mode fiber
  - 2. No modal dispersion in single mode fiber
  - 3. Single mode fiber has high modal dispersion
  - 4. Refractive index of single mode fiber gradually changes, this will help in long distance communication.
- a) 1 and 3 only
  - b) 1 and 2 only
  - c) 2 and 4 only
  - d) 3 and 4 only

92. The energy band gap of a semiconductor

- a) Increases with increase in T
- b) Decreases with increase in T
- c) Does not vary with change in T
- d) Changes as a function of T & H

93. Which act led to the Jallianwala Bagh incident?

- a) Defence of India Act
- b) Rowlatt Act
- c) Government of India Act
- d) Official secrets Act

94. Who among the following is the famous architect of pre-independence Punjab who prepared the architectural design of Khalsa College?

- a) John Lockwood Kipling
- b) Bhai Ram Singh
- c) Sir Ganga Ram
- d) Bhai Jodh Singh

95. Match the following collections with its poets

**List I**

- 1. Mohan Singh
- 2. Surjit Patar
- 3. Shiv Batalavi
- 4. Amrita Pritam

**Code**

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

**List II**

- i. *Hawa Vich Likhe Harf*
- ii. *Lajwanti*
- iii. *Saave Pattar*
- iv *Amrit Lehran*

96. Which of the following is the first multi-wavelength satellite to detect extreme ultraviolet light emanating from a galaxy 9.3 billion light years from Earth?

- a) SCATSAT-1
- b) INSAT-3DR
- c) CARTOSAT-2
- d) ASTROSAT

97. The term "golden rice" refers to rice varieties that have been genetically modified to address which of the following vitamin deficiencies?

- a) Vitamin D
- b) Vitamin A
- c) Vitamin K
- d) Vitamin B

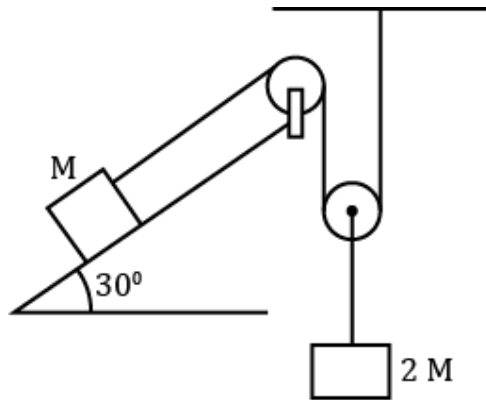
98. Provisions of single citizenship in Indian Constitution are borrowed from which of the following constitution?

- a) US Constitution
- b) British Constitution
- c) Canadian Constitution
- d) Weimar Constitution of Germany

99. Which Indian documentary short has won an Oscar at the 95th Academy Awards?

- a) The Elephant Whisperers
- b) The House That Ananda Built
- c) An Encounter With Faces
- d) RRR

100. Find the acceleration of the block of mass  $M$  in the situation shown in the figure. All the surfaces are frictionless and the pulley and the string are light.



- a)  $g$
- b)  $\frac{g}{2}$
- c)  $\frac{g}{3}$
- d)  $\frac{g}{5}$

101. A pendulum bob has a speed of  $3 \text{ m/s}$  at its lowest position. The pendulum is  $0.5 \text{ m}$  long. Then the speed of the pendulum bob, when it makes an angle of  $60^\circ$  with the vertical is: (Take  $g=10 \text{ m/s}^2$ )

- a)  $1 \text{ m/s}$
- b)  $2 \text{ m/s}$
- c)  $3 \text{ m/s}$
- d)  $4 \text{ m/s}$

102. A force  $F = (0.5x + 10)$  acts on a particle in the  $x$  direction, where  $F$  is in Newton and  $x$  is in meter. The work done by the force during the displacement of the particle from  $x = 0$  to  $x = 2$  meter is
- a) 9J
  - b) 15J
  - c) 21J
  - d) 36J
103. The image formed by an objective of a compound microscope is
- a) virtual and diminished
  - b) real and diminished
  - c) real and enlarged
  - d) virtual and enlarged
104. What is the limit of resolution of a telescope objective having a diameter of 200 cm, if it has to detect light of wavelength 500 nm coming from a distant star?
- a)  $152.5 \times 10^{-9}$  radian
  - b)  $305 \times 10^{-9}$  radian
  - c)  $510 \times 10^{-9}$  radian
  - d)  $610.5 \times 10^{-9}$  radian
105. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then focal length of the lens
- a) becomes zero
  - b) becomes infinite
  - c) remains unchanged
  - d) becomes small but non zero
106. When an inverter is placed between both inputs of an S–R flipflop, it becomes
- a) J–K flip-flop
  - b) D flip-flop
  - c) T flip-flop
  - d) Master slave flip-flop
107. Which of the following is D to A conversion technique?
- a) Successive approximation
  - b) Weighted resistor technique
  - c) Dual slope technique
  - d) Single slope technique



108. Consider two objects A and B, each of mass 1 kg. A is dropped from rest from the roof of a tall building, while B is projected horizontally with an initial velocity 10 m/s from the same roof. It is found that A reaches the ground after 3 seconds. Neglecting air resistance and assuming no obstructions, after how much time will B hit the ground?
- a) Less than 3 s
  - b) 3 s
  - c) More than 3 s but less than 4.5 s
  - d) 4.5 s or more
109. A billiard ball hits a rigid wall at an angle of  $45^\circ$  to the normal and is reflected at  $45^\circ$  on the other side of the normal without any change in speed. The direction of the force exerted by the ball on the wall is
- a) Along the initial direction of motion of the ball
  - b) Along the final direction of motion of the ball
  - c) Along the normal
  - d) Tangent to the wall
110. A bullet of mass 20 g is fired by a gun of mass 7.5 kg. If the muzzle speed of the bullet is 180 m/s, the recoil speed of the gun is
- a) 0.60 m/s
  - b) 0.48 m/s
  - c) 0.36 m/s
  - d) 0.24 m/s
111. A block of mass 5 kg rests on a wooden board which is initially placed horizontally on the floor. One end of the board is now slowly raised, keeping the other end fixed on the ground. When the board is at an angle of 30 degrees to the horizontal, the block *just* begins to slide. The coefficient of static friction between the block and the board is
- a) 0.50
  - b) 0.58
  - c) 0.73
  - d) 0.97
112. The driver of a fast-moving car applied emergency brakes, as a result of which the car skidded (underwent sliding motion) for 200 m before coming to a stop. Assuming that the car decelerated uniformly, and given that the coefficient of kinetic friction is 0.60, how fast was the car going (in km per hour) when the brakes were applied (approx.)?
- a) 292
  - b) 212
  - c) 175
  - d) 136

113. Which of the following statements is *not* true for a plane electromagnetic wave in vacuum?
- a) The electric and magnetic vectors oscillate in perpendicular planes
  - b) If the strength of the electric field is given, the strength of the magnetic field is known
  - c) The propagation direction is at right angles to both electric and magnetic fields
  - d) The energy transported by the wave falls off as the square of the distance
114. Microwave ovens use electromagnetic radiation for warming food. A typical wavelength used is around
- a) 1.2 mm
  - b) 12 mm
  - c) 1.2 cm
  - d) 12 cm
115. To examine powder burns in a gunshot wound, the most useful technique is likely to be
- a) X-ray imaging
  - b) UV photography
  - c) Visible light photography
  - d) IR photography
116. To obtain a photograph of a fingerprint on a drinking glass, the most useful lighting technique is likely to be
- a) Direct reflective lighting
  - b) 45 degree lighting
  - c) Transmission lighting
  - d) Small spot lights
117. A ray of light is incident on a slab of transparent material at an angle of 60 degrees. The refracted ray inside the slab makes an angle of 30 degrees to the normal. The refractive index of the slab's material is
- a) 1.33
  - b) 1.60
  - c) 1.73
  - d) 1.86
118. A mirage is formed by total internal reflection when
- a) The optical density of air near the ground increases with height and there are strong air currents
  - b) The optical density of air near the ground increases with height and there are no strong air currents
  - c) The optical density of air near the ground decreases with height and there are strong air currents
  - d) The optical density of air near the ground decreases with height and there are no strong air currents

119. Light from a point source in air falls on a convex spherical glass surface of radius of curvature 20 cm and refractive index 1.5. If the distance of the light source from the glass surface is 100 cm, the image is located at
- a) 43 cm from the surface, in the direction of incident light
  - b) 43 cm from the surface, opposite to the direction of incident light
  - c) 100 cm from the surface, in the direction of incident light
  - d) 100 cm from the surface, opposite to the direction of incident light
120. A thin convex lens has a focal length of 20 cm. When it is placed in contact with another lens, the combination focuses parallel rays at a distance 5 cm from the second lens. The second lens is
- a) Convex and of focal length 6.67 cm
  - b) Convex and of focal length 5.00 cm
  - c) Concave and of focal length -6.67 cm
  - d) Concave and of focal length -5.00 cm

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**SPACE FOR ROUGH WORK**