

# This is a Demonstration copy

1) The displacement time equation for a particle in linear motion is given as

$$x = \frac{a}{b}(1 - e^{-bt})$$

Which of the following option is correct

- a) The velocity and acceleration of the particle at  $t=0$  is  $a$  and  $-ab$  respectively
- b) The velocity will be decreasing as the time increases
- c) The displacement of the particle will fall between  $0 \leq x \leq \frac{a}{b}$
- d) The maximum acceleration in the motion is  $-ab$

2) What is true for gravitational force

- (a) work done between the two points does not depend on the path travel
- (b) work done in a closed loop is zero
- (c)  $W = -\Delta U$
- (d) it is a conservative force

3) A thin rod of length  $L$  and mass  $M$  is placed along  $x$  axis. One end of rod is placed at origin and other end is at  $(L,0)$ .

Let  $\mathbf{i}$  and  $\mathbf{j}$  are the unit vector across  $x$  and  $y$  axis

Find the Gravitational field at Point  $P(a,0)$  where  $a > L$

- a)  $\frac{GM}{a(L+a)} \mathbf{i}$
- b)  $\frac{GM}{a(a-L)} \mathbf{i}$
- c)  $\frac{GM}{(L-a)} \mathbf{i}$

d) None of these

4) Two concentric metal spherical shells of radius  $a$  and  $b$  respectively are separated by weakly conducting material of conductivity  $\sigma$ . A potential difference  $V$  is applied across the two shells

Find the resistance between the shells

- a)  $\frac{1}{4\pi\sigma} \left( \frac{1}{a} - \frac{1}{b} \right)$

b)  $\frac{1}{4\pi\sigma}(a-b)$

c)  $\frac{1}{4\pi\sigma}\left(\frac{1}{a} + \frac{1}{b}\right)$

d)  $\frac{1}{4\pi\sigma}(a+b)$

5) The magnetic flux through a coil perpendicular to its plane and directed into paper is varying according to the relation

$$\phi = (10t^2 + 20t + 10) \text{ milliweber}$$

Calculate the emf induced in the loop at  $t=5$  sec

6) A current sheet having current  $K$  A/m is placed at in the x-y plane at  $z=0$ . The direction of current is  $-\mathbf{j}$

Find the Magnetic Field at on the z axis

a)  $-\frac{1}{2}\mu_0 K\mathbf{i}$

b)  $\frac{1}{2}\mu_0 K\mathbf{i}$

c)  $\mu_0 K\mathbf{i}$

d) None of the above

7) A projectile of mass  $m$  is fired from point O(origin) with an initial velocity  $u$  at angle  $\theta$  above the horizontal

8) Find the X,Y,Z component of the angular momentum of the projectile as a function of time about the origin

a)  $0,0,\frac{-mgut^2 \cos \theta}{2}$

b)  $0,0,\frac{mgut^2 \cos \theta}{2}$

c)  $0,u^2 \cos \theta,-mgut^2$

d)  $0,u^2 \sin \theta,-mgut^2$

9) A particle of weight  $W$  moves under the action of a force  
 $F = A \cos \omega t$   
 where  $A$  and  $\omega$  are constant at  $x = 0$  and  $v = 0$  at  $t = 0$   
 find the velocity time relation

- (a)  $\frac{dx}{dt} + \frac{Ag}{W\omega} \sin \omega t = 0$   
 (b)  $\frac{dx}{dt} - \frac{Ag}{W\omega} \sin \omega t = 0$   
 (c)  $\frac{dx}{dt} - \frac{g}{W\omega} \sin \omega t = 0$   
 (d)  $\frac{dx}{dt} + \frac{g}{W\omega} \sin \omega t = 0$

10) A truck and car are moving on a plane road with same kinetic Energy. They are brought to rest by application of brakes which provide equal retarding forces. Which of the following statements is true.

- (a) Distance traveled by truck is shorter than car before coming to rest  
 (b) Distance traveled by car is shorter than truck before coming to rest  
 (c) Distance traveled depends on individual velocity of both the vehicles  
 (d) Both will travel same distance before coming to rest

11) A battery of EMF 10V is connected with three resistors A, B, C having resistance 1, 2, 3 ohms respectively in series. The voltage across the resistor B is measured by a voltmeter whose resistance is 10 ohm. What is the percentage error?

12)  $M$  moles of an ideal polyatomic gas ( $C_v = 7R/2$ ) are in a cylinder at temperature  $T$ . A heat  $Q$  is supplied to the gas. Some  $M/3$  moles of the gas dissociated into atoms while temperature remains constant. Find the correct relation

- a)  $3Q = 4MRT$   
 b)  $2Q = 3MRT$   
 c)  $Q = 4MRT$   
 d)  $7Q = 4MRT$

13) A container has a mixture of 1 mole of oxygen and 2 moles of nitrogen at 330K. The ratio of average rotational kinetic energy per  $O_2$  molecule to that per  $H_2$  molecule is

- a) 2:1
- b) 1:2
- c) 1:1
- d) None of these

14) When a 100 Kg mass is suspended from wire of length 1 meter and area  $1 \text{ cm}^2$ , its length increases.

- a) Find the stress in the wire
- b) Find the increase in length of the wire
- c) Find the elastic potential energy stored in the wire
- d) Find the tension in the wire in loaded position

15) Consider a mass-spring system. This system is given an initial displacement, it begins to oscillate with frequency  $f_1$ . The system is now brought to rest and again it is given a different displacement and  $f_2$  be its frequency of oscillation. Then frequencies

- a)  $f_1 = f_2$
- b)  $f_1 > f_2$
- c)  $f_1 < f_2$
- d) none of the above

16) Which of the following is true

- A) Magnetic field exerts force only on moving charges.
- B) Electric field exerts force on both stationary and moving charges
- C) Magnetic field exerts force on charge moving parallel to the direction of the field
- D) All of the above

17) During an adiabatic process the square of the pressure of a gas is proportional to the fifth power of its absolute temperature. The ratio of specific heat  $C_p / C_v$  for that gas is

- a.  $3/5$
- b.  $4/3$
- c.  $5/3$
- d.  $3/2$

18) Two absolute scales A and B have triple points of water defined as 200A and 350A. What is the relation between  $T_A$  and  $T_B$

19) The pressure of the gas in a constant volume gas thermometer are 80 cm, 90 cm and 100 cm of mercury at the ice point, the steam point and in a heated wax bath respectively. Find the temperature of the wax bath.

**20)** An elastic string has a mass  $M$  suspended at its lower end, the upper being fixed to a support. When the mass is pulled down over a short distance and let go, then it executes SHM with Time period given by

$$T_1 = 2\pi\sqrt{\frac{l_1}{g}}$$

where  $l_1$  is the elongation of the string. Now the mass  $m$  is added to the mass  $M$ , then it is found that Time period of oscillation ( $T_2$ ) such that

$$\frac{T_1}{T_2} = \frac{5}{4}.$$

Find the ratio  $m:M$

Given  $Y$  is the Young modulus of elasticity.  $L$  be the original length of string.

**21)** A rod of length  $L$  and mass  $M$  can freely rotate around a pivot at  $A$ . A bullet of mass  $m$  and velocity  $v$  hit the rod at a height  $h$  from  $A$  and becomes imbedded in it. Find the angular velocity of the Rod just after the collision

a)  $\frac{mvh}{mh^2 + ML^2}$

b)  $\frac{mvh}{mh^2 + \frac{1}{3}ML^2}$

c)  $\frac{mvh}{mh^2 + \frac{1}{2}ML^2}$