C 09-CHPP-103/C 09-EE-103

3035

BOARD DIPLOMA EXAMINATIONS (C-09)

MARCH/APRIL-2013

DEEE- FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

KEY & SCHEME OF VALUATION

Prepared by K.VEERANARAYANA, Lecturer in Physics, Govt. Polytechnic, Nellore.

PART-A

Q.NO.1

1. Numbers and non-dimensional constants can not be obtained by dimensional analysis.
2. This method can not be applied if an equation contains trigonometric, logarithmic and Exponential functions.
3. If a physical quantity is a sum of two terms it is difficult to use this method.
4. If a physical quantity depends on more than three quantities, dimensional method for deriving a formula can not be applied.

One mark each for any three points. 3x1=3 marks.

Q.NO.2

Scalar quantity : A physical quantity which has magnitude only is called a scalar quantity. -1mark

Vector quantity: A physical quantity which has both magnitude and direction (and obeys Parallelogram law of vectors) is called a vector quantity. ----1 mark

No. A vector can not be added to a scalar as scalar quantities have no direction.—1 mark

Q.NO.3

Time of Ascent: The time taken by the projectile to reach the maximum height .—1 mark

Range : The maximum horizontal distance travelled by the projectile during the time of

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Q.NO.3

Time of Ascent: The time taken by the projectile to reach the maximum height .—1 mark

Range : The maximum horizontal distance travelled by the projectile during the time of

Flight. ---1 mark.

Maximum Height : The height covered by the projectile when it reaches the highest point in its path. ----1 mark

Q.NO.4

Friction between two surfaces in contact is due to interlocking of irregularities (projections and depressions) of the two surfaces. -----1 mark.

If the surfaces are polished, the roughness decreases. As a result interlocking of irregularities becomes weak. Hence the friction is reduced. -----2 marks.

Q.NO.5

Ideal Simple Pendulum : A heavy point mass suspended by a weightless perfectly inextensible string from perfect rigid support is called an ideal simple pendulum. --- 1 ½ marks.

Seconds Pendulum : A pendulum whose time-period is 2 seconds is called a seconds Pendulum. ----1 ½ marks.

Q.NO.6;

When the temperature of an ideal gas is kept constant, according to Boyle's law

The pressure of a given mass of a gas is directly proportional to the density. – 2 marks.

$P \alpha D$

$P_1/D_1=P_2/D_2$ --1 mark.

Q.NO.7

Sabines formula : $T= 0.165 V/ \sum as$ ----1 mark

Where T is the time of Reverberation, V is the volume of the room in m^3

a is the absorption coefficient, s is the surface area that absorbs sound. ---1 marks.

Factors which influence T: 1. Volume of the hall/room 2. Total absorbing area.---1 mark.

Flight. ---1 mark.

Maximum Height : The height covered by the projectile when it reaches the highest point

in its path. ----1 mark

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Q.NO.8.

Stress : The Restoring force per unit area developed inside the body. ----- 1 mark.

Strain : The change in dimension produced per unit original dimension. – 1 mark.

Relation between Stress and strain : According to Hookes law, within the elastic limit,

Stress is directly proportional to the strain. --- 1 mark.

Q.NO.9

Ohm's law: At constant temperature, the current flowing through a conductor is directly

Proportional to the potential difference across it. -----2 marks.

At constant temperature, the resistance of a conductor does not change even if the

Voltage is increased. ------1 mark.

Q.NO.10

Critical angle in Refraction of Light : When a light ray passes from a denser medium to a

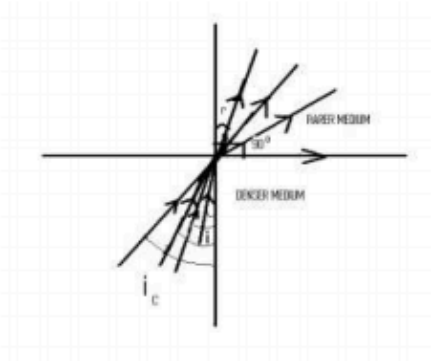
rarer medium, it bends away from the normal. -------1 mark

As the angle of incidence in the denser medium increases, the angle of refraction in the

rarer medium also increases. -------1 mark

At a particular angle of incidence the angle of refraction becomes 90^{o}. This angle of

incidence in the denser medium is called the Critical angle, ic ------1 mark.



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As the angle of incidence in the denser medium increases, the angle of refraction in the rarer medium also increases. -------1 mark

At a particular angle of incidence the angle of refraction becomes 900. This angle of incidence in the denser medium is called the Critical angle, ic ------1 mark.

PART-B

Q.NO.11

a) Polygon law: If a number of vectors are represented in magnitude and direction by the sides of a polygon taken in the same order, then their Resultant is represented in magnitude and direction by the closing side of the polygon taken in the opposite order. –2 marks

Explanation :

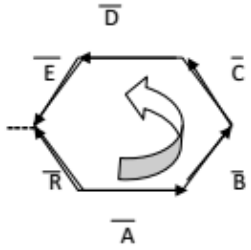

figure ----------1 mark

In the polygon,the given vectors $\overline{A},\overline{B},\overline{C},\overline{D},\overline{E}$, are represented as its sides in the same order; their Resultant $\overline{R}$ is represented as the closing side in the reverse order.

$\overline{R} = \overline{A} + \overline{B} + \overline{C} + \overline{D} + \overline{E}$ ----------2 marks

b) $\overline{F} = 6i + 12j + 8k$ $\overline{S} = 2i + 3j + 5k$ -----1 mark

Components of F : 6 , 12 , 8 Components of S : 2, 3,5 ------1 mark

Work done $W = \overline{F}.\overline{S}$ ----1 mark

$= (6x2) + (12x3) + (8x5)$ -----1 mark

$= 12 + 36 + 40$

$= 88$ joule 1 mark

Q.NO.12

a) Acceleration due to gravity : The acceleration produced in bodies by the gravitational pull (force) of the Earth is called acceleration due to gravity. Its symbol is g ---2 mark

b) Consider a body thrown vertically upwards with a velocity u from the ground.It reaches the maximum height and returns to the ground (point of projection).

PART-B

Q.NO.11

a) Polygon law: If a number of vectors are represented in magnitude and direction by the

sides of a polygon taken in the same order, then their Resultant is represented in magni-

tude and direction by the closing side of the polygon taken in the opposite order. –2 marks

D

E C figure ----------1 mark

Explanation : ----------

R B

A

In the polygon,the given vectors A,B,C,D,E, are represented as its sides in the same order; their Resultant R is represented as the closing side in the reverse order.

R =A + B +C +D+ E ----------2 marks

b) F= 6i + 12j+ 8k S = 2i + 3j + 5k -----1 mark

Components of F : 6 , 12 , 8 Components of S : 2, 3,5 ------1 mark

Work done W = F. S ----1 mark

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pull (force) of the Earth is called acceleration due to gravity. Its symbol is g ---2 mark

b) Consider a body thrown vertically upwards with a velocity u from the ground.It reaches

the maximum height and returns to the ground (point of projection).

Initial velocity during return journey $u = 0$

Uniform acceleration of the body $a = +g$

Distance travelled $s = h$

Final velocity $v = v$ -----1 mark

Using the equation $v^2 - u^2 = 2as$ -----1 mark

$v^2 - 0 = 2gh$

$v^2 = 2g \times u^2/2g$ since $h = u^2/2g$ -------1 mark

$v^2 = u^2$ or $v = u$

Hence velocity on reaching the point of projection is equal to the velocity with which it was thrown upwards. --------1 mark

c) Time of descent $t = 4$ s $g = 9.8$ m/s² ---------1 mark

Height of the building $h = \frac{1}{2} g t^2$ --------1 mark

$= \frac{1}{2} \times 9.8 \times 4 \times 4$ --------1 mark

$= 78.4$ m --------1 mark

Q.NO.13

a) Statement of Work- Energy Theorem: The work done by a force acting on a body is equal to the change in kinetic energy of the body. $W = \frac{1}{2} mv^2 - \frac{1}{2} mu^2$ --------2 marks

Proof : Consider a body of mass m moving with an initial velocity u . Let a force F be applied on the body. The final velocity becomes v over a distance s .

The work done on the body $W = F \times S$ ---------1 mark

$= ma \times s$ since $F = ma$ ---------- 1 mark

$= m(v^2 - u^2)/2$ since $v^2 - u^2 = 2as$ -----1 mark

$= \frac{1}{2} mv^2 - \frac{1}{2} mu^2$

= change in kinetic energy.

Initial velocity during return journey u = 0

Uniform acceleration of the body a = + g

Distance travelled s = h

Final velocity v = v -----1 mark

Using the equation v2—u2 =2as -----1 mark

v2 -0 = 2gh

v2 = 2g x u2/2g since h= u2/2g -------1 mark

v2 = u2 or v=u

Hence velocity on reaching the point of projection is equal to the velocity with which it was thrown upwards. --------1 mark

c) Time of descent t = 4 s g = 9.8 m/s2 ---------1 mark

Height of the building h = ½ g t2 --------1 mark

= ½ x 9.8 x 4x4 --------1 mark

= 78.4 m --------1 mark

Q.NO.13

a) Statement of Work- Energy Theorem: The work done by a force acting on a body is equal

to the change in kinetic energy of the body. W = ½ mv2 - ½ mu2 --------2 marks

Proof : Consider a body of mass m moving with an initial velocity u . Let a force F be applied on the body. The final velocity becomes v over a distance s .

The work done on the body W = F X S ---------1 mark

= ma x s since F= ma ---------- 1 mark

= m (v2 - u2)/2 since v2 - u2 = 2as -----1 mark

= ½ mv2 - ½ mu2

= change in kinetic energy.

Thus work done is equal to change in kinetic energy. -------1 mark

b) No. of bullets n = 240 per minute , m = 10 g = 0.001 kg

power p = 7.2 Kw = 7200 W t = 60 s v =? --------1 mark

Work done W = K.E of n bullets = n x ½ mv^2

= 240 x ½ x0.01 x v^2 ---------1 mark

Power of the gun P = W/t ----------1 mark

7200 = 240 x ½ x0.01 x v^2/ 60

V = 900 m/s ------1 mark

Q.NO.14

a) Definition of S.H.M. : The periodic motion in which the acceleration of the particle is directed towards a fixed point and is directly proportional to the displaceplacement –1mark

Conditions of S.H.M.: 1. The motion should be periodic.

2. The body should move to and fro about a fixed point.

3. The acceleration and displacement should be opposite to each other.

4. The acceleration (or Restoring force)should be directly proportional to the displacement.------ 1 mark each for any three points.

b) Expression for Velocity in S.H.M.: Consider a particle P moving along the circumference of a reference circle of radius r . N is the projection of P which executes simple harmonic motion along the diameter of the circle . At the point A , the velocity v of the particle P has no components. In time t , P reaches the point B , the component of P parallel to the diameter represents the velocity of the S.H.M. particle N. (including fig.) ---1mark

---

Thus work done is equal to change in kinetic energy. -------1 mark

b) No. of bullets n = 240 per minute , m = 10 g = 0.001 kg

power p = 7.2 Kw = 7200 W t = 60 s v =? --------1 mark

Work done W = K.E of n bullets = n x 1⁄2 mv2

= 240 x 1⁄2 x0.01 x v2 ---------1 mark

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7200 = 240 x 1⁄2 x0.01 x v2/ 60

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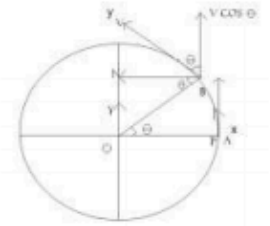


Velocity of N = v cos θ --------- 1 mark

= v cos ωt (θ=ωt)

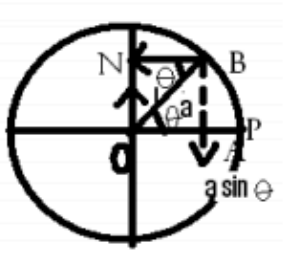
= rω cos ωt (v=rω)

V = rω cos ωt ------1 mark

Expression for Acceleration: The acceleration of the particle P is along the radius of the Circle towards the centre. At point A , the acceleration of N is zero. In a time t, P moves A to B, t he component of P parallel to the diameter represents the acceleration of N . (including figure)---- 1 mark

Acceleration of N = - a sinθ

= - a sin ωt ---------- 1 mark



a = - rω² sin ωt (a= rω²)

a = - ω² y

a α - y ------- 1 mark

Q.NO.15 a) To show that Cp - Cv = R:

= v cos ωt (θ=ωt)

= rω cos ωt (v=rω)

V = rω cos ωt ------1 mark

Expression for Acceleration: The acceleration of the particle P is along the radius of the Circle towards the centre. At point A , the acceleration of N is zero. In a time t, P moves A to B, t he component of P parallel to the diameter represents the acceleration of N . (including figure)---- 1 mark

Acceleration of N = - a sinθ

= - a sin ωt ---------- 1 mark

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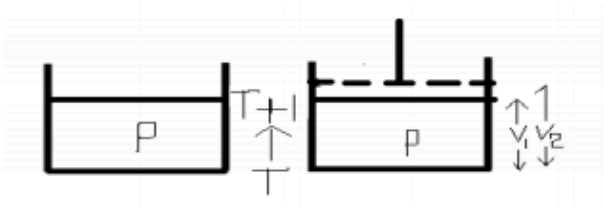
a = - ω2 y

a α - y ------- 1 mark

Q.NO.15 a) To show that Cp - Cv = R:

Velocity of N = v cos θ --------- 1 mark

Consider one gram mole of an ideal gas enclosed in a cylinder. The pressure, volume and temperature of the gas are P, V_1, T respectively.



----- 1 mark

First let the gas be heated at constant volume through 1 ^{o}K . By definition, the amount of heat required to raise the temperature of one gram mole of gas through 1^{o}K is equal to the molar Specific heat at constant volume Cv . All this heat is utilized by the gas to increase its internal energy only, the gas does no work -------1 mark

Next let the gas be heated at constant pressure through 1^{o}K. By definition, the amount of heat required to raise the temperature of one gram mole of gas thro 1^{o}K is equal to the molar

Specific heat at constant pressre Cp . All this heat is utilized by the gas i) To increase its internal Energy ii) to do external work during expansion. --- 1 mark

$C_p = C_v + W$

$C_p = C_v + P(V_2 - V_1)$ ----I since $W = Pdv = P(V_2 - V_1)$ - 1mark

According to Ideal Gas Equation:

Before heating $PV_1 = RT$

After heating $PV_2 = R(T+1)$ --------1 mark

$P(V_2 - V_1) = RT + R - RT = R$ --------II

From equations I & II , $C_p = C_v + R$

$C_p - C_v = R$ --------1 mark

b) I Law of Thermodynamics : The heat energy supplied to a system is equal to the sum of the increase of internal energy of the system and the external work done by it.

$dQ = dU + dW$ ---------2 marks

Consider one gram mole of an ideal gas enclosed in a cylinder. The

pressure, volume and temperature of the gas are P, V1, T respectively.

----- 1 mark

First let the gas be heated at constant volume through 1 0K . By definition, the amount of heat required to raise the temperature of one gram mole of gas through 10K is equal to the molar Specific heat at constant volume Cv . All this heat is utilized by the gas to increase its internal energy only, the gas does no work -------1 mark

Next let the gas be heated at constant pressure through 10K. By definition, the amount of heat required to raise the temperature of one gram mole of gas thro 10K is equal to the molar

Specific heat at constant pressre Cp . All this heat is utilized by the gas i) To increase its internal Energy ii) to do external work during expansion. --- 1 mark

C p= Cv + W

C p = Cv + P (V2 - V1) ----I since W = Pdv= P (V2 - V1) - 1mark

According to Ideal Gas Equation:

Before heating PV1= RT

After heating PV2 = R (T+1) --------1 mark

P (V2 - V1) = RT +R- RT= R -------II

From equations I & II , Cp = Cv + R

Cp - Cv = R --------1 mark

b) I Law of Thermodynamics : The heat energy supplied to a system is equal to the sum of the increase of internal energy of the system and the external work done by it.

d Q = d U + d W ---------2 marks

II Law of Thermodynamics : Heat by itself can not flow from a body at a lower temperature to a body at a higher temperature unless an external agency does work on the system.--2marks

Q.NO.16 a) Noise pollution : Pollution created by unwanted sounds produced in the environment which interferes human communication, comfort and health is called noise pollution. ------2 marks

Unit of Sound Intensity : decibel (d B) -------1 mark

b) Effects of Noise Pollution :

1. Noise pollution affects human health,comfort and efficiency.
2. It interrupts the communication of the people.
3. It causes impatience, tension and mental disorder.
4. It causes headache, contraction of blood vessels and increase in blood pressure.
5. It causes deafness, if the noise very loud it may rupture the ear drum.
6. It causes heart, kidney and liver diseases and damage our optical nerves.
7. Noise due to sudden explosions may cause cracks in walls, windows and glasses of buildings. --------- I mark each for any three points.

c) No. of beats per second N = 5 , n_1 = 200 Hz.

Before loading : $N = n_1 - n_2$ ---------- 1 mark

n_2 = 200 ±5,

n_2 = 205 or 195 hertz ----------1 mark

After loading : No. of beats = 0. Due to loading the frequency decreases --------1 mark

If n_2 is 205, it may become 200 Hz , then $N' = n_1 - n_2 = 200 - 200 = 0$ ----1 mark.

Q.NO.17 a) Surface Tension : The tangential force per unit length acting at right angles on either side of an imaginary line drawn on the free surface of a liquid. ----------2 marks

Capillarity : The phenomenon of rise or fall of a liquid in a capillary tube due to surface tension is called capillarity. ----------2 marks

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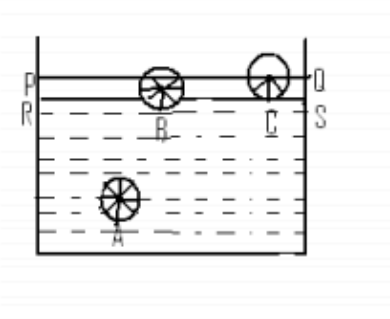
b) Molecular theory of Surface Tension:



Cohesive forces between the molecules of a liquid

are responsible for the surface tension.Thery are effective over 10^{-8} cm, called molecular range.

A sphere drawn with the molecule as centre and radius equal to the molecular range is called sphere ofInfluence. -----1 mark

In the figure, PQRS is the surface film of thickness 10^{-8}cm. A, B, C, are the molecules with their sphere of influence drawn around them.

Molecule A is well inside the liquid and is equally attracted by the molecules with in the sphere of influence. Hence there is no net force acting on it. All such molecules below the surface film experience no force on them. ---------1 mark

Molecule B has its sphere of influence partly outside the liquid surface .The number of molecules pulling B upwards is less than those pulling B downwards. Hence it experiences a net downward force. Molecule C is just on the free surface , half of its sphere of influence is outside the surface (in air). Hence it experiences a maximum downward force. All such molecules experience a maximum pull. ---------2 marks

Thus the molecules on the surface of liquid possess maximum potential energy due to downward pull. As a result the liquid loses stability. In order to attain stability, the number of molecules on the surface should decrease. For this ,the liquid surface contracts and acts like a stretched membrane to occupy minimum suface area. In this attempt surface tension developes on the liquid surface. -------2 marks

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b) Molecular theory of Surface Tension:

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