WARNING : Any malpractice or any attempt to commit any kind of malpractice in the Examination will DISQUALIFY THE CANDIDATE.			
PAPER – I PHYSICS & CHEMISTRY – 2014			
Version Code	A2	Question Booklet Serial Number :	6236219
Time : 150 Minutes		Number of Questions : 120	Maximum Marks : 480
Name of Candidate			
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INSTRUCTIONS TO THE CANDIDATE

1. Please ensure that the **VERSION CODE shown at the top of this Question Booklet is the same as that shown in the OMR Answer Sheet issued to you.** If you have received a Question Booklet with a different **VERSION CODE**, please get it replaced with a Question Booklet with the same VERSION CODE as that of the OMR Answer Sheet from the invigilator. **THIS IS VERY IMPORTANT.**
2. Please fill in the items such as name, signature and roll number of the candidate in the columns given above. Please also write the Question Booklet Sl. No. given at the top of this page against item 5 in the OMR Answer Sheet.
3. Please read the instructions given in the OMR Answer Sheet for marking answers. Candidates are advised to strictly follow the instructions contained in the OMR Answer Sheet.
4. This Question Booklet contains 120 questions. For each question, five answers are suggested and given against (A), (B), (C), (D) and (E) of which, only one will be the **Most Appropriate Answer**. Mark the bubble containing the letter corresponding to the 'Most Appropriate Answer' in the OMR Answer Sheet, by using either **Blue or Black ball-point pen only.**
5. Negative Marking: In order to discourage wild guessing, the score will be subject to penalization formula based on the number of right answers actually marked and the number of wrong answers marked. Each correct answer will be awarded FOUR marks. One mark will be deducted for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.

IMMEDIATELY AFTER OPENING THIS QUESTION BOOKLET, THE CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET ISSUED CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT.

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PLEASE ENSURE THAT THIS BOOKLET CONTAINS 120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120.
(Printed Pages : 32)

If a body of mass m has to be taken from the surface of earth to a height $h = R$, then the amount of energy required is (R: radius of earth)

(A) mgR (B) $\frac{mgR}{3}$ (C) $\frac{mgR}{2}$

(D) $\frac{mgR}{12}$ (E) $\frac{mgR}{9}$

The total energy of an artificial satellite of mass m revolving in a circular orbit around the earth with a speed v is

(A) $\frac{1}{2}mv^2$ (B) $\frac{1}{4}mv^2$ (C) $-\frac{1}{4}mv^2$

(D) $-mv^2$ (E) $-\frac{1}{2}mv^2$

Two soap bubbles each with radius r_1 and r_2 coalesce in vacuum under isothermal conditions to form a bigger bubble of radius R. Then R is equal to

(A) $\sqrt{r_1^2+r_2^2}$ (B) $\sqrt{r_1^2-r_2^2}$ (C) r_1+r_2

(D) $\frac{\sqrt{r_1^2+r_2^2}}{2}$ (E) $2\sqrt{r_1^2+r_2^2}$

The ratio of hydraulic stress to the corresponding strain is known as

(A) Compressibility (B) Bulk modulus

(C) Young's modulus (D) Rigidity modulus

(E) Expansion coefficient

Space for rough work

5. A boy can reduce the pressure in his lungs to 750 mm of mercury. Using a straw he can drink water from a glass upto the maximum depth of (atmospheric pressure = 760 mm of mercury; density of mercury = 13.6 gcm^{-3})

(A) 13.6 cm (B) 9.8 cm (C) 10 cm

(D) 76 cm (E) 1.36 cm

6. A spring stores 1 J of energy for a compression of 1 mm. The additional work to be done to compress it further by 1 mm is

(A) 1 J (B) 2 J (C) 3 J (D) 4 J (E) 0.5 J

7. If m represents the mass of each molecule of a gas and T, its absolute temperature, then the root mean square velocity of the gaseous molecule is proportional to

(A) $m\,T$ (B) $m^{1/2}\,T^{1/2}$ (C) $m^{-1/2}\,T$

(D) $m^{-1/2}\,T^{1/2}$ (E) $m\,T^{-1/2}$

8. A Carnot engine operating between temperatures T_1 and T_2 has efficiency 0.2. When T_2 is reduced by 50 K, its efficiency increases to 0.4. Then T_1 and T_2 are respectively

(A) 200 K, 150 K (B) 250 K, 200 K (C) 300 K, 250 K

(D) 300 K, 200 K (E) 300 K, 150 K

9. A molecule of a gas has six degrees of freedom. Then the molar specific heat of the gas at constant volume is

(A) $\frac{R}{2}$ (B) R (C) $\frac{3R}{2}$ (D) 2 R (E) 3 R

Space for rough work

Total number of degrees of freedom of a rigid diatomic molecule is

(A) 3 (B) 6 (C) 5 (D) 2 (E) 7

If the differential equation for a simple harmonic motion is $\frac{d^2y}{dt^2}+2y=0$, the time-period of the motion is

(A) $\pi\sqrt{2}$ s (B) $\frac{\sqrt{2}}{\pi}$ s (C) $\frac{\pi}{\sqrt{2}}$ s (D) 2π s (E) $\frac{\sqrt{\pi}}{2}$ s

Identify the wrong statement from the following

(A) If the length of a spring is halved, the time period of each part becomes $\frac{1}{\sqrt{2}}$ times the original

(B) The effective spring constant K of springs in parallel is given by $\frac{1}{K}=\frac{1}{K_1}+\frac{1}{K_2}+\ldots\ldots$

(C) The time period of a stiffer spring is less than that of a soft spring

(D) The spring constant is inversely proportional to the spring length

(E) The unit of spring constant is Nm^{-1}

The total energy of the particle executing simple harmonic motion of amplitude A is 100 J. At a distance of 0.707 A from the mean position, its kinetic energy is

(A) 25 J (B) 50 J (C) 100 J (D) 12.5 J (E) 70 J

Space for rough work

14. Two travelling waves, $y_1 = A \sin [k(x + ct)]$ and $y_2 = A \sin [k(x - ct)]$ are superposed on a string. The distance between adjacent antinodes is

(A) $\frac{ct}{\pi}$ (B) $\frac{ct}{2\pi}$ (C) $\frac{\pi}{2k}$

(D) $\frac{k}{\pi}$ (E) $\frac{\pi}{k}$

15. If a stretched wire is vibrating in the second overtone, then the number of nodes and antinodes between the ends of the string are respectively

(A) 2 and 2 (B) 1 and 2 (C) 4 and 3

(D) 2 and 3 (E) 3 and 4

16. Pick out the correct statement in the following with reference to stationary wave pattern

(A) In a tube closed at one end, all the harmonics are present

(B) In a tube open at one end, only even harmonics are present

(C) The distance between successive nodes is equal to the wavelength

(D) In a stretched string, the first overtone is the same as the second harmonic

(E) Reflection of a wave from a rigid wall changes the phase by 45^0

17. A plane square sheet of charge of side 0.5 m has uniform surface charge density. An electron at 1 cm from the centre of the sheet experiences a force of 1.6×10^{-12} N directed away from the sheet. The total charge on the plane square sheet is

($\epsilon_0 = 8.854 \times 10^{-12} C^2 m^{-2} N^{-1}$)

(A) 16.25 μC (B) – 22.15 μC (C) – 44.27 μC

(D) 144.27 μC (E) 8.854 μC

Space for rough work

. The energy stored in a capacitor of capacitance C having a charge Q under a potential V is

(A) $\frac{1}{2}Q^2V$ (B) $\frac{1}{2}C^2V$ (C) $\frac{1}{2}\frac{Q^2}{V}$ (D) $\frac{1}{2}QV$ (E) $\frac{1}{2}CV$

. The electrostatic force between two point charges is directly proportional to the

(A) sum of the charges

(B) distance between the charges

(C) permittivity of the medium

(D) square of the distance between the charges

(E) product of the charges

The time period of revolution of a charge q_1 and of mass m moving in a circular path of radius r due to Coulomb force of attraction with another charge q_2 at its centre is

(A) $\sqrt{\frac{16\pi\varepsilon_0 mr^3}{q_1 q_2}}$ (B) $\sqrt{\frac{8\pi^2\varepsilon_0 mr^3}{q_1 q_2}}$ (C) $\sqrt{\frac{\varepsilon_0 mr^3}{16 q_1 q_2}}$

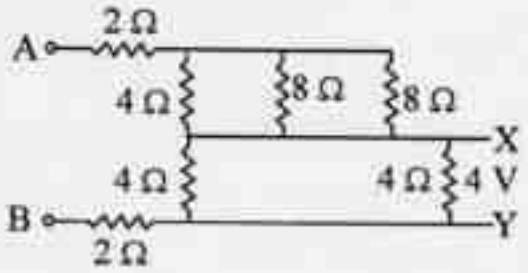
(D) $\sqrt{\frac{16\pi^3\varepsilon_0 mr^3}{q_1 q_2}}$ (E) $\sqrt{\frac{\pi^2\varepsilon_0 mr^3}{8 q_1 q_2}}$

A point charge of 2 C experiences a constant force of 1000 N when moved between two points separated by a distance of 2 cm in a uniform electric field. The potential difference between the two points is

(A) 12 V (B) 8 V (C) 10 V (D) 16 V (E) 5 V

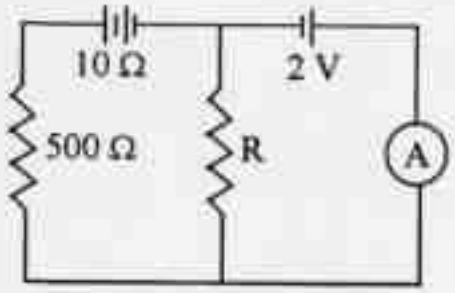
Space for rough work

22. In the network shown below, if potential across XY is 4 V, then the input potential across AB is



(A) 16 V (B) 20 V (C) 8 V (D) 12 V (E) 24 V

13. If the ammeter A shows a zero reading in the circuit shown below, the value of resistance R is



(A) 500 Ω (B) 125 Ω (C) 100 Ω (D) 41.5 Ω (E) 4 Ω

Space for rough work

4. Five cells each of emf E and internal resistance r send the same amount of current through an external resistance R whether the cells are connected in parallel or in series. Then the ratio $\left(\frac{R}{r}\right)$ is

(A) 2 (B) $\frac{1}{2}$ (C) $\frac{1}{5}$ (D) 1 (E) 5

5. The power dissipated in the transmission cables carrying current I and voltage V is inversely proportional to

(A) V (B) V^2 (C) $\sqrt{V}$ (D) $\sqrt{I}$ (E) I

6. A rigid container with thermally insulated walls contains a gas and a coil of resistance 50 Ω, carrying a current of 1 A. The change in internal energy of the gas after 2 minutes will be

(A) 6 kJ (B) 10 kJ (C) 3 kJ (D) 12 kJ (E) 1.5 kJ

7. The magnitude of the magnetic field inside a long solenoid is increased by

(A) decreasing its radius

(B) decreasing the current through it

(C) increasing its area of cross-section

(D) introducing a medium of higher permeability

(E) decreasing the number of turns in it

Space for rough work

28. A bar magnet of moment of inertia 9×10^{-5} kg m^2 placed in a vibration magnetometer and oscillating in a uniform magnetic field $16\pi^2 \times 10^{-5}$ T makes 20 oscillations in 15 s. The magnetic moment of the bar magnet is

(A) 3 Am^2 (B) 2 Am^2 (C) 5 Am^2
(D) 6 Am^2 (E) 4 Am^2

29. Identify the correctly matched pair

Material		Example
(A) Diamagnetic	-	Gadolinium
(B) Soft ferromagnetic	-	Alnico
(C) Hard ferromagnetic	-	Copper
(D) Paramagnetic	-	Sodium
(E) Permanent magnet	-	Aluminum

30. If the radius of the dees of cyclotron is r, then the kinetic energy of a proton of mass m accelerated by the cyclotron at an oscillating frequency v is

(A) $4\pi^2m^2v^2r^2$ (B) $4\pi^2mv^2r^2$ (C) $2\pi^2mv^2r^2$
(D) $\pi^2mv^2r^2$ (E) $\pi^2m^2v^2r^2$

31. If a magnetic dipole of moment M situated in the direction of a magnetic field B is rotated by 180°, then the amount of work done is

(A) MB (B) 2 MB (C) $\frac{MB}{\sqrt{2}}$ (D) 0 (E) $\sqrt{MB}$

Space for rough work

The polarity of induced emf is given by

(A) Ampere's circuital law

(B) Biot-Savart law

(C) Lenz' law

(D) Fleming's right hand rule

(E) Fleming's left hand rule

In an LCR series circuit, at resonance

(A) the current and voltage are in phase

(B) the impedance is maximum

(C) the current is minimum

(D) the quality factor is independent of R

(E) the current leads the voltage by $\frac{\pi}{2}$

A conducting ring of radius 1 m kept in a uniform magnetic field B of 0.01 T, rotates uniformly with an angular velocity 100 rad s^{-1} with its axis of rotation perpendicular to B. The maximum induced emf in it is

(A) 1.5πV (B) πV (C) 2πV (D) 0.5πV (E) 4πV

A step down transformer increases the input current 4 A to 24 A at the secondary. If the number of turns in the primary coil is 330, the number of turns in the secondary coil is

(A) 60 (B) 50 (C) 65 (D) 45 (E) 55

Space for rough work

36. In a plane electromagnetic wave, the electric field of amplitude 1 V m^{-1} varies with time in free space. The average energy density of magnetic field is (in Jm^{-2})

(A) 8.86×10^{-12} (B) 4.43×10^{-12} (C) 17.72×10^{-12}

(D) 2.21×10^{-12} (E) 1.11×10^{-12}

37. Which one of the following is the property of a monochromatic, plane electromagnetic wave in free space?

(A) Electric and magnetic fields have a phase difference of $\pi/2$

(B) The energy contribution of both electric and magnetic fields are equal

(C) The direction of propagation is in the direction of electric filed E

(D) The pressure exerted by the wave is the product of energy density and the speed of the wave

(E) The speed of the wave is B/E

38. The apparent flattening of the sun at sunset and sunrise is due to

(A) refraction

(B) diffraction

(C) total internal reflection

(D) interference

(E) polarization

39. The polarising angle for a medium is found to be 60°. The critical angle of the medium is

(A) $\sin^{-1}\left(\frac{1}{2}\right)$ (B) $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (C) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (D) $\sin^{-1}\left(\frac{1}{4}\right)$ (E) $\sin^{-1}\left(\frac{2}{\sqrt{3}}\right)$

Space for rough work

. Identify the mismatch in the following

(A) Myopia - Concave lens

(B) For rear view - Concave mirror

(C) Hypermetropia - Convex lens

(D) Astigmatism - Cylindrical lens

(E) Reflecting telescope - Convex mirror

. In Young's double slit experiment, to increase the fringe width

(A) the wavelength of the source is increased

(B) the source is moved towards the slit

(C) the source is moved away from the slit

(D) the slit separation is increased

(E) the screen is moved towards the slit

. Light of wavelength 5000 Å is incident normally on a slit of width 2.5×10^{-4} cm. The angular position of second minimum from the central maximum is

(A) $\sin^{-1}\left(\frac{1}{5}\right)$ (B) $\sin^{-1}\left(\frac{2}{5}\right)$ (C) $\left(\frac{\pi}{3}\right)$

(D) $\left(\frac{\pi}{6}\right)$ (E) $\left(\frac{\pi}{4}\right)$

Space for rough work

13. An electron of mass m_e and a proton of mass m_p are accelerated through the same potential. Then the ratio of their de Broglie wavelengths is

(A) 1 (B) $\sqrt{\frac{m_e}{m_p}}$ (C) $\frac{m_e}{m_p}$

(D) $\frac{m_p}{m_e}$ (E) $\sqrt{\frac{m_p}{m_e}}$

4. The half-life of a radioactive substance is 20 minutes. The time taken between 50% decay and 87.5% decay of the substance will be

(A) 20 minutes (B) 30 minutes (C) 40 minutes

(D) 25 minutes (E) 10 minutes

5. The ratio of the surface area of the nuclei $_{52}Te^{125}$ to that of $_{13}Al^{27}$ is

(A) $\frac{5}{3}$ (B) $\frac{125}{17}$ (C) $\frac{1}{4}$

(D) $\frac{25}{9}$ (E) $\frac{3}{5}$

6. If the frequency of incident light falling on a photosensitive metal is doubled, the kinetic energy of the emitted photoelectron is

(A) unchanged

(B) halved

(C) doubled

(D) more than twice its initial value

(E) reduced to $\frac{1}{4}$ th

Space for rough work

7. The significant result deduced from the Rutherford's scattering experiment is that

(A) whole of the positive charge is concentrated at the centre of atom

(B) there are neutrons inside the nucleus

(C) α-particles are helium nuclei

(D) electrons are embedded in the atom

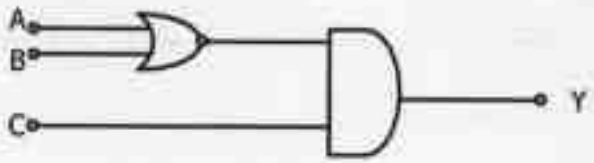
(E) electrons are revolving around the nucleus

8. On an average, the number of neutrons and the energy of a neutron released per fission of a uranium atom are respectively

(A) 2.5 and 2 keV (B) 3 and 1 keV (C) 2.5 and 2 MeV

(D) 2 and 2 keV (E) 1 and 2 MeV

9. The inputs A, B and C to be given in order to get an output Y = 1 from the following circuit are



(A) 0, 1, 0 (B) 1, 0, 0 (C) 1, 0, 1 (D) 1, 1, 0 (E) 0, 0, 1

10. The collector resistance and the input resistance of a CE amplifier are respectively 10 kΩ and 2 kΩ. If β of the transistor is 49, the voltage gain of the amplifier is

(A) 125 (B) 150 (C) 175 (D) 200 (E) 245

Space for rough work

51. The light emitting diode (LED) is

(A) a heavily doped p-n junction with no external bias

(B) a heavily doped p-n junction with reverse bias

(C) a heavily doped p-n junction with forward bias

(D) a lightly doped p-n junction with no external bias

(E) a lightly doped p-n junction with reverse bias

52. A point-to-point communication mode is seen in

(A) Satellite cable communication

(B) Television transmission

(C) FM radio transmission

(D) AM radio transmission

(E) Fax transmission

53. If the heights of transmitting and the receiving antennas are each equal to h, the maximum line-of-sight distance between them is (R is the radius of earth)

(A) $\sqrt{2Rh}$ (B) $\sqrt{4Rh}$ (C) $\sqrt{6Rh}$

(D) $\sqrt{8Rh}$ (E) $\sqrt{Rh}$

54. The ionospheric layer acts as a reflector for the frequency range

(A) 1 kHz to 10 kHz (B) 3 to 30 MHz (C) 3 to 30 kHz

(D) 100 kHz to 1 MHz (E) 3 GHz to 30 GHz

Space for rough work

In a simple pendulum experiment, the maximum percentage error in the measurement of length is 2% and that in the observation of the time-period is 3%. Then the maximum percentage error in determination of the acceleration due to gravity g is

(A) 5% (B) 6% (C) 7% (D) 8% (E) 10%

The pitch and the number of circular scale divisions in a screw gauge with least count 0.02 mm are respectively

(A) 1 mm and 100
(B) 0.5 mm and 50
(C) 1 mm and 50
(D) 0.5 mm and 100
(E) 1 mm and 200

A ball is dropped from the top of a tower of height 100 m and at the same time another ball is projected vertically upwards from ground with a velocity 25 ms^{-1}. Then the distance from the top of the tower, at which the two balls meet is

(A) 68.4 m (B) 48.4 m (C) 18.4 m
(D) 28.4 m (E) 78.4 m

The ratio of distances traversed in successive intervals of time when a body falls freely under gravity from certain height is

(A) 1 : 2 : 3 (B) 1 : 5 : 9 (C) 1 : 3 : 5
(D) $\sqrt{1} : \sqrt{2} : \sqrt{3}$ (E) 1 : 4 : 9

A particle starting with certain initial velocity and uniform acceleration covers a distance of 12 m in first 3 seconds and a distance of 30 m in next 3 seconds. The initial velocity of the particle is

(A) 3 ms^{-1} (B) 2.5 ms^{-1} (C) 2 ms^{-1}
(D) 1.5 ms^{-1} (E) 1 ms^{-1}

Space for rough work

60. A ball of mass 10 g moving perpendicular to the plane of the wall strikes it and rebounds in the same line with the same velocity. If the impulse experienced by the wall is 0.54 Ns, the velocity of the ball is

(A) $27\ ms^{-1}$ (B) $3.7\ ms^{-1}$ (C) $54\ ms^{-1}$

(D) $37\ ms^{-1}$ (E) $5.4\ ms^{-1}$

61. A particle has the position vector $\vec{r} = \hat{i} - 2\hat{j} + \hat{k}$ and the linear momentum $\vec{p} = 2\hat{i} - \hat{j} + \hat{k}$. Its angular momentum about the origin is

(A) $-\hat{i} + \hat{j} - 3\hat{k}$ (B) $-\hat{i} + \hat{j} + 3\hat{k}$ (C) $\hat{i} - \hat{j} + 3\hat{k}$

(D) $\hat{i} - \hat{j} - 5\hat{k}$ (E) $\hat{i} - \hat{j} + 5\hat{k}$

62. The vertical component of velocity of a projectile at its maximum height (u – velocity of projection, θ – angle of projection) is

(A) $u\sin\theta$ (B) $u\cos\theta$ (C) $\frac{u}{\sin\theta}$

(D) 0 (E) $\frac{u}{\cos\theta}$

63. The coordinates of a particle moving in x-y plane at any instant of time t are $x = 4t^2$; $y = 3t^2$. The speed of the particle at that instant is

(A) 10 t (B) 5 t (C) 3 t (D) 2 t (E) $\sqrt{13}$ t

64. A cyclist bends while taking turn in order to

(A) reduce friction

(B) provide required centripetal force

(C) reduce apparent weight

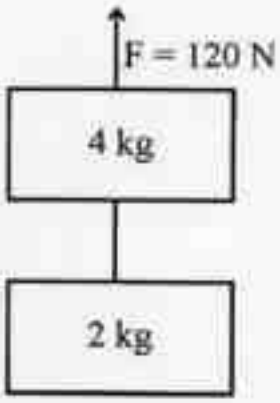
(D) reduce speed

(E) sit comfortably

Space for rough work

Two blocks of masses 2 kg and 4 kg are attached by an inextensible light string as shown in the figure. If a force of 120 N pulls the blocks vertically upward, the tension in the string is

(take $g = 10\ ms^{-2}$)



(A) 20 N (B) 15 N (C) 35 N (D) 40 N (E) 30 N

The total energy of a solid sphere of mass 300 g which rolls without slipping with a constant velocity of 5 ms^{-1} along a straight line is

(A) 5.25 J (B) 3.25 J (C) 0.25 J
(D) 1.25 J (E) 0.625 J

A bullet when fired into a target loses half of its velocity after penetrating 20 cm. Further distance of penetration before it comes to rest is

(A) 6.66 cm (B) 3.33 cm (C) 12.5 cm
(D) 10 cm (E) 5 cm

In elastic collision

(A) both momentum and kinetic energy are conserved
(B) neither momentum nor kinetic energy is conserved
(C) only momentum is conserved
(D) only kinetic energy is conserved
(E) forces involved in the interaction are non-conservative

Space for rough work

69. Two discs rotating about their respective axis of rotation with angular speeds 2 $rads^{-1}$ and 5 $rads^{-1}$ are brought into contact such that their axes of rotation coincide. Now, the angular speed of the system becomes 4 $rads^{-1}$. If the moment of inertia of the second disc is 1×10^{-3} kg m^2, then the moment of inertia of the first disc (in kg m^2) is

(A) 0.25×10^{-3} (B) 1.5×10^{-3} (C) 1.25×10^{-3}

(D) 0.75×10^{-3} (E) 0.5×10^{-3}

70. A wheel is rotating at 1800 rpm about its own axis. When the power is switched off, it comes to rest in 2 minutes. Then the angular retardation in rad s^{-1} is

(A) 2π (B) π (C) $\frac{\pi}{2}$ (D) $\frac{\pi}{4}$ (E) $\frac{\pi}{6}$

71. If the angular momentum of a particle of mass m rotating along a circular path of radius r with uniform speed is L, the centripetal force acting on the particle is

(A) $\frac{L^2}{mr^3}$ (B) $\frac{L^2}{mr}$ (C) $\frac{L}{mr^2}$

(D) $\frac{L^2 m}{r}$ (E) $\frac{Lm}{r^2}$

72. Pick out the wrong statement from the following

(A) The SI unit of universal gravitational constant is Nm^2kg^{-2}

(B) The gravitational force is a conservative force

(C) The force of attraction due to a hollow spherical shell of uniform density on a point mass inside it is zero

(D) The centripetal acceleration of the satellite is equal to acceleration due to gravity

(E) Gravitational potential energy = $\frac{\text{gravitation potential}}{\text{mass of the body}}$

Space for rough work

Q.No.	VERSION A2	Q.No.	VERSION A2	Q.No.	VERSION A2
1	C	31	B	61	B
2	E	32	C	62	D
3	A	33	A	63	A
4	B	34	B	64	B
5	A	35	E	65	D
6	C	36	D	66	A
7	D	37	B	67	A
8	B	38	A	68	A
9	E	39	C	69	E
10	C	40	B	70	C
11	A	41	A	71	A
12	B	42	B	72	E
13	B	43	E		
14	E	44	C		
15	D	45	D		
16	D	46	D		
17	C	47	A		
18	D	48	C		
19	E	49	E		
20	D	50	E		
21	C	51	C		
22	A	52	E		
23	B	53	D		
24	D	54	B		
25	B	55	D		
26	A	56	C		
27	D	57	E		
28	E	58	C		
29	D	59	E		
30	C	60	A		

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PAPER – I PHYSICS & CHEMISTRY-2015

Version Code	A1	Question Booklet Serial Number :	1138443

Time : 150 Minutes	Number of Questions : 120	Maximum Marks : 480
Name of Candidate		
Roll Number		
Signature of Candidate		

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4. **Negative Marking:** In order to discourage wild guessing, the score will be subjected to penalization formula based on the number of right answers actually marked and the number of wrong answers marked. Each correct answer will be awarded FOUR marks. ONE mark will be deducted for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.
5. Please read the instructions given in the OMR Answer Sheet for marking answers. Candidates are advised to strictly follow the instructions contained in the OMR Answer Sheet.

IMMEDIATELY AFTER OPENING THIS QUESTION BOOKLET, THE CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET ISSUED CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT.

DO NOT OPEN THE SEAL UNTIL THE INVIGILATOR ASKS YOU TO DO SO.

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PLEASE ENSURE THAT THIS QUESTION BOOKLET CONTAINS 120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120. PRINTED PAGES : 32

1. The physical quantity that does not have the dimensional formula $[ML^{-1}T^{-2}]$ is

   (A) force (B) pressure (C) stress
   (D) modulus of elasticity (E) energy density

2. A force F is applied onto a square plate of side L. If the percentage error in determining L is 2% and that in F is 4%, the permissible percentage error in determining the pressure is

   (A) 2% (B) 4% (C) 6% (D) 8% (E) 1%

3. From a balloon moving upwards with a velocity of 12 ms^{-1}, a packet is released when it is at a height of 65 m from the ground. The time taken by it to reach the ground is $(g = 10\ ms^{-2})$

   (A) 5 s (B) 8 s (C) 4 s (D) 7 s (E) 10 s

4. A bus is moving with a velocity of 10 ms^{-1} on a straight road. A scootorist wishes to overtake the bus in one minute. If the bus is at a distance of 1.2 km ahead, then the velocity with which he has to chase the bus is

   (A) 20 ms^{-1} (B) 25 ms^{-1} (C) 60 ms^{-1} (D) 40 ms^{-1} (E) 30 ms^{-1}

Space for rough work

5. If the displacement of a body varies as the square of elapsed time, then its

(A) velocity is constant
(B) velocity varies non-uniformly
(C) acceleration is constant
(D) acceleration changes continuously
(E) momentum is constant

6. The magnitudes of a set of 3 vectors are given below. The set of vectors for which the resultant cannot be zero is

(A) 15, 20, 30
(B) 20, 20, 30
(C) 25, 20, 35
(D) 10, 10, 20
(E) 10, 20, 40

7. A ball dropped from a point A falls down vertically to C, through the midpoint B. The descending time from A to B and that from A to C are in the ratio

(A) 1 : 1
(B) 1 : 2
(C) 1 : 3
(D) $1 : \sqrt{2}$
(E) $1 : \sqrt{3}$

8. A cricket ball is hit at an angle of 30° to the horizontal with a kinetic energy E. Its kinetic energy when it reaches the highest point is

(A) $\frac{E}{2}$
(B) 0
(C) $\frac{2E}{3}$
(D) $\frac{3E}{4}$
(E) E

Space for rough work

9. If n bullets each of mass m are fired with a velocity v per second from a machine gun, the force required to hold the gun in position is

(A) $(n+1)mv$ (B) $\frac{mv}{n^2}$ (C) $\frac{mv}{n}$ (D) n^2mv (E) mnv

10. The time required to stop a car of mass 800 kg, moving at a speed of 20 ms^{-1} over a distance of 25 m is

(A) 2 s (B) 2.5 s (C) 4 s (D) 4.5 s (E) 1 s

11. A car moves at a speed of 20 ms^{-1} on a banked track and describes an arc of a circle of radius $40\sqrt{3}$ m. The angle of banking is ($g = 10\ ms^{-2}$)

(A) 25° (B) 60° (C) 45° (D) 30° (E) 40°

12. When a body is projected vertically up from the ground with certain velocity, its potential energy and kinetic energy at a point A are in the ratio 2 : 3. If the same body is projected with double the previous velocity, then at the same point A the ratio of its potential energy to kinetic energy is

(A) 9 : 1 (B) 2 : 9 (C) 1 : 9 (D) 9 : 2 (E) 3 : 2

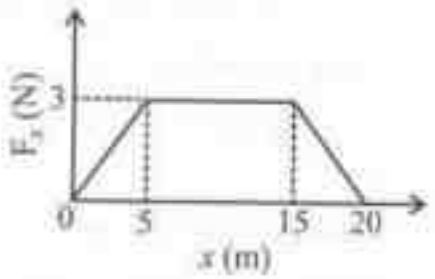
Space for rough work

13. A spring with force constant k is initially stretched by x_1. If it is further stretched by x_2, then the increase in its potential energy is

(A) $\frac{1}{2}k(x_2 - x_1)^2$ (B) $\frac{1}{2}kx_2(x_2 + 2x_1)$ (C) $\frac{1}{2}kx_1^2 - \frac{1}{2}kx_2^2$

(D) $\frac{1}{2}k(x_1 + x_2)^2$ (E) $\frac{1}{2}k(x_1^2 + x_2^2)$

14. A force F_x acts on a particle such that its position x changes as shown in the figure.



The work done by the particle as it moves from $x = 0$ to 20 m is

(A) 37.5 J (B) 10 J (C) 15 J (D) 22.5 J (E) 45 J

15. Two objects P and Q initially at rest move towards each other under mutual force of attraction. At the instant when the velocity of P is v and that of Q is $2v$, the velocity of centre of mass of the system is

(A) v (B) $3v$ (C) $2v$ (D) $1.5v$ (E) zero

Space for rough work

16. A body rolls down an inclined plane. If its kinetic energy of rotation is 40% of its kinetic energy of translation motion, then the body is

(A) hollow cylinder (B) ring (C) solid disc

(D) solid sphere (E) hollow sphere

17. A circular disc A and a ring B have same mass and same radius. If they are rotated with the same angular speed about their own axis, then

(A) A has less moment of inertia than B

(B) A has less rotational kinetic energy than B

(C) A and B have the same angular momentum

(D) A has greater angular momentum than B

(E) A has the same moment of inertia as that of B

18. Angular momentum of earth revolving around the sun in a circular orbit of radius R is proportional to

(A) $\sqrt{R}$ (B) R (C) R^2 (D) $R^{1/3}$ (E) $R^{1/2}$

19. A body of mass m is released from a height equal to the radius R of earth. The velocity with which it will strike earth's surface is

(A) $\sqrt{2gR}$ (B) $\sqrt{gR}$ (C) $\sqrt{2mgR}$ (D) $\sqrt{mgR}$ (E) $m\sqrt{gR}$

Space for rough work

20. A satellite revolves around the earth of radius R in a circular orbit of radius 3R. The percentage increase in energy required to lift it to an orbit of radius 5R is

(A) 10% (B) 20% (C) 30% (D) 40% (E) 67%

21. Two capillary tubes A and B of diameter 1 mm and 2 mm respectively are dipped vertically in a liquid. If the capillary rise in A is 6 cm, then the capillary rise in B is

(A) 2 cm (B) 3 cm (C) 4 cm (D) 6 cm (E) 9 cm

22. Two wires A and B of same material and of equal length with the radii in the ratio 1 : 2 are subjected to identical loads. If the length of A increases by 8 mm, then the increase in length of B is

(A) 2 mm (B) 4 mm (C) 8 mm (D) 16 mm (E) 1 mm

23. After terminal velocity is reached, the acceleration of a body falling through a fluid is

(A) equal to g (B) zero (C) less than g
(D) greater than g (E) constant but not zero

24. A liquid is filled upto a height of 20 cm in a cylindrical vessel. The speed of liquid coming out of a small hole at the bottom of the vessel is ($g = 10\ ms^{-2}$)

(A) 1.2 ms^{-1} (B) 1 ms^{-1} (C) 2 ms^{-1} (D) 3.2 ms^{-1} (E) 1.4 ms^{-1}

Space for rough work

25. A metallic bar of coefficient of linear expansion 10^{-5} K^{-1} is heated from 0°C to 100°C. The percentage increase in its length is

(A) 0.1% (B) 1% (C) 10% (D) 0.01% (E) 0.001%

26. Two perfectly black spheres A and B having radii 8 cm and 2 cm are maintained at temperatures 127°C and 527°C respectively. The ratio of the energy radiated by A to that by B is

(A) 1 : 2 (B) 1 : 1 (C) 2 : 1 (D) 1 : 4 (E) 1 : 16

27. For a monatomic gas, the molar specific heat at constant pressure divided by the molar gas constant R is equal to

(A) 2.5 (B) 1.5 (C) 5.0 (D) 3.5 (E) 4.0

28. Hot water in a vessel kept in a room, cools from 70°C to 65°C in t_1 minutes, from 65°C to 60°C in t_2 minutes and from 60°C to 55°C in t_3 minutes. Then

(A) $t_1 < t_2 > t_3$ (B) $t_1 = t_2 = t_3$ (C) $t_1 > t_2 > t_3$

(D) $t_1 > t_2 = t_3$ (E) $t_1 < t_2 < t_3$

Space for rough work

29. When two springs A and B with force constants k_A and k_B are stretched by the same force, then the respective ratio of the work done on them is

(A) $k_B : k_A$ (B) $k_A : k_B$ (C) $k_A k_B : 1$

(D) $\sqrt{k_B} : \sqrt{k_A}$ (E) $\sqrt{k_A} : \sqrt{k_B}$

30. For a particle moving according to the equation $x = a \cos \pi t$, the displacement in 3 s is

(A) 0 (B) $0.5a$ (C) $1.5a$ (D) $2a$ (E) a

31. Two oscillating simple pendulums with time periods T and $\frac{5T}{4}$ are in phase at a given time. They are again in phase after an elapse of time

(A) 4T (B) 3T (C) 6T (D) 5T (E) 8T

32. A wave of frequency 500 Hz travels with a speed of 360 ms^{-1}. The distance between two nearest points which are 60° out of phase is

(A) 12 cm (B) 18 cm (C) 50 cm (D) 24 cm (E) 6 cm

33. The apparent frequency observed by a moving observer away from a stationary source is 20% less than the actual frequency. If the velocity of sound in air is 330 ms^{-1}, then the velocity of the observer is

(A) 660 ms^{-1} (B) 330 ms^{-1} (C) 66 ms^{-1} (D) 33 ms^{-1} (E) 20 ms^{-1}

Space for rough work

34. A string under tension of 129.6 N produces 10 beats/second when it vibrates along with a tuning fork. When the tension in the string is increased to 160 N, it vibrates in unison with the tuning fork. Then frequency of the tuning fork is

(A) 100 Hz (B) 110 Hz (C) 90 Hz (D) 220 Hz (E) 95 Hz

35. An electric dipole of moment ($\vec{\mu}$) of 400 μC m is placed in a transverse electric field ($\vec{E}$) of 50 Vm^{-1} at an angle of 30° to $\vec{E}$. Then a torque of

(A) 10^{-2} Nm acts along the direction of $\vec{E}$

(B) 10^{-1} Nm acts along the direction of $\vec{\mu}$

(C) 10^{-5} Nm acts normal to both $\vec{E}$ and $\vec{\mu}$

(D) 10^{-3} Nm acts along the direction of $\vec{E}$

(E) 10^{-2} Nm acts normal to both $\vec{E}$ and $\vec{\mu}$

36. A charge Q is distributed over two concentric hollow spheres of radii a and b $(a>b)$, so that the surface charge densities are equal. The potential at the common centre is $\frac{1}{4\pi\varepsilon_0}$ times

(A) $Q\left(\frac{a+b}{a^2+b^2}\right)$ (B) $2Q\left(\frac{a+b}{a^2+b^2}\right)$ (C) Q

(D) $\frac{Q}{2}\left(\frac{a+b}{a^2+b^2}\right)$ (E) $\frac{Q}{4}\left(\frac{a+b}{a^2+b^2}\right)$

Space for rough work

37. The velocity acquired by a charged particle of mass m and charge Q accelerated from rest by a potential of V is

(A) $\frac{QV}{m}$ (B) $\sqrt{\frac{m}{QV}}$ (C) $\sqrt{mQV}$ (D) mQV (E) $\sqrt{\frac{2QV}{m}}$

38. A 5 μF capacitor is fully charged by a 12 V battery and then disconnected. If it is connected now parallel to an uncharged capacitor, the voltage across it is 3 V. Then the capacity of the uncharged capacitor is

(A) 5 μF (B) 15 μF (C) 50 μF ((D) 10 μF (E) 25 μF

39. An electron moving with a constant velocity v along X-axis enters a uniform electric field applied along Y-axis. Then the electron moves

(A) with uniform acceleration along Y-axis

(B) without any acceleration along Y-axis

(C) in a trajectory represented as $y = ax^2$

(D) in a trajectory represented as $y = ax$

(E) with uniform deceleration along X-axis

40. The resistivity of the material of a potentiometer wire is $5 \times 10^{-6}\ \Omega$ m and its area of cross section is $5 \times 10^{-6}\ m^2$. If 0.2 A current is flowing through the wire, then the potential drop per metre length of the wire is

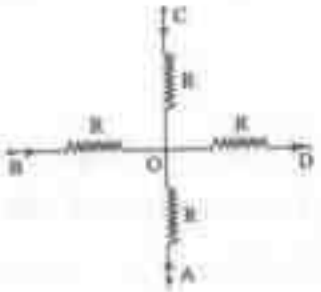
(A) $0.1\ Vm^{-1}$ (B) $0.5\ Vm^{-1}$ (C) $0.25\ Vm^{-1}$ (D) $0.2\ Vm^{-1}$ (E) $0.01\ Vm^{-1}$

Space for rough work

41. A battery of 6 V and internal resistance 2 Ω is connected to a silver voltameter. If the current of 1.5 A flows through the circuit, the resistance of the voltameter is

(A) 4 Ω (B) 2 Ω (C) 6 Ω (D) 1 Ω (E) 5 Ω

42. In the given circuit below, the points A, B and C are at same potential. If the potential difference between B and D is 30 V, then the potential difference between A and O is



(A) 7.5 V (B) 10 V (C) 15 V (D) 5 V (E) 3.75 V

43. The ratio of resistances of two copper wires of the same length and of same cross sectional area when connected in series to that when connected in parallel is

(A) 1 : 1 (B) 1 : 2 (C) 2 : 1 (D) 4 : 1 (E) 1 : 4

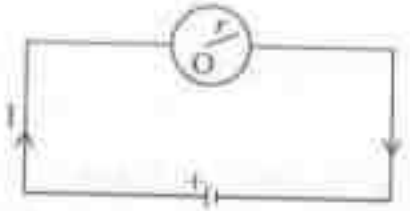
44. A flow of 10^8 electrons per second in a conducting wire constitutes a flow of current of

(A) 1.6×10^{-13}A (B) 1.6×10^{-11}A (C) 1.6×10^{-12}A

(D) 1.6×10^{-19}A (E) 1.6×10^{-11}A

Space for rough work

45. A single turn circular coil is connected to a cell as shown. Magnetic field at the centre O of the coil is



(A) $\frac{2\pi I}{r}$ (B) $2\pi Ir$ (C) zero (D) $\frac{I}{2\pi r}$ (E) $\frac{I}{\pi r}$

46. Identify the wrong statement

(A) Current loop is equivalent to a magnetic dipole

(B) Magnetic dipole moment of a planar loop of area A carrying current I is I^2A

(C) Particles like proton, electron carry an intrinsic magnetic moment

(D) The current loop (magnetic moment $\vec{m}$) placed in a uniform magnetic field, $\vec{B}$ experiences a torque $\vec{\tau} = \vec{m} \times \vec{B}$

(E) Ampere's circuital law is not independent of Biot Savart's law

47. A proton is travelling along the X-direction with velocity 5×10^6 ms^{-1}. The magnitude of force experienced by the proton in a magnetic field $\vec{B} = (0.2\hat{i} + 0.4\hat{k})$ tesla is

(A) 3.2×10^{-13} N (B) 5.3×10^{-13} N (C) 3.2×10^{13} N

(D) 6.3×10^{-13} N (E) 3.5×10^{-12} N

48. The shunt required to send 10 % of the main current through a moving coil galvanometer of resistance 99 Ω is

(A) 99 Ω (B) 9.9 Ω (C) 9 Ω (D) 10 Ω (E) 11 Ω

Space for rough work

49. Two identical coils of 5 turns each carry 1 A and 2 A current respectively. Assume they have common centre with their planes parallel to each other. If their radius is 1 m each and the direction of flow of current in the coils are in opposite directions, then the magnetic field produced on its axial line at a distance of $\sqrt{3}$ m from the common centre is (in tesla)

(A) 0 (B) $\frac{15}{16}\mu_0$ (C) $\frac{8}{16}\mu_0$ (D) $\frac{5}{16}\mu_0$ (E) $\frac{16}{5}\mu_0$

50. The ratio of the magnetic fields produced at the centre of a solenoid for a flow of current 1 A to that produced inside toroid for the flow of current 2 A both having same number of turns per unit length is

(A) 1 : 1 (B) 1 : 2 (C) 2 : 1 (D) 1 : 4 (E) 4 : 1

51. A transformer connected to 220 V mains is used to light a lamp of rating 100 W and 110 V. If the primary current is 0.5 A, the efficiency of the transformer is (approximately)

(A) 60% (B) 35% (C) 50% (D) 90% (E) 44%

52. Two long parallel wires carrying equal currents which are 8 cm apart produce a magnetic field of 200 μT mid way between them. The magnitude of the current in each wire is

(A) 10 A (B) 20 A (C) 30 A (D) 40 A (E) 50 A

Space for rough work

53. A lamp consumes only 25% of the peak power in an ac circuit. The phase difference between the applied voltage and the current is

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{3}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{2}$ (E) π

54. The amplitudes E_0 and B_0 of electric and the magnetic component of an electromagnetic wave respectively are related to the velocity c in vacuum as

(A) $E_0 B_0 = \frac{1}{c}$ (B) $E_0 = \frac{c}{B_0}$ (C) $B_0 = cE_0$

(D) $E_0 = cB_0$ (E) $E_0 = c^2 B_0$

55. Identify the mismatched pair

(A) Microwaves - Aircraft navigation
(B) Radio waves - Cellular phone
(C) Infrared waves - Remote switches
(D) Ultraviolet rays - LASIK
(E) γ – rays - Klystron

56. An aperture of size a is illuminated by a parallel beam of light of wavelength λ. The distance at which ray optics has a good approximation is

(A) $\frac{a^2}{\lambda}$ (B) $\frac{\lambda}{a^2}$ (C) $\frac{\lambda}{a}$ (D) $\frac{\lambda^2}{a}$ (E) $a^2\lambda$

Space for rough work

57. Two plane wavefronts of light, one incident on a thin convex lens and another on the refracting face of a thin prism. After refraction at them, the emerging wavefronts respectively become

(A) plane wavefront and plane wavefront

(B) plane wavefront and spherical wavefront

(C) spherical wavefront and plane wavefront

(D) spherical wavefront and spherical wavefront

(E) elliptical wavefront and spherical wavefront

58. If a ray of light is incident at a glass surface at the Brewster's angle of 60°, then the angle of deviation inside glass is

(A) 90° (B) 60° (C) 45° (D) 30° (E) 15°

59. Identify the wrong sign convention

(A) The magnification for virtual image formed by a convex lens is positive

(B) The magnification for real image formed by a convex lens is negative

(C) The height measured normal to the principal axis upwards is positive

(D) The distances measured in the direction of incident light is positive

(E) The magnification for virtual image formed by a concave lens is negative

Space for rough work

60. A ray of light is incident normally on one refracting surface of an equilateral prism. If the refractive index of the material of the prism is 1.5, then

(A) the emergent ray is deviated by 30°

(B) the emergent ray is deviated by 60°

(C) the emergent ray just graces the second reflecting surface

(D) the ray undergoes total internal reflection at second refracting surface

(E) the ray emerges normally from the second refracting surface

61. The maximum velocities of the photoelectrons ejected are v and $2v$ for the incident light of wavelength 400 nm and 250 nm on a metal surface respectively. The work function of the metal in terms of Planck's constant h and velocity of light c is

(A) $hc \times 10^6$ J (B) $2hc \times 10^6$ J (C) $1.5hc \times 10^6$ J

(D) $2.5hc \times 10^6$ J (E) $3hc \times 10^6$ J

62. A radioactive sample contains 10^{-3} kg each of two nuclear species A and B with half-life 4 days and 8 days respectively. The ratio of the amounts of A and B after a period of 16 days is

(A) 1 : 2 (B) 4 : 1 (C) 1 : 4 (D) 2 : 1 (E) 1 : 1

63. The binding energy per nucleon for deuteron ($_1H^2$) and helium ($_2He^4$) are 1.1 MeV and 7.0 MeV respectively. The energy released when two deuterons fuse to form a helium nucleus is

(A) 36.2 MeV (B) 23.6 MeV (C) 47.2 MeV

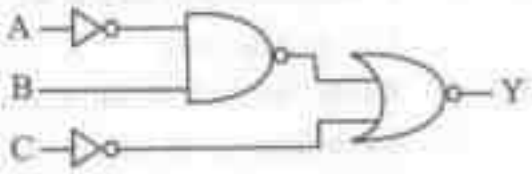
(D) 11.8 MeV (E) 9.31 MeV

Space for rough work

64. In a series of radioactive decays, if a nucleus of mass number 180 and atomic number 72 decays into another nucleus of mass number 172 and atomic number 69, then the number of alpha and beta particles released respectively are

(A) 2, 3 (B) 2, 2 (C) 2, 1 (D) 2, 0 (E) 1, 3

65. For which one of the following input combinations, the given logic circuit gives the output Y = 1?



(A) A = 0 ; B = 0 ; C = 0 (B) A = 0 ; B = 1 ; C = 1

(C) A = 0 ; B = 1 ; C = 0 (D) A = 1 ; B = 1 ; C = 1

(E) A = 1 ; B = 0 ; C = 1

66. In a semiconductor, $\frac{2}{3}$rd of the total current is carried by electrons and remaining $\frac{1}{3}$rd by the holes. If at this temperature, the drift velocity of electrons is 3 times that of holes, the ratio of number density of electrons to that of holes is

(A) $\frac{3}{2}$ (B) $\frac{2}{3}$ (C) $\frac{5}{3}$ (D) $\frac{3}{5}$ (E) $\frac{1}{3}$

67. In an PNP transistor, 10^{10} holes enter the emitter in 10^{-6} s. If 2% of holes is lost in the base, then the current amplification factor is

(A) 49 (B) 19 (C) 29 (D) 39 (E) 59

Space for rough work

68. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 600 nm is incident on it. The energy band gap (in eV) for the semiconductor is

(A) 1.50 (B) 0.75 (C) 2.06 (D) 1.35 (E) 0.90

69. Identify the mismatched pair

(A) Noise - Unwanted signals
(B) Repeater - Communication satellite
(C) Transducer - Energy converter
(D) Demodulation - Retrieval of information
(E) Attenuation - Strengthening of signal

70. Pick out the wrong statement

(A) Analog signals provide a continuous set of values
(B) Digital signals represent values as discrete steps
(C) Analog signals cannot utilize the binary system
(D) Digital signals can be processed by logic gates
(E) Digital signals can utilize decimal as well as binary systems

71. A ground receiver receives a signal at 5 MHz, transmitted by a ground transmitter at a height of 320 m, which is 110 km away from it. Then it can communicate through (radius of earth R = 6400 km)

(A) space waves (B) ground waves (C) sky waves
(D) both sky and ground waves (E) sky waves, ground waves and space waves

72. The power radiated by a linear antenna of length ℓ at wavelength λ is

(A) directly proportional to ℓ (B) inversely proportional to λ
(C) inversely proportional to ℓ (D) directly proportional to λ^2
(E) inversely proportional to λ^2

Space for rough work

Engg. Paper-I PHYSICS & CHEMISTRY			
Q. No.	Answer Key	Q. No.	Answer Key
	A1		A1
1	A	61	B
2	D	62	C
3	A	63	B
4	E	64	C
5	C	65	B
6	E	66	B
7	D	67	A
8	D	68	C
9	E	69	E
10	B	70	E
11	D	71	C
12	C	72	E
13	B		
14	E		
15	E		
16	D		
17	D		
18	A		
19	B		
20	D		
21	B		
22	A		
23	B		
24	C		
25	A		
26	B		
27	A		
28	E		
29	A		
30	D		
31	D		
32	A		
33	C		
34	A		
35	E		
36	A		
37	E		
38	B		
39	C		
40	D		
41	B		
42	A		
43	D		
44	E		
45	C		
46	B		
47	A		
48	E		
49	D		
50	B		
51	D		
52	B		
53	B		
54	D		
55	E		
56	A		
57	C		
58	D		
59	E		
60	D		

WARNING	Any malpractice or any attempt to commit any kind of malpractice in the Examination will DISQUALIFY THE CANDIDATE.

PAPER – I PHYSICS & CHEMISTRY–2016

Version Code	A2	Question Booklet Serial Number :	5237666

Time : 150 Minutes	Number of Questions : 120	Maximum Marks : 480
Name of Candidate		
Roll Number		
Signature of Candidate		

INSTRUCTIONS TO THE CANDIDATE

1. **Please ensure that the VERSION CODE shown at the top of this Question Booklet is the same as that shown in the OMR Answer Sheet issued to you.** If you have received a Question Booklet with a different Version Code, please get it replaced with a Question Booklet with the same Version Code as that of the OMR Answer Sheet from the Invigilator. **THIS IS VERY IMPORTANT.**
2. Please fill the items such as Name, Roll Number and Signature in the columns given above. Please also write Question Booklet Serial No. given at the top of this page against item 3 in the OMR Answer Sheet.
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PLEASE ENSURE THAT THIS QUESTION BOOKLET CONTAINS 120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120. PRINTED PAGES : 32

1. The one which does not represent a force in any context is

(A) friction (B) impulse (C) tension
(D) weight (E) viscous drag

2. The Work-Energy theorem states that the change in

(A) kinetic energy of a particle is equal to the work done on it by the net force
(B) kinetic energy of a particle is equal to the work done by one of forces acting on it
(C) potential energy of a particle is equal to the work done on it by the net force
(D) potential energy of a particle is equal to the work done by one of forces acting on it
(E) total energy of a particle is equal to the work done on it by the net force

3. A car of mass 1500 kg is lifted up a distance of 30 m by crane A in 0.5 minutes. The second crane B does the same job in 1 minute. The ratio of their powers is

(A) 1 : 2 (B) 2 : 1 (C) 1 : 1
(D) 1 : 4 (E) 4 : 1

4. Water from a hose pipe of radius 5 cm strikes a wall normally at a speed of 5 ms^{-1}. The force exerted on the wall in newton is

(A) 13.5π (B) 6.25π (C) 62.5π
(D) 27π (E) 125π

Space for rough work

5. The position vectors of two identical particles with respect to the origin in three dimensional co-ordinate system are $\vec{r}_1$ and $\vec{r}_2$. The position vector of centre of mass of the system is given by

(A) $\vec{r}_1 + \vec{r}_2$ (B) $\frac{\vec{r}_1 - \vec{r}_2}{2}$ (C) $\vec{r}_1 - \vec{r}_2$

(D) $\frac{\vec{r}_1 + \vec{r}_2}{2}$ (E) $\frac{\vec{r}_1 + \vec{r}_2}{3}$

6. If a body of moment of inertia 2 kg m^2 revolves about its own axis making 2 rotations per second, then its angular momentum (in Js) is

(A) 2π (B) 4π (C) 6π

(D) 8π (E) 10π

7. A rigid body is the one in which

(A) it can have only rotational motion

(B) it can have only translational motion

(C) the distances between all pairs of particles of the body do not change

(D) its shape can be deformed

(E) its centre of mass always lies inside the material of the body

8. A body hanging from a massless spring stretches it by 3 cm on earth's surface. At a place 800 km above the earth's surface, the same body will stretch the spring by (Radius of earth = 6400 km)

(A) $\left(\frac{34}{27}\right)$ cm (B) $\left(\frac{64}{27}\right)$ cm (C) $\left(\frac{27}{64}\right)$ cm

(D) $\left(\frac{27}{34}\right)$ cm (E) $\left(\frac{35}{81}\right)$ cm

Space for rough work

9. The acceleration due to gravity on the surface of a planet is one-fourth of the value on earth. When a brass ball is brought to this planet, its

(A) mass is halved
(B) weight is halved
(C) mass becomes one-fourth
(D) weight becomes one-fourth
(E) mass and weight remain the same

10. Polar satellites

(A) are high altitude satellites
(B) are widely used for telecommunication
(C) are used for environmental studies
(D) go around the earth in a east-west direction
(E) have time-period of rotation of 24 hours

11. If a capillary tube of radius r is immersed in a liquid, the liquid rises to a height h. The corresponding mass of liquid column is m. The mass of water that would rise in another capillary tube of twice the radius is

(A) $2m$ (B) $5m$ (C) $3m$
(D) $4m$ (E) $\frac{m}{2}$

12. In a horizontal pipe of non-uniform cross-section, water flows with a velocity of 1 ms^{-1} at a point where the diameter of the pipe is 20 cm. The velocity of water (in ms^{-1}) at a point where the diameter of the pipe is 5 cm is

(A) 64 (B) 24 (C) 8
(D) 32 (E) 16

Space for rough work

13. A spherical ball of diameter 1 cm and density 5×10^3 kg m^{-3} is dropped gently in a large tank containing viscous liquid of density 3×10^3 kg m^{-3} and coefficient of viscosity 0.1 Ns m^{-2}. The distance, the ball moves in 1 s after attaining terminal velocity is ($g = 10$ ms^{-2})

(A) $\frac{10}{9}$ m (B) $\frac{2}{3}$ m (C) $\frac{4}{9}$ m

(D) $\frac{4}{5}$ m (E) $\frac{9}{10}$ m

14. A stone of density 2000 kg m^{-3} completely immersed in a lake is allowed to sink from rest. If the effect of friction is neglected, then after 4 seconds, the stone will reach a depth of

(A) 78.4 m (B) 39.2 m (C) 19.6 m

(D) 9.8 m (E) 24.6 m

15. The Zeroth law of thermodynamics leads to the concept of

(A) internal energy (B) heat content (C) pressure

(D) temperature (E) work done

16. If the average kinetic energy of a molecule of a hydrogen gas at 300 K is E, the average kinetic energy of a molecule of a nitrogen gas at the same temperature is

(A) 7E (B) $\frac{E}{14}$ (C) 14E

(D) $\frac{E}{7}$ (E) E

Space for rough work

17. The difference between the specific heats of a gas is 4150 J kg^{-1} K^{-1}. If the ratio of specific heats is 1.4, then the specific heat at constant volume of the gas (in J kg^{-1} K^{-1}) is

(A) 1037.5 (B) 2037.5 (C) 8300

(D) 10375 (E) 4150

18. The Carnot cycle of a reversible heat engine consists of

(A) one isothermal and two adiabatic processes

(B) two isothermal and one adiabatic processes

(C) two isothermal and two adiabatic processes

(D) two isobaric and two isothermal processes

(E) two isochoric and two adiabatic processes

19. Two equal masses hung from two massless springs of spring constants k_1 and k_2 have equal maximum velocity when executing simple harmonic motion. The ratio of their amplitudes is

(A) $\left(\frac{k_1}{k_2}\right)^{1/2}$ (B) $\left(\frac{k_1}{k_2}\right)$ (C) $\left(\frac{k_2}{k_1}\right)$

(D) $\left(\frac{k_2}{k_1}\right)^{1/2}$ (E) $\left(\frac{k_1^2}{k_2^2}\right)$

20. The simple harmonic motion of a particle is given by $x = a \sin 2\pi t$. Then the location of the particle from its mean position at a time $\frac{1}{8}$th of a second is

(A) a (B) $\frac{a}{2}$ (C) $\frac{a}{\sqrt{2}}$

(D) $\frac{a}{4}$ (E) $\frac{a}{8}$

Space for rough work

21. The time period of a simple pendulum of length $\sqrt{5}$ m suspended in a car moving with uniform acceleration of 5 ms^{-2} in a horizontal straight road is ($g = 10\ ms^{-2}$)

(A) $\frac{2\pi}{\sqrt{5}}$s (B) $\frac{\pi}{\sqrt{5}}$s (C) 5πs

(D) 4πs (E) 3πs

22. The apparent change in frequency of sound due to the relative motion between the observer and the source of sound is called

(A) Doppler effect (B) Phenomenon of beats

(C) Phenomenon of stationary waves (D) Diffraction of sound waves

(E) Interference of sound waves

23. Pick out the condition which is not required for the formation of stationary waves

(A) The medium on which waves are formed should be bound medium

(B) Both the waves should have same frequency

(C) Both the waves should have same velocity

(D) The waves should travel in same direction

(E) Both the waves should have same wavelength

24. The harmonic mode which resonates with a closed pipe of length 22 cm, when excited by a 1875 Hz source and the number of nodes present in it respectively are (velocity of sound in air = 330 ms^{-1})

(A) 1^{st}, 1 (B) 3^{rd}, 1 (C) 3^{rd}, 2 (D) 5^{th}, 4 (E) 5^{th}, 3

25. The force between two point charges placed in a material medium of dielectric constant ε_r is F. If the material is removed, then the force between them becomes

(A) $\varepsilon_r F$ (B) εF (C) $\frac{F}{\varepsilon_r}$ (D) $\frac{\varepsilon}{F}$ (E) $\varepsilon_0 F$

Space for rough work

26. The electric field strength in $N\,C^{-1}$ that is required to just prevent a water drop carrying a charge 1.6×10^{-19} C from falling under gravity is
($g = 9.8\ ms^{-2}$, mass of water drop = 0.0016 g)

(A) 9.8×10^{-16} (B) 9.8×10^{16} (C) 9.8×10^{-13}
(D) 9.8×10^{13} (E) 9.8×10^{10}

27. A cylinder of radius r and length ℓ is placed in a uniform electric field of intensity E acting parallel to the axis of the cylinder. The total flux over curved surface area is

(A) $2\pi rE$ (B) $\left(\frac{2\pi}{\ell}\right)E$ (C) $2\pi r\ell E$
(D) $\frac{E}{2\pi r\ell}$ (E) zero

28. A conductor with a cavity is charged positively and its surface charge density is σ. If E and V represent the electric field and potential, then inside the cavity

(A) $\sigma = 0$ and $V = 0$ (B) $E = 0$ and $V = 0$
(C) $E = 0$ and σ = constant (D) $V = 0$ and σ = constant
(E) $E = 0$ and V = constant

29. Electric lines of force about a positive point charge are

(A) radially outwards (B) circular clockwise
(C) radially inwards (D) parallel straight lines
(E) circular anticlockwise

30. An ammeter, voltmeter and a resistor are connected in series to a cell and the readings are noted as I and V. If another resistor R is connected in parallel with voltmeter, then

(A) I and V increase (B) I increases
(C) I and V will remain same (D) I decreases
(E) I remains constant

Space for rough work

31. One gram of copper is deposited in a copper voltameter when a current of 0.5 A flows for 30 minutes. Then the current required to deposit 2 g of silver in a silver voltameter in the same time is (ece of copper = 3.3×10^{-4} gC^{-1}, ece of silver = 1.1×10^{-4} gC^{-1})

(A) 4 A (B) 6 A (C) 2 A (D) 5 A (E) 3 A

32. The amount of charge flowing per second per unit area normal to the flow is called

(A) electrical conductivity (B) electrical resistivity
(C) mobility (D) current density
(E) areal current

33. A galvanometer of resistance G is converted into an ammeter using a shunt of resistance R. If the ratio of the heat dissipated through the galvanometer and shunt is 3 : 4, then R equals

(A) $\frac{4}{3}$G (B) $\frac{3}{4}$G (C) $\frac{16}{9}$G
(D) $\frac{9}{16}$G (E) G

34. Two bulbs of equal power are connected in parallel and they totally consume 110 W at 220 V. The resistances of each bulb is

(A) 550 Ω (B) 440 Ω (C) 330 Ω
(D) 880 Ω (E) 660 Ω

35. The wire of length ℓ is bent into a circular loop of a single turn and is suspended in a magnetic field of induction B. When a current I is passed through the loop, the maximum torque experienced by it is

(A) $\left(\frac{1}{4\pi}\right)BI\ell^2$ (B) $\frac{1}{4\pi}BI^2\ell$ (C) $\left(\frac{1}{4\pi}\right)BI\ell$
(D) $\left(\frac{1}{4\pi}\right)B^2I\ell$ (E) $\left(\frac{1}{4\pi}\right)B^2I^2\ell^2$

Space for rough work

36. A particle having charge 10 times that of the electron revolves in a circular path of radius 0.4 m with an angular speed of one rotation per second. The magnetic induction produced at the centre of the circular path is

(A) $4\pi \times 10^{-26}$ T (B) $2\pi \times 10^{-26}$ T (C) $16\pi \times 10^{-26}$ T

(D) $8\pi \times 10^{-25}$ T (E) $9\pi \times 10^{-25}$ T

37. Pick out the **wrong** statement among the following

(A) Time varying magnetic field creates an electric field

(B) Charges in motion can exert force on a stationary magnet

(C) Stationary charges can exert torque on a stationary magnet

(D) A bar magnet in motion can exert force on a stationary charge

(E) Electric fields produced by static charges have different properties from those produced by time varying magnetic fields

38. If a magnet is plunged into a coil, then the magnitude of induced emf does not depend upon

(A) the number of turns in the coil

(B) the medium of the core of the coil

(C) the insertion speed of the magnet

(D) the strength of the magnet

(E) the resistance of the coil

39. A bar magnet has a period of oscillation T. If a similar brass piece of the same mass is placed over it, then the number of oscillations it makes in one second is

(A) $\frac{1}{\sqrt{2}T}$ (B) $\frac{\sqrt{2}}{T}$ (C) $\frac{1}{2T}$

(D) $\frac{2}{T}$ (E) $\frac{1}{T}$

Space for rough work

40. If 0.1 J of energy is stored for the flow of current of 0.2 A in an inductor, then its inductance value is

(A) 5 H (B) 0.5 H (C) 5 mH
(D) 50 H (E) 50 mH

41. The self inductance of a long solenoid carrying current is independent of

(A) its length (B) the current
(C) its cross-sectional area (D) magnetic permeability of the core
(E) the number of turns

42. The r.m.s. value of A.C. which when passed through a resistor produces heat, which is twice that produced by a steady current of 1.414 amp in the same resistor is

(A) 2 A (B) 3.46 A (C) 2.818 A
(D) 1.732 A (E) 1 A

43. In a series LCR ac circuit, the current is maximum when the impedance is equal to

(A) the reactance (B) the resistance (C) zero
(D) twice the reactance (E) twice the resistance

44. γ-rays are detected by

(A) point contact diodes (B) thermopiles
(C) ionization chamber (D) photocells (E) bolometers

Space for rough work

45. If the direction of electric and magnetic field vectors of a plane electromagnetic wave are along positive y direction and positive z direction respectively, then the direction of propagation of the wave is along

(A) positive z direction
(B) negative z direction
(C) negative y direction
(D) positive x direction
(E) negative x direction

46. When an object is viewed with a light of wavelength 6000Å under a microscope its resolving power is 10^4. The resolving power of the microscope when the same object is viewed with a light of wavelength 4000 Å is

(A) 10^4
(B) 2×10^4
(C) $3\sqrt{2}\times10^4$
(D) 3×10^4
(E) 1.5×10^4

47. Secondary rainbow in the atmosphere is

(A) the result of polarization and dispersion of light
(B) brighter than the primary rainbow
(C) due to the phenomenon of double refraction
(D) formed with red colour on the top
(E) formed due to two reflections in the rain drop

48. For a diffraction from a single slit, the intensity of the central point is

(A) infinite
(B) finite and same magnitude as the surrounding maxima
(C) finite but much larger than the surrounding maxima
(D) finite and substantially smaller than the surrounding maxima
(E) zero

49. If the radius of curvature of the curved surface of a plano-convex lens is 50 cm, its focal length is $(\mu=1.5)$

(A) 0.5 m
(B) 0.75 m
(C) 1.25 m
(D) 0.25 m
(E) 1 m

Space for rough work

50. The magnification of an image by a convex lens is positive only when the object is placed

(A) at its focus F
(B) between F and 2F
(C) at 2F
(D) between F and optical centre
(E) beyond 2F

51. If the work functions of three photosensitive materials are 1 eV, 2 eV and 3 eV respectively, then the ratio of the respective frequencies of light that produce photoelectrons of maximum kinetic energy of 1 eV from each of them is

(A) 1 : 2 : 3
(B) 2 : 3 : 4
(C) 1 : 1 : 1
(D) 3 : 2 : 1
(E) 4 : 3 : 2

52. During β^- emission

(A) a neutron in the nucleus decays emitting an electron
(B) an atomic electron is ejected
(C) an electron already present within the nucleus is ejected
(D) a part of the binding energy of the nucleus is converted into an electron
(E) a proton in the nucleus decays emitting an electron

53. The binding energy per nucleon of ^{16}O is 7.97 MeV and that of ^{17}O is 7.75 MeV. The energy in MeV required to remove a neutron from ^{17}O is

(A) 3.52 (B) 3.64 (C) 4.23 (D) 7.86 (E) 1.68

54. If the ratio of the radius of a nucleus with 61 neutrons to that of helium nucleus is 3, the atomic number of this nucleus is

(A) 27 (B) 47 (C) 51 (D) 61 (E) 108

Space for rough work

55. The electron density of intrinsic semi-conductor at room temperature is $10^{16} m^{-3}$. When doped with a trivalent impurity, the electron density is decreased to $10^{14} m^{-3}$ at the same temperature. The majority carrier density is

(A) $10^{16} m^{-3}$ (B) $10^{18} m^{-3}$ (C) $10^{22} m^{-3}$

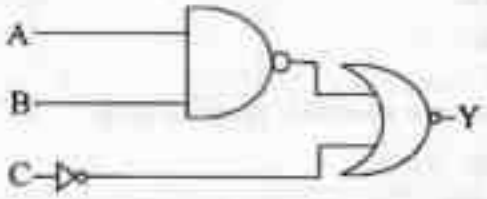
(D) $10^{20} m^{-3}$ (E) $10^{19} m^{-3}$

56. In a Zener diode regulated power supply, unregulated d.c. input of 10 V is applied. If the resistance (R_s) connected in series with a Zener diode is 200 Ω and the Zener voltage $V_z = 5$ V, the current across the resistance R_s is

(A) 15 mA (B) 10 mA (C) 20 mA

(D) 5 mA (E) 25 mA

57. The circuit gives the output as that of



(A) AND gate (B) OR gate (C) NAND gate

(D) NOR gate (E) NOT gate

58. To detect light of wavelength 500 nm, the photodiode must be fabricated from a semiconductor of minimum bandwidth of

(A) 1.24 eV (B) 0.62 eV (C) 2.48 eV

(D) 3.2 eV (E) 4.48 eV

Space for rough work

59. If the height of TV tower is increased by 21%, the transmission range is enhanced by

(A) 10% (B) 5% (C) 15%
(D) 25% (E) 12%

60. The range of a communication system can be extended by a

(A) modulator (B) transmitter (C) demodulator
(D) receiver (E) repeater

61. For commercial telephonic communication, the frequency range for speech signals is

(A) 50 Hz to 1000 Hz
(B) 3000 Hz to 4500 Hz
(C) 1000 Hz to 2000 Hz
(D) 5000 Hz to 6500 Hz
(E) 300 Hz to 3100 Hz

62. The role of envelope detector in an AM receiver is to

(A) retrieve the message signal
(B) rectify the AM signal
(C) modify the AM signal
(D) modulate the message signal
(E) retrieve the AM signal

Space for rough work

63. When the voltage and current in a conductor are measured as (100 ± 4) V and (5 ± 0.2) A, then the percentage of error in the calculation of resistance is

(A) 8% (B) 4% (C) 20%

(D) 10% (E) 6%

64. The set of physical quantities among the following which are dimensionally different is

(A) Terminal velocity, drift velocity, critical velocity

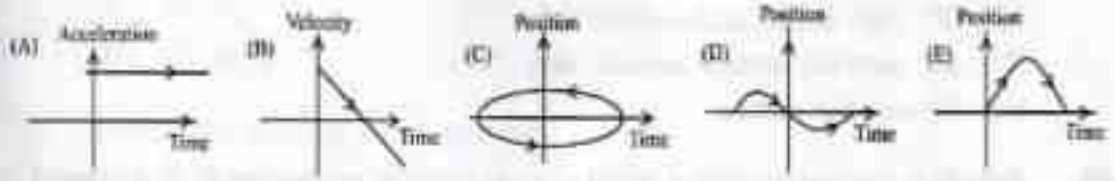
(B) Potential energy, work done, kinetic energy

(C) Pressure, stress, rigidity modulus

(D) Disintegration constant, frequency, angular velocity

(E) Dipole moment, electric flux, electric field

65. The graph which cannot possibly represent one-dimensional motion is



66. An aeroplane is flying with a uniform speed of 150 km hr^{-1} along the circumference of a circle. The change in its velocity in half the revolution (in km hr^{-1}) is

(A) 150 (B) 100 (C) 200

(D) 300 (E) 50

Space for rough work

67. In uniform circular motion, the centripetal acceleration is

(A) towards the centre of the circular path and perpendicular to the instantaneous velocity

(B) a constant acceleration

(C) away from the centre of the circular path and perpendicular to the instantaneous velocity

(D) a variable acceleration making 45° with the instantaneous velocity

(E) a variable acceleration, parallel to the instantaneous velocity

68. A man rides a bicycle with a speed of 17.32 ms^{-1} in east-west direction. If the rain falls vertically with a speed of 10 ms^{-1}, the direction in which he must hold his umbrella is

(A) 30° with the vertical towards east

(B) 60° with the vertical towards west

(C) 30° with the vertical towards west

(D) 60° with the vertical towards east

(E) 0° with the vertical

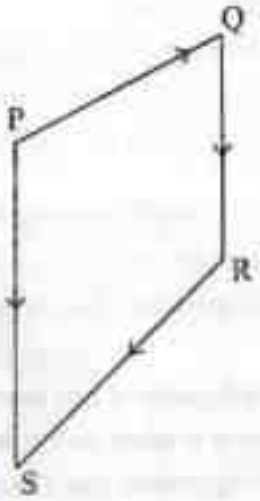
69. A body is thrown up with a speed u, at an angle of projection θ. If the speed of the projectile becomes $\frac{u}{\sqrt{2}}$ on reaching the maximum height, the maximum vertical height attained by the projectile is

(A) $\frac{u^2}{4g}$ (B) $\frac{u^2}{3g}$ (C) $\frac{u^2}{2g}$

(D) $\frac{u^2}{g}$ (E) $\frac{2u^2}{g}$

Space for rough work

70. In the given diagram, if $\overrightarrow{PQ} = \vec{A}$, $\overrightarrow{QR} = \vec{B}$ and $\overrightarrow{RS} = \vec{C}$ then $\overrightarrow{PS}$ equals



(A) $\vec{A}-\vec{B}+\vec{C}$ (B) $\vec{A}+\vec{B}-\vec{C}$ (C) $\vec{A}+\vec{B}+\vec{C}$

(D) $\vec{A}-\vec{B}-\vec{C}$ (E) $-\vec{A}-\vec{B}-\vec{C}$

71. The net force acting is not zero on

(A) a retarding train

(B) a ball falling with terminal velocity

(C) a kite held stationary in the sky

(D) a truck moving with constant velocity

(E) a book placed on a table

72. An engine of power 58.8 kW pulls a train of mass 2×10^5 kg with a velocity of 36 km h^{-1}. The coefficient of friction is

(A) 0.3 (B) 0.03 (C) 0.003

(D) 0.0003 (E) 0.04

Space for rough work

Engg. Paper-I PHYSICS & CHEMISTRY			
Q. No.	Answer Key	Q. No.	Answer Key
	A2		A2
1	B	61	E
2	A	62	A
3	B	63	A
4	C	64	E
5	D	65	C
6	D	66	D
7	C	67	A
8	B	68	C
9	D	69	A
10	C	70	C
11	A	71	A
12	E	72	C
13	A		
14	B		
15	D		
16	E		
17	D		
18	C		
19	D		
20	C		
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48	C		
49	E		
50	D		
51	B		
52	A		
53	C		
54	B		
55	B		
56	E		
57	A		
58	C		
59	A		
60	E		

WARNING:	Any malpractice or any attempt to commit any kind of malpractice in the Examination will DISQUALIFY THE CANDIDATE.

PAPER –I PHYSICS & CHEMISTRY-2017

Version code	A1	Question Booklet Serial Number :	1102417
Time: 150 Minutes		Number of Questions: 120	Maximum Marks: 480

Name of the Candidate	
Roll Number	
Signature of the Candidate	

INSTRUCTIONS TO CANDIDATES

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PRINTED PAGES 32

1. A person observes that the full length of a train subtends an angle of 15 degrees. If the distance between the train and the person is 3 km, the length of the train, calculated using parallax method, in meters is

(A) 45 (B) 45π (C) 250π
(D) 250 (E) 450

2. In a measurement, the random error

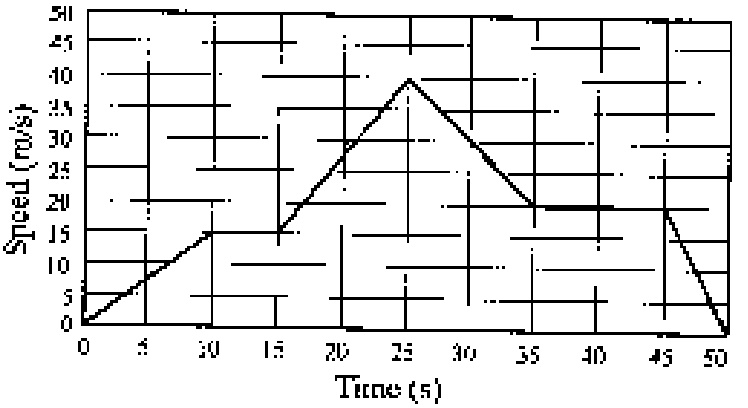
(A) can be decreased by increasing the number of readings and averaging them
(B) can be decreased by changing the person who takes the reading
(C) can be decreased by using new instrument
(D) can be decreased by using a different method in taking the reading
(E) can never be decreased

3. In order to measure the period of a single pendulum using a stop clock, a student repeated the experiment for 10 times and noted down the time period for each experiment as 5.1, 5.0, 4.9, 4.9, 5.1, 5.0, 4.9, 5.1, 5.0, 4.9 s. The correct way of expressing the result for the period is

(A) 4.99 s (B) 5.0 s (C) 5.00 s
(D) 4.9 s (E) 5.1 s

Space for rough work

4. The following figure gives the movement of an object. Select the correct statement from the given choices



(A) The total distance travelled by the object is 975 m
(B) The maximum acceleration of the object is 2 m/s^2
(C) The maximum deceleration happened between 25^{th} and 35^{th} seconds
(D) The object was at rest between 10^{th} and 15^{th} seconds
(E) At 40^{th} second, the object was decelerating

5. Two objects, P and Q, travelling in the same direction starts from rest. While the object P starts at time $t = 0$ and the object Q starts later at $t = 30$ min. The object P has an acceleration of 40 km/h^2. To catch P at a distance of 20 km, the acceleration of Q should be

(A) 40 km/h^2 (B) 80 km/h^2 (C) 100 km/h^2
(D) 120 km/h^2 (E) 160 km/h^2

Space for rough work

6. A train of length L moves with a constant speed V_t. A person at the back of the train fires a bullet at time $t = 0$ towards a target which is at a distance of D (at time $t = 0$) from the front of the train (on the same direction of motion). Another person at the front of the train fires another bullet at time $t = T$ towards the same target. Both bullets reach the target at the same time. Assuming the speed of the bullets, V_b, are same, the length of the train is

(A) $T \times (V_b + 2V_t)$ (B) $T \times (V_b + V_t)$ (C) $2 \times T \times (V_b + V_t)$
(D) $2 \times T \times (V_b - V_t)$ (E) $T \times (V_b - V_t)$

7. From the ground, a projectile is fired at an angle of 60 degrees to the horizontal with a speed of 20 m/s. Take acceleration due to gravity as 10 m/s^2. The horizontal range of the projectile is

(A) $10\sqrt{3}$ m (B) 20 m (C) $20\sqrt{3}$ m
(D) $40\sqrt{3}$ m (E) $400\sqrt{3}$ m

8. A person from a truck, moving with a constant speed of 60 km/h, throws a ball upwards with a speed of 60 km/h. Neglecting the effect of rotation of Earth, choose the correct answer from the given choices

(A) The person cannot catch the ball when it comes down since the truck is moving
(B) The person can catch the ball when it comes down, if the truck is stopped immediately after throwing the ball
(C) The person can catch the ball when it comes down, if the truck moves with speed less than 60 km/h but does not stop
(D) The person can catch the ball when it comes down, if the truck moves with speed more than 60 km/h
(E) The person can catch the ball when it comes down, if the truck continues to move with a constant speed of 60 km/h

Space for rough work

9. A body of mass $2m$ moving with velocity v makes a head on elastic collision with another body of mass m which is initially at rest. Loss of kinetic energy of the colliding body (mass $2m$) is

(A) 1/9 of its initial kinetic energy
(B) 1/6 of its initial kinetic energy
(C) 1/4 of its initial kinetic energy
(D) 1/2 of its initial kinetic energy
(E) 8/9 of its initial kinetic energy

10. Displacement, x (in meters), of a body of mass 1 kg as a function of time, t, on a horizontal smooth surface is given as $x = 2t^2$. The work done in the first one second by the external force is

(A) 1 J
(B) 2 J
(C) 4 J
(D) 8 J
(E) 16 J

11. A massless spring of length l and spring constant k is placed vertically on a table. A ball of mass m is just kept on top of the spring. The maximum velocity of the ball is

(A) $g\sqrt{\frac{m}{k}}$
(B) $g\sqrt{\frac{2m}{k}}$
(C) $2g\sqrt{\frac{m}{k}}$
(D) $\frac{g}{2}\sqrt{\frac{m}{k}}$
(E) $g\sqrt{\frac{m}{2k}}$

12. Under the action of a constant force, a particle is experiencing a constant acceleration. The power is

(A) Zero
(B) Positive constant
(C) Negative constant
(D) Increasing uniformly with time
(E) Decreasing uniformly with time

Space for rough work

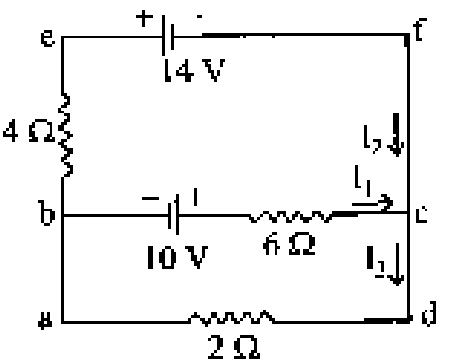
13. A copper wire with a cross-sectional area of 2×10^{-6} m^2 has a free electron density equal to 5×10^{22} /cm^3. If this wire carries a current of 16 A, the drift velocity of the electron is

(A) 1 m/s (B) 0.1 m/s (C) 0.01 m/s
(D) 0.001 m/s (E) 0.0001 m/s

14. The resistance of the tungsten wire in the light bulb, which is rated at 120 V/ 75 W and powered by a 120 V direct-current supply, is

(A) 0.37 Ω (B) 1.2 Ω (C) 2.66 Ω
(D) 192 Ω (E) 9×10^3 Ω

15. The values of the currents I_1, I_2, and I_3 flowing through the circuit given below is



(A) $I_1 = -3$ A, $I_2 = 2$ A, $I_3 = -1$ A
(B) $I_1 = 2$ A, $I_2 = 3$ A, $I_3 = -1$ A
(C) $I_1 = 3$ A, $I_2 = -1$ A, $I_3 = 2$ A
(D) $I_1 = 1$ A, $I_2 = -3$ A, $I_3 = -2$ A
(E) $I_1 = 2$ A, $I_2 = -1$ A, $I_3 = -3$ A

16. A silver wire has temperature coefficient of resistivity 4×10^{-3}/°C and its resistance at 20°C is 10 Ω. Neglecting any change in dimensions due to the change in temperature, its resistance at 40°C is

(A) 0.8 Ω (B) 1.8 Ω (C) 9.2 Ω
(D) 10.8 Ω (E) 11.6 Ω

Space for rough work

17. A charge Q placed at the center of a metallic spherical shell with inner and outer radii R_1 and R_2 respectively. The normal component of the electric field at any point on the Gaussian surface with radius between R_1 and R_2 will be

(A) zero (B) $\frac{Q}{4\pi R_1^2}$ (C) $\frac{Q}{4\pi R_1^2}\hat{i}$

(D) $\frac{Q}{4\pi(R_1-R_2)^2}$ (E) $\frac{Q}{4\pi(R_2-R_1)^2}$

18. A sphere of radius R has a uniform volume charge density, ρ. The magnitude of electric field at a distance r from the center of the sphere, where $r > R$, is

(A) $\frac{\rho}{4\pi\varepsilon_0 r^2}$ (B) $\frac{\rho R^2}{\varepsilon_0 r^2}$ (C) $\frac{\rho R^3}{\varepsilon_0 r^2}$

(D) $\frac{\rho R^3}{3\varepsilon_0 r^2}$ (E) $\frac{\rho R^2}{4\varepsilon_0 r^2}$

19. Five equal point charges with charge Q=10 nC are located at x = 2, 4, 5, 10 and 20 m. If $\varepsilon_0 = [10^{-9}/36\pi]$ F/m, then the potential at the origin (x = 0) is

(A) 9.9 V (B) 11.1 V (C) 90 V
(D) 99 V (E) 111 V

20. Two infinitely long parallel plates of equal areas, 6 cm^2, are separated by a distance of 1 cm. While one of the plates has a charge of +10 nC and the other has -10 nC. The magnitude of the electric field between the plates, if $\varepsilon_0 = \frac{10^{-9}}{36\pi}$ F/m, is

(A) 0.6π kV/m (B) 6π kV/m (C) 600π kV/m
(D) 60π V/m (E) 6π V/m

Space for rough work

21. A proton moves with a speed of 5.0×10^6 m/s along the x-axis. It enters a region where there is a magnetic field of magnitude 2.0 Tesla directed at an angle of 30° to the x-axis and lying in the xy plane. The magnitude of the magnetic force on the proton is

(A) 0.8×10^{-13} N (B) 1.6×10^{-13} N (C) 4.0×10^{-13} N
(D) 8.0×10^{-13} N (E) 16×10^{-13} N

22. A long straight wire of radius R carries a steady current, I_0, uniformly distributed throughout the cross-section of the wire. The magnetic field at a radial distance r from the center of the wire, in the region $r > R$, is

(A) $\frac{\mu_0 I_0}{2\pi r}$ (B) $\frac{\mu_0 I_0}{2\pi R}$ (C) $\frac{\mu_0 I_0 R^2}{2\pi r}$
(D) $\frac{\mu_0 I_0 r^2}{2\pi R}$ (E) $\frac{\mu_0 I_0 r^2}{2\pi R^3}$

23. If the cyclotron oscillator frequency is 16 MHz, then what should be the operating magnetic field for accelerating the proton of mass 1.67×10^{-27} kg?

(A) 0.334π T (B) 3.34π T (C) 33.4π T
(D) 334π T (E) 3340π T

24. The speed of light in vacuum is equal to

(A) $\mu_0\varepsilon_0$ (B) $\mu_0^2\varepsilon_0^2$ (C) $\sqrt{\mu_0\varepsilon_0}$
(D) $\frac{1}{\mu_0\varepsilon_0}$ (E) $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$

25. A comet orbits around Sun in an elliptical orbit. Which of the following quantities remains constant during the course of its motion?

(A) Linear velocity (B) Angular velocity (C) Angular momentum
(D) Kinetic energy (E) Potential energy

Space for rough work

26. Consider a satellite moving in a circular orbit around Earth. If K and V denote its kinetic energy and potential energy respectively then (Choose the convention where $V=0$ as $r \to \infty$)

(A) $K < V$ (B) $K = 2V$ (C) $V = 2K$
(D) $K = -2V$ (E) $V = -2K$

27. Assuming the mass of Earth to be ten times the mass of Mars and its radius to be twice the radius of Mars and the acceleration due to gravity on the surface of Earth to be 10 m/s^2, the acceleration due to gravity on the surface of Mars is given by

(A) 0.2 m/s^2 (B) 0.4 m/s^2 (C) 2 m/s^2
(D) 4 m/s^2 (E) 5 m/s^2

28. The semi-major axis of the orbit of Saturn is approximately nine times that of Earth. The time period of revolution of Saturn is approximately equal to

(A) 81 years (B) 27 years (C) 729 years
(D) $\sqrt[3]{81}$ years (E) 9 years

29. A particle of mass 3 kg, attached to a spring with force constant 48 N/m executes simple harmonic motion on a frictionless horizontal surface. The time period of oscillation of the particle, in seconds, is

(A) $\pi/4$ (B) $\pi/2$ (C) 2π
(D) 8π (E) $\pi/8$

Space for rough work

30. The position and velocity of a particle executing simple harmonic motion at $t = 0$ are given by 3 cm and 8 cm/s respectively. If the angular frequency of the particle is 2 rad/s then the amplitude of oscillation, in centimeters, is

(A) 3 (B) 4 (C) 5
(D) 6 (E) 8

31. A simple harmonic motion is represented by, $x(t) = \sin^2 \omega t - 2\cos^2 \omega t$. The angular frequency of oscillation is given by

(A) ω (B) 2ω (C) 4ω
(D) $\omega/2$ (E) $\omega/4$

32. A transverse wave is propagating on a stretched string whose mass per unit length is 32 g/m. The tension on the string is 80 N. The speed of the wave in the string is

(A) 5/2 m/s (B) $\sqrt{5/2}$ m/s (C) 2/5 m/s
(D) $\sqrt{2/5}$ m/s (E) 50 m/s

33. Consider the propagation of sound (with velocity 330 m/s) in a pipe of length 1.5 m with one end closed and the other open. The frequency associated with the fundamental mode is

(A) 11 Hz (B) 55 Hz (C) 110 Hz
(D) 165 Hz (E) 275 Hz

34. A standing wave propagating with velocity 300 m/s in an open pipe of length 4 m has four nodes. The frequency of the wave is

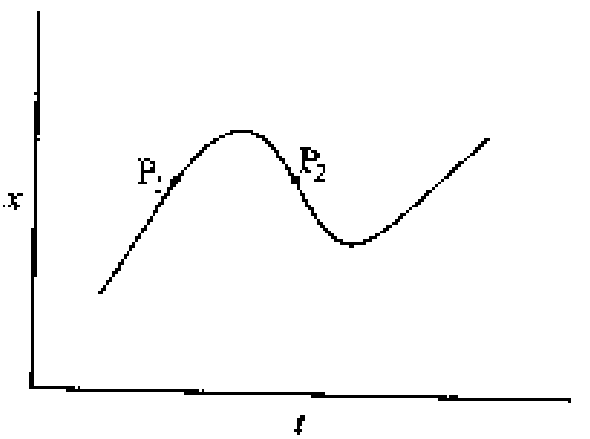
(A) 75 Hz (B) 100 Hz (C) 150 Hz
(D) 300 Hz (E) 600 Hz

Space for rough work

35. Consider a vehicle emitting sound wave of frequency 700 Hz moving towards an observer at a speed 22 m/s. Assuming the observer as well as the medium to be at rest and velocity of sound in the medium to be 330 m/s, the frequency of sound as measured by the observer is

(A) 2525/4 Hz (B) 1960/3 Hz (C) 2240/3 Hz
(D) 750 Hz (E) 5625/7 Hz

36. The x-t plot shown in the figure below describes the motion of the particle, along x-axis, between two positions A and B. The particle passes through two intermediate points P_1 and P_2 as shown in the figure



(A) The instantaneous velocity is positive at P_1 and negative at P_2
(B) The instantaneous velocity is negative at both P_1 and P_2
(C) The instantaneous velocity is negative at P_1 and positive at P_2
(D) The instantaneous velocity is positive at both P_1 and P_2
(E) The instantaneous velocity is always positive

Space for rough work

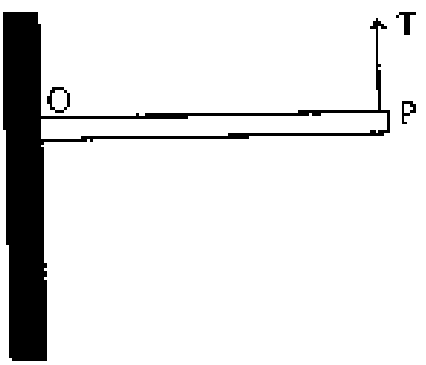
37. A ball falls from a table top with initial horizontal speed V_0. In the absence of air resistance, which of the following statement is correct

(A). The vertical component of the acceleration changes with time
(B) The horizontal component of the velocity does not change with time
(C) The horizontal component of the acceleration is non zero and finite
(D) The time taken by the ball to touch the ground depends on V_0
(E) The vertical component of the acceleration varies with time

38. A man of mass 60 kg climbed down using an elevator. The elevator had an acceleration 4 ms^{-2}. If the acceleration due to gravity is 10 ms^{-2}, the main apparent weight on his way down is

(A) 60 N (B) 240 N (C) 360 N
(D) 840 N (E) 3600 N

39. A uniform rod of length of 1 m and mass of 2 kg is attached to a side support at O as shown in the figure. The rod is at equilibrium due to upward force T acting at P. Assume the acceleration due to gravity as 10 m/s^2. The value of T is



(A) 0
(B) 2 N
(C) 5 N
(D) 10 N
(E) 20 N

Space for rough work

40. A capillary tube of radius 0.5 mm is immersed in a beaker of mercury. The level inside the tube is 0.8 cm below the resonance and angle of contact is 120°. What is the surface tension of mercury if the mass density of mercury is $\rho = 13.6 \times 10^{3}$ kgm^{-3} and acceleration due to gravity is $g = 10$ m/s^{2}?

(A) 0.225 N/m (B) 0.544 N/m (C) 0.285 N/m
(D) 0.375 N/m (E) 0.425 N/m

41. Which of the following statements related to stress-strain relation is correct

(A) Stress is linearly proportional to strain irrespective of the magnitude of the strain
(B) Stress is linearly proportional to strain above the yield point
(C) Stress is linearly proportional to strain for stress much smaller than at the yield point
(D) Stress-strain curve is same for all materials
(E) Stress is inversely proportional to strain

42. The lower edge of a square slab of side 50 cm and thickness 20 cm is rigidly fixed to the base of a table. A tangential force of 30 N is applied to the slab. If the shear moduli of the material is 4×10^{9} N/m^{2}, then displacement of the upper edge, in meters, is

(A) 4×10^{-12} (B) 4×10^{-10} (C) 6×10^{-10}
(D) 6×10^{-12} (E) 8×10^{-10}

43. Initially a beaker had 100 g of water at temperature 90°C. Later another 600 g of water at temperature 20°C was poured into the beaker. The temperature, T, of the water after mixing is

(A) 20°C (B) 30°C (C) 45°C
(D) 55°C (E) 90°C

Space for rough work

44. Match the following:

I)	Isothermal process	1)	$\Delta Q = 0$
II)	Isobaric process	2)	$\Delta V = 0$
III)	Isochoric process	3)	$\Delta P = 0$
IV)	Adiabatic process	4)	$\Delta T = 0$

(A) I-4, II-3, III-2, IV-1
(B) I-3, II-2 III-1, IV-4
(C) I-1, II-2, III-3, IV-4
(D) I-4, II-2, III-3, IV-1
(E) I-1, II-4, III-2, IV-3

45. For an ideal gas, the specific heat at constant pressure C_p is greater than the specific heat at constant volume C_v. This is because

(A) There is a finite work done by the gas on its environment when its temperature is increased while the pressure remains constant
(B) There is a finite work done by the gas on its environment when its pressure is increased while the volume remains constant
(C) There is a finite work done by the gas on its environment when its pressure is increased while the temperature remains constant
(D) The pressure of the gas remains constant when its temperature remains constant
(E) The internal energy of the gas at constant pressure is more than at constant volume

46. Which of the following statements is correct?

(A) Light waves are transverse but sound waves and waves on strings are longitudinal
(B) Sound waves and waves on a string are transverse but light waves are longitudinal
(C) Light waves and waves on a string are transverse but sound waves are longitudinal
(D) Light waves and sound waves are transverse, but waves on strings are longitudinal
(E) Light waves, sound waves and waves on a string are all longitudinal

Space for rough work

47. In Young's double slit experiment, if the separation between the slits is halved, and the distance between the slits and the screen is doubled, then the fringe width compared to the unchanged one will be

(A) Unchanged (B) Halved (C) Doubled
(D) Quadrupled (E) Fringes will disappear

48. The phase velocity of a wave described by the equation $y=\psi_0 \sin\left(kx+\omega t+\frac{\pi}{2}\right)$ is

(A) $\frac{\lambda}{T}$ (B) $\frac{\psi_0}{\omega}$ (C) $\frac{\omega}{k}$
(D) $\frac{\pi}{2k}$ (E) ψ_0

49. The direction of propagation of electromagnetic wave is along

(A) Electric field vector, $\vec{E}$ (B) Magnetic field vector, $\vec{B}$
(C) $\vec{E}\cdot\vec{B}$ (D) $\vec{E}\times\vec{B}$ (E) $\vec{B}\times\vec{E}$

50. Assume that a radio station is about 200 km away from your location and the station operates at 972 kHz. How long does it take for an electromagnetic signal to travel from the station to you and how many wave crests does it send out per second

(A) 666 μs and 9.72×10^5 crests per second
(B) 666 μs and 972×10^5 crests per second
(C) 555 μs and 97.2×10^7 crests per second
(D) 555 μs and 0.972×10^5 crests per second
(E) 444 μs and 9×10^6 crests per second

51. What wavelength must electromagnetic radiation have if a photon in the beam has the same momentum as an electron moving with a speed 1.1×10^5 m/s (Planck's constant = 6.6×10^{-34} Js, rest mass of electron 9×10^{-31} kg)?

(A) 2/3 nm (B) 20/3 nm (C) 4/3 nm
(D) 40/3 nm (E) 3/20 nm

Space for rough work

52. The electric field portion of an electromagnetic wave is given by (all variables in SI units) $E = 10^{-4} \sin(6\times10^{6}\, t - 0.01\, x)$. The frequency ($f$) and the speed ($v$) of electromagnetic wave are

(A) $f = 30/\pi$ kHz and $v = 1.5 \times 10^{7}$ m/s
(B) $f = 90/\pi$ kHz and $v = 6.0 \times 10^{7}$ m/s
(C) $f = 300/\pi$ kHz and $v = 6.0 \times 10^{7}$ m/s
(D) $f = 600/\pi$ kHz and $v = 7.5 \times 10^{7}$ m/s
(E) $f = 900/\pi$ kHz and $v = 8.0 \times 10^{7}$ m/s

53. Huygens' wave theory of light cannot explain

(A) Diffraction phenomena
(B) Interference phenomena
(C) Photoelectric effect
(D) Polarization of light
(E) Propagation of light

54. An electron, a neutron and an alpha particle have same kinetic energy and their de-Broglie wavelengths are λ_e, λ_n and λ_α respectively. Which statement is correct about their de-Broglie wavelengths?

(A) $\lambda_e > \lambda_n > \lambda_\alpha$
(B) $\lambda_e < \lambda_n > \lambda_\alpha$
(C) $\lambda_e < \lambda_n < \lambda_\alpha$
(D) $\lambda_e > \lambda_n < \lambda_\alpha$
(E) $\lambda_e = \lambda_n < \lambda_\alpha$

55. It takes 4.6 eV to remove one of the least tightly bound electrons from a metal surface. When monochromatic photons strike the metal surface, electrons having kinetic energy from zero to 2.2 eV are ejected. What is the energy of the incident photons?

(A) 2.4 eV
(B) 2.2 eV
(C) 6.8 eV
(D) 4.6 eV
(E) 5.8 eV

56. If copper and silicon pieces are heated, the resistance of

(A) each will increase
(B) each will decrease
(C) copper will increase and silicon will decrease
(D) copper will decrease and silicon will increase
(E) both does not change

Space for rough work

57. In an insulator, band gap is of the order of

(A) 0.1 eV (B) 1 eV (C) 5 eV
(D) 100 eV (E) 1 MeV

58. For a P-N junction diode

(A) Forward current is in mA and reverse current is in μA
(B) Forward current is in μA and reverse current is in mA
(C) Both forward and reverse currents are in μA
(D) Both forward and reverse currents are in mA
(E) No current flows in any direction

59. For a Zener diode

(A) both p and n regions are heavily doped
(B) p region is heavily doped but n region is lightly doped
(C) n region is heavily doped but p region is lightly doped
(D) both p and n regions are lightly doped
(E) depletion region is very thick

60. Speech signal is in the range of

(A) 3700 to 7000 Å wavelength (B) 20 Hz to 20 kHz frequency
(C) 300 to 3100 Hz frequency (D) 540 to 1600 kHz frequency
(E) 88 to 108 MHz frequency

61. Wavelength of the wave with 30 MHz frequency is

(A) 1 cm (B) 10 cm (C) 100 cm
(D) 1000 cm (E) 10000 cm

62. To transmit a signal of frequency, ω_m, with a carrier frequency, ω_c, in AM transmission, the bandwidth of the filter and amplifier is

(A) ω_m (B) $2\omega_m$ (C) ω_c
(D) $\omega_c - \omega_m$ (E) $\omega_c + \omega_m$

Space for rough work

63. If a magnet is dropped through a vertical hollow copper tube then

(A) the time taken to reach the ground is longer than the time taken if the tube was made out of plastic

(B) the magnet will get attracted and stick to the copper tube

(C) the time taken to reach the ground is longer than the time taken if the tube was made out of stainless steel

(D) the time taken to reach the ground does not depend on the radius of the copper tube

(E) the magnet will be repelled away by the tube

64. Consider a circular wire loop of radius R spinning about a diametrical chord which is perpendicular to a uniform magnetic field $\left(\vec{B}=B_0\hat{k}\right)$.

(A) The magnitude of the induced EMF in the loop is maximum when the plane of the loop is perpendicular to $\vec{B}$

(B) Flux through the loop is minimum when the plane of the loop is perpendicular to $\vec{B}$

(C) The direction of induced current remains same during the spinning motion of the loop

(D) EMF induced will be the same for a larger radius of the loop in the same field

(E) No EMF will be induced since magnetic field is constant

65. An electric motor when loaded has an effective resistance of 30 Ω and an inductive reactance of 40 Ω. If the motor is powered by a source with maximum voltage of 420 V, the maximum current is

(A) 6 A (B) 8.4 A (C) 10 A
(D) 12 A (E) 13 A

66. Which of the following particle when bombards on ^{65}Cu will turn into ^{66}Cu

(A) Proton (B) Neutron (C) Electron
(D) Alpha particle (E) Deutron

Space for rough work

67. CO^+ ion moving with kinetic energy of 20 keV dissociates into O^+ and C which move along the parent ion direction. Assuming no energy is released during dissociation, the kinetic energies of the daughters $(K.E)_{O^+}$ and $(K.E)_C$ are related as

(A) $(K.E)_{O^+} = (K.E)_C$ (B) $(K.E)_{O^+} / (K.E)_C = 16/12$
(C) $(K.E)_{O^+} / (K.E)_C = 12/16$ (D) $(K.E)_{O^+} / (K.E)_C = 16/28$
(E) $(K.E)_{O^+} / (K.E)_C$ 28/16

68. If the rms value of sinusoidal input to a full wave rectifier is $V_0/\sqrt{2}$ then the rms value of the rectifier's output is

(A) $\frac{V_0}{\sqrt{2}}$ (B) $\frac{V_0^2}{\sqrt{2}}$ (C) $\frac{V_0^2}{2}$
(D) $\sqrt{2}V_0^2$ (E) $2V_0^2$

69. Eight grams of Cu^{66} undergoes radioactive decay and after 15 minutes only 1 g remains. The half-life, in minutes, is then

(A) 15 ln(2)/ln(8) (B) 15 ln(8)/ln(2) (C) 15/8
(D) 8/15 (E) 15 ln(2)

70. For a light nuclei, which of the following relation between the atomic number (Z) and mass number (A) is valid

(A) A = Z/2 (B) Z = A (C) Z A/2
(D) Z = A^2 (E) A Z^3

71. A wheel rotating at 12 rev/s is brought to rest in 6 s. The average angular deceleration in rad/s^2 of the wheel during this process is

(A) 4π (B) 4 (C) 72
(D) $1/\pi$ (E) π

72. A torque of 1 N.m is applied to a wheel which is at rest. After 2 seconds the angular momentum in kg.m^2/s is

(A) 0.5 (B) 1 (C) 2
(D) 4 (E) 3

Space for rough work

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Q. No.	Answer Key
	Ver. A1
1	C
2	A
3	B
4	A
5	E
6	E
7	C
8	E
9	E
10	D
11	A
12	D
13	D
14	D
15	B
16	D
17	A
18	D
19	D
20	C
21	D
22	A
23	A
24	E
25	C
26	E
27	D
28	B
29	B
30	C
31	B
32	E
33	B
34	C
35	D
36	A
37	B
38	C
39	D
40	B
41	C
42	C
43	B
44	A
45	A
46	C
47	D
48	C
49	D
50	A
51	B
52	C
53	C
54	A
55	C
56	C
57	C
58	A
59	A
60	C

Q. No.	Answer Key
	Ver. A1
61	D
62	B
63	A
64	A
65	B
66	B
67	B
68	A
69	A
70	C
71	A
72	C

Commissioner for Entrance Examinations
Thiruvananthapuram