YAKEEN NEET 2.0

2026

Basic Maths and Calculus (Mathematical Tools)

Physics | **Assignment Solution 05**

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Question-01

A particle's speed varies with time as

$$v(t) = 4\sin(\pi t)$$

What is the total distance travelled between $t = 0$ and $t = 1$s?

$v = 3\sin t\,\hat{i} + 3\cos t\,\hat{j}$

1. 8π ✓
2. π
3. 2π
4. Zero

As

$v = 4\sin(\pi t)$

$\frac{dx}{dt} = 4\sin(\pi t)$

$\underbrace{\int dx}_{x} = \int_{t=0}^{t=1} 4\sin(\pi t)\,dt$ ✓

$x = 4\left(-\frac{\cos \pi t}{\pi}\right)_0^1$

$= -\frac{4}{\pi}\left[\cos \pi\times 1 - \cos 0\right]$

$= -\frac{4}{\pi}[-1-1]$

$= \frac{4\times 2}{\pi}$

Speed avg $= \frac{\text{total dist}}{\text{total time}}$

$\int \sin x\,dx$ ✓

$\int \sin\theta\,d\theta$ ✓

$\int \sin t\,dt$ ✓

$\int \sin\theta\,dt$ ✗

Question-02

A particle moves along a straight line with acceleration given by

$a(x) = 6x.$

If the particle starts from rest at position $x = 0$, what is its velocity when it reaches position $x = 2\text{m}$?

1. $\sqrt{6}$ m/s
2. $2\sqrt{3}$ m/s
3. $2\sqrt{6}$ m/s $= \sqrt{24} = \sqrt{6\times4}$
   $= 2\sqrt{6}$
4. 6 m/s

$a = 6x$

$\frac{dv}{dt} = 6x$

$\int dv = \int \boxed{6x}\, dt$

$v\frac{dv}{dx} = 6x$

$\int_{v=0}^{v} v\, dv = \int_{x=0}^{2} 6x\, dx$

$\left[\frac{v^2}{\cancel{2}}\right]_0^v = 6\left[\frac{x^2}{\cancel{2}}\right]_0^2$

$v^2 = 6\left(2^2 - 0^2\right) = 24$

$v = \sqrt{24}$

Question-03

Evaluate:

$$\int\left(2x+\frac{1}{x^2}\right)dx$$

$$\int 2x\,dx + \int \frac{1}{x^2}\,dx$$

$$\cancel{2}\frac{x^2}{\cancel{2}} + \frac{x^{-2+1}}{-2+1}$$

$$= \left(x^2 - \frac{1}{x}\right)_{\text{Q}}$$

$$\int \frac{1}{x^2}\,dx = \int x^{-2}\,dx$$

$$= \frac{x^{-2+1}}{-2+1} = \frac{x^{-1}}{-1}$$

$$= -\frac{1}{x}$$

✓

Question-04

Evaluate:

$$\int (3e^x + 4x^2)dx$$

$$3\int e^x + 4\int x^2 dx$$

$$= 3e^x + \frac{4x^3}{3}$$

Question-05

Evaluate:

$$\int\left(\frac{1+\sin x}{\cos^2 x}\right)dx$$

$$\boxed{\cos\theta = \frac{1}{\sec\theta}}$$

$$\boxed{\frac{d\tan x}{dx} = \sec^2 x}$$

$$\frac{d\sec x}{dx} = \sec x\tan x$$

$$\int \frac{1+\sin x}{\cos^2 x}\,dx = \int\left(\frac{1}{\cos^2 x} + \frac{\sin x}{\cos^2 x}\right)dx$$

$$\int \sec^2 x\,dx + \int \tan x \sec x\,dx$$

$$= \tan x + \sec x$$

Question-06

A square plate's side is measured as 7.1 cm instead of the actual 7 cm. Using ~~binomial~~ expansion, the percentage error in area is approximately:

1. 2.5%
2. 2.86% ✓
3. 3.2%
4. 5%

$l_T = 7\,cm$

$l_m = 7.1\,cm$

$\Delta T = 0.1\,cm$

$A = l^2$

$100 \times \frac{\Delta A}{A} = 2\frac{\Delta l}{l} \times 100$ → error unit & dimn

$= 2\frac{0.1\,cm}{7\,cm} \times 100$

$= 2 \times \frac{10}{7}$ 1.4

$= 2.8\%$

Question-07

The distance to a star is given as $(9.99 \times 10^{15})^2$m. Approximate this using binomial expansion:

1. 1.0×10^{33} m
2. 9.98×10^{31} m
3. 9.99×10^{32} m
4. 1.02×10^{33} m

$$(9.99 \times 10^{15})^2$$
$$= (10 - 0.01)^2 \times 10^{30}$$
$$= 10^2(1 - 0.001)^2 \times 10^{30}$$
$$= 10^{32}(1 - 0.002)$$
$$= 10^{32}(0.998)$$
$$= 0.998 \times 10^{31} \times 10$$
$$= 9.98 \times 10^{31}$$

Question-08

A defibrillator capacitor discharges such that its voltage reduces to 10% of its initial value in 20 milliseconds. What is the time constant (τ) of the circuit?

$\left(V = V_0 e^{-t/\tau}\right)$ given in qu

1. 8.7 ms
2. 18.2 ms
3. 23.4 ms
4. 43.3 ms

initial val

$V_t = V_0 e^{-t/\tau}$

$V = 10\% \cdot V_0$

$10\% \cdot \cancel{V_0} = \cancel{V_0} e^{-t/\tau}$

$\frac{10}{100} = e^{-t/\tau}$

$\boxed{0.1 = e^{-20ms/\tau}}$

taking log both side.

$\log_e 0.1 = \log_e e^{-\frac{20ms}{\tau}}$

$\log_e 10^{-1} = \frac{-20ms}{\tau} \log_e e \rightarrow 1$

$-1(2.303) = -\frac{20ms}{\tau}$

$\tau = \frac{20ms}{2.3}$

Question-09

You're on a ride where your speed changes with time: $v(t) = 3t^2 + 2t$. You started from rest at the station (position = 0). The rise lasts t seconds. Since distance is just the total speed added up over time, how far do you end up?

(1) $t^3 + t^2 + C$ ✓

(2) $t^3 + t^2$

(3) $t^3 + t^2 + 1$

(4) $3t^3 + 2t^2$

$v\,dt$

$V = 3t^2 + 2t$

dist^n = $v\,dt$

dis $= \int (3t^2 + 2t)\,dt$

$= \cancel{3}\frac{t^3}{\cancel{3}} + \cancel{2}\frac{t^2}{\cancel{2}}$

$= t^3 + t^2$

Question-10

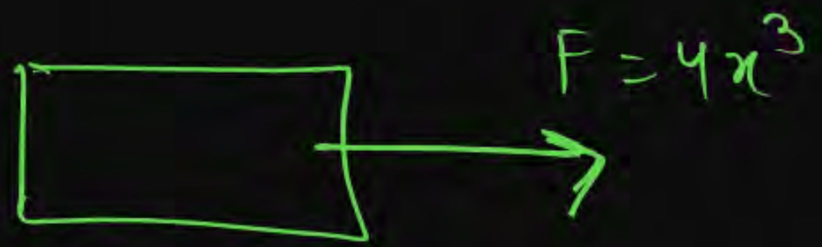
You're pulling a crate, and your rope somehow gets stronger with every meter: the force at position x is $F(x) = 4x^3$. Since work is just force adding up over distance, how much work did you do from $x = 1$ to $x = 3$ meters?

(1) 64 J

(2) 80 J ✓

(3) 120 J

(4) 256 J



$F = 2x^2$, $3x^3$

$dW = F\,dx$

given in $\int dW = \int 4x^3\,dx$

$W = \cancel{4}\frac{x^{3+1}}{\cancel{3+1}} = \left(x^4\right)_1^3 = 3^4 - 1^4 =$

Question-11

You're designing a glowing rod, and charge density grows with length: $\boxed{\lambda(x) = kx.}$ Since total charge is just all the little pieces of charge added from start to end, how much charge is in the rod from 0 to L?

1. $\dfrac{kL^2}{2}$ ✓
2. kL
3. $\dfrac{2kL^2}{3}$
4. kL^2

$\lambda = \dfrac{(dm)}{dL}$

linear charge $\lambda = \dfrac{dq}{dx}$

$\lambda = \text{const}$

$\lambda = \text{var.}$

$dq = \lambda\, dx$

$\int dq = \int kx\, dx$

$Q = k\left(\dfrac{x^2}{2}\right)_0^L = \dfrac{kL^2}{2}$

Question-12

Imagine a rod where the mass isn't evenly spread – it gets heavier the farther you go: $\lambda(x) = ax$. Since center of mass is just the average position weighted by mass, where's the spot it would perfectly balance?

$$\boxed{x_{c.m} = \frac{\int x\,dm}{\int dm}}$$

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

(2) $\frac{2L}{3}$

(3) $\frac{L}{3}$

(4) $\frac{3L}{4}$

λ (line mass density) $= ax = \frac{dm}{dx}$

$dm = ax\,dx$ — (1)

$$x_{c.m} = \frac{\int x\,dm}{\int dm}$$

$$= \frac{\int x\,ax\,dx}{\int ax\,dx} = \frac{\cancel{a}\int x^2\,dx}{\cancel{a}\int x\,dx} = \frac{x^3}{3 \times \frac{x^2}{2}} = \frac{2}{3}(x)$$

Question-13

You're got a rod that gets better at conducting heat the farther along you go: $k(x) = k_0(1 + x)$. It has a fixed area A. Since thermal resistance is how much a rod fights heat flow, what's the total resistance from start to end of length L?

$\left(R = \frac{L}{KA}\right)$

given in question

(1) $\dfrac{L}{k_0 A}$

(2) $\dfrac{\ln(1 + L)}{k_0 A}$ ✓

(3) $\dfrac{L}{2k_0 A}$

(4) $\dfrac{1}{k_0}\ln(L + 1)$

$K_x = K_0(1+X)$

Thermal resistance for dx length.

$$dR = \frac{dx}{A K_x}$$

$$dR = \frac{dx}{AK_0(1+X)}$$

$$\int dR = \frac{1}{AK_0}\int_0^L \frac{dx}{(1+x)^1}$$

$$R = \frac{1}{AK_0}\Big(\log(1+x)\Big)_0^L$$

$$= \frac{1}{AK}\Big[\log(1+L) - \log 1\Big)$$

Question-14

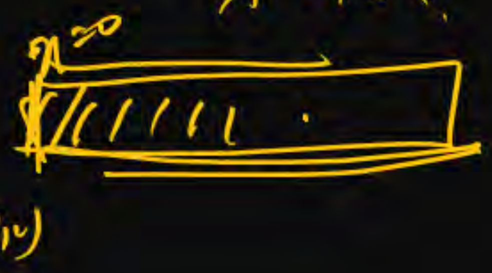
There's a rod whose mass gets thicker as you go down: $\boxed{\lambda(x) = \lambda_0 x}$. A small object sits distance d away from one end. Since gravity is the pull from each bit of mass, what does the total pull (force) look like?

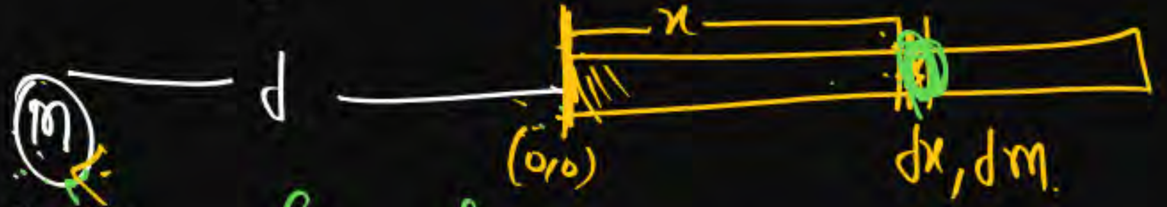
(1) $Gm\int_0^L \frac{\lambda_0}{x^2}\,dx$

(2) $Gm\int_0^L \frac{\lambda_0 x}{(x+d)^2}\,dx$ ✓

(3) $Gm\int_0^L \frac{x^2}{\lambda_0 (x+d)^2}\,dx$

(4) $Gm\int_0^L \lambda_0 x (x+d)^2\,dx$





$\int dF = \int \frac{Gm\lambda_0 x\,dx}{(d+x)^2}$

$\lambda = \frac{dm}{dx}$

$\boxed{dm = \lambda\,dx = \lambda_0 x\,dx \quad \text{—(1)}}$

$\boxed{\text{Put } \lambda = \lambda_0 x}$

Question-15

5, 10, 15, 20 ..., 500 find the sum of the series.

1. 25250
2. 252500
3. 2525
4. 5000

$a = 5$

$c.d = 5$

n^{th} term $= a + (n-1)d$

$500 = 5 + (n-1)\times 5$

$\frac{495}{5} = (n-1)$

$n - 1 = 99$

$n = 100$

Sum of n term $= \frac{n}{2}\left[1^{st} + n^{th} \text{ term}\right]$

$= \frac{n}{2}\left[2a + (n-1)d\right]$

Sum of n term $= \frac{n}{2}(5 + 500)$

$= \frac{\cancel{100}^{50}}{\cancel{2}}(505)$

$= 50 \times 505$

$$\begin{array}{r} 505 \\ \times\ 50 \\ \hline 000 \\ 2525 \\ \hline 25250 \end{array}$$

Question-16

3, 6, 9, 12, 15, ...,120 find the sum of series.

A.P

1. 1960
2. 1760
3. 1560
4. 2460 ✓

$a = 3$

$d = 3$

n^{th} term $= a + (n-1)d$

$120 = 3 + (n-1)3$

$117 = (n-1) \times 3$

$39 = n-1$

$n = 40$

Sum of n-terms $= \frac{40}{2}[3 + 120]$

$= 20 \times (123)$

$= 296$

Question-17

If acceleration due to gravity g at height $h \ll R$ where R is radius of earth $g_h = g_0\left(1+\frac{h}{R}\right)^{-2}$, then using binomial theorem which is correct?

(1) $g_h = g_0$

(2) $g_h = g_0\left(1-\frac{2h}{R}\right)$

(3) $g_h = g_0\left(1+\frac{2h}{R}\right)$

(4) $g_h = g_0\left(1-\frac{h}{2R}\right)$

$$g_h = g_0\left(1+\frac{h}{R}\right)^{-2}$$

$$= g_0\left(1-\frac{2h}{R}\right)$$

Question-18

Find approximate value of the $(9.6)^4$

1. 4200
2. 3600
3. 2100
4. 8400 ✓

$(9.6)^4 = (10-0.4)^4$

$= [10(1-0.04)]^4$

$= 10^4(1-0.04)^4$

$= 10^4(1-0.16)$

$= 10^4(0.84)$

$\begin{array}{r} 1.00 \\ -\ 0.16 \\ \hline 0.84 \end{array}$

$(10.02)^2 = (10+0.2)^2$

$= (10(1+0.02))^2 = 10^2(1+0.02)^2 = 10^2(1+0.04) = 10^2(1.04)$

$= 104$

$= 10000 \times \frac{84}{100} = 8400$

Question-19

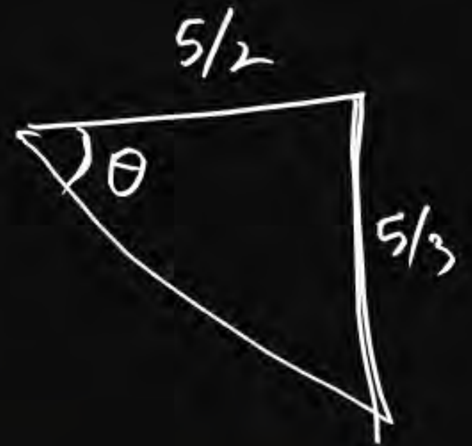
Perpendicular

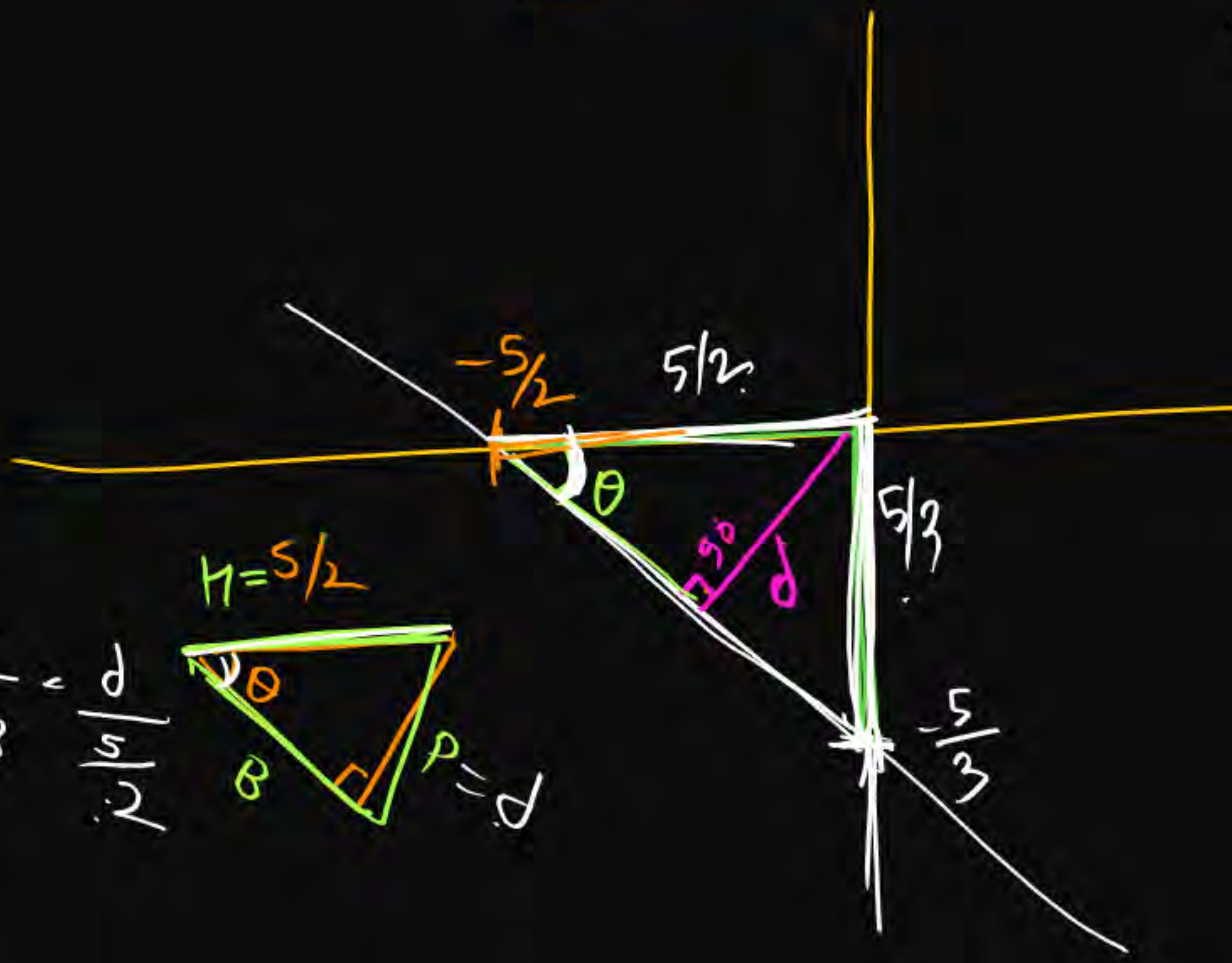
Find distance between the straight line $2x + 3y + 5 = 0$ from origin?

1. $\frac{10}{\sqrt{13}}$
2. $\frac{5}{\sqrt{13}}$ ✓
3. $\frac{2}{\sqrt{13}}$
4. $\frac{3}{\sqrt{13}}$

$3y = -2x - 5$ ✓

$$\boxed{y = -\frac{2}{3}x - \frac{5}{3}}$$





$\sin\theta = \frac{2}{\sqrt{13}} = \frac{d}{\frac{5}{2}}$

$d = \frac{5}{\cancel{2}} \times \frac{\cancel{2}}{\sqrt{13}}$

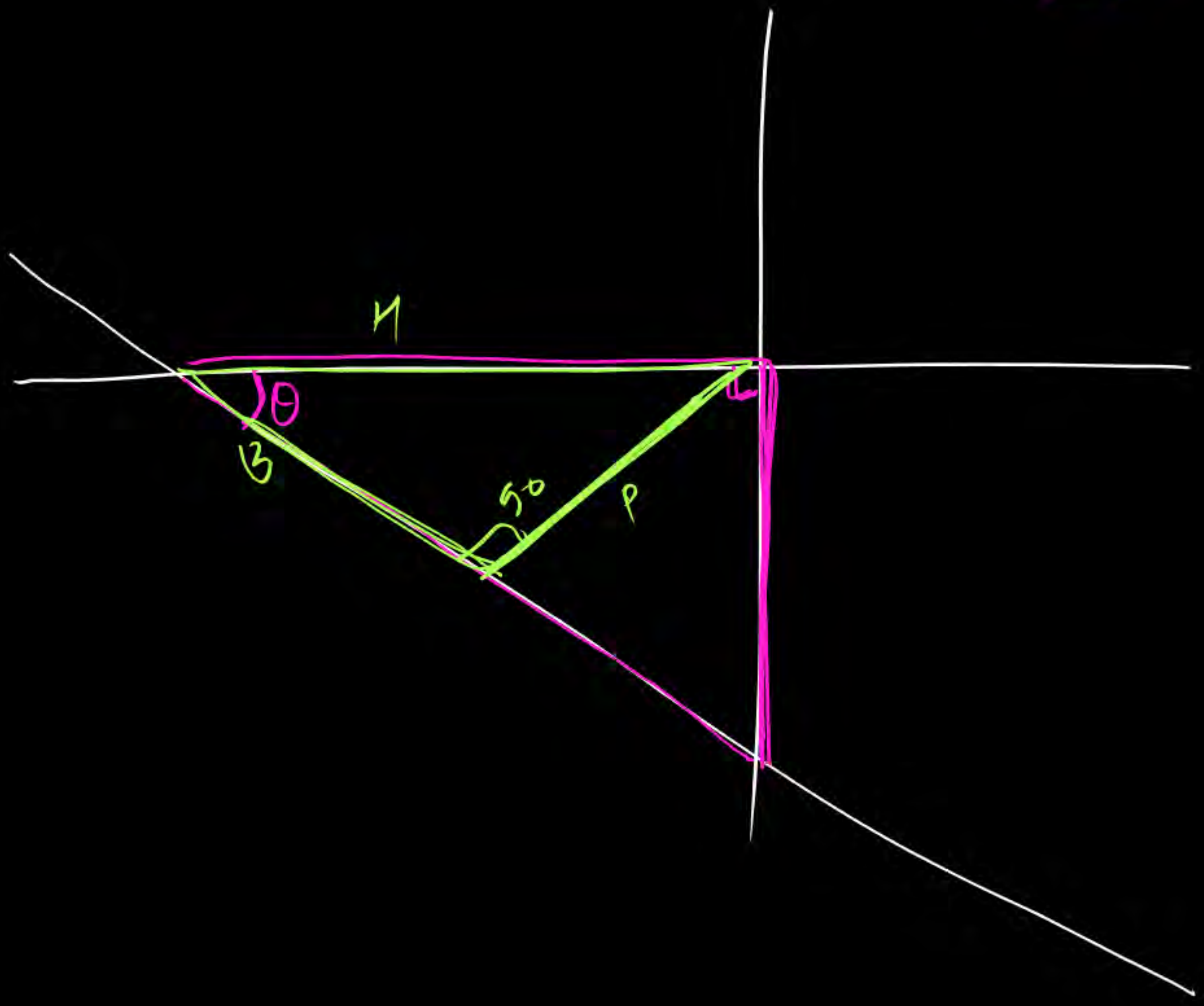
$d = \frac{5}{\sqrt{13}}$

$$\boxed{\tan\theta = \frac{\cancel{5}/3}{\cancel{5}/2} = \frac{2}{3} = \frac{P}{B}}$$

$H = \sqrt{9+4}$

$H = \sqrt{13}$ ✓

$\underbrace{\tan\theta}_{\sin\theta} =$



Question-20

$\log_e 15$ is equal to

1. $\log_e 3 + \log_e 5$
2. $\log_e 5 - \log_e 3$
3. $\log_e 10 + \log_e 5$
4. $\log_e 10 - \log_e 5$

$\log_e 15 =$

$\log_e 5\times3 = \log_e 5 + \log_e 3$

Question-21

$\log_2 x = 3$, find the value of x

1. 8
2. 16
3. 32
4. 34

$\log_2 x = 3$

$2^3 = x$

$x = 8$

Question-22

$\log 25 + \log 4 - \log 5$ is equal to

1. $\log 20$ ✓
2. $\log 25$
3. $\log 15$
4. $\log 10$

$\log \frac{\cancel{25}^{5} \times 4}{\cancel{5}} = \log 20$

Question-23

Find distance between the straight line $2x + 3y + 5 = 0$ from origin?

(1) $4(2 - x^2) \times (2x)$

(2) $4(2 - x^2)^3$

(3) $4(2 - x^2) \times 2x$

(4) $-8x(2 - x^2)^3$ ✓

$y = (2 - x^2)^4$

$\frac{dy}{dx} = 4(2 - x^2)^{4-1} \times (-2x)$

$= -8x(2 - x^2)^3$

Question-24

If $y = \cos(\sin x^2)$, and $x = \sqrt{\frac{\pi}{2}}$ $\frac{dy}{dx} =$

1. -2
2. 2
3. $-2\sqrt{\frac{\pi}{2}}$
4. 0

$y = \cos(\sin(x^2))$

$\frac{dy}{dx} = -\sin(\sin x^2) \times \cos(x^2) \times 2x$

$= -2x \sin(\sin x^2) \times \cos(x^2)$

$= -2\sqrt{\frac{\pi}{2}} \sin\left(\sin\left(\frac{\pi}{2}\right)\right) \times \cos\left(\frac{\pi}{2}\right)$

$= -2$

Question-25

If $y = (\sin x)^2$ then find $\dfrac{dy}{dx}$

1. $2 \sin x$

2. $2 \cos x$

3. ✓ $2 \sin x \,.\cos x$

4. $2 \cos^2 x$

$y = (\sin x)^2$

$\frac{dx}{dx} = 2 \sin x \cdot \cos x$

Question-26

Find out minimum/maximum value $y = 2x^3 - 15x^2 + 36x + 11$. Also, find out those points where value is minimum/maximum.

1. max = 39 at $x = 2$, min = 39 at $x = -2$
2. max = 39 at $x = 3$, min = 38 at $x = 2$
3. max = 39 at $x = 2$, min = 38 at $x = 3$
4. max = 39 at $x = 2$, min = 38 at $x = -2$

$$\frac{dy}{dx} = 2(3x^2) - 15(2x) + 36\times 1 + 0$$

$$\frac{6x^2}{6} - \frac{30x}{6} + \frac{36}{6} = 0$$

$$x^2 - 5x + 6 = 0$$

$$x^2 - 3x - 2x + 6 = 0$$

$$x(x-3) - 2(x-3) = 0$$

$$(x-3)(x-2) = 0$$

$$x_1 = 3, \; x_2 = 2$$

$$y = 2(8) - 15(4) + 72 + 11$$

$$= 16 - 60 + 83$$

$$= 16 + 23 = 39$$

Question-27

Find derivative of $y = (x^3 + 1)^2$

1. $(x^3 + 1)(3x^2)$
2. $2(x^3 + 1)$
3. $2(3x^2)$
4. ✓ $2(x^3 + 1)(3x^2)$

$y = (x^3+1)^2$

$\frac{dy}{dx} = 2(x^3+1)^{2-1} \times (3x^2+0)$

$= 6x^2(x^3+1)$

Question-28

A metallic disc is being heated. Its area A (in m^2) at any time t (in sec) is given by $A = 4t^2 + 2t$. Calculate the rate of increase in area at $t = 4$ sec.

1. $72\ m^2/sec$
2. $72\ m^2$
3. $34\ m^2/sec$
4. $34\ m^2$

$A = 4t^2 + 2t$

$\frac{dA}{dt} = 4(2t) + 2$

$= 8t + 2$

$= 8 \times 4 + 2$

Question-29

$$\int \frac{4}{\sqrt{x}} dx$$

(1) $\frac{-8}{\sqrt{x}} + C$

(2) $\frac{2}{\sqrt{x}} + C$

(3) $\frac{4}{\sqrt{x}} + C$

(4) $8\sqrt{x} + C$

$$\int \frac{4}{\sqrt{x}} dx = \int 4x^{-1/2} dx = 4\frac{x^{-\frac{1}{2}+1}}{-\frac{1}{2}+1} = 4\frac{x^{1/2}}{1/2}$$

$$= 8\sqrt{x}$$

Question-30

Area bounded by curve $y = \sin x$, with x-axis, when x varies from 0 to $\frac{\pi}{2}$ is:

1. 1 unit ✓
2. 2 units
3. 3 units
4. 0

$$\int_0^{\pi/2} y\,dx = \int_0^{\pi/2} \sin x\,dx = 1$$

Question-31

$$\int_0^1 (x^3+1)dx = ?$$

1. $1/4$
2. $3/4$
3. $5/4$
4. $7/4$

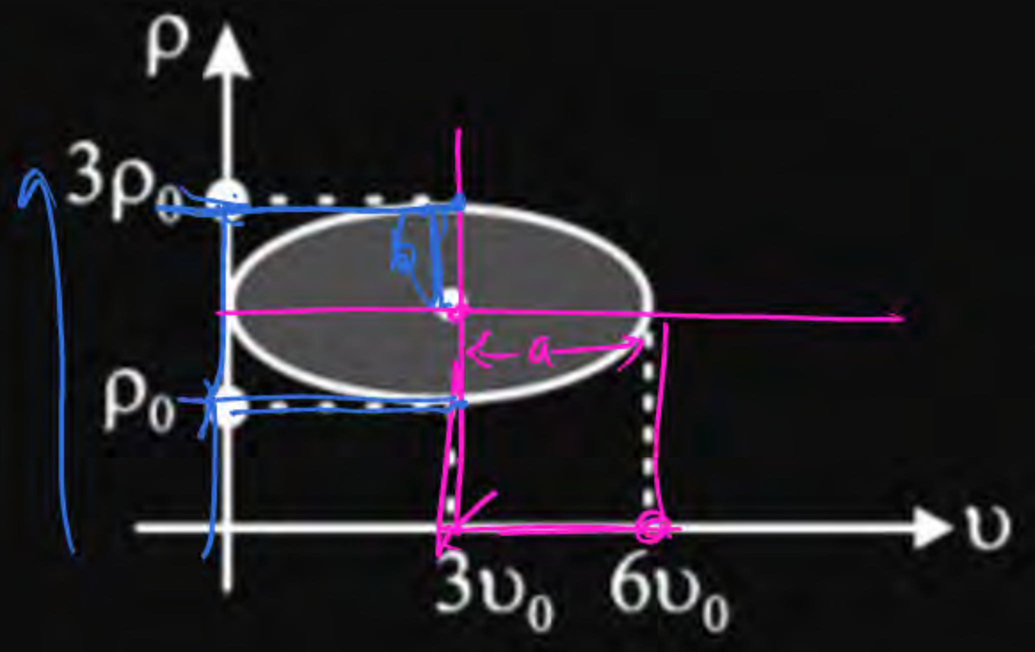
$$\left(\frac{x^4}{4}\right)_0^1 + (x)_0^1$$

$$\frac{1}{4}+1 = \frac{5}{4}$$

Question-32

Find area of shaded region?

1. $\pi\rho_0\upsilon_0$
2. $4.5\,\pi\rho_0\upsilon_0$
3. $2\rho_0\upsilon_0$
4. $3\pi\rho_0\upsilon_0$



Area = $\pi a b$

$= \pi\, 3V_0 \rho_0$

$= \underline{3\pi V_0 \rho_0}$

THANK

YOU