Kafr Elshiekh University
Faculty of Engineering
Department of
Physical and Mathematical Engineering
Preparatory Year

Engineering physics (1)

16- 03- 2021
3 hours
90 Marks
Final exam: 8 pages

Answer the following questions:

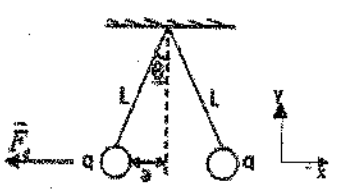
K_e=8.9*10^9 Nm^2/C^2,g=9.8m/s, e=1.6*10^{-19}C , $\epsilon_o = 8.8 * 10^{-12} \frac{C^2}{Nm^2}$, k for air=1

(ILOs: a1,a2,b1,c2)

Coulombs' constant K_e=?

1. (A) $\frac{\epsilon_o}{4\pi}$ (B) $4\pi\epsilon_0$ (C) $\frac{1}{4\pi\epsilon_o}$ (D) $\frac{1}{2\pi\epsilon_o}$

Two identical small charged spheres, each having a mass of 3x10^{-2}Kg, hang in equilibrium as shown in Fig. The length of each string is 0.15 m, and the angle θ is 5°.



Find: - $\sum F_x$ =?

2. (A) $\sum F_x = T - mg = 0$ (B) $\sum F_x = T\sin\theta - F_e = 0$ (C) $\sum F_x = T - F_e = 0$ (D) $\sum F_x = T\cos\theta - mg = 0$

- $\sum F_y$ =?

3. (A) $\sum F_y = T - mg = 0$ (B) $\sum F_y = T - F_e = 0$ (C) $\sum F_y = T\sin\theta - F_e = 0$ (D) $\sum F_y = T\cos\theta - mg = 0$

- F_e=?

4. (A) 2.6*10^{-2}N (B) 4.4*10^{-8}N (C) 0.013N (D) 2.6 N

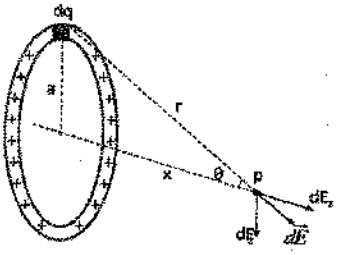
- a=?

5. (A) 2.6*10^{-2}m (B) 4.4*10^{-8}m (C) 0.013m (D) 2.6m

- q=?

6. (A) 2.6*10^{-2}C (B) 4.4*10^{-8}C (C) 0.013C (D) 2.6C

A ring of radius a carries a uniformly distributed positive total charge Q. Calculate the electric field due to the ring at a point P lying a distance x from its center along the central axis perpendicular to the plane of the ring.



- $\sum E_y$ =?

7. (A) $\sum E_y = \int K_e \frac{dq}{r^2}\cos\theta$ (B) $\sum E_y = \frac{x}{\sqrt{a^2+x^2}}$ (C) $\sum E_y = \frac{K_e xQ}{(a^2+x^2)^{3/2}}$ (D) $\sum E_y = 0$

- $\sum E_x$ =?

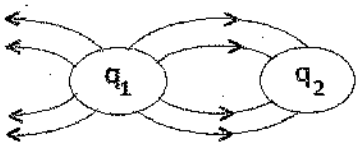
8. (A) $\sum E_x = \int K_e \frac{dq}{r^2}\cos\theta$ (B) $\sum E_x = \frac{x}{\sqrt{a^2+x^2}}$ (C) $\sum E_x = \frac{K_e xQ}{(a^2+x^2)^{3/2}}$ (D) $\sum E_x = 0$

- $\cos\theta$ =?

9. (A) $\cos\theta = \frac{x}{\sqrt{a^2+x^2}}$ (B) $\cos\theta = \frac{x}{a}$ (C) $\cos\theta = \frac{x}{(a^2+x^2)^{3/2}}$ (D) $\cos\theta = \frac{x}{a^2+x^2}$

- E=? Electric field at point P

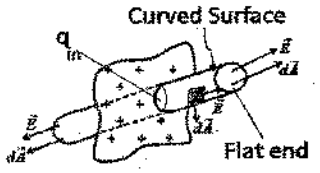
10. (A) $E = \frac{K_e Q}{(a^2 + x^2)^{3/2}}$ (B) $E = \frac{x}{\sqrt{a^2 + x^2}}$ (C) $E = \frac{K_e x Q}{(a^2 + x^2)^{3/2}}$ (D) $E = \frac{xQ}{(a^2 + x^2)^{3/2}}$



$\frac{q_1}{q_2} = ?$

11. (A) 0.5 (B) 4 (C) 8 (D) 2

Find the electric field due to an infinite plane of positive charge with uniform surface charge density σ.



- $\oint E.dA = ?_{curved\ surface}$

12. (A) σA (B) $\frac{\sigma}{2\epsilon_o}$ (C) $\frac{q_{in}}{\epsilon_o}$ (D) zero

- $\oint E.dA = ?_{flat\ end}$

13. (A) σA (B) $\frac{\sigma}{2\epsilon_o}$ (C) $\frac{q_{in}}{\epsilon_o}$ (D) zero

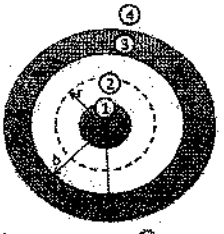
- q_{in}=?

14. (A) σA (B) $\frac{\sigma}{2\epsilon_o}$ (C) $\frac{q_{in}}{\epsilon_o}$ (D) zero

- E=?

15. (A) σA (B) $\frac{\sigma}{2\epsilon_o}$ (C) $\frac{q_{in}}{\epsilon_o}$ (D) zero

A solid insulating sphere of radius a carries a net positive charge Q uniformly distributed throughout its volume. A conducting shell of inner radius b and outer radius c is concentric with the solid sphere and carries a net charge -2Q. Using Gauss's law, find the electric field in the regions labeled (1), (2), (3), and (4) in figure.



- At region (1) r<a E_1=?

16. (A) $E = 0$ (B) $E = -K_e \frac{Q}{r^2}$ (C) $E = K_e \frac{Q}{r^2}$ (D) $E = K_e \frac{Qr}{a^3}$

- At region (2)a<r<b E_2=?

17. (A) $E = K_e \frac{Q}{r^2}$ (B) $E = 0$ (C) $E = -K_e \frac{Q}{r^2}$ (D) $E = K_e \frac{Qr}{a^3}$

- At region (3)b<r<c E_3=?

18. (A) $E = -K_e \frac{Q}{r^2}$ (B) $E = K_e \frac{Q}{r^2}$ (C) $E = K_e \frac{Qr}{a^3}$ (D) $E = 0$

- At region (4) r>c E_4=?

19. (A) $E = K_e \frac{Qr}{a^3}$ (B) $E = -K_e \frac{Q}{r^2}$ (C) $E = 0$ (D) $E = K_e \frac{Q}{r^2}$

$\Phi = E.A$

- Φ =?

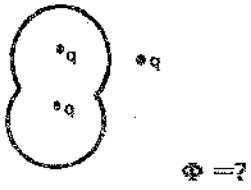
20. (A) Electric flux N/C (B) Electric field N/C (C) Electric field Nm^2/C (D) Electric flux Nm^2/C

- E=?

21. (A) Electric flux N/C (B) Electric field N/C (C) Electric field Nm^2/C (D) Electric flux Nm^2/C

$$\oint E.dA = \frac{q_{in}}{\epsilon_o}$$

22. (A) Ohm's law (B) Coulombs' law (C) Kirchhoff's law (D) Gauss's law



Φ =?

23. (A) $\frac{q}{\epsilon_o}$ (B) $\frac{2q}{\epsilon_o}$ (C) $\frac{3q}{\epsilon_o}$ (D) zero

$\frac{volt}{m}$ =?

24. (A) Joule (B) $\frac{N}{C}$ (C) Watt (D) $\frac{C}{N}$

$3.2*10^{-19}$J=?

25. (A) 0.5 eV (B) 1 eV (C) 2 eV (D) 4 eV

If $V_A=V_B$ the surface is ?

26. (A) Gauss's surface (B) Equipotential surface (C) Coulombs' surface (D) Ohm's surface

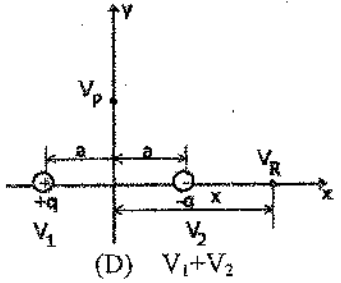
The potential difference between two parallel sheets distance 1.5cm apart, is 2500V. Calculate the uniform electric field between the sheets.

27. (A) $0.6*10^5$N/C (B) $1.6*10^5$N/C (C) $2.6*10^5$N/C (D) $3.6*10^5$N/C

An electric dipole consists of two charges of equal magnitude and opposite sign separated by a distance 2a as shown in Fig. The dipole is along the x-axis and is centered at the origin.

Calculate:

- V_R=?



28. (A) $V_1^2+V_2^2$ (B) $(V_1+V_2)^2$ (C) V_1+2V_2 (D) V_1+V_2

- V_1=?

29. (A) $\frac{K_e q}{x-a}$ (B) $\frac{-2aK_e q}{x^2}$ (C) zero (D) $\frac{K_e q}{x+a}$

- V_2=?

30 (A) $\frac{-2aK_e q}{x^2-a^2}$ (B) $\frac{K_e q}{x-a}$ (C) zero (D) $\frac{K_e q}{x+a}$

- The electric potential at point R on the +x axis. V_R=?

31. (A) $\frac{K_e q}{x-a}$ (B) $\frac{-2aK_e q}{x^2}$ (C) zero (D) $\frac{-2aK_e q}{x^2-a^2}$

- If x>>a = V_R=?

32. (A) $\frac{K_e q}{x-a}$ (B) zero (C) $\frac{-2aK_e q}{x^2}$ (D) $\frac{K_e q}{x+a}$

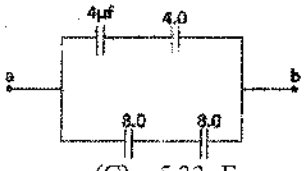
- The electric potential at point P on the +y axis. V_P=?

33. (A) $\frac{K_e q}{x-a}$ (B) $\frac{-2aK_e q}{x^2}$ (C) zero (D) $\frac{K_e q}{x+a}$

$\frac{1C}{1\,Volt}$ =?

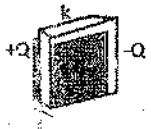
34. (A) 1 Farad (B) 1 Frequency (C) 1 Fahrenheit (D) 1 Fourier

Find the equivalent capacitance between a and b



35. (A) 4μF (B) 8μF (C) 5.33μF (D) 6μF

$C = \frac{k\epsilon_o A}{l}$



- C=?

36. (A) Charge density (B) Coulombs' constant (C) Dielectric constant (D) Capacitance

- k=?

37. (A) Charge density (B) Coulombs' constant (C) Dielectric constant (D) Capacitance

An air-filled capacitor consists of two parallel plates, each with an area of 7.6 cm^2 separated by a distance of 1.8mm. A 20-V potential difference is applied to these plates. Calculate:

- the electric field between the plates

38. (A) $11.11*10^3$V/m (B) $9.82*10^{-8}$V/m (C) $8.8*10^{-12}$V/m (D) 74v/m

- the surface charge density

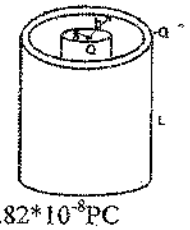
39. (A) $9.82*10^{-8}$c/m^2 (B) $11.11*10^3$c/m^2 (C) 74c/m^2 (D) $8.8*10^{-12}$c/m^2

- the capacitance

40. (A) $9.82*10^{-8}$PF (B) 74PF (C) $8.8*10^{-12}$PF (D) $11.11*10^3$PF

- the charge on each plate

41. (A) 74PC (B) $8.8*10^{-12}$PC (C) $11.11*10^3$PC (D)



$9.82*10^{-8}$PC

A 50-m length of coaxial cable has an inner conductor that has a diameter of 2.58 mm and carries a charge of 8.1μC. The surrounding conductor has an inner diameter of 7.27 mm and a charge of -8.1 μC. Assume the region between the conductors is air.

- C=?

42. (A) $C = 2k_e\lambda \ln\left(\frac{b}{a}\right)$ (B) $C = \frac{l}{2k_e \ln\left(\frac{b}{a}\right)}$ (C) $C = \frac{k\epsilon_o A}{l}$ (D) $C = 2k_e \ln\left(\frac{b}{a}\right)$

- What is the capacitance of this cable?

43. (A) 2.65nF (B) 3.65nF (C) 4.65nF (D) 5.65nF

- ΔV=?

44. (A) $\Delta V = \frac{k\epsilon_o A}{l}$ (B) $\Delta V = 2k_e\lambda \ln\left(\frac{b}{a}\right)$ (C) $\Delta V = \frac{l}{2k_e \ln\left(\frac{b}{a}\right)}$ (D) $\Delta V = 2k_e \ln\left(\frac{b}{a}\right)$

- What is the potential difference between the two conductors?

45. (A) 3.02V (B) 4.02V (C) $3.02*10^3$V (D) $4.02*10^3$V

A pendulum on Planet X, where the value of gravity is g. What will happen to the energy of this pendulum if:

46- Its mass is doubled?
A.-still the same B. halved C. doubled D. none of the above

47- Its length is doubled?
A. still the same B. halved C. doubled D. none of the above

48- Its oscillation amplitude is doubled?
A. still the same B. halved C. doubled D. none of the above

49- A certain spring elongates 9mm when it is suspended vertically and a block of mass M is hung on it. The natural angular frequency of this block-spring system:

A. is 0.088 rad/s B. is 33 rad/s C. is 200 rad/s D. cannot be computed unless the value of M is given

50-A weight suspended from an ideal spring oscillates up and down with a period T. If the amplitude of the oscillation is doubled, the period will be:
A. T B. 2T C. T/2 D. 1.5T

51-The standard 1kg mass is attached to a compressed spring and the spring is released. If the mass initially has an acceleration of $5.6m/s^2$, the force of the spring has a magnitude of:
A. 2.8N B. 5.6N C. 0 D. an undetermined amount

52-An object attached to one end of a spring makes 20 vibrations in 10 s. Its angular frequency is:
A. 0.79 rad/s B. 1.57 rad/s C. 2.0 rad/s D. 12.6 rad/s

53-A large water tank, open at the top, has a small hole in the bottom. When the water level is 30m above the bottom of the tank, the speed of the water leaking from the hole:
A. is 2.5m/s
B. is 24m/s
C. cannot be calculated unless the area of the hole is given
D. cannot be calculated unless the areas of the hole and tank are given

54-Water (density = 1×10^3 kg/m^3) flows through a horizontal tapered pipe. At the wide end its speed is 4m/s. The difference in pressure between the two ends is 4.5×10^3 Pa. The speed of the water at the narrow end is:
A. 2.6m/s B. 3.4m/s C. 4m/s D. 5m/s

55- Water flows through a cylindrical pipe of varying cross section. The velocity is 3m/s at a point where the pipe diameter is 1.0 cm. At a point where the pipe diameter is 3cm, the velocity is:
A. 9m/s B. 3m/s C. 1m/s D. 0.33m/s

56-One end of a cylindrical pipe has a radius of 1.5 cm. Water (density = 1×10^3 kg/m^3) streams steadily out at 7m/s. The rate at which mass is leaving the pipe is:
A. 2.5kg/s B. 4.9kg/s C. 7kg/s D. 48 kg/s

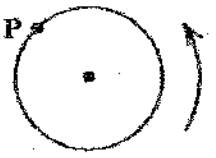
57-If a wheel is turning at 3 rad/s, the time it takes to complete one revolution is about:
A. 0.33 s B. 0.67 s C. 1 s D. 2.1 s

58-A wheel initially has an angular velocity of 18 rad/s but it is slowing at a rate of 2rad/s^2. By the time it stops it will have turned through:

A. 81 rad B. 160 rad C. 245 rad D. 330 rad

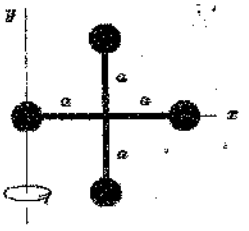
ans: A

59-The figure shows a cylinder of radius 0.7m rotating about its axis at 10 rad/s. The speed of the point P is:



A. 7m/s B. 14 rad/s C. 7rad/s D. none of these

60-Four identical particles, each with mass m, are arranged in the x, y plane as shown. They are connected by light sticks to form a rigid body. If m = 2 kg and a =1m, the rotational inertia of this array about the y axis is:



A. 4kg · m^2 B. 12 kg · m^2 C. 9.6kg · m^2 D. none of these

61-The dimensions of a wooden raft (density = 150 kg/m^3) are 3m × 3m × 1m. What maximum load can it carry in seawater (density = 1020 kg/m^3)?

A. 1350 kg B. 7800 kg C. 9200 kg D. 19, 500 kg

62-A certain wheel has a rotational inertia of 12 kg · m^2. As it turns through 5rev its angular velocity increases from 5rad/s to 6 rad/s. If the net torque is constant its value is:

A. 0.016N · m B. 0.18N · m C. 0.57N · m D. 2.1N · m

63-A boat floating in fresh water displaces 16, 000N of water. How many Newtons of saltwater would it displace if it floats in saltwater of specific gravity 1.17?

A. 14, 500 B. 17, 600 C. 16, 000 D. 284

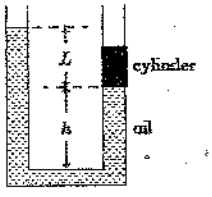
64-A disk has a rotational inertia of 6kg · m^2 and a constant angular acceleration of 2rad/s^2. If it starts from rest the work done during the first 5.0 s by the net torque acting on it is:

A. 0 B. 30 J C. 60 J D. 300 J

65-A fir wood board floats in fresh water with 60% of its volume under water. The density of the wood in g/cm^3 is:

A. 0.4 B. 0.6 C. less than 0.4 D. more than 0.6

66-The diagram shows a U-tube with cross-sectional area A and partially filled with oil of density ρ. A solid cylinder, which fits the tube tightly but can slide without friction, is placed in the right arm. The system is in equilibrium. The weight of the cylinder is:



A. ALρg B. L^{3}ρg C. Aρ(L + h)g D. none of these

67-To measure moderately low pressures oil with a density of 8.5 × 10^2 kg/m^3 is used in place of mercury in a barometer. A change in the height of the oil column of 1mm indicates a change in pressure of about:

A. 1.2 × 10^{-7} Pa B. 1.2 × 10^{-5} Pa C. 8.3Pa D. 1.2Pa

68-A certain wire stretches 0.9 cm when outward forces with magnitude F are applied to each end. The same forces are applied to a wire of the same material but with three times the diameter and three times the length. The second wire stretches:

A. 0.1 cm B. 0.3 cm C. 0.9 cm D. 2.7 cm

69-A cube with 2cm sides is made of material with a bulk modulus of 4.7 × 10^5 N/m^2. When it is subjected to a pressure of 2 × 10^5 Pa the length of its any of its sides is:

A. 0.85 cm B. 1.15 cm C. 1.66 cm D. none of these

70- Bernoulli's equation can be derived from the conservation of:

A. energy B. mass C. angular momentum D. volume

71- A simple pendulum of length L and mass M has frequency f. To increase its frequency to 2f:
A. increase its length to 4L
B. increase its length to 2L
C. decrease its length to L/2
D. decrease its length to L/4

72-A car travels east at constant acceleration. The net force on the car is:
A. east B. west C. up D. zero

73- A radian is about:
A. 25° B. 37° C. 45° D. 57°

74- The bulk modulus is a proportionality constant that relates the pressure acting on an object to:
A. the shear
B. the fractional change in volume
C. the fractional change in length
D. Young's modulus

75- A fly wheel is initially rotating at 20 rad/s and has a constant angular acceleration. After 9s it has rotated through 450 rad. Its angular acceleration is:
A. 3.3 rad/s B. 4.4 rad/s C. 5.6 rad/s D. 6.7 rad/s

76- A body executes simple harmonic motion. The potential energy, the kinetic energy and total energy are measured as a function of displacement x. Which of the following statements is true?
a) Kinetic energy is maximum when x = 0
b) Total energy is zero, when x = 0
c) Kinetic energy is maximum when x is maximum
d) Potential energy is maximum when x = 0

77- The rotational inertia of a wheel about its axle does not depend upon its:
A. diameter B. mass C. distribution of mass D. speed of rotation

78- A 2kg block travels around a 0.5m radius circle with an angular velocity of 12 rad/s. The magnitude of its angular momentum about the center of the circle is:
A. 6kg . m^2/s B. 12 kg . m^2/s C. 6 kg/m^2 . s D. 72 kg . m^2/s^2

79-All fluids are:
A. gases B. liquids C. gases or liquids D. non-metallic

80-The dimensions of a wooden raft (density = 150 kg/m^3) are 3m × 3m × 1m. What maximum load can it carry in seawater (density / 1020 kg/m^3)?
A. 1350 kg B. 7800 kg C. 9200 kg D. 19500 kg

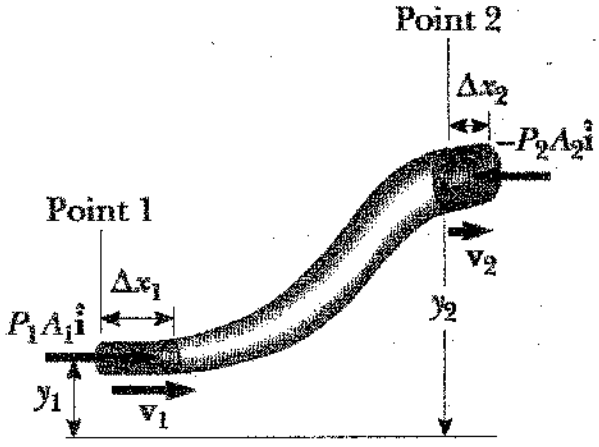
81-An object attached to one end of a spring makes 20 complete oscillations in 10 s. Its period is:
A. 2Hz B. 10 s C. 0.5Hz D.0.50 s

82-In simple harmonic motion, the restoring force must be proportional to the:
A. amplitude B. frequency C. velocity D. displacement

83-A 0.25kg block oscillates on the end of the spring with a spring constant of 200N/m. If the system has an energy of 6J, then the amplitude of the oscillation is:
A. 0.06m B. 0.17m C. 0.24m D. 4.9m

84-The amplitude of oscillation of a simple pendulum is increased from 1± to 4±. Its maximum acceleration changes by a factor of:
A. 1/4 B. 1/2 C. 2 D. 4

For the following figure



85- The external work done by the force associated with the fluid pressure is
A. $dW = P_1A_1dl_1$
B. $dW = -P_2A_2dl_2$
C. $dW = P_1A_1\, dl_1 - P_2A_2dl_2$
D. none of the above

86- The change in the potential energy of this system is
A. $dU = \rho\, A_2dl_2g(\, y_2 - y_1)$
B. $dU = \rho\, A_2dl_2g\, y_2$
C. $dU = \rho\, P_1A_1\, dl_1g$
D. none of the above

87- The change in the kinetic energy of this system is
A. $dk = \rho\, A_2dl_2g(\, y_2 - y_1)$
B. $dk = \rho\, A_2dl_2g\, y_2$
C. $dk = \rho\, y_1A_1\, dl_1g$
D. none of the above

88- Which of the following represents viscosity?
A. Potential energy stored in fluid
B. Resistance to fluid motion
C. Roughness of the surface
D. The pressure difference between the two fluids

89- Water flows between two plates of which the upper one is stationary and the lower one is moving with a velocity V. What will be the velocity of the fluid in contact with the upper plate?
A. V B. N/2 C. 2V D. 0

90- What happens to the viscosity of liquid with the increase in temperature?
A. It increases B. It decreases C. It may increase or decrease D. No change

Assume any missing data.

Best Wishes

Dr. Ahmed Saeed **Dr. Demyana Adel**