

$$1. \quad 1+2+3+\dots+100 = \frac{n(n+1)}{2} \quad \text{where } n=100$$

$$= 50 \times 101 = 5050$$

$$2. \quad (0.25)^{-\frac{1}{2}} = \left(\frac{1}{4}\right)^{-\frac{1}{2}} = 4^{\frac{1}{2}} = 2$$

$$(0.09)^{\frac{3}{2}} = \left(\frac{9}{100}\right)^{\frac{3}{2}} = \left(\frac{3}{10}\right)^3 = \frac{127}{1000} = 0.127$$

$$3. \quad (1+x)^{m+1} (1-2x)^m$$

$$= \left(1 + (m+1)x + \frac{m(m+1)}{2}x^2 + \dots\right) \left(1 - 2mx + 2m(m-1)x^2 + \dots\right)$$

$$= 1 + (1-m)x + \left(-m+2m + \frac{m(m+1)}{2} + 2m(m-1)\right)x^2$$

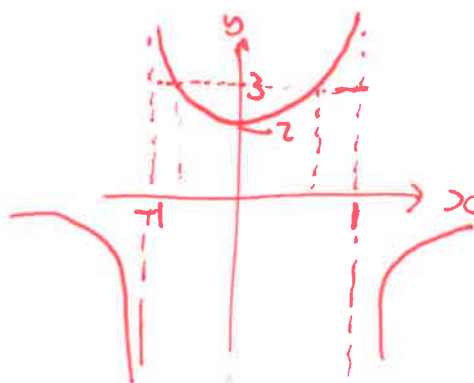
$$= 1 + (1-m)x + \left(\frac{m^2 - 7m}{2}\right)x^2$$

4.

$$\frac{x^2+2}{1-x^2} < 3$$

$$x^2+2 < 3-3x^2$$

$$4x^2$$



True for  $|x| > 1$

AND in between 2 points where  $\frac{x^2+2}{1-x^2} = 3$

$$\text{i.e. } 4x^2 = 1$$

$$x = \sqrt{\frac{1}{4}} = \pm \frac{1}{2}$$

So  $x < -1$ ,  $-\frac{1}{2} < x < \frac{1}{2}$ ,  $x > 1$

$$5 \quad i) \quad x = \log_9 2 \quad q^x = 2 \quad 2^{\frac{1}{x}} = 9 \quad \log_2 9 = \underline{\underline{\frac{1}{x}}}$$

$$ii) \quad \log_8 3 = \frac{\log_9 3}{\log_9 8} = \frac{\frac{1}{2}}{\log_9(2^3)} = \frac{\frac{1}{2}}{3 \log_9 2} = \underline{\underline{\frac{1}{6x}}}$$

6

For a.p.:

$$x^2 - 1 = x - x^2 \quad 2x^2 - x - 1 = 0$$

$$(2x+1)(x-1) = 0$$

$$x = \underline{\underline{-\frac{1}{2}}} \text{ or } \underline{\underline{1}}$$

7

$$y = x + \frac{x^2}{2} + \frac{x^3}{3} + \dots$$

$$y = ax$$

$$\frac{dy}{dx} = 1 + x + x^2 + \dots$$

$$\frac{dy}{dx} = a$$

$$a = \underline{\underline{1}} \text{ when } x=0$$

$$\text{at } x = \frac{1}{4} \quad a = 1 + \frac{1}{4} + \left(\frac{1}{4}\right)^2 + \dots$$

$$\text{A.P. } a = \frac{a}{1-r} = \frac{1}{1-\frac{1}{4}} = \underline{\underline{\frac{4}{3}}}$$

8

$$\text{Midpoint} = (1, 5)$$



$$\text{radius} = \sqrt{(1-(-3))^2 + (5-(-5))^2}$$

$$= 5$$

$$(x-1)^2 + (y-5)^2 = 25$$

9

$$i) \quad \frac{1}{9}$$

$$ii) \quad \begin{array}{l} 4+6 \\ 5+6 \\ 6+6 \\ 6+5 \\ 6+4 \end{array} \quad \begin{array}{l} \frac{1}{9} \times \frac{8}{9} \\ \frac{1}{3} \times \frac{1}{3} \\ \frac{1}{3} \times \frac{1}{3} \\ \frac{1}{3} \times \frac{1}{3} \\ \frac{1}{9} \times \frac{1}{3} \end{array}$$

$$\frac{42}{81} = \underline{\underline{\frac{14}{27}}}$$

10.

$$r^2 = a^2 + a^2 + a^2 \quad (\text{Pythag})$$

$$r = \underline{\underline{a\sqrt{3}}}$$

$$11. \text{ i) } \int_{-1}^1 x + x^3 + x^5 + x^7 dx$$

$$= \left[ \frac{x^2}{2} + \frac{x^4}{4} + \frac{x^6}{6} + \frac{x^8}{8} \right]_{-1}^1 = \underline{\underline{0}}$$

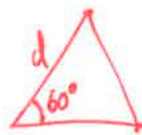
all even powers

$$11. \text{ ii) } \int_0^1 \frac{x^9 + x^{99}}{11} dx$$

$$= \left[ \frac{x^{10}}{110} + \frac{x^{100}}{1100} \right]_0^1$$

$$= \frac{10 + 1}{1100} = \frac{11}{1100} = \underline{\underline{0.01}}$$

12. Triangle ABC



$$\begin{aligned} \text{Area} &= \frac{1}{2} d^2 \sin 60^\circ \\ &= \frac{d^2 \sqrt{3}}{4} \end{aligned}$$

$$\text{Small circle radius} = \frac{d}{2 \sin 60^\circ} = \frac{d}{\sqrt{3}}$$

$$\text{Small circle area} = \frac{\pi d^2}{3} \times \frac{2}{3} \text{ for sector}$$

$$\text{Large circle radius} = d + r = d + \frac{d}{\sqrt{3}}$$

$$\text{Area} = \pi \left( d + \frac{d}{\sqrt{3}} \right)^2 \times \frac{2}{3}$$

$$\text{Ratio} = \frac{8\pi (2 + \sqrt{3})}{9}$$

# Physics

- 13 D
- 14 B
- 15 D
- 16 A
- 17 C
- 18 B
- 19 C
- 20 C
- 21 A
- 22 A

23

$$W = \frac{q^2}{2C} = \frac{1}{2} CV^2$$
$$= \frac{1}{2} \frac{\rho A V^2}{d}$$

$$Ad = \frac{m}{D}$$

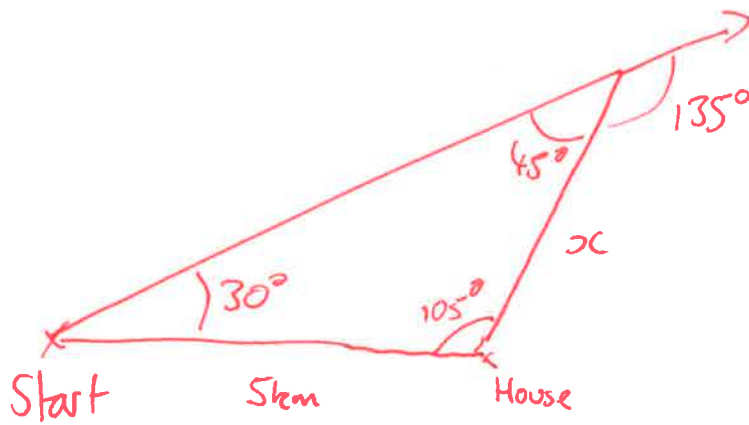
$$W_{\max} = \frac{1}{2} \frac{\rho m B^2}{D}$$

$$= \frac{1}{2} \times \frac{2 \times 10^{-11} \times 1 \times 4 \times 10^{14}}{1000}$$

$$= \underline{\underline{4 \text{ J}}}$$

~~24~~

24



$$\frac{x}{\sin 30^\circ} = \frac{5000}{\sin 45^\circ}$$

$$x = \frac{5000\sqrt{2}}{2} = 3500\text{m}$$

- D 21
- E 21
- D 21
- A 21
- C 21
- B 21
- C 21
- C 21
- A 21
- A 21

25

$\frac{1}{2} \times \text{base} \times \text{height}$

$\frac{1}{2} \times \text{base} \times \text{height}$

$\frac{1}{2} \times \text{base} \times \text{height}$

$\frac{1}{2} \times \text{base} \times \text{height}$

114

26

25

$$C + R = 25 \quad \textcircled{1}$$

$$C^2 + S^2 = R^2 \quad \textcircled{2}$$

$$2C + S = 1 \quad \textcircled{3}$$

$$S = 1 - 2C \rightarrow \textcircled{3} \rightarrow C + R = 2 - 4C$$

$$R = 2 - 5C$$

↓  
②  
↓

$$C^2 + (1 - 2C)^2 = (2 - 5C)^2$$

$$C^2 + 1 - 4C + 4C^2 = 4 - 20C + 25C^2$$

$$20C^2 - 16C + 3 = 0$$

$$C = \frac{16 \pm \sqrt{256 - 240}}{40}$$

$$C = \left(\frac{12}{40}\right) \text{ or } \frac{20}{40} = \underline{0.3\text{m}}$$

S=0!

$$S = 1 - 2C = \frac{16}{40} = \underline{0.4\text{m}}$$

$$R = \underline{0.5\text{m}}$$

26

25

7am

2.5m in 120min

250cm in 125min = 2cm/min

$25 = 2t + 7$

$2t = 25 - 7$

$t = 9$

$2(9) - 5 = 13$

$k = 5 - 20$

100+

$(2 - 1) = \frac{2(5 - 1)}{5 - 2} + 2$

$2 - 1 = \frac{2(5 - 1)}{5 - 2} + 2$

$2 - 1 = 2 + 2 - \frac{2(5 - 1)}{5 - 2}$

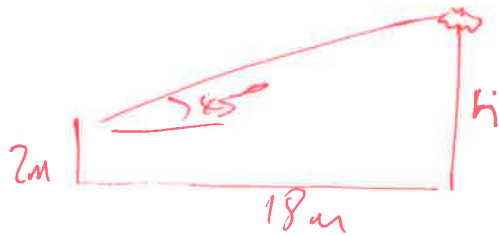
$1 = 4 - \frac{2(5 - 1)}{5 - 2}$

$\frac{2(5 - 1)}{5 - 2} = 4 - 1$

$\frac{2(5 - 1)}{5 - 2} = 3$

$2(5 - 1) = 3(5 - 2)$

27 a) Tree = 18m tall



$$h = 20m$$

$$\frac{1}{2}at^2 = 20$$

$$a = 10m/s^2$$

$$t^2 = 4 \quad t = \underline{\underline{2s}}$$

$$b) \quad v = u + at = 0 + 10 \times 2 = \underline{\underline{20m/s}}$$

$$c) \quad F \times 0.001 = \frac{1}{2}mv^2 = \frac{1}{2} \times 0.02 \times 20^2 = 4$$

$$F = \underline{\underline{4000N}}$$

$$d) \quad \underline{\underline{4J}} \quad \underline{\underline{\text{same}}}$$

$$e) \quad F_{\text{new}} \times 0.05 = \underline{\underline{4}}$$

$$F = \underline{\underline{80N}}$$

$$\text{time } t = \frac{v-u}{a} = \frac{0-20}{-80/0.02} = \frac{0.4}{80} = \underline{\underline{5 \times 10^{-3} s}}$$

$$f) \quad mgh = 100 \times 20 \times 10 = \underline{\underline{20 \text{ kJ}}} \quad (\text{or } 18?)$$

$$g) \quad W_{\text{output}} = 4000 \times (100-20) \times 0.02 = 6400J$$

$$\eta = \frac{6.4}{20} = \underline{\underline{32\%}}$$



