Section A (40 marks)

Answer all questions in this section

1. (a) Differentiate error from mistake. **(2 marks)**

   (b) A new born baby was measured in four different ways and her mass was found to be 2000g, 2001g, 2003g and 1999g respectively. Determine

   (i) Her actual mass. **(2 marks)**

   (ii) Mean absolute error of the measurement. **(2 marks)**

   (c) Name the physical quantities with the following dimensions **(2 marks)**

   (i) $ML^{-1}T^{-2}$ (ii) $ML^{2}T^{-1}$

   (d) Prove whether the following equation is dimensional correct or not **(2 marks)**

   $v = \sqrt{2gR}$, where g is acceleration due to gravity and R is the radius of the earth.

2. (a) (i) According to Newton's third law of motion, action and reaction are in opposite direction. Will they cancel each other on addition? **(3 marks)**

   (ii) Differentiate the two types of collision in terms of their coefficient of restitution. **(3 marks)**

   (b) Can a projectile motion be observed inside a free fall cube? Give reasons for your answer. **(4 marks)**

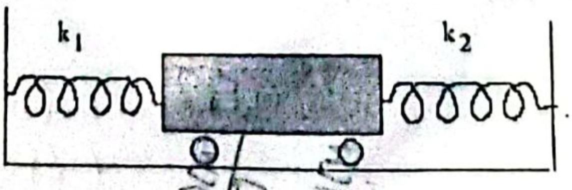
3. (a) What cause a body whirled in a vertical circle not to have constant velocity? **(2 mark)**

   (b) A particle of mass 50g is whirled in a vertical circle by a string of 40cm in length. Find what must be the minimum possible velocity of the particle to have tension equal to the weight of the particle at the top of a described vertical circle. **(4 marks)**

   (c) A car moving round a circular path of radius of curvature 200m has a pendulum of mass 100g hangs from its ceiling. If the pendulum get inclined at 30° from the vertical as the car goes round the path, find the velocity of the car. **(4 marks)**

4. (a) Briefly explain the importance of inertia in simple harmonic motion. **(2 marks)**

   (b) Prove that the following system will execute simple harmonic motion if slightly pushed parallel to the springs and get released **(4 marks)**



(c) An object of mass 2kg executes simple harmonic motion with a frequency of 2Hz and amplitude of 2.5cm. Calculate its maximum velocity and maximum potential energy.

(4 marks)

SECTION B(30 MARKS)

Answer all questions in this section

5. (a) Why does a good absorber of radiant energy appear black? **(03 marks)**

   (b) Two bodies A and B are kept in evacuated vessel maintained at a temperature of 27°C.The temperature of A is 527°C and that of B is 127°C. Compare the rates at which heat is lost from A and B. **(03 marks)**

   (c) When a block of metal of mass 0.11kg and specific heat capacity of 400J/kgK heated to 100°C and quickly transferred to a copper calorimeter of mass 0.1kg containing 0.2kg of liquid at 10°C the resulting temperature after stirring is 18°C.Calculate the specific heat capacity of liquid **(04 marks)**

6. (a) A person sitting on a bench on a calm hot summer day is aware of a cool breeze blowing from the sea. Briefly explain why there is a natural convection? **(03 marks)**

   (b) Briefly explain why forced convection is necessary for excess temperate less than 20 K? **(03 marks)**

   (c) A cup of tea kept in a room with temperature of 22°C cools from 66°C to 63°C in 1 minute. How long will the same cup of tea take to cool from the temperature of 43°C to 40°C under the same conditions? **(04 marks)**

7. (a) How does the average translational kinetic energy of a molecule of an ideal gas change if;

   (i) The pressure is doubled while the volume is kept constant? **(02 marks)**

   (ii) The volume is doubled while the pressure is kept constant? **(02 marks)**

   (b) Based on the kinetic theory of gases determine;

   (i) The average translational kinetic energy of air at a temperature of 290K. **(02 marks)**

   (ii) The root mean square speed (r.m.s) of an air molecule at the same temperature (above).One mole of air has a mass of 29 g. **(02 marks)**

   (c). Compare the law governing the conduction of heat and electricity by pointing out the corresponding quantities in each case. **(02 marks)**

Heat loss by metal = Heat gained by calo + Heat gain by liquid

$mc\Delta\theta = mc\Delta\theta + mc\Delta\theta$

$f_1 = 4f_0$

$f_2 = 8f_0$

SECTION C (30 MARKS)

Answer all questions in this section

8. (a) (i) Why doesn't the Doppler effect take place when the listener and the source are moving perpendicularly? **(2.0 marks)**

(ii) Would the Doppler Effect in sound still happen if the source and the listener move in a circle? **(2.0 marks)**

(b) (i) A bike rider approaching a vertical wall observes that the frequency of his bike horn changes from 440 Hz to 480 Hz when it gets reflected from the wall. Find the speed of the bike if the speed of sound is 330 m/s. **(3.0 marks)**

(ii) Two trains A and B are moving toward each other at a speed of 432 km/h. If the frequency of the whistle emitted by A is 800 Hz, then what is the apparent frequency of the whistle heard by the passenger sitting in train B. (The velocity of sound in air is 360 m/s). **(3.0 marks)**

9. (a) (i) *If the third harmonics of a closed organ pipe is equal to the fundamental frequency of an open organ pipe, compute the length of the open organ pipe if the length of the closed organ pipe is 30 cm.* **(2.0 marks)**

(ii) A student performed an experiment to determine the speed of sound in air using the resonance column method. The length of the air column that resonates in the fundamental mode with a tuning fork is 0.2 m. If the length is varied such that the same tuning fork resonates with the first overtone at 0.7 m. Calculate the end correction. **(3.0 marks)**

(b) (i) A string has both ends kept fixed, produces a fundamental tone with a frequency of 420 Hz. Determine the third overtone. **(2.0 marks)**

(ii) The wavelength of the first overtone of a string is 40 cm. If the speed of sound wave in air is 340 m/s, determine the third overtone. **(3.0 marks)**

10. (a) (i) When do we use the progressive wave equation as $y = Asin(\omega t - kx)$ and when do we use $y = Asin(kx - \omega t)$? **(2.0 marks)**

(ii) Two vibrating tuning forks produce waves whose equation is given by

$y_1 = 5sin(240\pi t)$ and $y_2 = 4sin(244\pi t)$. Compute the number of beats per second. **(2.0 marks)**

$2\pi f = 240\pi$ $\quad$ $\frac{2\pi f_2}{2\pi} = \frac{244\pi}{2\pi}$

$f_1 = 120$ $\quad$ $f_2 = 122$

(b) Two waves of the same frequency are out of phase by 30 degrees, and both waves have amplitude 6 m. Find the amplitude of the resultant wave when the waves combine. Round to two decimal places. **(2.0 marks)**

(c) The transverse displacement of a string clamped at its two ends is given by

$y(x,t) = 0.06sin\frac{2\pi}{3}xcos(120\pi t)$, where x, y are in metres and t is in seconds. The length of the string is 1.5m and its mass is $3 \times 10^{-2}kg$

(i) Does the function represent a travelling or a stationary wave? **(1.0 mark)**

(ii) Interpret the wave as a superposition of two waves travelling in opposite directions. What are the wavelength, frequency and speed of propagation of each wave? **(2.0 marks)**

(iii) Determine the tension in the string. **(1.0 mark)**

$\sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\theta}$

$2A\cos\left(\frac{\theta}{2}\right)$

*************************************THE END*************************************

1 (a)(i) Error
is the difference between the actual value and measured value WHILE Mistake is the wrong way of doing measurement. (01) (01)

(ii) Error can be accounted for but mistake can't be accounted for.

(iii) Error can be minimized WHILE Mistake can't be minimized.

1 b) (i) $= \frac{2000 g + 2001 + 2003 + 1999 g}{4}$ (01)

$= 2000.75 g$ (01)

∴ the actual mass is 2000.75g.

(ii) $\Delta \bar{X}e_1 = X - \bar{X}e = 2000 - 2000.75 = -0.75$

$\Delta Xe_2 = X - \bar{X}e = 2001 - 2000.75 = 0.25$

$\Delta Xe_3 = X - Xe = 2003 - 2000.75 = 2.25$

$\Delta Xe_4 = X - Xe = 1999 - 2000.75 = -1.75$

but

$\overline{\Delta Xe} = \frac{\Delta Xe_1 + \Delta Xe_2 + \Delta Xe_3 + \Delta Xe_4}{4}$ (01)

$= \frac{0.75 + 0.25 + 2.25 + 1.75}{4}$

$= 5/4$

$= 1.25$ (01)

∴ The mean absolute error is 1.25g

1 (c) (1) $ML^{-1}T^{-2}$ – <u>Pressure</u> (01)

$ML^{2}T^{-1}$ – <u>Power</u> Planks constant Angular momentum

1.(d) $V = \sqrt{2gR}$

L.H.S	R.H.S
$[V]$	$[g]^{\frac{1}{2}}[R]^{\frac{1}{2}}$
$[M^{0}LT^{-1}]$	$[M^{0}LT^{-2}]^{\frac{1}{2}}[M^{0}LT^{0}]^{\frac{1}{2}}$
$[M^{0}LT^{-1}]$	$[M^{0}L^{\frac{1}{2}}T^{-1}][M^{0}L^{\frac{1}{2}}T^{0}]$
$[M^{0}LT^{-1}]$	$[M^{0}LT^{-1}]$

L.H.S = R.H.S

<u>Hence Proved</u>

(01) $\frac{1}{2}$ (01)

2 (a)(i) Action and reaction do not cancel each other even through they act on opposite direction, due to the fact that they act on two different bodies.

03

2(a)(ii) Elastic collission is the type of collusion whose coefficient of restitution is equal to 1 (e=1)

$1\frac{1}{2}$

WHILE

Inelastic collision is the type of collusion whose coefficient of restitution is less than 1 (e<1).

$1\frac{1}{2}$

2 (b) No, projectile motion can not be observed in a free fall cube because One of the assumption of projectile motion is acceleration due to gravity is constant but in free fall motion acceleration due to gravity is zero

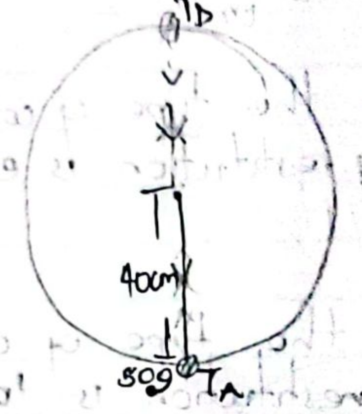
04

10

Direction of the body will be changing with direction rotation of the body

3 (a) The vertical circle can not have constant velocity since the tension of the string acts differently at different position.

(b)



$T_D = T + mg (\pm F_c)$

$mg + mg \pm F_c$

$2mg = \frac{mv^2}{r}$

$V = 2.8$

$T_D = mg \Rightarrow P = mg$

for this to occur $\cancel{T_D}$ $F_c = 0$

then.

$PE_A + KE_A = PE_A + KE_B$

$\frac{1}{2}mv_A^2 = mgh + \frac{1}{2}mV_D^2$

$\frac{1}{2}0.05kg\ V_A^2 = 0.05 \times 9.8 \times 0.8 + \frac{1}{2}0.05 \times V_D^2$

$0.025V_A^2 = 0.392 + 0.025V_D^2$ — 1

Then

from

$$\frac{mV_D^2}{r} = mg$$

$$\frac{V_D^2}{r} = \cancel{m}g$$

$$V_D^2 = r\cancel{m}g$$

$$V_D^2 = rg$$

$$V_D = \sqrt{rg}$$

$$V_D = 1.98\ m/s$$

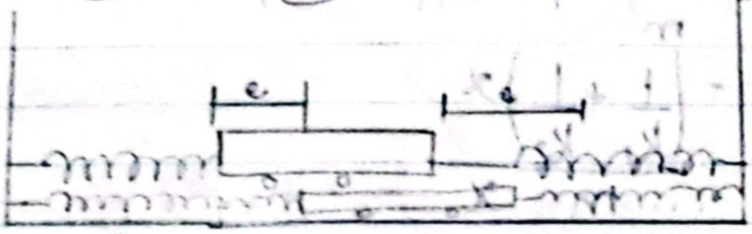
∴ The minimum velocity of the is. 1.98m/s

(4)

4 (a) Inertia helps to bring back the body back into its mean position and conserve its kinetic energy and Potential energy.

-Reducing damping effect of oscillation. 02

4 (b)



$$e_T = e_1 + e_2$$

$$\frac{F}{K_T} = \frac{F_1}{K_1} + \frac{F}{K_2}$$

$$\frac{F}{K_T} = \frac{1}{K_1} + \frac{1}{K_2}$$

then

$$-\cancel{Fr = -Fc} \quad Fc = -Fr$$

$$\frac{mv^2}{r} = -\mu N$$

$$\frac{mv^2}{r} = -Kx$$

$$\frac{v^2}{r} = -\frac{K}{m}x$$

$$a_c = \frac{-K_T x}{m}$$

$$a_c = \frac{-\left(\frac{1}{k_1} + \frac{k_2}{k_2}\right) x}{m}$$

$$a_c = -w^2 y$$

then,

Since acele

P.T.O →

20

4(b) then
$\therefore F_c = -F_r$ (01)
$ma = -Kx$
$a = -\frac{K}{m}x$ (01)
$a = -\frac{\left(\frac{1}{K_1}+\frac{1}{K_2}\right)}{m}x$ $\times$ $a = -\frac{(K_1+K_2)}{m}x$
x
$a = -w^2 y$
Since acceleration is directly prop' to displacement then it executes S.H.M.

4 (c) from
$y = A\sin wt$
$v = Aw\cos wt$

fro
$V_{max} = Aw$ (01)
$V_{max} = A \times 2\pi f$
$V_{max} = 0.025m \times 2 \times \pi \times 2$
$V_{max} = 0.314 m/s$ (01)
$\therefore$ The maximum velocity is $0.314 m s^{-1}$

Max potential energy
$P.E_{max} = \frac{1}{2} m w^2 A^2$ (0.5)
$= \frac{1}{2} \times 2kg \times (2\times\pi\times 2)^2 \times (0.025m)$
$= 1 \times 157.7536 \times 0.025$
$= 3.944 J$ $\times$ 0.0985961
$\therefore$ The maximum potential energy is $3.944 J$.

7

5 (a) A good absorber of radiant energy appears black because as the radiations are received by the body, the body absorbs all radiations and reflects none hence appearing black.

(b) Case 01

$$P_1 = \sigma A(T_1^4 - T_s^4) \longrightarrow i$$
$$P_2 = \sigma A(T_2^4 - T_s^4) \longrightarrow ii$$

Taking ratio of the two equations

$$\frac{P_1}{P_2} = \frac{\sigma A(T_1^4 - T_s^4)}{\sigma A(T_2^4 - T_s^4)}$$

$$\frac{P_1}{P_2} =$$

*5 (b) Case 01

$$\left(\frac{dQ}{dt}\right)_1 = K(\theta_1 - \theta_s) \longrightarrow i$$

Case 02

$$\left(\frac{dQ}{dt}\right)_2 = K(\theta_2 - \theta_s) \longrightarrow ii$$

On ~~con~~ taking ratio

$$\frac{(dQ/dt)_1}{(dQ/dt)_2} = \frac{K(\theta_1 - \theta_s)}{K(\theta_2 - \theta_s)}$$

$$\frac{(dQ/dt)_1}{(dQ/dt)_2} = \frac{\theta_1 - \theta_s}{\theta_2 - \theta_s}$$

$$\frac{(dQ/dt)_1}{(dQ/dt)_2} = \frac{527°C - 27°C}{127°C - 27°C}$$

$$\frac{(dQ/dt)_1}{(dQ/dt)_2} = \frac{300}{100} = 3$$

∴ The rate of heat loss by A is 3 times rate of heat loss by body B.

03

03

(93)

5 (c) Heat loss by metal = Heat gained by Liquid and copper callorimeter.

$m c \Delta \theta = m c \Delta \theta$

$0.11 \times 400 \times \cancel{100} = (0.1 + 0.2 kg) \times c \times (8)$

$\cancel{16412} = 0.3 \times 8 c$

$4400 = 2.4 c$

$c = 1833.3 J kg^{-1} K^{-1}$

$\therefore$ The specific heat capacity of liquid is 1833.3 J/KgK.

$0.11 \times 400 \times (100 - 18) = 0.3 \times 8 c$

6 (a) There is natural convection because of the differences in temperature between the land and sea. As in, during the day, the land absorbs energy, hence it is warm correspondingly the sea looses heat during the day, thus the warm air of the land rises as cool air from the sea moves to the land. → Because there is no cooling agent

03

6. (b) Forced convection is not necessary for excess temperature loss than 20K because the validity of the law under natural ~~forced~~ convection is $20K \leq \theta - \theta_s \leq 500K$ 50K, hence the application of other factors (forced convection) are needed for body to cool.

→ To allow movement of air around the object

03

6 (c) from

$\theta_f = \theta_s + (\theta_1 - \theta_s)e^{-\lambda t}$

$63 = 22 + (66-63)e^{-\lambda 1}$

$41 = 3e^{-\lambda t}$

$\frac{41}{3} = e^{-\lambda t}$

$\lambda = \ln(41/3)/-1$

$\lambda = -2.615$

then

$\theta_F = \theta_s + (\theta_1 - \theta_s)e^{-\lambda t}$

$40 = 22 + (43-40)e^{+2.615t}$

$18 = 3e^{+2.615t}$

$6 = e^{+2.615t}$

$t = \frac{\ln 6}{2.615} = 0.68$ minutes.

∴ It will take the cup 0.68 minutes

01

7 (a)(i) from:

$$P = \frac{2}{3} N \overline{KE_1} \quad \text{--- 1}$$

$$2P = \frac{2}{3} N \overline{KE_2} \quad \text{--- 2}$$

On taking ratio of eqn 2 to eqn 1.

$$\frac{2P_1}{P_1} = \frac{2/3 N (KE_1)}{2/3 N (KE)_2}$$

$$2 = \frac{KE_1}{KE_2}$$

$$KE_1 = 2KE_2$$

$$KE_2 = \frac{1}{2} KE_1$$

∴ The average translational energy will be halved.

(ii) Since from Boyles law

$$P \propto \frac{1}{V}$$

Hence, when the volume is doubled, the pressure becomes halved, thus the kinetic energy will be doubled.

$$\frac{KE_1}{KE_2} = \frac{1}{2}$$

$$KE_2 = 2KE_1$$

∴ the average translational energy will be doubled.

(b) (ii) from

$$\overline{KE} = \frac{3}{2} K_b T$$

$$KE = \frac{3}{2} \times 1.38 \times 10^{-23} \times 290$$

$$KE = 6.003 \times 10^{-21} J$$

∴ The average translational Kinetic energy is $6.003 \times 10^{-21} J$

(iii) from

$$KE = \frac{1}{2} m\bar{u}^2$$

$29g \to 6.02 \times 10^{23}$

$x \to 1$.

$x = 4.817 \times 10^{-26}$

$$\bar{u}^2 = \frac{2KE}{m}$$

$$\bar{u} = \sqrt{\frac{2KE}{m}}$$

$$\bar{u} = \sqrt{\frac{2 \times 6.003 \times 10^{-21}}{\cancel{m}(29 \times 10^{-3})}}$$

$$\bar{u} = 6.43 \times 10^{-10} m/s.$$

499.086 m/s

∴ The root mean square speed is $6.43 \times 10^{-10} m/s$.

(c) Conduction of heat

$$\left(\frac{dQ}{dt}\right) = \frac{KA\Delta\theta}{L} \quad \text{--- i}$$

Conduction of electricity

$$\frac{dq}{dt} = I = \frac{V}{R} = \frac{VA}{\rho L}$$

$$\frac{dQ}{dt} = \cancel{\gamma}\frac{1}{\rho} \cdot \cancel{A} \cdot \frac{dv}{dl} \quad \text{--- ii}$$

$V_o 8$

$\frac{1}{2}$

7 (c) On comparing eqn v and vi

$$K A \frac{\Delta \theta}{l} = \frac{1}{S} \cdot A \cdot \frac{dV}{dl}$$

the

Corresponding quantities

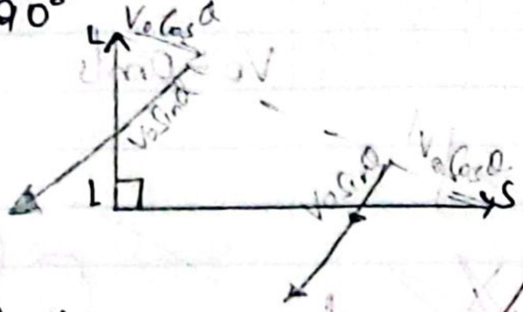
$$K = \frac{1}{S}$$

$$A = A$$

$$\frac{\Delta \theta}{l} = \frac{V}{L}$$

Good

8 (a)(i) Because when the source and listener are moving perpendicularly, the angle betwee them is 90°



A.

then

$$f' = \left(\frac{V \pm V_0 \cos\theta}{V + V_s \cos\theta}\right) f$$

$$f' = \left(\frac{V \pm V_0 \cos 90°}{V \pm V_s \cos 90°}\right) f$$

$$f' = \left(\frac{V \pm 0}{V \pm 0}\right) f$$

$$f' = f$$

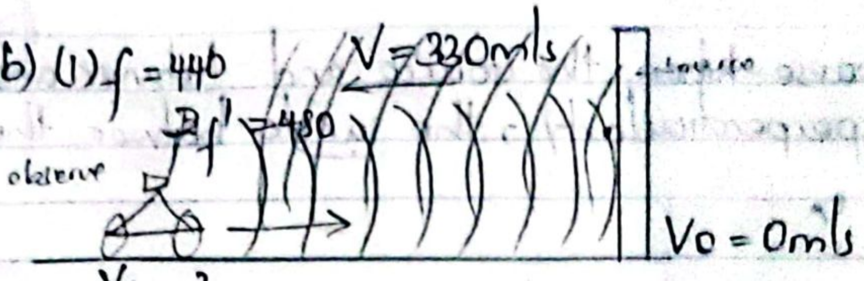
∴ No doppler effect can occur since $\cos 90°$ is 0.

02

(b) (ii) No, doppler effect in sound would not happen 4 the source and listener are moving in a circle because one of the major conditions for doppler effect to occur is that the source and obserer by a straight line.

02

8 (b) (i) $f = 440$



After reflection

$$f'' = \left(\frac{V + V_s}{V}\right) f \qquad f'$$

00

$$480 = \left(\frac{330 + V_s}{330}\right) 440$$

$$480 = \frac{440(330 + V_s)}{330}$$

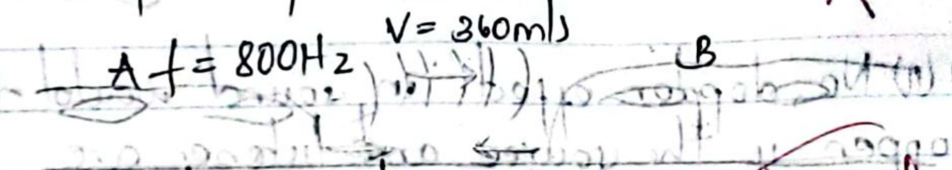
$$158400 = 145200 + 440V_s$$

$$13200 = 440 V_s$$

$$V_s = 30 m/s$$

$\therefore$ The speed of the bike is $30 m/s$

b(ii)



$V = 432 km/h = 120 m/s$

01

The Relative velocity of A and B

$$RV = V_A \mp V_B$$

$$120 = V_A - V_B \quad , \quad V_B = V_A - 120$$

then

$$f'' = \left(\frac{V + V_o}{V - V_s}\right) f$$

01

$$f'' = \left(\frac{V + V_B}{V - V_A}\right) 800$$

$$f'' = \left(\frac{360 + (V_A - 120)}{360 - V_A}\right) 800$$

$$f'' = \left(\frac{360 + V_A - 120}{360 - V_A}\right)800$$

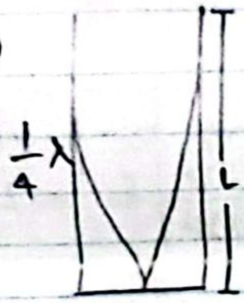
$$f'' = \left(\frac{240 + V_A}{360 - V_A}\right)800$$

$$f'' = \frac{192000 + 800V_A}{360 - V_A}$$

$$\cancel{\lambda = V_A \Big/ \frac{192000}{V_A}}$$

$\therefore$ The apparent frequency is $\dfrac{192000 + 800V_A}{360 - V_A}$.

2) (ii)



$$\lambda = 4L$$

the

$$V = \lambda f_0$$

$$f_0 = \frac{V}{\lambda}$$

$$f_0 = \frac{V}{4L}$$

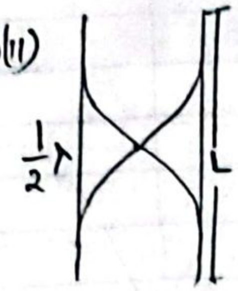
then

$$f_3 = (2n+1)f_0$$

$$= (2\times 3 + 1)f_0$$

$$7\left(\frac{V}{4L}\right)$$

9 (a)(ii)



$\lambda = 2L$

the

$v = \lambda f_0$

$f_0 = \frac{v}{2L}$

So

$f_3 = f_0$

$7\left(\frac{v}{4L}\right) = \frac{v}{2L}$

$\frac{7}{4L} = \frac{1}{2L}$

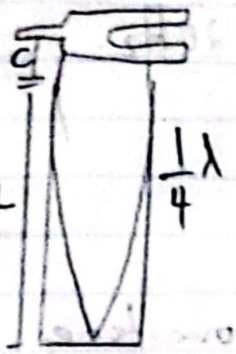
$\frac{7}{4 \times 30} = \frac{1}{2L}$

$14L = 120$

$L = 8.57\,\text{cm}$

∴ The length of open pipe is 8.57 cm.

9 (a)(ii)



For,
$4(C+L) = \lambda$

the frequency

$$f_0 = \frac{V}{4(c+L)}$$

In the first overtone

$$f_1 = 3\left(\frac{V}{4(c+L)}\right)$$

$$f_1 = \frac{3V}{4(c+L)}$$

then

$$f_0 = f_1$$

$$\frac{V}{4(c+0.2)} = \frac{3V}{4(c+0.7)}$$

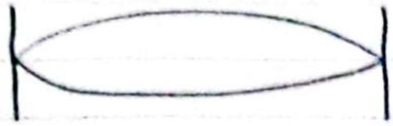
$$\frac{1}{4c+0.8} = \frac{3}{4c+2.8}$$

$$4c+2.8 = 12c+2.4$$

$$\frac{0.4}{8} = \frac{8c}{8}$$

$$c = 0.05\,m$$

∴ The length of the end correction is 0.05m.

9 (b) (i)  $f_o = 420 Hz$.

$f_3 = 3f_o$
$= 3 \times 420$
$= 1260 Hz$

∴ The frequency of third overtone is 1260Hz

(ii) First overtone - fundamental frequency from

$\frac{1}{2}\lambda = L$

$\lambda = 2L$

then

$f_o = \frac{V}{\lambda}$

$f_o = \frac{V}{2L}$

$f_o = \frac{V}{40cm} = \frac{340m/s}{0.4m}$

$f_o = 850 Hz$

then

$f_3 = 3f_o$

$f_3 = 3 \times 850$
$= 2250 Hz$

∴ The frequency of the third overtone is 2250Hz.

10 Q1) We use $y = A\sin(wt - kx)$ when a wave is progressing towards the positive x-direction and $y = A\sin(kx - wt)$ when the wave is progressing towards the negative x-direction

(a) (ii) $y = 5\sin(240\pi t)$ $y = 4\sin(244\pi t)$

form case 01

$2\pi f = 240\pi$

$2f = 240$

$f_1 = 120\,Hz$

02/2

Case 02

$2\pi f' = 244\pi$

$2f = 244$

$f_2 = 122\,Hz$

02/2

then

$f_B = |f_1 - f_2|$

$f_B = |120 - 122|$

$f_B = 2\,Hz$.

01

∴ The number of beats heard per second is 2Hz.

(b) Resultant amplitude

$A = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$

$A = \sqrt{6^2 + 6^2 + 2(6\times6)\cos 30^\circ}$

$A = 11.59\,M$.

∴ the resultant amplitude is 11.59M.

01

01

10 (c)(i) The function represents a stationary wave since it does not ~~was~~ indicate direction of wave.

01

10 (c) (ii) ~~7~~

10 (c) (ii) $y = 0.06 \sin \frac{2\pi x}{3} \cos(120\pi t)$

Amplitude,

$2A = 0.06$

$A = 0.03M$

$\therefore$ The amplitude of each wave is 0.03M

Wavelength

$\frac{2\pi}{\lambda} = \frac{2\pi}{3}$

$\frac{2}{\lambda} = \frac{2}{3}$

$2\lambda = 6$

$\lambda = 3M$

$\therefore$ The wavelength of each wave is 3M.

0.½

frequency

$2\pi f = 120\pi$

$f = 60Hz$

$\therefore$ The frequency of the waves is 60Hz

0.½

Then

$V = \lambda f$

$V = 3 \times 60$

$V = 180m/s$

$\therefore$ The speed of propagation of each wave is 180M/s.

01

10 (c) (iii) Tension

$$V = \sqrt{\frac{TL}{m}}$$

$$V^2 = \frac{TL}{m}$$

$$T = \frac{V^2 \cancel{L}}{\cancel{m}} \quad T = \frac{V^2 m}{L}$$

$$T = \frac{(180)^2 \times 3 \times 10^{-7} kg}{1.5M}$$

$$T = 648N$$

∴ The tension in the string is 648N.

$\frac{00}{2}$

$\frac{00}{2}$