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Secondary School Certificate Examination

March 2016

Marking Scheme — Mathematics 30/2/1, 30/2/2, 30/2/3

General Instructions:

1. The Marking Scheme provides general guidelines to reduce subjectivity in the marking. The answers given in the Marking Scheme are suggested answers. The content is thus indicative. If a student has given any other answer which is different from the one given in the Marking Scheme, but conveys the meaning, such answers should be given full weightage

2. Evaluation is to be done as per instructions provided in the marking scheme. It should not be done according to one's own interpretation or any other consideration — Marking Scheme should be strictly adhered to and religiously followed.

3. Alternative methods are accepted. Proportional marks are to be awarded.

4. In question (s) on differential equations, constant of integration has to be written.

5. If a candidate has attempted an extra question, marks obtained in the question attempted first should be retained and the other answer should be scored out.

6. A full scale of marks - 0 to 100 has to be used. Please do not hesitate to award full marks if the answer deserves it.

7. Separate Marking Scheme for all the three sets has been given.

8. As per orders of the Hon'ble Supreme Court. The candidates would now be permitted to obtain photocopy of the Answer book on request on payment of the prescribed fee. All examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

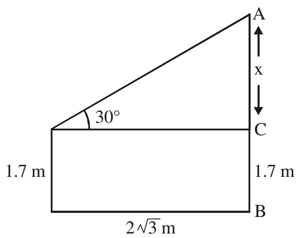
QUESTION PAPER CODE 30/2/1

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. Getting $\angle AOC = 50^\circ$, Getting $\angle ACO = 40^\circ$ $\frac{1}{2}+\frac{1}{2}$

2.



$\frac{x}{20\sqrt{3}} = \tan 30^\circ = \frac{1}{\sqrt{3}} \Rightarrow x = 20$ m $\frac{1}{2}$

$\therefore$ AB = 21.7 m $\frac{1}{2}$

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

$\Rightarrow$ $k = 6$ $\frac{1}{2}$

4. n(s) = 20, Multiples of 3 or 7 A: {3, 6, 9, 12, 15, 18, 7, 14} For n (A) = 8 .... $\frac{1}{2}$

$\therefore$ Reqd. Probability $= \frac{8}{20}$ or $\frac{2}{5}$ $\frac{1}{2}$

SECTION B

5. Let the ten's digit be x and unit's digit = y

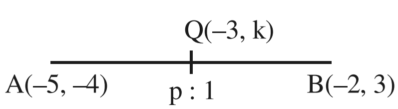
$\Rightarrow$ $10x + y = 4(x + y)$ or $2x = y$ $\frac{1}{2}$

Again $10x + y = 3xy$

$10x + 2x = 3x(2x) \Rightarrow x = 2$ (rejecting $x = 0$) 1

$\left.\begin{array}{l} 2x = y \Rightarrow y = 4 \\ \therefore \text{ The required number is 24} \end{array}\right\}$ $\frac{1}{2}$

6.



Let Q divide AB in the ratio of p : 1 $\frac{1}{2}$

$-3 = \frac{-2p-5}{p+1} \Rightarrow p = 2$ $\frac{1}{2}$

$\therefore$ Ratio is 2 : 1 $\frac{1}{2}$

$$k = \frac{2\times3-4}{2+1} = \frac{2}{3}$$ $\frac{1}{2}$

7. Let PT = x = PS, $\angle SPT = 120° \Rightarrow \angle TPO = 60°$ $(\because \Delta OSP \cong \Delta OTP)$ 1

$\therefore \quad \frac{OP}{x} = \sec 60° = 2 \Rightarrow$ OP = 2x or OP = 2PS 1

8. Let A(2, –2), B(–2, 1) and (5, 2) be given points

$\therefore AB^2 = (4)^2 + (-3)^2 = 25,\ BC^2 = (-2-5)^2 + (1-2)^2 = 50,\ CA^2 = 9 + 16 = 25$ 1

$\therefore BC^2 = AB^2 + CA^2$ ABC is a right triangle and BC is the hypotenuse $\frac{1}{2}$

$\therefore \ ar(\Delta ABC) = \frac{AB \times AC}{2} = \frac{25}{2}$ sq. units $\frac{1}{2}$

9. $\frac{S_m}{S_n} = \frac{m^2}{n^2} = \frac{\frac{m}{2}(2a+(m-1)d}{\frac{n}{2}(2a+(n-1)d)} \Rightarrow d = 2a$ 1

$\frac{a_m}{a_n} = \frac{a+(m-1)d}{a+(n-1)d} = \frac{a+2(m-1)a}{a+2(n-1)a} = \frac{2m-1}{2n-1}$ 1

10. OA = 6 cm, OB = 4 cm, AP = 8 cm

$OP^2 = OA^2 + AP^2 = 36 + 64 = 100 \Rightarrow OP = 10$ cm 1

$BP^2 = OP^2 - OB^2 = 100 - 16 = 84$

$\Rightarrow \quad BP = 2\sqrt{21}$ cm $\frac{1}{2}+\frac{1}{2}$

SECTION C

11. $ar(\Delta OAB) = \frac{\sqrt{3}}{4}(12)^2 = 36\sqrt{3} = 36\times1.73 = 62.28\ cm^2$ 1

ar(cricle with centre O) = $3.14(6)^2 = 113.04\ cm^2$ $\frac{1}{2}$

$ar(\text{sector OLQP}) = 3.14(6)^2 \times \frac{60}{360} = 18.84\ cm^2$ $\frac{1}{2}$

$$\left.\begin{aligned} \text{area(shaded region)} &= (62.28 + 113.04 - 2\times18.84)\ cm^2 \\ &= 137.64\ cm^2 \end{aligned}\right\}$$ 1

12. Radius of hemispherical tank = 150 cm

Volume of water in the hemispherical tank = $\frac{2}{3}\times\frac{22}{7}\times 150\times 150\times 150\ \text{cm}^3$

Volume of water to be emptied = $\frac{1}{\cancel{2}}\times\frac{\cancel{2}}{\cancel{3}}\times\frac{22}{7}\times\frac{\overset{5}{15\cancel{0}}\times 15\cancel{0}\times 15\cancel{0}}{\cancel{1000}}$ litres 1 + 1

Time taken to empty the tank = $\frac{\overset{11}{\cancel{22}}}{\cancel{7}}\times\frac{\cancel{5}\times\overset{\cancel{3}}{\cancel{15}}\times\overset{3}{\cancel{15}}\times\cancel{7}}{\times\underset{\underset{\underset{2}{\cancel{4}}}{\cancel{20}}}{\cancel{60}}\times\cancel{25}}$ min

$= 16\frac{1}{2}$ min 1

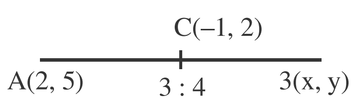
13. 

Figure $\frac{1}{2}$

$\frac{3x+8}{7} = -1 \Rightarrow x - 5$ 1

$\frac{3y+20}{7} = 2 \Rightarrow y = -2$ 1

$\therefore\ x^2 + y^2 = 29$ $\frac{1}{2}$

14. Area of minor segment APBQ = $\frac{\pi r^2 .90}{360} - r^2 \sin 45° \cos 45°$ $\frac{1}{2}$

$$\left.\begin{aligned} &= \left(\frac{3.14\times 10^2}{4} - 100\times\frac{1}{2}\right)\text{cm}^2 \\ &= (78.5 - 50)\ \text{cm}^2 = 28.5\ \text{cm}^2 \end{aligned}\right\}$$ $1\frac{1}{2}$

$\therefore$ Area of major segment $= \pi r^2 -$ ar(minor segment)

$= (314 - 28.5)\ \text{cm}^2 = 285.5\ \text{cm}^2$ 1

15. Let the four parts in AP be a – 3d, a – d, a + d, a + 3d $\frac{1}{2}$

Their sum is 56 $\Rightarrow$ 4a = 56 or a = 14 1

$$\frac{(14-3d)\,(14+3d)}{(14-d)\,(14+d)} = \frac{5}{6} \ \text{or} \left.\begin{aligned} &196 = 49d^2 \\ &\text{or } d = \pm 2 \end{aligned}\right\}$$ 1

$\therefore$ The number (parts) are 8, 12, 16, 20 or 20, 16, 12, 8 $\frac{1}{2}$

16. The given equation is $9x^2 - 9(a + b)x + (2a^2 + 2b^2 + 5ab) = 0$

Using quadratic formula, we have

$$x = \frac{9(a+b) \pm \sqrt{81(a^2 + b^2 + 2ab) - 36(2a^2 + 2b^2 + 5ab)}}{18}$$ 1+1

$$= \frac{9(a+b) \pm \sqrt{9(a-b)^2}}{18} = \frac{2a+b}{3}, \frac{a+2b}{3}$$ 1

17. Volume of ice-cream in the cylinder = $(\pi(6)^2 \times 15)\ cm^3$ $\frac{1}{2}$

Volume of ice-cream in one ice-cream cone = $\frac{1}{3}\pi r^2 (4r) + \frac{2}{3}\pi r^3$

$= 2\pi r^3$ 1

$\therefore$ Volume of ice-cream in 10 such cones = $20\pi r^3$ $\frac{1}{2}$

$$\therefore \left.\begin{aligned} &20\pi r^3 = \pi \times 36 \times 15 \\ &r^3 = \frac{36 \times 15}{20} = 27 \Rightarrow r = 3\ cm \end{aligned}\right\}$$ 1

$\therefore$ Diameter of conical ice-cream cup = 6 cm

18. Volume of milk in the container = $\frac{1}{3}\pi h\,(r_1^2 + r_2^2 + r_1 r_2)$ $\frac{1}{2}$

$$\left.\begin{aligned} &= \frac{1}{\cancel{3}} \times \frac{22}{\cancel{7}} \times \cancel{21}[400 + 64 + 160]\ cm^3 \\ &= \frac{22 \times 624}{1000} \text{ litres} \end{aligned}\right\}$$ $1 + \frac{1}{2}$

$$\therefore \text{cost of milk} = \frac{\overset{11}{\cancel{22}} \times 624}{\cancel{1000}\ 100} \times \cancel{35}^{\,7} = 480.48$$ 1

$= ₹\ 480.48$

19.

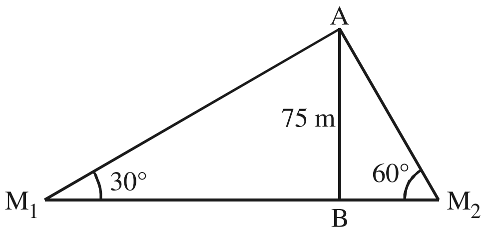


Figure $\frac{1}{2}$

(i) $\frac{AB}{BM_1} = \tan 30° = \frac{1}{\sqrt{3}}$

$\Rightarrow \quad BM_1 = 75\sqrt{3}$ m $\quad$ 1

(ii) $\frac{AB}{BM_2} = \tan 60° = \sqrt{3}$

$\Rightarrow \; BM_2 = 25\sqrt{3}$ m $\quad$ 1

$\therefore \; M_1M_2 = 100\sqrt{3}\text{ m} = 173\text{ m}$ $\quad \frac{1}{2}$

20. S = {HHH, HHT, HTH, HTT, TTT, TTH, THT, THH}, n(S) = 8 $\quad$ 1

Same result on all the tosses A = (HHH, TTT), n(A) = 2 $\quad$ 1

P(Ramesh will lose the game) = $\frac{8-2}{8} = \frac{6}{8}$ or $\frac{3}{4}$ $\quad$ 1

SECTION D

21.

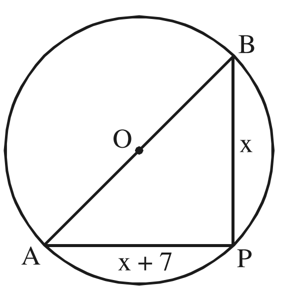


Figure $\frac{1}{2}$

Let P be the location of the pole sueh that its distance from gate B is x metres $\frac{1}{2}$

$\therefore \quad AP = x + 7$

AB is a diameter $\Rightarrow \angle APB = 90°$ and AB = 17m $\quad \frac{1}{2}$

$\therefore \quad x^2 + (x + 7)^2 = 17^2$

$x^2 + x^2 + 14x - 240 = 0$ or $x^2 + 7x - 120 = 0$ $\quad 1\frac{1}{2}$

$$\left.\begin{array}{l} x = \dfrac{-7 \pm \sqrt{49+480}}{2} = 8, -15 \\ \therefore x = 8\text{m},\; x + 7 = 15\text{ m} \end{array}\right\}$$ $\quad$ 1

22. Correctly stated given, to prove, const. and figure $\quad$ 2

Correct Proof $\quad$ 2

23. Correct Construction 4

24. Let PL = y, OP is $\perp$ bisector of AB $\Rightarrow$ AL = BL = 8cm

$OL^2 = OA^2 - AL^2 = 10^2 - 8^2 = 36 \Rightarrow OL = 6$ cm 1

$$\left.\begin{array}{ll} \text{In } \Delta OAP, & AP^2 = (y+6)^2 - 10^2 \quad \text{....(i)} \\ \text{In } \Delta ALP, & AP^2 = y^2 + 64 \quad \text{....(ii)} \end{array}\right\}$$ 2

From (i) and (iii) $y = \frac{32}{3}$ $\frac{1}{2}$

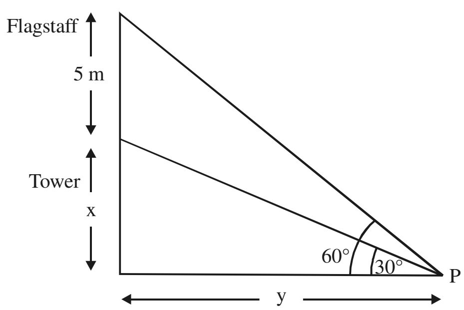
$\therefore$ $AP = \frac{40}{3}$ cm $\frac{1}{2}$

25. (i) For $x^2 + kx + 64 = 0$ to have real roots $k^2 - 256 \geq 0$ ...(i) $1\frac{1}{2}$

(ii) For $x^2 - 8x + k = 0$ to have real roots $64 - 4k \geq 0$ ...(ii) $1\frac{1}{2}$

For (i) and (ii) to hold simultaneously k = 16 1

26. Figure 1



(i) $\frac{x}{y} = \tan 30° = \frac{1}{\sqrt{3}} \Rightarrow y = \sqrt{3}x$ 1

$$\left.\begin{array}{l} \text{(ii)} \quad \frac{x+5}{y} = \tan 60° = \sqrt{3} \text{ or } \frac{x+5}{\sqrt{3}\,x} = \sqrt{3} \\ \Rightarrow \quad x = 2.5 \end{array}\right\}$$ $1 + \frac{1}{2}$

Height of Tower = 2.5 m

Distance of P from tower = (2.5 × 1.732) or 4.33 m $\frac{1}{2}$

27. Here a = ₹ 450, d = ₹ 20, n = 12

$S_{12} = \frac{12}{2}[2 \times 450 + 11 \times 20] = 6\,[1120] = 6720 > 6500$ $1+1+\frac{1}{2}$

$\therefore$ Reshma will be able to send her daughter to school $\frac{1}{2}$

Efforts for Girl child education 1

28. P(x, y), B(–3, 5), C(4, –2), A(6, 3)

$\therefore \quad \text{ar}(\Delta PBC) = \frac{1}{2}|x(7)+3(2+y)+4(y-5)| = \frac{1}{2}|7x+7y-14|$ $\quad 1\frac{1}{2}$

$\text{ar}(\Delta ABC) = \frac{1}{2}|6\times 7-3(-5)+4(3-5)| = \frac{49}{2}$ $\quad 1\frac{1}{2}$

$\therefore \quad \left|\frac{\text{ar}(\Delta PBC)}{\text{ar}(\Delta ABC)}\right| = \left|\frac{x+y-2}{7}\right|$ $\quad 1$

29. For a/b > 1, when a = 1, b can not take any value, a = 2, b can take 1 value, a = 3, b can take 2 values, a = 4, b can take 3 values $\quad 2\frac{1}{2}$

when a = 5, b can take 4 values, a = 6, b can take 5 values

Total Possible outcomes = 36 $\quad \frac{1}{2}$

$\therefore \quad P(a/b > 1) = \frac{1+2+3+4+5}{36} = \frac{15}{36} \text{ or } \frac{5}{12}$ $\quad 1$

30. Area of Shaded region $= \frac{1}{2}\times\frac{22}{7}\left[7^2+\left(\frac{7}{2}\right)^2-2\left(\frac{7}{4}\right)^2\right]\text{cm}^2$ $\quad 2$

$= \frac{1}{2}\times\frac{22}{7}\left[49+\frac{49}{4}-\frac{49}{8}\right] = \frac{1}{\cancel{2}}\times\frac{\overset{11}{\cancel{22}}}{\cancel{7}}\times\overset{7}{\cancel{4}}9\left[\frac{9}{8}\right]$ $\quad 1\frac{1}{2}$

$= \frac{693}{8}\text{ sq. cm or } 86.625\text{ cm}^2$ $\quad \frac{1}{2}$

31.

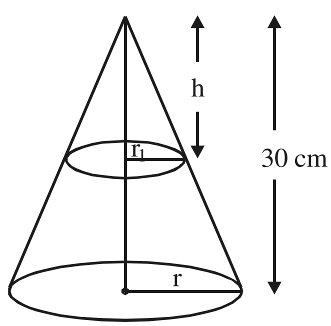


Figure $\quad \frac{1}{2}$

$\frac{r_1}{r} = \frac{h}{30} \Rightarrow h = \frac{30\times r_1}{r}$ $\quad 1$

$\frac{\frac{1}{\cancel{3}}\cancel{\pi}r_1^2\times h}{\frac{1}{\cancel{3}}\cancel{\pi}r^2\times 30} = \frac{1}{27} \text{ or } \frac{r_1^2\times\cancel{30}\times r_1}{r^3\times\cancel{30}} = \frac{1}{27}$ $\quad 1\frac{1}{2}$

$\left.\begin{array}{l} \therefore \quad \frac{r_1}{r} = \frac{1}{3} \Rightarrow h = 10\text{ cm} \\ \therefore \quad \text{The section is made 20 cm above base} \end{array}\right\}$ $\quad 1$

QUESTION PAPER CODE 30/2/2

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. n(s) = 20, Multiples of 3 or 7 A: {3, 6, 9, 12, 15, 18, 7, 14} For n (A) = 8 .... $\frac{1}{2}$

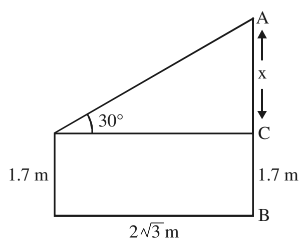
$\therefore$ Reqd. Probability $= \frac{8}{20}$ or $\frac{2}{5}$ $\frac{1}{2}$

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

$\Rightarrow$ $k = 6$ $\frac{1}{2}$

3. Getting $\angle AOC = 50^\circ$, Getting $\angle ACO = 40^\circ$ $\frac{1}{2}+\frac{1}{2}$

4.



$\frac{x}{20\sqrt{3}} = \tan 30^\circ = \frac{1}{\sqrt{3}} \Rightarrow x = 20$ m $\frac{1}{2}$

$\therefore$ AB = 21.7 m $\frac{1}{2}$

SECTION B

5. Let A(2, –2), B(–2, 1) and (5, 2) be given points

$\therefore AB^2 = (4)^2 + (-3)^2 = 25,\ BC^2 = (-2 - 5)^2 + (1 - 2)^2 = 50,\ CA^2 = 9 + 16 = 25$ 1

$\therefore BC^2 = AB^2 + CA^2$ ABC is a right triangle and BC is the hypotenuse $\frac{1}{2}$

$\therefore ar(\Delta ABC) = \frac{AB \times AC}{2} = \frac{25}{2}$ sq. units $\frac{1}{2}$

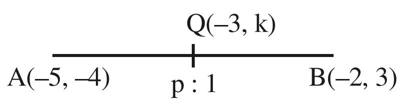
6. $\frac{S_m}{S_n} = \frac{m^2}{n^2} = \frac{\frac{m}{2}(2a+(m-1)d}{\frac{n}{2}(2a+(n-1)d)} \Rightarrow d = 2a$ 1

$\frac{a_m}{a_n} = \frac{a+(m-1)d}{a+(n-1)d} = \frac{a+2(m-1)a}{a+2(n-1)a} = \frac{2m-1}{2n-1}$ 1

7. Let PT = x = PS, $\angle SPT = 120^\circ \Rightarrow \angle TPO = 60^\circ$ $(\because \Delta OSP \cong \Delta OTP)$ 1

$\therefore \quad \frac{OP}{x} = \sec 60^\circ = 2 \Rightarrow OP = 2x$ or $OP = 2PS$ 1

8.



Let Q divide AB in the ratio of p : 1 $\frac{1}{2}$

$-3 = \frac{-2p-5}{p+1} \Rightarrow p = 2$ $\frac{1}{2}$

$\therefore$ Ratio is 2 : 1 $\frac{1}{2}$

$k = \frac{2\times3-4}{2+1} = \frac{2}{3}$ $\frac{1}{2}$

9. OA = 6 cm, OB = 4 cm, AP = 8 cm

$OP^2 = OA^2 + AP^2 = 36 + 64 = 100 \Rightarrow OP = 10$ cm 1

$BP^2 = OP^2 - OB^2 = 100 - 16 = 84$

$\Rightarrow \quad BP = 2\sqrt{21}$ cm $\frac{1}{2}+\frac{1}{2}$

10. $\sqrt{3}\,x^2 - 3\sqrt{2}x + \sqrt{2}x - 2\sqrt{3} = 0$

$\sqrt{3}x\left[x-\sqrt{6}\right] + \sqrt{2}\left[x-\sqrt{6}\right] = 0$ or $\left(x-\sqrt{6}\right)\left(\sqrt{3}x+\sqrt{2}\right) = 0$ 1

$\Rightarrow x = \sqrt{6}, -\sqrt{\frac{2}{3}}$ 1

SECTION C

11. S = {HHH, HHT, HTH, HTT, TTT, TTH, THT, THH}, n(S) = 8 1

Same result on all the tosses A = (HHH, TTT), n(A) = 2 1

P(Ramesh will lose the game) = $\frac{8-2}{8} = \frac{6}{8}$ or $\frac{3}{4}$ 1

12. $ar(\Delta OAB) = \frac{\sqrt{3}}{4}(12)^2 = 36\sqrt{3} = 36\times1.73 = 62.28\ cm^2$ 1

ar(cricle with centre O) = $3.14(6)^2 = 113.04\ cm^2$ $\frac{1}{2}$

ar (sector OLQP) = $3.14(6)^2 \times \frac{60}{360} = 18.84\ cm^2$ $\frac{1}{2}$

$$\left.\begin{aligned} \text{area(shaded region)} &= (62.28 + 113.04 - 2\times 18.84)\ \text{cm}^2 \\ &= 137.64\ \text{cm}^2 \end{aligned}\right\}$$ 1

13. Radius of hemispherical tank = 150 cm

Volume of water in the hemispherical tank = $\frac{2}{3}\times\frac{22}{7}\times 150\times 150\times 150\ \text{cm}^3$

Volume of water to be emptied = $\frac{1}{\cancel{2}}\times\frac{\cancel{2}}{\cancel{3}}\times\frac{22}{7}\times\frac{15\cancel{0}^{5}\times 15\cancel{0}\times 15\cancel{0}}{\cancel{1000}}$ litres 1 + 1

Time taken to empty the tank = $\frac{\overset{11}{\cancel{22}}}{\cancel{7}}\times\frac{\cancel{5}\times\overset{\cancel{3}}{\cancel{15}}\times\overset{3}{\cancel{15}}\times\cancel{7}}{\times\underset{\underset{\underset{2}{\cancel{4}}}{\cancel{20}}}{\cancel{60}}\times\cancel{25}}$ min

$= 16\frac{1}{2}$ min 1

14. Volume of milk in the container = $\frac{1}{3}\pi h\,(r_1^2 + r_2^2 + r_1 r_2)$ $\frac{1}{2}$

$$\left.\begin{aligned} &= \frac{1}{\cancel{3}}\times\frac{22}{\cancel{7}}\times\cancel{2}1\,[400 + 64 + 160]\ \text{cm}^3 \\ &= \frac{22\times 624}{1000}\ \text{litres} \end{aligned}\right\}$$ $1+\frac{1}{2}$

$\therefore$ cost of milk $= \frac{\overset{11}{\cancel{22}}\times 624}{\cancel{1000}\ 100}\times\cancel{35}^{7} = 480.48$ 1

$= ₹\ 480.48$

15. Area of minor segment APBQ = $\frac{\pi r^2 .90}{360} - r^2 \sin 45°\cos 45°$ $\frac{1}{2}$

$$\left.\begin{aligned} &= \left(\frac{3.14\times 10^2}{4} - 100\times\frac{1}{2}\right)\text{cm}^2 \\ &= (78.5 - 50)\ \text{cm}^2 = 28.5\ \text{cm}^2 \end{aligned}\right\}$$ $1\frac{1}{2}$

$\therefore$ Area of major segment $= \pi r^2 -$ ar(minor segment)

$= (314 - 28.5)\ \text{cm}^2 = 285.5\ \text{cm}^2$ 1

16. Volume of ice-cream in the cylinder = $(\pi(6)^2 \times 15)\ \text{cm}^3$ $\frac{1}{2}$

Volume of ice-cream in one ice-cream cone $= \frac{1}{3}\pi r^2\,(4r) + \frac{2}{3}\pi r^3$

$= 2\pi r^3$ 1

$\therefore$ Volume of ice-cream in 10 such cones = $20\pi r^3$ $\frac{1}{2}$

$$\therefore \left.\begin{array}{l} 20\,\pi r^3 = \pi \times 36 \times 15 \\ r^3 = \dfrac{36\times 15}{20} = 27 \Rightarrow r = 3\ \text{cm} \end{array}\right\}$$ 1

$\therefore$ Diameter of conical ice-cream cup = 6 cm

17.

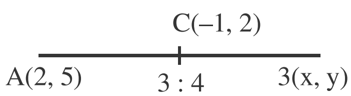


Figure $\frac{1}{2}$

$\frac{3x+8}{7} = -1 \Rightarrow x - 5$ 1

$\frac{3y+20}{7} = 2 \Rightarrow y = -2$ 1

$x^2 + y^2 = 29$ $\frac{1}{2}$

18.

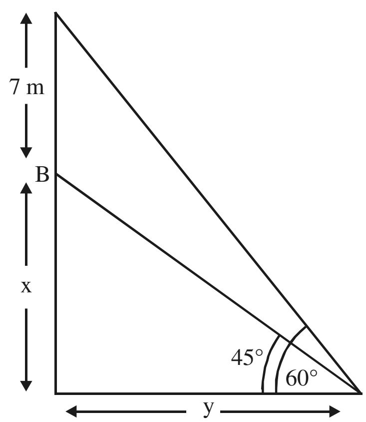


Figure $\frac{1}{2}$

(i) $\frac{x}{y} = \tan 45° = 1 \Rightarrow x = y$ 1

(ii) $$\left.\begin{array}{l} \dfrac{x+7}{x} = \tan 60° = \sqrt{3} \Rightarrow 7 = \left(\sqrt{3}-1\right)x \\ x = \dfrac{7\left(\sqrt{3}+1\right)}{2} = \dfrac{7(2.73)}{2} \end{array}\right\}$$ $1+\frac{1}{2}$

$= 9.6\ \text{m}$

19. $a = a' + (p-1)d,\ b = a' + (q-1)d,\ c = a' + (r-1)d$ $1\frac{1}{2}$

$a(q-r) = [a' + (p-1)d]\,[q-r],\ b(r-p) = [a' + (q-1)d]\,[r-p]$ and $c\,(p-q) = [a' + (r-1)d]\,[p-q]$ $\frac{1}{2}$

$\therefore$ a(q − r) + b(r − p) + c (p − q) = a′[q − r + r − p + p − q)] + d [p(q − r) − q + r + (q − 1) (r − p) (r −1) (p − q)] $\frac{1}{2}$

$= a' \times 0 + d\,[p\cancel{q} - \cancel{p}r + \cancel{q}r - \cancel{pq} + \cancel{p}r - \cancel{q}r + (\cancel{-}q + \cancel{r} - \cancel{r} + \cancel{p} - \cancel{p} + \cancel{q})] = 0$ $\frac{1}{2}$

20. $(x - 2)(2x - 3 + 2x) = 2x^2 - 3x$ 1

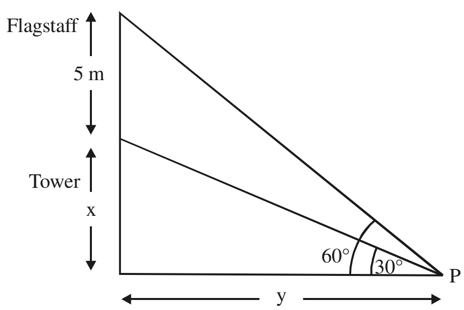
or $(x - 2)(4x - 3) = 2x^2 - 3x$ 1

$4x^2 - 11x + 6 = 2x^2 - 3x$ or $2x^2 - 8x + 6 = 0$ or $x^2 - 4x + 3 = 0$ $\frac{1}{2}$

$\left.\begin{array}{r}(x-1)(x-3)=0\\ x=1, 3\end{array}\right\}$ $\frac{1}{2}$

SECTION D

21. Figure 1



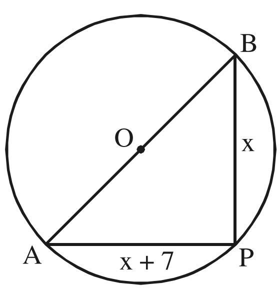
(i) $\frac{x}{y} = \tan 30° = \frac{1}{\sqrt{3}} \Rightarrow y = \sqrt{3}x$ 1

(ii) $\left.\begin{array}{l}\frac{x+5}{y} = \tan 60° = \sqrt{3} \text{ or } \frac{x+5}{\sqrt{3}\,x} = \sqrt{3}\\ \Rightarrow x = 2.5\end{array}\right\}$ $1 + \frac{1}{2}$

Height of Tower = 2.5 m

Distance of P from tower = (2.5 × 1.732) or 4.33 m $\frac{1}{2}$

22. Figure $\frac{1}{2}$



Let P be the location of the pole sueh that its distance from gate B is x metres $\frac{1}{2}$

$\therefore$ AP = x + 7

AB is a diameter $\Rightarrow \angle APB = 90°$ and AB = 17m $\frac{1}{2}$

$\therefore$ $x^2 + (x + 7)^2 = 17^2$

$x^2 + x^2 + 14x - 240 = 0$ or $x^2 + 7x - 120 = 0$ $1\frac{1}{2}$

$\left.\begin{array}{l}x = \frac{-7 \pm \sqrt{49 + 480}}{2} = 8, -15\\ \therefore x = 8\text{m},\ x + 7 = 15 \text{ m}\end{array}\right\}$ 1

23. Let PL = y, OP is $\perp$ bisector of AB $\Rightarrow$ AL = BL = 8cm

$OL^2 = OA^2 - AL^2 = 10^2 - 8^2 = 36 \Rightarrow OL = 6$ cm 1

$$\left.\begin{array}{ll} \text{In } \Delta OAP, & AP^2 = (y+6)^2 - 10^2 \quad \text{....(i)} \\ \text{In } \Delta ALP, & AP^2 = y^2 + 64 \quad \text{....(ii)} \end{array}\right\}$$ 2

From (i) and (iii) $y = \frac{32}{3}$ $\frac{1}{2}$

$\therefore$ $AP = \frac{40}{3}$ cm $\frac{1}{2}$

24. For a/b > 1, when a = 1, b can not take any value, a = 2, b can take 1 value, a = 3, b can take 2 values, a = 4, b can take 3 values $2\frac{1}{2}$

when a = 5, b can take 4 values, a = 6, b can take 5 values

Total Possible outcomes = 36 $\frac{1}{2}$

$\therefore$ $P(a/b > 1) = \frac{1+2+3+4+5}{36} = \frac{15}{36}$ or $\frac{5}{12}$ 1

25. Area of Shaded region $= \frac{1}{2} \times \frac{22}{7}\left[7^2 + \left(\frac{7}{2}\right)^2 - 2\left(\frac{7}{4}\right)^2\right] cm^2$ 2

$$= \frac{1}{2} \times \frac{22}{7}\left[49 + \frac{49}{4} - \frac{49}{8}\right] = \frac{1}{\cancel{2}} \times \frac{\overset{11}{\cancel{22}}}{\cancel{7}} \times \overset{7}{\cancel{4}}9\left[\frac{9}{8}\right]$$ $1\frac{1}{2}$

$$= \frac{693}{8} \text{ sq. cm or } 86.625 \text{ cm}^2$$ $\frac{1}{2}$

26.

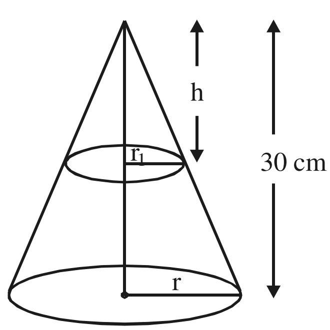


Figure $\frac{1}{2}$

$$\frac{r_1}{r} = \frac{h}{30} \Rightarrow h = \frac{30 \times r_1}{r}$$ 1

$$\frac{\frac{1}{\cancel{3}}\cancel{\pi} r_1^2 \times h}{\frac{1}{\cancel{3}}\cancel{\pi} r^2 \times 30} = \frac{1}{27} \text{ or } \frac{r_1^2 \times \cancel{30} \times r_1}{r^3 \times \cancel{30}} = \frac{1}{27}$$ $1\frac{1}{2}$

$$\left.\begin{array}{l} \therefore \quad \frac{r_1}{r} = \frac{1}{3} \Rightarrow h = 10 \text{ cm} \\ \therefore \quad \text{The section is made 20 cm above base} \end{array}\right\}$$ 1

27. Here a = ₹ 450, d = ₹ 20, n = 12

$$S_{12} = \frac{12}{2}[2 \times 450 + 11 \times 20] = 6\,[1120] = 6720 > 6500 \qquad 1+1+\frac{1}{2}$$

$\therefore$ Reshma will be able to send her daughter to school $\quad \frac{1}{2}$

Efforts for Girl child education $\quad 1$

28.

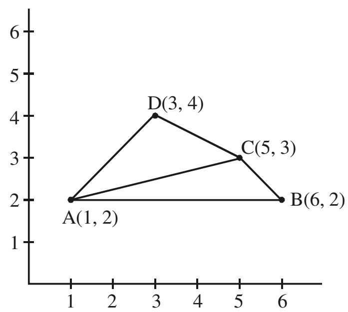


Figure $\quad \frac{1}{2}$

$$\text{ar}(\Delta ABC) = \frac{1}{2}\,|1\,(2-3) + 6\,(3-2) + 5\,(2-2)| = \frac{5}{2}\text{ sq. units} \qquad 1\frac{1}{2}$$

$$\text{ar}(\Delta ACD) = \frac{1}{2}\,|1(3-4) + 5\,(4-2) + 3\,(2-3)| = 3\text{ sq. units} \qquad 1\frac{1}{2}$$

$\therefore$ ar(Quad ABCD) = $\frac{11}{2}$ sq. units $\quad \frac{1}{2}$

29. For equal roots of $x^2 + 2px + mn = 0$, $4p^2 - 4mn = 0$

$\Rightarrow \quad p^2 = mn \qquad$ ...(i) $\quad 1\frac{1}{2}+\frac{1}{2}$

For equal roots of $x^2 - 2\,(m + n)\,x + (m^2 + n^2 + 2p^2) = 0$

$4(m + n)^2 - 4(m^2 + n^2 + 2p^2) = 0$ $\quad 1$

$\cancel{m}^2 + \cancel{n}^2 + 2\cancel{m}n - \cancel{m}^2 - \cancel{n}^2 - 2\,(\cancel{mn}) = 0$ ...(From (i)) $\quad 1$

$\therefore$ If roots of $x^2 + 2px + mn = 0$ are equal then those of $x^2 - 2a\,(m + n)x + (m^2 + n^2 + 2p^2) = 0$ are also eqal

30. Correct construction $\quad 4$

31. Correctly stated given, to prove, const. and correct figure $\quad 2$

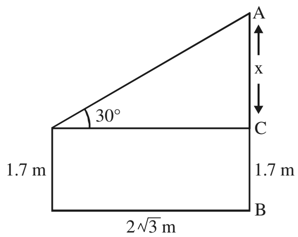
Correct Proof $\quad 2$

QUESTION PAPER CODE 30/2/3

EXPECTED ANSWER/VALUE POINTS

SECTION A

1.



$\dfrac{x}{20\sqrt{3}} = \tan 30^\circ = \dfrac{1}{\sqrt{3}} \Rightarrow x = 20$ m $\qquad \dfrac{1}{2}$

$\therefore$ AB = 21.7 m $\qquad \dfrac{1}{2}$

2. $2(3k + 3) = (2k + 1) + (5k - 1)$ $\qquad \dfrac{1}{2}$

$\Rightarrow \quad k = 6$ $\qquad \dfrac{1}{2}$

3. n(s) = 20, Multiples of 3 or 7 A: {3, 6, 9, 12, 15, 18, 7, 14} For n (A) = 8 .... $\qquad \dfrac{1}{2}$

$\therefore$ Reqd. Probability $= \dfrac{8}{20}$ or $\dfrac{2}{5}$ $\qquad \dfrac{1}{2}$

4. Getting $\angle AOC = 50^\circ$, Getting $\angle ACO = 40^\circ$ $\qquad \dfrac{1}{2} + \dfrac{1}{2}$

SECTION B

5. $\dfrac{S_m}{S_n} = \dfrac{m^2}{n^2} = \dfrac{\frac{m}{2}}{\frac{n}{2}} \dfrac{(2a + (m-1)d}{(2a + (n-1)d)} \Rightarrow d = 2a$ $\qquad 1$

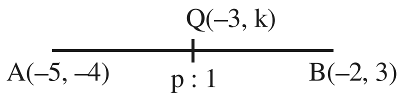
$\dfrac{a_m}{a_n} = \dfrac{a + (m-1)d}{a + (n-1)d} = \dfrac{a + 2(m-1)a}{a + 2(n-1)a} = \dfrac{2m-1}{2n-1}$ $\qquad 1$

6. Let A(2, –2), B(–2, 1) and (5, 2) be given points

$\therefore AB^2 = (4)^2 + (-3)^2 = 25,\ BC^2 = (-2 - 5)^2 + (1 - 2)^2 = 50,\ CA^2 = 9 + 16 = 25$ $\qquad 1$

$\therefore BC^2 = AB^2 + CA^2$ ABC is a right triangle and BC is the hypotenuse $\qquad \dfrac{1}{2}$

$\therefore \ ar(\Delta ABC) = \dfrac{AB \times AC}{2} = \dfrac{25}{2}$ sq. units $\qquad \dfrac{1}{2}$

7. 

Let Q divide AB in the ratio of p : 1 $\frac{1}{2}$

$-3 = \frac{-2p-5}{p+1} \Rightarrow p = 2$ $\frac{1}{2}$

$\therefore$ Ratio is 2 : 1 $\frac{1}{2}$

$k = \frac{2\times3-4}{2+1} = \frac{2}{3}$ $\frac{1}{2}$

8. Let PT = x = PS, $\angle SPT = 120° \Rightarrow \angle TPO = 60°$ $(\because \Delta OSP \cong \Delta OTP)$ 1

$\therefore \quad \frac{OP}{x} = \sec 60° = 2 \Rightarrow OP = 2x$ or $OP = 2PS$ 1

9. OA = 6 cm, OB = 4 cm, AP = 8 cm

$OP^2 = OA^2 + AP^2 = 36 + 64 = 100 \Rightarrow OP = 10$ cm 1

$BP^2 = OP^2 - OB^2 = 100 - 16 = 84$

$\Rightarrow \quad BP = 2\sqrt{21}$ cm $\frac{1}{2}+\frac{1}{2}$

10. Simplification of given equation gives

$6(x + 5 - x + 3) = x^2 + 2x - 15$ $\frac{1}{2}$

$48 = x^2 + 2x - 15$ or $x^2 + 2x - 63 = 0$ 1

$(x + 9)(x - 7) = 0$

or $\quad x = 7, -9$ $\frac{1}{2}$

SECTION C

11. S = {HHH, HHT, HTH, HTT, TTT, TTH, THT, THH}, n(S) = 8 1

Same result on all the tosses A = (HHH, TTT), n(A) = 2 1

P(Ramesh will lose the game) = $\frac{8-2}{8} = \frac{3}{4}$ or $\frac{6}{8}$ 1

12. $ar(\Delta OAB) = \frac{\sqrt{3}}{4}(12)^2 = 36\sqrt{3} = 36\times1.73 = 62.28 \text{ cm}^2$ 1

ar(cricle with centre O) = $3.14(6)^2 = 113.04 \text{ cm}^2$ $\frac{1}{2}$

$$\text{ar (sector OLQP)} = 3.14(6)^2 \times \frac{60}{360} = 18.84\ \text{cm}^2$$ $\frac{1}{2}$

$$\left.\begin{aligned}\text{area(shaded region)} &= (62.28 + 113.04 - 2\times 18.84)\ \text{cm}^2\\ &= 137.64\ \text{cm}^2\end{aligned}\right\}$$ 1

13. Radius of hemispherical tank = 150 cm

Volume of water in the hemispherical tank = $\frac{2}{3}\times\frac{22}{7}\times 150\times 150\times 150\ \ \text{cm}^3$

Volume of water to be emptied = $\frac{1}{\cancel{2}}\times\frac{\cancel{2}}{\cancel{3}}\times\frac{22}{7}\times\frac{\overset{5}{15\cancel{0}}\times 15\cancel{0}\times 15\cancel{0}}{\cancel{1000}}$ litres 1 + 1

Time taken to empty the tank = $\frac{\overset{11}{\cancel{22}}}{\cancel{7}}\times\frac{\cancel{5}\times\overset{\cancel{3}}{\cancel{15}}\times\overset{3}{\cancel{15}}\times\cancel{7}}{\times\underset{\underset{\underset{2}{\cancel{4}}}{\cancel{20}}}{\cancel{60}}\times\cancel{25}}$ min

$$= 16\frac{1}{2}\ \text{min}$$ 1

14. Volume of milk in the container = $\frac{1}{3}\pi h\,(r_1^2 + r_2^2 + r_1r_2)$ $\frac{1}{2}$

$$\left.\begin{aligned}&= \frac{1}{\cancel{3}}\times\frac{22}{\cancel{7}}\times\cancel{2}1\,[400 + 64 + 160]\ \text{cm}^3\\ &= \frac{22\times 624}{1000}\ \text{litres}\end{aligned}\right\}$$ $1+\frac{1}{2}$

$$\left.\begin{aligned}\therefore\quad \text{cost of milk} &= \frac{\overset{11}{\cancel{22}}\times 624}{\cancel{1000}\ 100}\times\cancel{25}\,7 = 480.48\\ &= ₹\ 480.48\end{aligned}\right\}$$ 1

$\therefore$ ₹ 480.48

15. Area of minor segment APBQ = $\frac{\pi r^2.90}{360} - r^2\sin 45°\cos 45°$ $\frac{1}{2}$

$$\left.\begin{aligned}&= \left(\frac{3.14\times 10^2}{4} - 100\times\frac{1}{2}\right)\text{cm}^2\\ &= (78.5 - 50)\ \text{cm}^2 = 28.5\ \text{cm}^2\end{aligned}\right\}$$ $1\frac{1}{2}$

$\therefore$ Area of major segment $= \pi r^2 - \text{ar(minor segment)}$

$= (314 - 28.5)\ \text{cm}^2 = 285.5\ \text{cm}^2$ 1

16. Volume of ice-cream in the cylinder $= (\pi(6)^2 \times 15)\ \text{cm}^3$ $\frac{1}{2}$

Volume of ice-cream in one ice-cream cone $= \frac{1}{3}\pi r^2\ (4r) + \frac{2}{3}\pi r^3$

$= 2\pi r^3$ 1

$\therefore$ Volume of ice-cream in 10 such cones $= 20\pi r^3$ $\frac{1}{2}$

$$\therefore \left.\begin{array}{l} 20\ \pi r^3 = \pi \times 36 \times 15 \\ r^3 = \dfrac{36 \times 15}{20} = 27 \Rightarrow r = 3\ \text{cm} \end{array}\right\}$$ 1

$\therefore$ Diamter of conical ice-cream cup = 6 cm

17.

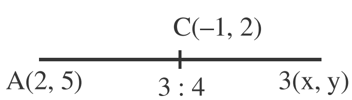


Figure $\frac{1}{2}$

$\frac{3x+8}{7} = -1 \Rightarrow x - 5$ 1

$\frac{3y+20}{7} = 2 \Rightarrow y = -2$ 1

$x^2 + y^2 = 29$ $\frac{1}{2}$

18. $S_1 = \frac{n}{2}[10 + (n-1)2], S_2 = \frac{n}{2}[10 + (n-1)4], S_3 = \frac{n}{2}[10 + (n-1)6]$ $\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$

$S_1 + S_3 = \frac{n}{2}[20 + 2n - 2 + 6n - 6] = \frac{n}{2}[20 + 8(n-1)] = 2 \times \frac{n}{2}[10 + 4(n-1)]$ 1

$= 2S_2$ $\frac{1}{2}$

19. $a(x - a) + b(x - b) = 2[x^2 - (a + b)x + ab]$ $\frac{1}{2}$

or $ax - a^2 + bx - b^2 = 2x^2 - 2(a + b)x + 2ab$

or $2x^2 - 3\ (a + b)x + (a + b)^2 = 0$

$2x^2 - 2(a + b)\ x - (a + b)\ x + (a + b)^2 = 0$ $1\frac{1}{2}$

$[2x - (a + b)]\ [x - (a + b)] = 0$

$x = a + b, \dfrac{a + b}{2}$ 1

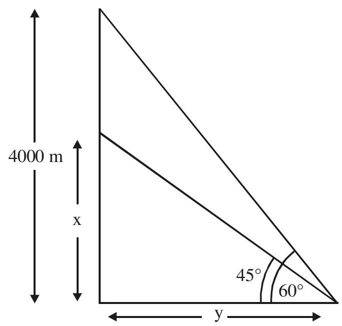
20. 

Figure $\frac{1}{2}$

(i) $\dfrac{x}{y} = \tan 45° = 1 \Rightarrow x = y$ $\frac{1}{2}$

(ii) $\dfrac{4000}{y} = \tan 60° = \sqrt{3} \Rightarrow y = \dfrac{4000\sqrt{3}}{3} = 2306.67$ m 1

$\therefore$ Vertical distance between two = 4000 – y = 1693.33 m 1

SECTION D

21. Correctly stated gives, to prove const. and figure 2

Correct Proof 2

22. Let PL = y, OP is $\perp$ bisector of AB $\Rightarrow$ AL = BL = 8cm

$OL^2 = OA^2 - AL^2 = 10^2 - 8^2 = 36 \Rightarrow OL = 6$ cm 1

$$\left.\begin{array}{lll} \text{In } \Delta OAP, & AP^2 = (y+6)^2 - 10^2 & ....(i) \\ \text{In } \Delta ALP, & AP^2 = y^2 + 64 & ....(ii) \end{array}\right\}$$ 2

From (i) and (iii) $y = \dfrac{32}{3}$ $\frac{1}{2}$

$\therefore$ $AP = \dfrac{40}{3}$ cm $\frac{1}{2}$

23. For a/b > 1, when a = 1, b can not take any value, a = 2, b can take 1 value, a = 3, b can take 2 values, a = 4, b can take 3 values $2\frac{1}{2}$

when a = 5, b can take 4 values, a = 6, b can take 5 values

Total Possible outcomes = 36 $\frac{1}{2}$

$\therefore$ $P(a/b > 1) = \dfrac{1+2+3+4+5}{36} = \dfrac{15}{36}$ or $\dfrac{5}{12}$ 1

24. Area of Shaded region $= \frac{1}{2} \times \frac{22}{7} \left[7^2 + \left(\frac{7}{2}\right)^2 - 2\left(\frac{7}{4}\right)^2 \right] \text{cm}^2$ 2

$= \frac{1}{2} \times \frac{22}{7} \left[49 + \frac{49}{4} - \frac{49}{8} \right] = \frac{1}{\cancel{2}} \times \frac{\overset{11}{\cancel{22}}}{\cancel{7}} \times \overset{7}{\cancel{4}}9 \left[\frac{9}{8} \right]$ $1\frac{1}{2}$

$= \frac{693}{8}$ sq. cm or 86.625 cm^2 $\frac{1}{2}$

25.

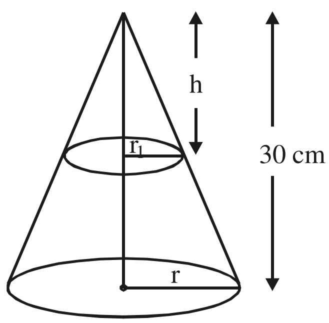


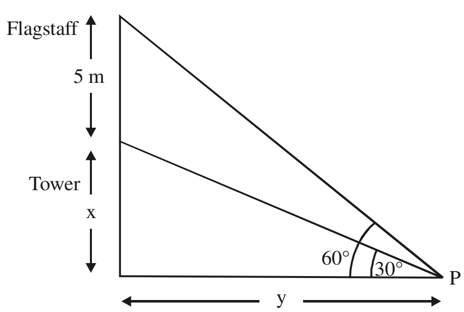
Figure $\frac{1}{2}$

$\frac{r_1}{r} = \frac{h}{30} \Rightarrow h = \frac{30 \times r_1}{r}$ 1

$\frac{\frac{1}{\cancel{3}} \cancel{\pi} r_1^2 \times h}{\frac{1}{\cancel{3}} \cancel{\pi} r^2 \times 30} = \frac{1}{27}$ or $\frac{r_1^2 \times \cancel{30} \times r_1}{r^3 \times \cancel{30}} = \frac{1}{27}$ $1\frac{1}{2}$

$\left.\begin{array}{l} \therefore \quad \frac{r_1}{r} = \frac{1}{3} \Rightarrow h = 10 \text{ cm} \\ \therefore \quad \text{The section is made 20 cm above base} \end{array}\right\}$ 1

26. Figure 1



(i) $\frac{x}{y} = \tan 30° = \frac{1}{\sqrt{3}} \Rightarrow y = \sqrt{3}x$ 1

(ii) $\left.\begin{array}{l} \frac{x+5}{y} = \tan 60° = \sqrt{3} \text{ or } \frac{x+5}{\sqrt{3}\,x} = \sqrt{3} \\ \Rightarrow \quad x = 2.5 \end{array}\right\}$ $1 + \frac{1}{2}$

Height of Tower = 2.5 m

Distance of P from tower = (2.5 × 1.732) or 4.33 m $\frac{1}{2}$

27. Here a = ₹ 450, d = ₹ 20, n = 12

$S_{12} = \frac{12}{2}[2 \times 450 + 11 \times 20] = 6\,[1120] = 6720 > 6500$ $1+1+\frac{1}{2}$

$\therefore$ Reshma will be able to send her daughter to school $\frac{1}{2}$

Efforts for Girl child education 1

28. Correct Construction 4

29. Let the tap with smaller diameter fills the tank in x hours

$\therefore$ The other tap fills the tank in (x – 8) hours $\frac{1}{2}$

$$\therefore \quad \frac{1}{x}+\frac{1}{x-8} = \frac{5}{48} \qquad 1$$

or $5x\,(x-8) = (2x-8)\,48$

$$5x^2 - 136x + 384 = 0 \qquad 1\frac{1}{2}$$

$$x = \frac{136 \pm 104}{10} = 24, \frac{16}{5} \text{ (rejected)} \qquad \frac{1}{2}$$

$\therefore$ Two taps can fill the tank in 16 hrs. and 24 hrs. $\frac{1}{2}$

30.

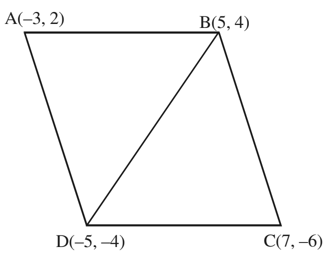


Figure $\frac{1}{2}$

$$\text{ar}(\Delta ABD) = \frac{1}{2}\left|-3(8) + 5\,(-6) + -5(2-4)\right| = 22 \text{ sq. units} \qquad 1\frac{1}{2}$$

$$\text{ar }(\Delta BCD) = \frac{1}{2}\left|5(-2) + 7(-8) - 5(10)\right| = 58 \text{ sq. units} \qquad 1\frac{1}{2}$$

ar(Quad ABCD) = 80 sq. units $\frac{1}{2}$

31. Let the fraction be $\frac{x}{2x+1}$ $\frac{1}{2}$

$$\therefore \quad \frac{x}{2x+1}+\frac{2x+1}{x} = \frac{58}{21} \qquad 1$$

$$21[x^2 + (2x+1)^2] = 58\,(2x^2 + x)$$

$$\Rightarrow \quad 11x^2 - 26x - 21 = 0 \qquad 1$$

$$\left.\begin{array}{l} x = 3, -\frac{7}{11} \text{ (rejected)} \\ \therefore \quad \text{Fraction} = \frac{3}{7} \end{array}\right\} \qquad \frac{1}{2}+1$$