SATISH SCIENCE ACADEMY

DHANORI PUNE-411015

PHYSICS

MHT - CET - Physics

Time Allowed: 1 hour **Maximum Marks: 50**

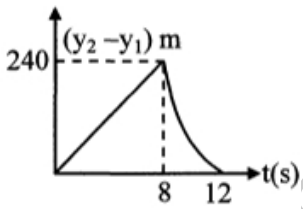
1. A particle is projected obliquely into air with velocity of 20 m/s at an angle of elevation of 45^o. Neglecting air resistance the equation of motion is **[1]**

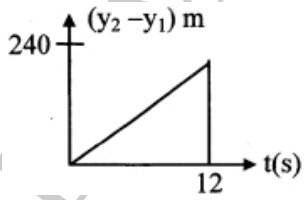
   a) $y = x\left[\frac{1}{2} - \frac{gx}{400}\right]$ b) $y = x - \frac{gx^2}{200}$

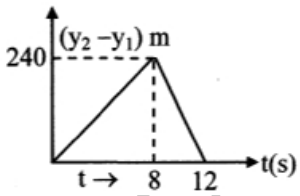
   c) $y = x\left[1 - \frac{gx}{400}\right]$ d) $y = \frac{x}{\sqrt{2}} - \frac{gx}{200}$

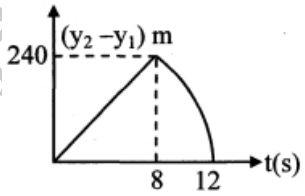
2. Two stones are thrown up simultaneously from the edge of a cliff 240 m high with initial speed of 10 m/s and 40 m/s respectively. Which of the following graphs best represents the time variation of relative position of the second stone with respect to the first? **[1]**

   (Assume stones do not rebound after hitting the ground and neglect air resistance, take g = 10 m/s^2)
   (The figures are schematic and not drawn to scale).

   a) 

   b) 

   c) 

   d) 

3. For a truck with 14 tyres, only rear 8 wheels are power driven and can produce acceleration. These 8 wheels support half the entire load. If the coefficient of friction between road and each tyre is 0.6, the maximum attainable acceleration by this truck would be (Acceleration due to gravity = 10 ms^{-2}) **[1]**

   a) 24 ms^{-2} b) 10 ms^{-2}

   c) 6 ms^{-2} d) 3 ms^{-2}

4. The centre of mass of two particles lies **[1]**

   i. on the line joining the particles.
   ii. along the third quadrant of coordinate axes.
   iii. on the line perpendicular to the line joining the particles.
   iv. at the midpoint on the line joining the two particle.

   a) option (iii) b) option (ii)

   c) option (iv) d) option (i)

5. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_p) whose radius and mean density are twice as that of earth is **[1]**

a) 1 : 2

b) 1 : $\sqrt{2}$

c) 1 : 4

d) 1 : $2\sqrt{2}$

6. The value of 'g' at a certain height h above the free surface of Earth is $\frac{x}{16}$ where x is the value of 'g' at the surface of Earth. The height h is **[1]**

a) R

b) 4R

c) 2R

d) 3R

7. Newton's law of cooling leads to the expression **[1]**

a) log θ_0 = Kt + c

b) (θ - θ_0) = Kt + c

c) θ = Kθ_0 + c

d) log (θ - θ_0) = -Kt + c

8. When water is heated from 0 °C to 10 °C its density **[1]**

a) decreases.

b) first increases and then decreases.

c) does not change.

d) increases.

9. The speed of sound is NOT affected by **[1]**

a) pressure of medium.

b) density of medium.

c) moisture of medium.

d) temperature of medium.

10. Newton assumed that changes taking place in a medium, when sound waves propagating through medium, are _____. **[1]**

a) adiabatic

b) isothermal

c) isomeric

d) isobaric

11. Two beams of red and violet colours are made to pass separately through a prism of A = 60°. In the minimum deviation position, the angle of refraction inside the prism will be **[1]**

a) greater for red colour.

b) greater for violet colour.

c) 30° for both the colours.

d) equal but not 30° for both the colours.

12. A convex lens of glass (μ = 1.5) has a focal length of 8 cm when placed in air. What is the focal length of lens when it is immersed in water $(\mu = \frac{4}{3})$? **[1]**

a) 4 cm

b) 16 cm

c) 8 cm

d) 32 cm

13. Two charges of 2 μC and 5 μC are separated by distance of 20 cm. Upon placing a copper plate of thickness 6 cm at midpoint between the two, force experienced by changes will be **[1]**

a) zero

b) 2.5×10^{-3} N

c) 5.625×10^{-3} N

d) 9×10^{-4} N

14. Charge per unit area is called as _____. **[1]**

a) unit charge density

b) volume charge density

c) linear charge density

d) surface charge density

15. If the two ends p and n of p-n junction diode are joined by a wire, **[1]**

a. there will not be a steady current in the circuit.

b. there will be a steady current from n-side to p-side.

c. there will be a steady current from p-side to n-side.

d. there will not be a current depending upon the resistance of the connecting wire.

a) option (d)

b) option (c)

c) option (b)

d) option (a)

16. If the equation for the displacement of a particle moving on a circular path is given by $\theta = 2t^3 + 0.5$, where θ is in radian and t is in seconds, then the angular velocity of the particle at t = 2s is **[1]**

a) 8 rad/s

b) 12 rad/s

c) 24 rad/s

d) 36 rad/s

17. Angular displacement (θ) of a flywheel varies with time as $\theta = 2t + 3t^2$ radian. The angular acceleration at t = 2s is given by **[1]**

a) 6 rad/s^2

b) 16 rad/s^2

c) 14 rad/s^2

d) 18 rad/s^2

18. The radius of gyration of a thin rod of mass 100 gm and length 1 m about an axis passing through its centre of gravity and perpendicular to its length is **[1]**

a) $\frac{1}{3\sqrt{2}}$ m

b) $\frac{1}{4\sqrt{3}}$ m

c) $\frac{1}{6\sqrt{2}}$ m

d) $\frac{1}{2\sqrt{3}}$ m

19. From a uniform wire, two circular loops are made **[1]**

i. P of radius r and

ii. Q of radius nr.

If the moment of inertia of Q about an axis passing through its centre and perpendicular to its plane is 8 times that of P about a similar axis, the value of n is (diameter of the wire is very much smaller than r or nr)

a) 2

b) 8

c) 4

d) 6

20. A particle performs S.H.M. with amplitude 5 m, period 0.02 s and x = 2.5 m at t = 0. Which is the correct equation? **[1]**

a) $x = 5 \sin\left(100\pi t + \frac{\pi}{3}\right)$

b) $x = 5 \sin\left(50\pi t + \frac{\pi}{6}\right)$

c) $x = 5 \sin\left(50\pi t + \frac{\pi}{3}\right)$

d) $x = 5 \sin\left(100\pi t + \frac{\pi}{6}\right)$

21. A particle is executing SHM along a straight line. Its velocities at distances x_1 and x_2 from the mean position are v_1 and v_2 respectively. Its time period is **[1]**

a) $2\pi\sqrt{\frac{v_1^2 - v_2^2}{x_1^2 - x_2^2}}$

b) $2\pi\sqrt{\frac{x_2^2 - x_1^2}{v_1^2 - v_2^2}}$

c)

d)

$2\pi\sqrt{\frac{v_1^2+v_2^2}{x_1^2+x_2^2}}$ $2\pi\sqrt{\frac{x_1^2+x_2^2}{v_1^2+v_2^2}}$

22. A particle is performing S.H.M. starting from extreme position. Graphical representation shows that, between displacement and acceleration, there is a phase difference of **[1]**

a) π rad b) $\frac{\pi}{2}$ rad

c) $\frac{\pi}{4}$ rad d) 0 rad

23. The standard voltage of A.C. mains in India is **[1]**

a) 50 V b) 150 V

c) 110 V d) 220 V

24. A large open tank has two holes in the wall. One is a square hole of side L at a depth y from the top and the other is a circular hole of radius R at a depth 4y from the top. When the tank is completely filled with water, the quantity of water flowing out per second from both the holes are the same. Then R is equal to **[1]**

a) 2πL b) L

c) $\frac{L}{2\pi}$ d) $\frac{L}{\sqrt{2\pi}}$

25. For streamline flow of an incompressible fluid, If A is area and v is speed then equation of continuity is **[1]**

a) $\frac{A}{v}$ = constant b) Av = constant

c) A + v = constant d) $\frac{V}{A}$ = constant

26. In forced vibration, the body vibrates with **[1]**

a. same frequency as that of external periodic force.

b. any frequency having value between natural and external periodic force.

c. natural frequency.

d. both same frequency as that of external periodic force and natural frequency.

a) Option (a) b) Option (d)

c) Option (b) d) Option (c)

27. The phase difference between two points separated by 0.8 m in a wave of frequency 120 Hz is 90°. The wave velocity is **[1]**

a) 384 m/s b) 720 m/s

c) 144 m/s d) 256 m/s

28. At N.T.P., the R.M.S velocity of hydrogen molecule is (P = 1.013×10^5 N/m^2, Density of hydrogen = 0.09 kg/m^3) **[1]**

a) 1938 m/s b) 1738 m/s

c) 1838 m/s d) 1640 m/s

29. A gas mixture consists of 2 moles of O_2 and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is **[1]**

a) 15RT b) 11RT

c) 9RT d) 4RT

30. A vessel of volume V contains an ideal gas at absolute temperature T and pressure P. The gas is allowed to leak till its pressure falls to P'. Assuming that the temperature remains constant during leakage, the number of moles of the gas that have leaked is **[1]**

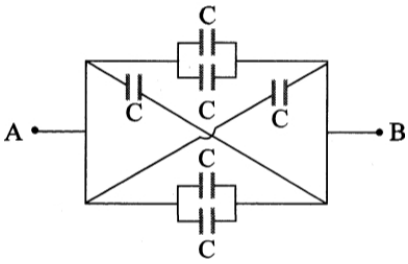
a) $\frac{V}{2RT}(P - P')$

b) $\frac{V}{RT}(P + P')$

c) $\frac{V}{RT}(P - P')$

d) $\frac{V}{2RT}(P + P')$

31. Six capacitors, each of capacitance of 2 μF, are connected as shown in the figure. The effective capacitance between A and B is **[1]**



a) 3 μF

b) 12 μF

c) 6 μF

d) $\frac{8}{3}$ μF

32. Three capacitors, each of capacitance C and of breakdown voltage V, are joined in series. The capacitance and breakdown voltage of the combination will be **[1]**

a) $\frac{C}{3}$, 3V

b) 3C, 3V

c) $\frac{C}{3}$, $\frac{V}{3}$

d) 3C, $\frac{V}{3}$

33. While a capacitor remains connected to a battery and dielectric slab is inserted between the plates, then **[1]**

a) charge flows from the battery to the capacitor.

b) electric field between the plates increases.

c) energy stored in the capacitor decreases.

d) potential difference between the plates is changed.

34. In Young's double slit experiment, the ratio of intensities of bright and dark bands is 16 which means **[1]**

a) the ratio of their amplitudes is 4

b) the ratio of their amplitudes is 5

c) intensities of individual sources are 4 and 3 units respectively

d) intensities of individual sources are 25 and 9 units respectively

35. The wavefront due to a source situated at infinity is _____. **[1]**

a) cylindrical

b) linear

c) planar

d) spherical

36. Different colours of light are due to **[1]**

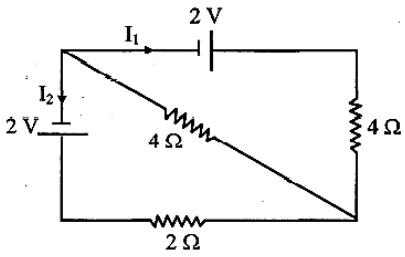
a) different speeds.

b) different frequencies.

c) same wavelength.

d) different wavelengths.

37. In the given circuit diagram, the internal resistance of the cell is negligible. The ratio of the currents $\frac{I_2}{I_1}$ is **[1]**



a) 1 b) 2

c) 4 d) $\frac{1}{2}$

38. A filament bulb (500 W, 100 V) is to be used in a 230 V main supply. When a resistance is connected in series, it works perfectly and the bulb consumes 500 W. The value of R is **[1]**

a) 13 Ω b) 26 Ω

c) 46 Ω d) 230 Ω

39. Two current carrying coils have radii r and 2r and have same magnetic induction at their centres. The ratio of voltage applied across them is **[1]**

a) 2 : 1 b) 1 : 8

c) 1 : 4 d) 1 : 2

40. A toroid has a core (non-ferromagnetic) of inner radius 25 cm and outer radius 26 cm, around which 4,000 turns of a wire are wound. If the current in the wire is 10 A, the magnetic field inside the core of the toroid will be **[1]**

a) 31.4×10^{-2} T b) 31.4×10^{-3} T

c) 40.2×10^{-2} T d) 40.2×10^{-3} T

41. The ratio of the magnetic field at the centre of a current carrying circular wire and the magnetic field at the centre of a semi-circular coil made from the same length of wire will be **[1]**

a) 4 : 1 b) 1 : 2

c) 2 : 1 d) 1 : 4

42. A thin diamagnetic rod is placed vertically between the poles of an electromagnet. When the current in the electromagnet is switched ON, then the diamagnetic rod is pushed up, out of the horizontal magnetic field. Hence the rod gains gravitational potential energy. The work required to do this comes from **[1]**

a) the magnetic field b) the induced electric field due to the changing magnetic field

c) the lattice structure of the material of the rod d) the current source

43. An e.m.f. of 5 volt is produced by a self inductance when the current changes at a steady rate from 3 A to 2 A in 1 millisecond. The value of self inductance is **[1]**

a) zero b) 5000 H

c) 5 H d) 5 mH

44. The magnetic flux across a loop of resistance 10 Ω is given by $\phi = 5t^2 - 4t + 1$ weber. How much current is induced in the loop after 0.2 s? **[1]**

a) 0.02 A b) 0.4 A

c) 0.2 A

d) 0.04 A

45. When light of frequency v_1 is incident on a metal with work function W_0 (where $h\nu_1 > W_0$), the photocurrent falls to zero at a stopping potential of V_1. If the frequency of light is increased to v_2, the stopping potential changes to V_2. Therefore, the charge of an electron is given by **[1]**

a) $\frac{W_0(v_2-v_1)}{v_1V_2-v_2V_1}$

b) $\frac{W_0(v_2+v_1)}{v_1V_1+v_2V_2}$

c) $\frac{W_0(v_2+v_1)}{v_1V_2+v_2\ V_1}$

d) $\frac{W_0(v_2-v_1)}{v_2V_2-v_1V_1}$

46. An electron revolves around the nucleus. The radius of the circular orbit is r. To double the kinetic energy of electron its orbit radius is **[1]**

a) 2 r

b) $\frac{r}{2}$

c) $\sqrt{2}r$

d) $\frac{r}{\sqrt{2}}$

47. Rutherford proposed his model of the atom in order to explain the scattering of **[1]**

a) cathode rays

b) X-rays

c) neutrons

d) alpha rays

48. Which of the following transitions gives the highest frequency for electron emission? **[1]**

a) $n_1 = 1$ to $n_2 = 2$

b) $n_1 = 2$ to $n_2 = 5$

c) $n_1 = 5$ to $n_2 = 2$

d) $n_1 = 2$ to $n_2 = 1$

49. For a transistor, the current gain is 0.8. The transistor is connected in common emitter configuration. The change in the collector current when the base current changes by 6 mA is **[1]**

a) 24 mA

b) 6 mA

c) 8 mA

d) 4.8 mA

50. An ideal refrigerator has a freezer at a temperature of -13° C. The coefficient of performance of the engine is 5. The temperature of the air (to which heat is rejected) will be **[1]**

a) 325 °C

b) 320 K

c) 39 °C

d) 39 K