GENERAL DIRECTIONS:

- CHOOSE THE BEST ANSWER FROM THE SUGGESTED OPTIONS
- YOU MAY REFER THE INFORMATION GIVEN BELOW WHEN YOU WORK ON SOME OF THE QUESTIONS.

Constant	Symbol	Value
Acceleration due to gravity	g	10 m/s^2
Pi	π	3.14
The specific heat capacity of water	c	4200 J/kgK
Permittivity of free space	ε_0	$8.85x10^{9}Fm^{-1}$
Sin 45^0 = Cos 45^0 = $\frac{\sqrt{2}}{2}$		
Sin 60^0 = Cos 30^0 = 0.866		
Sin 30^0 = Cos 60^0 = 0.5		
Sin 37^0 = 0.6		
Cos 37^0 = 0.8		
Sin 29^0 = 0.484		
Cos 29^0 = 0.8		
Sin 15^0 = 0.258		

Grade 9 & 11
Vectors

1. Two vectors A and B are perpendicular to each other. The magnitude of the resultant is $\sqrt{80}$ unit and $A = 2B$. Determine the magnitude of A and B.
   A. A = 8 and B = 4 B. A = 4 and B = 2 C. A = 16 and B = 8 D. A = 6 and B = 3
2. Which of the following set of units are units of basic quantities?
   A. Kilogram, Newton, Ampere
   B. Meter per second, Mole, Pascal
   C. Kelvin, Meter, Second
   D. Watt, Ampere, Newton
3. If $|\vec{A}x\vec{B}| = \sqrt{3}\vec{A}.\vec{B}$ then the value of $|\vec{A}+\vec{B}|$ is
   A. $\sqrt{A^2+B^2+\sqrt{3}AB}$ B. $\sqrt{A^2+B^2+AB}$ C. $\sqrt{A^2+B^2+\frac{AB}{\sqrt{3}}}$ D. $A+B$
4. The angle between the two vectors $\vec{A} = 3\hat{\imath}+4\hat{\jmath}+5\hat{k}$ and $\vec{B} = 3\hat{\imath}+4\hat{\jmath}-5\hat{k}$ will be
   A. Zero B. 45^0 C. 90^0 D. 180^0
5. The dimensional formula of torque is
   A. $[ML^2T^{-2}]$ B. $[MLT^{-2}]$ C. $[ML^{-1}T^{-2}]$ D. $[ML^{-2}T^{-2}]$
6. If the magnitude of sum of two vectors is equal to the magnitude of difference of the two vectors, the angle between these vectors is:
   A. 0° B. 90° C. 45° D. 180°
7. If $\vec{A} = p\hat{\imath}-2p\hat{\jmath}-\hat{k}$ and $\vec{B} = -3\hat{\imath}+2\hat{\jmath}-14\hat{k}$ are perpendicular to each other. Then $p =$ ___.
   A. 3 B. 4 C. 2 D. 1
8. $\vec{A} = -\hat{\imath}+\hat{\jmath}-2\hat{k}$ and $\vec{B} = 2\hat{\imath}-\hat{\jmath}+\hat{k}$. Find the unit vector in the direction of $\vec{A}\,x\,\vec{B}$
   A. $\frac{1}{\sqrt{23}}(-\hat{\imath}-5\hat{\jmath}-2\hat{k})$ C. $\frac{1}{\sqrt{29}}(-\hat{\imath}-5\hat{\jmath}-3\hat{k})$
   B. $\frac{1}{\sqrt{35}}(-\hat{\imath}+5\hat{\jmath}-3\hat{k})$ D. $\frac{1}{\sqrt{35}}(-\hat{\imath}-5\hat{\jmath}-3\hat{k})$

9. Find a unit vector in the direction of $\hat{\imath} + 2\hat{\jmath} - 3\hat{k}$

A. $\frac{1}{\sqrt{7}}(\hat{\imath} + 2\hat{\jmath} - 3\hat{k})$ C. $\frac{1}{\sqrt{14}}(\hat{\imath} + 2\hat{\jmath} - 3\hat{k})$

B. $-\frac{1}{2}(\hat{\imath} + 2\hat{\jmath} - 3\hat{k})$ D. $\frac{1}{\sqrt{5}}(\hat{\imath} + 2\hat{\jmath} - 3\hat{k})$

10. Which of the following is **NOT** a vector quantity?

A. Displacement B. Electric field C. Work D. Acceleration

Motion in a straight line and Kinematics

11. A body is moving with velocity 30 m/s towards east. After 10 seconds its velocity becomes 40 m/s towards north. The average acceleration of the body is

A. $1\frac{m}{s^2}$ B. $7\frac{m}{s^2}$ C. $7\frac{m}{s^2}$ D. $5\frac{m}{s^2}$

12. If a car at rest accelerates uniformly to a speed of 144 km/h in 20 s, it covers a distance of

A. 2880 m B. 1440 m C. 400 m D. 20 m

13. The displacement x (in meter) of a particle of mass m (in kg) moving in one dimension under the action of a force, is related to time t (in sec) by $t = \sqrt{x} + 3$. The displacement of the particle when its velocity is zero, will be

A. 2 m B. 4 m C. zero D. 6 m

14. Two bodies, A (of mass 1 kg) and B (of mass 3 kg), are dropped from heights of 16m and 25m, respectively. The ratio of the time taken by them to reach the ground is

A. 12/5 B. 5/12 C. 4/5 D. 5/4

15. A ball is thrown vertically upward. It has a speed of 10 m/sec when it has reached one half of its maximum height. How high does the ball rise? Take g = 10 m/s^2

A. 10 m B. 5 m C. 15 m D. 20 m

16. If the velocity of a particle is $V = At + Bt^2$, where A and B are constants, then the distance travelled by it between 1s and 2s is:

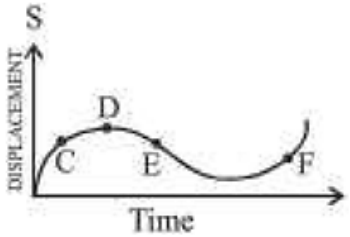
A. $\frac{3}{2}A + 4B$ B. $3A + 7B$ C. $\frac{3}{2}A + \frac{7}{3}B$ D. $\frac{1}{2}A + \frac{B}{3}$

17. A boy standing at the top of a tower of 20m height drops a stone. Assuming g = 10 m/s^2 , the velocity with which it hits the ground is

A. 10.0 m/s C. 40.0 m/s

B. 20.0 m/s D. 5.0 m/s

18. The displacement time graph of a moving particle is shown below



The instantaneous velocity of the particle is negative at the point

A. D

B. F

C. C

D. E

Work, energy and power

19. A particle moves with a velocity $\vec{v} = 6\hat{\imath} - 4\hat{\jmath} + 3\hat{k}$ m/s under the influence of a constant force $\vec{F} = 20\hat{\imath} + 15\hat{\jmath} - 5\hat{k}$ N. The instantaneous power applied to the particle is

A. 45 J/s B. 35 J/s C. 25 J/s D.195 J/s

20. The potential energy of a system increases if work is done

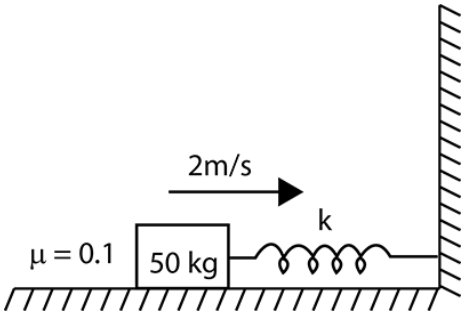
A. Upon the system by a non-conservative force B. By the system against a conservative force

C. By the system against a non-conservative force D. Upon the system by a conservative force

21. A body of mass 3 kg is under a constant force which causes a displacement s in metres in it, given by the relation $s = \frac{1}{3}t^2$, where t is in seconds. Work done by the force in 2 seconds is

A. $\frac{3}{8}$ J B. $\frac{8}{3}$ J C. $\frac{19}{5}$ J D. $\frac{5}{19}$ J

22. A block of mass 50 kg is projected horizontally on a rough horizontal floor. The coefficient of friction between the block and the floor is 0.1. The block strikes a light spring of stiffness k=100 N/m with a velocity 2 m/s. The maximum compression of the spring is :



A. 4m
B. 3m
C. 2m
D. 1m

23. A uniform force of $(3\hat{\imath} + \hat{\jmath})$N acts on a particle of mass 2 kg. The particle is displaced from position $(2\hat{\imath} + \hat{k})$ m to position $(4\hat{\imath} + 3\hat{\jmath} - \hat{k})$ m. The work done by the force on the particle is

A. 6 J B. 13 J C. 15 J D. 9 J

Simple machines

24. Which of the following statements are correct?

A. Centre of mass of a body always coincides with the centre of gravity of the body.
B. Centre of mass of a body is the point at which the total gravitational torque on the body is zero.
C. A couple on a body produces both translational and rotation motion in a body.
D. Mechanical advantage greater than one means that small effort can be used to lift a large load

a) (A) and (B) c) (C) and (D)
b) (B) and (C) d) (B) and (D)

Fluid statics and Properties of bulk matter

25. Which of the following is **true**?

A. The buoyant force on a floating object is less than its weight.
B. A pressure applied to a confined fluid increases the pressure throughout the fluid by the same amount.
C. The buoyant force on an object immersed in a fluid is equal to the weight of the object.
D. The downward pressure on the top surface of a block immersed in a fluid is greater than the upward pressure on its bottom surface.

26. If you stand on one foot on the floor of your class room, what will be the pressure exert on the floor?

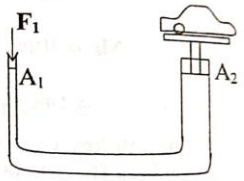
A. Twice the pressure you exert if you stand on two feet.
B. Half the pressure you exert if you stand on two feet.
C. The same as the pressure you exert if you stand on two feet.
D. Half the pressure you exert if you sit on the floor.

27. An egg is placed at the bottom of a vessel filled with water. Common salt is slowly added and dissolved in the water until the egg rises and floats at the surface. From this information one could conclude that:

A. The density of the salt exceeds the density of the egg.

B. There is a tendency for Calcium in the egg shell to be repelled by sodium chloride.
C. Salt sinks to the bottom.
D. There is no physical explanation.

28. Which of the following describes Pascal's principle?
    A. Pressure change in an enclosed liquid is transmitted to every part equally.
    B. Pressure at the same depth in a given liquid is the same everywhere.
    C. A body immersed in a liquid is pushed up by a force equal to the weight of water it displaces.
    D. In a given liquid, the greater the depth the greater is pressure.
29. Consider the hydraulic press as shown below. Suppose a force of 12000 N is applied to the right of the piston. If the area of the cylinder holding the car up is 10 times greater than the area of the left cylinder, what is the force F_1 that must be applied to the left piston?



A. $1.2\ x\ 10^4 N$
B. $1.2\ x\ 10^3 N$
C. $12\ x\ 10^3 N$
D. $0.12\ x\ 10^3 N$

30. Steam at 100°C is passed into 20 g of water at 10°C. When water acquires a temperature of 80°C, the mass of water present will be: [Take specific heat of water = 1 cal g^{-1} $°C^{-1}$ and latent heat of steam = 540 cal g^{-1}]
    A. 24 g B. 31.5 g C. 42.5 g D. 22.5 g
31. The density of unknown liquid is 500kg/m^3. What is the relative density of the liquid? (Density of water $= 1000 kg/m^3$)
    B. 0.5 B. 2 C. 5 D. 0.2
    Solution

Temperature and heat

32. Absolute zero temperature is
    A. The temperature at which particles change its state from solid to liquid
    B. The temperature at which particles change its state from liquid to gas
    C. The temperature at which solid and liquid phase can coexist in phase equilibrium condition.
    D. The lowest temperature at which particles stop moving
33. The amount of heat required to raise temperature of a unit mass (1kg) of the substance per unit kelvin (K) or ℃ is:
    A. Heat capacity C. Temperature
    B. Specific heat capacity D. Quantity of heat

Wave motion and sound

34. Two waves of the same frequency and intensity superimpose each other in opposite phases. After the superposition, the intensity and frequency of waves will
    A. Increase B. Decrease C. Remain constant D. Become zero
35. Which one of the following statements is true?
    A. The sound waves in air are longitudinal while the light waves are transverse
    B. Both light and sound waves in air are longitudinal
    C. Both light and sound waves can travel in vacuum
    D. Both light and sound waves in air are transverse
36. Which of the following statement is **FALSE** for the properties of electromagnetic waves?
    A. Both electric and magnetic field vectors attain the maxima and minima at the same place and same time.

B. The energy in electromagnetic wave is divided equally between electric and magnetic vectors
C. Both electric and magnetic field vectors are parallel to each other and perpendicular to the direction of propagation of wave
D. These waves do not require any material medium for propagation.

37. Rainbow is formed due to a combination of
A. Dispersion and total internal reflection
B. Refraction and absorption
C. Dispersion and focusing
D. Refraction and scattering

Grade 10
Motion in 2D and rotational motion

38. A wheel rotates with a constant acceleration of 2.0 rad/s^2. If the wheel starts from rest, how many revolutions will it make in the first 10 seconds?
A. 16 revolution B. 160 revolution C. 6 revolution D. 1 revolution

39. A uniform circular disc of mass 200 g and radius 4.0 cm is rotated about one of its diameter at an angular speed of 10 rad/s. Find the kinetic energy of the disc and its angular momentum about the axis of rotation.
A. 4.0×10^{-2} J and 8.0×10^{-4} J. s
B. 4.0×10^{-3} J and 8.0×10^{-4} J. s
C. 4.0×10^{-7} J and 8.0×10^{-3} J. s
D. 4.0×10^{-8} J and 8.0×10^{-9} J. s

40. Two bullets are fired simultaneously, horizontally and with different speeds from the same place. Which bullet will hit the ground first?
A. The faster one
B. The slower one
C. Both will reach simultaneously
D. Depends on the masses.

41. A missile is fired for maximum range with an initial velocity of 20 m/s. If g = 10 m/s^2, the range of the missile is
A. 40 m B. 50 m C. 60 m D. 20 m

Introduction to electronics

42. Choose the only **FALSE** statement from the following
A. In conductors, the valence and conduction bands may overlap
B. Substances with energy gap of the order of 10 eV are insulators
C. The resistivity of a semiconductor increases with increase in temperature
D. The conductivity of a semiconductor increases with increase in temperature

43. The output of OR gate is 1
A. if either input is zero B. if both inputs are zero C. if either or both inputs are D. only if both inputs are 1

44. To obtain a *p*-type germanium semiconductor, it must be doped with
A. Arsenic B. Antimony C. Indium D. Phosphorus

45. When arsenic is added as an impurity to silicon, the resulting material is
A. *n*-type semiconductor B. *p*-type semiconductor C. *n*-type conductor D. insulator

46. Which one of the following statement is **FALSE**?
A. Pure Si doped with trivalent impurities gives a p-type semiconductor
B. Majority carriers in a n-type semiconductor are holes

C. Minority carriers in a p-type semiconductor are electrons
D. The resistance of intrinsic semiconductor decreases with increase of temperature

47. In forward bias, the width of potential barrier in a p-n junction diode

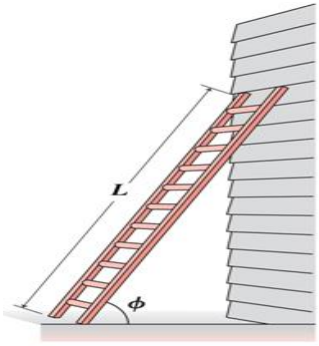
A. Increases B. Decreases C. Remains constant D. No change

48. In forward biasing of the p–n junction
A. the positive terminal of the battery is connected to p–side and the depletion region becomes thick
B. the positive terminal of the battery is connected to n–side and the depletion region becomes thin
C. the positive terminal of the battery is connected to n–side and the depletion region becomes thick
D. the positive terminal of the battery is connected to p–side and the depletion region becomes thin

Grade 11

Forces and Newton's laws of motion, and Dynamics

49. A ladder rests against a wall at an angle of 60° to the horizontal as shown below. The ladder is 10m long and has a mass of 40kg. The wall is considered to be frictionless. Which one of the following is the magnitude of the frictional force applied to keep the ladder in its state of static equilibrium? ($\mu_{ground} = 0.24$)



A. 400N
B. 48N
C. 96N
D. 40N

50. A 50 kg block rest on a smooth plane inclined at 37^0 to the horizontal. The force needed to push the block up the plane is 400N. What is the magnitude of the acceleration of the block?
A. 2 m/s^2 B. 3 m/s^2 C. 5 m/s^2 D. 1 m/s^2

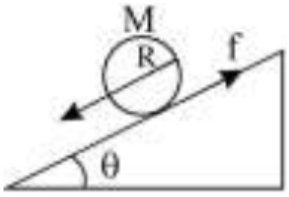
51. What force is required to accelerate a 2kg object at 4 m/s^2?
A. 2 N B. 8 N C. 5 N D. 1 N

52. Which of the following is not true?
A. The rolling friction is much less than sliding friction.
B. Once the body is in motion, the force needed to keep the body in motion is less than the starting force.
C. The static friction depends on the area of the surface in contact.
D. The value of static coefficient of friction is always between 0 and 1.

53. A 10 N force is applied on a body produces an acceleration of 1 m/s^2. The mass of the body is
A. 5 kg B. 10 kg C. 15 kg D. 20 kg

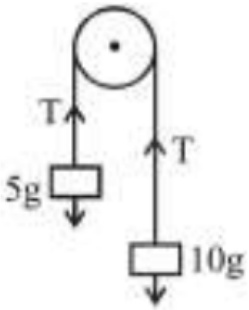
54. A ball is dropped from a satellite revolving around the earth at a height of 120 km. The ball will
A. continue to move with same speed along a straight line tangentially to the satellite at that time
B. continue to move with the same speed along the original orbit of satellite
C. fall down to earth gradually
D. go far away in space

55. A drum of radius R and mass M, rolls down without slipping along an inclined plane of angle θ. The frictional force



A. Dissipates energy as heat
B. Decreases the rotational motion
C. Decreases the rotational and translational motion
D. Converts translational energy to rotational energy

56. Two blocks $m_1 = 5\ gm$ and $m_2 = 10\ gm$ are hung vertically over a light frictionless pulley as shown here. What is the acceleration of the masses when they are left free?



A. $\frac{g}{3}$
B. $\frac{g}{2}$
C. g
D. $\frac{g}{5}$

57. The speed of a homogenous solid sphere after rolling down an inclined plane of vertical height h from rest without sliding is

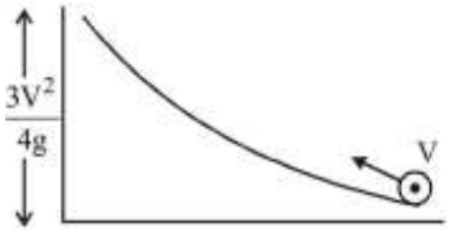
A. $\sqrt{\frac{10}{7}gh}$ B. $\sqrt{gh}$ C. $\sqrt{\frac{6}{5}gh}$ D. $\sqrt{\frac{4}{3}gh}$

58. A particle of mass m is thrown upwards from the surface of the earth, with a velocity u. The mass and the radius of the earth are, respectively, M and R. G is gravitational constant and g is acceleration due to gravity on the surface of the earth. The minimum value of **u** so that the particle does not return back to earth, is

A. $\sqrt{\frac{2GM}{R}}$ B. $\sqrt{\frac{2GM}{R^2}}$ C. $\sqrt{2gR^2}$ D. $\sqrt{\frac{2GM}{R}}$

59. When a body moves with a constant speed along a circle
    A. its velocity remains constant
    B. no force acts on it
    C. no work is done on it
    D. no acceleration is produced in it

60. A small object of uniform density rolls up a curved surface with an initial velocity v. It reaches up to a maximum height of with respect to the initial position.



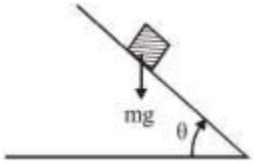
The object is a:_____
A. solid sphere B. hollow sphere C. disc D. ring

61. Two bodies of masses m and 4 m are moving with equal KE. The ratio of their linear momentum is
A. 4 : 1 B. 1 : 1 C. 1 : 2 D. 1 : 4

62. Two bodies with kinetic energies in the ratio 4:1 are moving with equal linear momentum. The ratio of their masses is

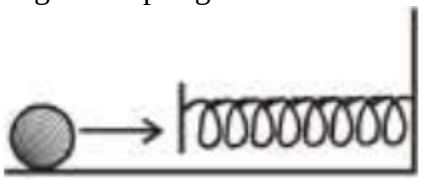
A. 1 : 2 B. 1 : 1 C. 4 : 1 D. 1 : 4

63. A plank with a box on it at one end is gradually raised about the other end. As the angle of inclination with the horizontal reaches 30º the box starts to slip and slides 4.0 m down the plank in 4.0s. The coefficients of static and kinetic friction between the box and the plank will be, respectively:



A. 0.6 and 0.5 B. 0.5 and 0.6 C. 0.4 and 0.3 D. 0.6 and 0.6

64. A mass of 0.5 kg moving with a speed of 1.5 m/s on a horizontal smooth surface, collides with a nearly weightless spring of force constant k = 50 N/m. The maximum compression of the spring would be



A. 0.5 m B. 0.15 m C. 0.12 m D. 1.5 m

65. The co-efficient of restitution (e) for a perfectly elastic collision is

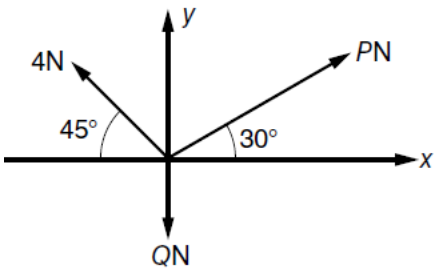
A. 1 B. 0 C. ∞ D. -1

66. A block of mass 1 kg is placed on a truck which accelerates with acceleration 5m/s^2. The coefficient of static friction between the block and truck is 0.6. The frictional force acting on the block is

A. 5 N B. 6 N C. 5.88 N D. 4.6 N

Equilibrium

67. A particle is acted on by the forces as shown in Figure below. Which one of the following is the magnitude of the force P to be the particle is in its state of equilibrium?



A. $\frac{4\sqrt{6}}{3}$N C. $9\sqrt{6}$N

B. $4\sqrt{2}$N D. 4N

Grade 12

Thermodynamics

68. The molar specific heats of an ideal gas at constant pressure and volume are denoted by C_p and C_v respectively. If $\gamma = \frac{C_p}{C_v}$ and R is the universal gas constant, then C_v is equal to:

A. $\frac{R}{\gamma-1}$ B. $\frac{\gamma-1}{R}$ C. γR D. $\frac{1+\gamma}{1-\gamma}$

69. A sample of gas expands from volume V_1 to V_2. The amount of work done by the gas is greatest, when the expansion is
    A. Adiabatic B. Isobaric C. Isothermal D. Equal in all cases
70. A gas at 27ºC temperature and 30 atmospheric pressure is allowed to expand to the atmospheric pressure. If the volume becomes 10 times its initial volume, then the final temperature becomes
    A. 100ºC B. 173ºC C. 273ºC D. –173ºC
71. In thermodynamic processes which of the following statements is not true?
    A. In an isochoric process pressure remains constant
    B. In an isothermal process the temperature remains constant
    C. In an adiabatic process $PV^{\gamma} = constant$
    D. In an adiabatic process the system is insulated from the surroundings
72. An ideal Carnot engine, whose efficiency is 40%, receives heat at 500 K. If its efficiency is 50%, then the intake temperature for the same exhaust temperature is
    A. 600 K B. 700 K C. 800 K D. 900 K
73. At 0 K, which of the following properties of a gas will be zero?
    A. Kinetic energy B. Potential energy C. Density D. Mass
74. Which of the following processes is reversible?
    A. Transfer of heat by conduction
    B. Transfer of heat by radiation
    C. Isothermal compression
    D. Electrical heating of a nichrome wire
75. An engine has an efficiency of 1/6. When the temperature of sink is reduced by 62°C, its efficiency is doubled. Temperature of the source is
    A. 37°C B. 62°C C. 99°C D. 124°C

Oscillations and waves

76. A transverse wave propagating along x-axis is represented by $\boldsymbol{y(x,t) = 80 \sin\left(0.5\pi x - 4\pi t - \frac{\pi}{4}\right)}$ where x is in metres and t is in seconds. The speed of the wave is
    A. 0.5 π m/s B. $\frac{\pi}{4}$ m/s C. 8 m/s D. 4π m/s
77. The potential energy of a simple harmonic oscillator when the particle is half way to its end point is
    A. $\frac{1}{2}$E B. $\frac{2}{3}$E C. $\frac{1}{8}$E D. $\frac{1}{4}$E
78. Which one of the following is a simple harmonic motion?
    A. Ball bouncing between two rigid vertical walls
    B. Particle moving in a circle with uniform speed
    C. Wave moving through a string fixed at both ends
    D. Earth spinning about its own axis.
79. The time period of a mass suspended from a spring is T. If the spring is cut into four equal parts and the same mass is suspended from one of the parts, then the new time period will be
    A. 2T B. $\frac{T}{4}$ C. 2 D. $\frac{T}{2}$
80. A particle starts simple harmonic motion from the mean position. Its amplitude is A and time period is T. What is its displacement when its speed is half of its maximum speed
    A. $\frac{\sqrt{2}}{3}A$ B. $\frac{\sqrt{3}}{2}A$ C. $\frac{2}{\sqrt{2}}A$ D. $\frac{A}{\sqrt{2}}$
81. A particle executes simple harmonic oscillation with an amplitude a. The period of oscillation is T. The minimum time taken by the particle to travel half of the amplitude from the equilibrium position is

A. $\frac{T}{8}$ B. $\frac{T}{12}$ C. $\frac{T}{2}$ D. $\frac{T}{4}$

82. The circular motion of a particle with constant speed is
    A. periodic but not simple harmonic
    B. simple harmonic but not periodic
    C. periodic and simple harmonic
    D. neither periodic nor simple harmonic

83. A transverse wave is represented by $y = A\,sin\,(\omega\,t - kx)$. For what value of the wavelength is the wave velocity equal to the maximum particle velocity?
    A. $\frac{\pi A}{2}$ B. πA C. $2\pi A$ D. $3\pi A$

84. Resonance is an example of
    A. tuning fork
    B. forced vibration
    C. free vibration
    D. damped vibration

Wave optics and Electromagnetic waves and geometrical optics

85. Two sound waves with wavelengths 5.0 m and 5.5m respectively each propagate in a gas with velocity 330 m/s. We expect the following number of beats per second
    A. 0 Hz B. 1 Hz C. 6 Hz D. 12 Hz

86. Which one of the following statements is true for the speed v and the acceleration (a) of a particle executing simple harmonic motion?
    A. When v is maximum, a is zero
    B. When v is maximum, a is maximum
    C. Value of a is zero, whatever may be the value of v
    D. When v is zero, a is zero

87. Which of the following equations represent a wave?
    A. $y = A \sin \omega t$
    B. $y = A\cos kx$
    C. $y = A \sin (\omega t - kx + c)$
    D. $y = A (\omega t - kx)$

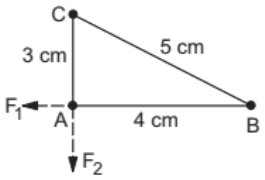
88. Which of the following electromagnetic radiations has the least wavelength?
    A. Gamma rays B. Infra-red C. Ultraviolet D. X-ray

89. A closed organ pipe (closed at one end) is excited to support the third overtone. It is found that air in the pipe has
    A. Three nodes and three antinodes
    B. Three nodes and four antinodes
    C. Four nodes and three antinodes
    D. Four nodes and four antinodes

90. If we study the vibration of a pipe open at both ends, and then which of the following statements is **not** true?
    A. Odd harmonics of the fundamental frequency will be generated
    B. All harmonics of the fundamental frequency will be generated
    C. Pressure change will be maximum at both ends
    D. Antinode will be at open end

Electrostatics

91. Three equal charges, each having a magnitude of 2.0×10^{-6} C, are placed at the three corners of a right angled triangle of sides 3 cm, 4 cm and 5 cm. Find the force on the charge at the right-angle corner.



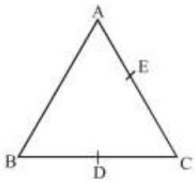
A. 45.9N B. 459N C. 4.59N D. 49N

92. As a result of change in the magnetic flux linked to the closed loop shown in the Figure below an emf V volt is induced in the loop. The work done (Joules) in taking a charge Q coulomb once along the loop is



A. QV B. 2QV C. $\frac{QV}{2}$ D. Zero

93. Three charges, each +q, are placed at the corners of an isosceles triangle ABC of sides BC and AC, 2a. D and E are the mid points of BC and CA. The work done in taking a charge Q from D to E is



A. $\frac{3qQ}{8\pi\varepsilon_0 a}$ B. $\frac{qQ}{4\pi\varepsilon_0 a}$ C. Zero D. $\frac{3qQ}{4\pi\varepsilon_0 a}$

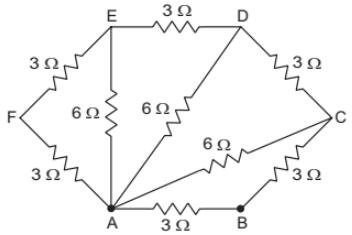
94. The formation of a dipole is due to two equal and dissimilar point charges placed at a
    A. short distance
    B. long distance
    C. Infinite distance
    D. Any distance

95. A parallel plate capacitor has a uniform electric field *E* in the space between the plates. If the distance between the plates is *d* and area of each plate is *A*, the energy stored in the capacitor is:

A. $\frac{1}{2}\varepsilon_0 E^2$ B. $\frac{AdE^2}{\varepsilon_0}$ C. $\frac{1}{2}\varepsilon_0 E^2 Ad$ D. $\varepsilon_0 EAd$

Steady electric current and circuit properties

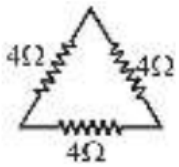
96. Find the effective resistance between the points A and B in figure below.



A. 6Ω B. 2Ω C. 3Ω D. 1Ω

97. Eddy currents are produced when
    A. A metal is kept in varying magnetic field
    B. A metal is kept in steady magnetic field
    C. A circular coil is placed in a magnetic field
    D. Through a circular coil, current is passed

98. Three resistances each of 4 Ω are connected to form a triangle.



The resistance between any two terminals is

A. 12 Ω B. 2 Ω C. 6Ω D. $\frac{8}{3}\Omega$

99. A step-up transformer operates on a 230 V line and supplies a load of 2 ampere. The ratio of the primary and secondary windings is 1:25. The current in the primary is
A. 25 A B. 50 A C. 15 A D. 12.5 A

100. If specific resistance of a potentiometer wire is $10^{-7}\Omega m$, the current flow through it is 0.1 A and the crosssectional area of wire is $10^{-6}\,m^2$ then potential gradient will be
A. $10^{-2}\ \frac{volt}{m}$ B. $10^{-4}\ \frac{volt}{m}$ C. $10^{-6}\ \frac{volt}{m}$ D. $10^{-8}\ \frac{volt}{m}$

101. The resistivity (specific resistance) of a copper wire
A. Increases with increase in its temperature
B. Decreases with increase in its cross-section
C. Increases with increase in its length
D. Increases with increase in its cross-section

102. Kirchhoff's first and second laws for electrical circuits are consequences of
A. conservation of electric charge and energy respectively
B. conservation of electric charge
C. conservation of energy and electric charge respectively
D. conservation of energy

103. A 4μF conductor is charged to 400 volts and then its plates are joined through a resistance of 1 kΩ. The heat produced in the resistance is
A. 0.16 J B. 1.28 J C. 0.64 J D. 0.325 J

104. A galvanometer acting as a voltmeter will have
A. A low resistance in series with its coil
B. A high resistance in parallel with its coil
C. A high resistance in series with its coil
D. A low resistance in parallel with its coil

105. Kirchhoff's first law, $\Sigma i = 0$ at a junction, deals with the conservation of
A. Charge B. Energy C. Momentum D. Angular momentum

Electromagnetism and Electromagnetic induction and a.c circuits

106. A positively charged particle moving due east enters a region of uniform magnetic field directed vertically upwards. The particle will
A. Continue to move due east
B. Move in a circular orbit with its speed unchanged
C. Move in a circular orbit with its speed increased
D. Gets deflected vertically upwards.

107. Tesla is the unit of
A. Magnetic flux B. Magnetic field C. Magnetic induction D. Magnetic moment

108. There are four light–weight–rod samples A, B, C, D separately suspended by threads. A bar magnet is slowly brought near each sample and the following observations are noted
I. A is feebly repelled
II. B is feebly attracted
III. C is strongly attracted
IV. D remains unaffected
Which one of the following is true?
a) B is of a paramagnetic material
b) C is of a diamagnetic material
c) D is of a ferromagnetic material

d) A is of a non–magnetic material

109. The magnetic field ($d\vec{B}$) due to a small element (dl) at a distance ($\vec{r}$) and element carrying current I is

A. $d\vec{B} = \frac{\mu_0 I}{4\pi}\left(\frac{d\vec{l}\,x\,\vec{r}}{r}\right)$ C. $d\vec{B} = \frac{\mu_0 I^2}{4\pi}\left(\frac{d\vec{l}\,x\,\vec{r}}{r}\right)$

B. $d\vec{B} = \frac{\mu_0 I^2}{4\pi}\left(\frac{d\vec{l}\,x\,\vec{r}}{r^2}\right)$ D. $d\vec{B} = \frac{\mu_0 I}{4\pi}\left(\frac{d\vec{l}\,x\,\vec{r}}{r^3}\right)$

110. A charged particle of charge q and mass m enters perpendicularly in a magnetic field $\vec{B}$. Kinetic energy of the particle is E; then frequency of rotation is

A. $\frac{qB}{m\pi}$ B. $\frac{qB}{2m\pi}$ C. $\frac{qBE}{2m\pi}$ D. $\frac{qB}{2\pi E}$

111. A charged particle moves through a magnetic field in a direction perpendicular to it. Then the

A. velocity remains unchanged C. direction of the particle remains unchanged

B. speed of the particle remains unchanged D. acceleration remains unchanged

112. When a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non-zero. This implies that

A. angle between $\vec{v}$ and $\vec{B}$ can have any value other than 90°

B. angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°

C. angle between $\vec{v}$ and $\vec{B}$ is either zero or 180°

D. angle between $\vec{v}$ and $\vec{B}$ is necessarily 90°

113. A long solenoid carrying a current produces a magnetic field *B* along its axis. If the current is double and the number of turns per cm is halved, the new value of the magnetic field is

A. 4B B. $\frac{B}{2}$ C. B D. 2B

114. Faraday's laws are consequence of conservation of

A. Energy B. Energy and magnetic field C. Charge D. Magnetic field

115. An inductor 20 mH, a capacitor 50 μF and a resistor 40Ω are connected in series across a source of emf $V = 10\,sin\,340\,t$. The power loss in A.C. circuit is:

A. 0.51 W B. 0.67 W C. 0.76 W D. 0.89 W

116. The current in self-inductance L = 40 mH is to be increased uniformly from 1 amp to 11 amp in 4 milliseconds. The emf induced in the inductor during the process is

A. 100 volt B. 0.4 volt C. 4.0 volt D. 440 volt

117. The instantaneous values of alternating current and voltages in a circuit are given as

$$I = \frac{1}{\sqrt{2}}\sin(100\pi t)\ \text{A}$$

$$V = \frac{1}{\sqrt{2}}\sin\left(100\pi t + \frac{\pi}{3}\right)\text{V}$$

The average power in Watts consumed in the circuit is:

A. $\frac{1}{4}$ B. $\frac{\sqrt{3}}{4}$ C. $\frac{1}{2}$ D. $\frac{1}{8}$

118. In an experiment, 200 V A.C. is applied at the ends of an **LCR** circuit. The circuit consists of an inductive reactance $X_L = 50\ \Omega$, capacitive reactance $X_C = 50\ \Omega$ and Ohmic resistance $R = 10\ \Omega$. The impedance of the circuit is

A. 10Ω B. 20Ω C. 30Ω D. 40Ω

119. A capacitor has capacity *C* and reactance *X*. If capacitance and frequency become double, then reactance will be

A. 4X B. $\frac{X}{2}$ C. $\frac{X}{4}$ D. 2X

120. A coil of 40 henry inductance is connected in series with a resistance of 8 ohm and the combination is joined to the terminals of a 2 volt battery. The time constant of the circuit is

A. 20 seconds B. 5 seconds C. 1/5 seconds D. 40 seconds

121. A transistor-oscillator using a **resonant** circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency f. If L is doubled and C is changed to 4C, the frequency will be

A. 8f B. $\frac{f}{2\sqrt{2}}$ C. $\frac{f}{2}$ D. $\frac{f}{4}$

122. An inductor may store energy in

A. its electric field B. its coils C. its magnetic field D. both in electric and magnetic fields

123. Two coils have a mutual inductance 0.005 H. The current changes in the first coil according to equation $\boldsymbol{I = I_0 sin\, \omega t}$, where $\boldsymbol{I_0 = 10A}$ and $\omega = 100\pi$ radian/sec. The maximum value of emf in the second coil is

A. 2π B. 5π C. π D. 4π

Atomic Physics

124. Fusion reaction takes place at high temperature because

A. nuclei break up at high temperature
B. atoms get ionized at high temperature
C. kinetic energy is high enough to overcome the coulomb repulsion between nuclei
D. molecules break up at high temperature

125. A nuclear reaction is given by ${}^{A}_{z}X \rightarrow {}_{z+1}{}^{A}Y + {}_{-1}{}^{0}e + \bar{\nu}$ represents

A. Fission B. γ-decay C. β-decay D. Fusion

126. Which of the following is positively charged?

A. α-particle B. β-particle C. γ-rays D. X-rays

127. Solar energy is due to

A. Fusion reaction B. Fission reaction C. Combustion reaction D. Chemical reaction

128. The mass number of a nucleus is

A. sometimes less than and sometimes more than its atomic number
B. always less than its atomic number
C. always more than its atomic number
D. sometimes equal to its atomic number

129. The photoelectric work function for a metal surface is 4.125 eV. The cut off wavelength (λ_0) for this surface is

A. 4125 Å B. 3000 Å C. 6000 Å D. 2062.5 Å

130. The Bohr model of atoms

A. Predicts the same emission spectra for all types of atoms
B. Assumes that the angular momentum of electrons is quantized
C. Uses Einstein's photoelectric equation
D. Predicts continuous emission spectra for atoms

131. Two radiations of photons energies 1 eV and 2.5 eV successively illuminate a photosensitive metallic surface of work function 0.5 eV. The ratio of the maximum speeds of the emitted electrons is:

A. 1:4 B. 1:2 C. 1:1 D. 1:5

132. Photoelectric emission occurs only when the incident light has more than a certain minimum

A. Power B. Wavelength C. Intensity D. Frequency

133. In any fission process, the ratio $\frac{\text{mass of fission products}}{\text{mass of parent nuclues}}$ is

A. Equal to 1 C. Less than 1

B. Greater than 1 D. Depends on the mass of the parent nucleus

134. $\alpha-$ particles, $\beta-$ particles and $\gamma-$ rays are all having same energy. Their penetrating power in a given medium in increasing order will be

A. β, γ, α B. γ, α, β C. α, γ, β D. β, α, γ

135. Light of wavelength $5000\,m$ falls on a sensitive plate with photo-electric work function of 1.9 eV. The kinetic energy of the photo-electrons emitted will be

A. 0.58 eV B. 2.48 eV C. 1.24 eV D. 1.16 eV

136. The momentum of a photon of energy $h\nu$ will be

A. $\frac{h\nu}{c}$ B. $\frac{c}{h\nu}$ C. $h\nu$ D. $\frac{h\nu}{c^2}$

137. In photoelectric emission process from a metal of work function 1.8 eV, the kinetic energy of most energetic electrons is 0.5 eV. The corresponding stopping potential is

A. 1.8 V B. 1.2 V C. 0.5 V D. 2.3 V

138. The most penetrating radiation of the following is

A. Gamma-rays B. Alpha particles C. Beta-rays D. X-*rays*

139. The nature of ions knocked out from hot surfaces is

A. Protons B. Neutrons C. Electrons D. Nuclei

140. Number of ejected photoelectron increases with increase

A. In intensity of light B. in wavelength of light C. in frequency of light D. never

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