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Secondary School Certificate Examination

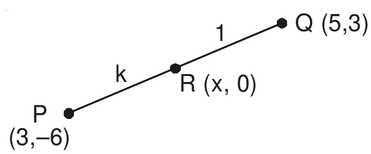
Compartment (July 2019)

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

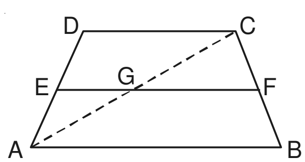
General Instructions:

1. You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully. **Evaluation is a 10-12 days mission for all of us. Hence, it is necessary that you put in your best efforts in this process.**
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. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and marks be awarded to them.**
3. The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
4. Evaluators will mark (✓) wherever answer is correct. For wrong answer 'X"be marked. Evaluators will not put right kind of mark while evaluating which gives an impression that answer is correct and no marks are awarded. This is most common mistake which evaluators are committing.
5. If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled.
6. If a question does not have any parts, marks must be awarded in the left hand margin and encircled.
7. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.
8. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
9. A full scale of marks 0 to 80 has to be used. Please do not hesitate to award full marks if the answer deserves it.
10. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 20 / 25 answer books per day.
11. Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
    - Leaving answer or part thereof unassessed in an answer book.
    - Giving more marks for an answer than assigned to it.
    - Wrong transfer of marks from the inside pages of the answer book to the title page.
    - Wrong question wise totaling on the title page.
    - Wrong totaling of marks of the two columns on the title page.
    - Wrong grand total.
    - Marks in words and figures not tallying.
    - Wrong transfer of marks from the answer book to online award list.
    - Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)
    - Half or a part of answer marked correct and the rest as wrong, but no marks awarded.
12. While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as (X) and awarded zero (0) Marks.
13. Any unassessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
14. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.
15. Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.
16. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

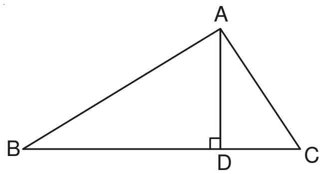
QUESTION PAPER CODE 30/1/1
EXPECTED ANSWER/VALUE POINTS
SECTION A

Q.NO.		MARKS
1.	Common difference (d) = p	1
2.	cot 54° = tan 36°	$\frac{1}{2}$
	$\therefore \frac{\tan 36°}{\cot 54°} = 1$	$\frac{1}{2}$
	OR	
	$\text{cosec}^2 \theta \times \sin^2 \theta = k$	$\frac{1}{2}$
	$\Rightarrow k = 1$	$\frac{1}{2}$
3.	$D = 9a^2 - 36 = 0$	$\frac{1}{2}$
	$\Rightarrow a = \pm 2$	$\frac{1}{2}$
	OR	
	$2\left(-\frac{1}{3}\right)^2 + 2\left(-\frac{1}{3}\right) + k = 0$	$\frac{1}{2}$
	$\Rightarrow k = \frac{4}{9}$	$\frac{1}{2}$
4.	 Let the point of division be (x, 0)	
	$\frac{3k - 6}{k + 1} = 0 \Rightarrow k = 2$	$\frac{1}{2}$
	Required ratio is 2 : 1.	$\frac{1}{2}$
5.	LCM = 9 × HCF	$\frac{1}{2}$
	HCF = 50	$\frac{1}{2}$
6.	AE : EF = 3 : 7	$\frac{1}{2}$
	AE : AF = 3 : 10	$\frac{1}{2}$

	SECTION B	
7.	Points (x, y) (1, 2) and (7, 0) are collinear	
	$\therefore\ x(2-0)+1(0-y)+7(y-2)=0$	1
	$\Rightarrow 2x+6y-14=0$ or $x+3y-7=0$	1
8.	$a=7,\ d=3,\ 46=7+(n-1)\times 3$	
	$\Rightarrow n=14$	1
	$S_{14}=\frac{14}{2}(7+46)=371$	1
	OR	
	$a+8d=0 \Rightarrow a=-8d$	$\frac{1}{2}$
	$a_{29}=a+28d=20d$	$\frac{1}{2}$
	$a_{19}=a+18d=10d$	$\frac{1}{2}$
	$\therefore\ a_{29}=2\times a_{19}$	$\frac{1}{2}$
9.	Let $\frac{3+\sqrt{7}}{5}$ be a rational number	$\frac{1}{2}$
	$\frac{3+\sqrt{7}}{5}=\frac{p}{q},\ q\neq 0$	
	$\Rightarrow \sqrt{7}=\frac{5p-3q}{q}$	$\frac{1}{2}$
	RHS is a rational no. whereas LHS is an irrational number which is wrong.	$\frac{1}{2}$
	$\therefore\ \frac{3+\sqrt{7}}{5}$ is an irrational number.	$\frac{1}{2}$
	OR	
	$n^2+n=n(n+1)$ which is product of two concecutive natural numbers.	1
	Hence, one of them has to be an even number.	
	$\therefore\ n(n+1)$ is always divisible by 2.	1

10.	Substituting x = 3, y = 1	
	$3 - 4 + p = 0,\ 6 + 1 - q - 2 = 0$	$\frac{1}{2}+\frac{1}{2}$
	$\Rightarrow p = 1,\ q = 5$	$\frac{1}{2}+\frac{1}{2}$
	Hence, q = 5p or any other valid relation.	
11.	Total number of possible outcomes = 36.	
	(i) Favourable outcomes: (2, 2) (2, 4), (2, 6) (4, 2) (4, 4) (4, 6) (6, 2) (6, 4) (6, 6): 9 outcomes	
	P(getting even no. on each die) = $\frac{9}{36}$ or $\frac{1}{4}$	1
	(ii) Favourable outcomes: (3, 6) (4, 5) (5, 4) (6, 3): 4 outcomes.	
	P(getting a total of 9) = $\frac{4}{36}$ or $\frac{1}{9}$	1
12.	Total number of balls = 6x	1
	(i) P (selected ball is not red) = $\frac{3x}{6x}$ or $\frac{1}{2}$	1
	(ii) P (selected ball is white) = $\frac{x}{6x}$ or $\frac{1}{6}$	1
	SECTION C	
13.	Join AC.	$\frac{1}{2}$
		
	In $\Delta CAB,\ GF \parallel AB \Rightarrow \frac{CG}{GA} = \frac{CF}{FB}$ ....(1)	1
	In $\Delta ADC,\ EG \parallel DC \Rightarrow \frac{AG}{GC} = \frac{AE}{ED}$ ....(2)	1
	Using (1) & (2)	
	$\frac{CF}{FB} = \frac{ED}{AE}$	
	$\Rightarrow \frac{AE}{ED} = \frac{BF}{FC}$	$\frac{1}{2}$

OR



In ΔADC, $AD^2 = AC^2 - CD^2$ ...(1) $\frac{1}{2}$

In ΔADB, $AD^2 = AB^2 - BD^2$ ...(2) $\frac{1}{2}$

Also $BD = 3CD \Rightarrow CD = \frac{1}{4}BC$ ...(3) $\frac{1}{2}$

Using (1) and (2)

$AC^2 - CD^2 = AB^2 - BD^2$ $\frac{1}{2}$

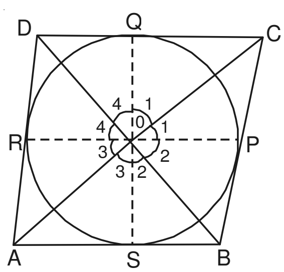
$\Rightarrow AB^2 = AC^2 - CD^2 + BD^2$

Using (3)

$AB^2 = AC^2 + \frac{BC^2}{2}$

$\Rightarrow 2AB^2 = 2AC^2 + BC^2$ 1

14.



Correct Fig. $\frac{1}{2}$

$\Delta OCQ \cong \Delta OCP$ (SSS) $\frac{1}{2}$

$\angle COP = \angle COQ = \angle 1$

Similarly $\angle BOP = \angle BOS = \angle 2$

$\angle AOS = \angle AOR = \angle 3$

and $\angle DOR = \angle DOQ = \angle 4$ 1

Since $\angle DOC + \angle COB + \angle BOA + \angle AOD = 360°$ $\frac{1}{2}$

$\Rightarrow 2(\angle 1 + \angle 2 + \angle 3 + \angle 4) = 180°$

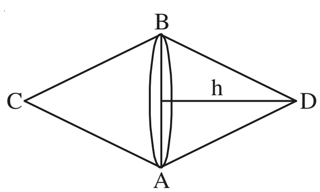
Hence, $\angle AOB + \angle DOC = \angle BOC + \angle AOD = 180°$ $\frac{1}{2}$

15. LHS $= \frac{\tan A(1 - \sec A) - \tan A(1 + \sec A)}{1 - \sec^2 A}$ 1

$= \frac{-2 \tan A \sec A}{-\tan^2 A}$ 1

	$= \frac{1}{\cos A} \times \frac{\cos A}{\sin A}$	
	$= \text{cosec } A = \text{RHS}.$	1
	OR	
	LHS	
	$= 1 + \frac{\text{cosec}^2\theta - 1}{1 + \text{cosec } \theta}$	1
	$= 1 + \frac{(\text{cosec } \theta - 1)(\text{cosec } \theta + 1)}{1 + \text{cosec } \theta}$	1
	$= 1 + \text{cosec } \theta - 1$	
	$= \text{cosec } \theta = \text{RHS}$	1
16.	AP : PB = 1 : 2 Let the pt P be (x_1, y_1)	$\frac{1}{2}$
	$x_1 = \frac{5+4}{3} = 3$	$\frac{1}{2}$
	$y_1 = \frac{-8+2}{3} = -2$	$\frac{1}{2}$
	$\because$ point P lies on $2x - y + k = 0$	
	$\Rightarrow 2x_1 - y_1 + k = 0$	$\frac{1}{2}$
	$\Rightarrow 6 + 2 = -k$	
	$\therefore k = -8$	1
	OR	
	Let A(a, a), B(–a, –a) and $C(-\sqrt{3}a, \sqrt{3}a)$ be vertices of ΔABC.	
	$AB = \sqrt{(a+a)^2 + (a+a)^2} = \sqrt{8a^2}$	1
	$BC = \sqrt{(-a+\sqrt{3}a)^2 + (-a-\sqrt{3}a)^2} = \sqrt{8a^2}$	1
	$CA = \sqrt{(a+\sqrt{3}a)^2 + (a-\sqrt{3}a)^2} = \sqrt{8a^2}$	$\frac{1}{2}$
	$\therefore AB = BC = CA$	
	Hence, ΔABC is an equilateral triangle.	$\frac{1}{2}$

17.	Since, $(2+\sqrt{3})$ and $(2-\sqrt{3})$ are zeroes of the polynomial.	
	Therefore, $(x-2-\sqrt{3})\times(x-2+\sqrt{3})$ is factor of given polynomial.	
	$\Rightarrow (x^2 - 4x + 1)$ is a factor of $p(x) = 2x^4 - 13x^3 + 19x^2 + 7x - 3$.	1
	Dividing p(x) by $x^2 - 4x + 1$, quotient $= 2x^2 - 5x - 3$	1
	$2x^2 - 5x - 3 = 2x^2 - 6x + x - 3 = (2x + 1)(x - 3)$	
	$\therefore$ Other zeroes are $x = -\frac{1}{2}, x = 3$	$\frac{1}{2}$
	Hence, all zeroes are	
	$2+\sqrt{3}, 2-\sqrt{3}, -\frac{1}{2}$ and 3.	$\frac{1}{2}$
18.	Roots of the given equation are equal.	
	$\therefore D = 4(ac + bd)^2 - 4(a^2 + b^2)(c^2 + d^2) = 0$	1
	$\Rightarrow 4[a^2c^2 + b^2d^2 + 2acbd - a^2c^2 - a^2d^2 - b^2c^2 - b^2d^2] = 0$	1
	$\Rightarrow 4(ad - bc)^2 = 0$	
	$\Rightarrow ad = bc$	1
19.	a = 12576, b = 4052	$\frac{1}{2}$
	Using Euclid's division algorithm	
	$12576 = 4052 \times 3 + 420$	
	$4052 = 420 \times 9 + 272$	
	$420 = 272 \times 1 + 148$	
	$272 = 148 \times 1 + 124$	2
	$148 = 124 \times 1 + 24$	
	$124 = 24 \times 5 + 4$	
	$24 = 4 \times 6 + 0$	
	Hence HCF of 12576 and 4052 is 4.	$\frac{1}{2}$
20.	Modal class is 201-202	$\frac{1}{2}$
	$\therefore \quad l = 201, h = 1, f_1 = 26, f_0 = 12, f_2 = 20$	1

	$\therefore$ Mode $= 201+\frac{26-12}{52-12-20}\times 1$	1
	$= 201+\frac{7}{10}$	
	$= 201.7$	$\frac{1}{2}$
21.	$r = \frac{3}{2}$ m	$\frac{1}{2}$
	Volume of tank $= \frac{2}{3}\times\frac{22}{7}\times\frac{3}{2}\times\frac{3}{2}\times\frac{3}{2}$	
	$= \frac{99}{14}$ m^3	1
	Capacity of tank $= \frac{99}{14}\times 1000$ litre	$\frac{1}{2}$
	Time taken to empty the tank $= \frac{7}{25}\times\frac{99}{14}\times 1000$ sec.	
	= 1980 sec. or 33 minutes	1
	OR	
		
	Diameter AB = 16 cm	
	$\therefore$ r = 8 cm	
	h = 15 cm	$\frac{1}{2}$
	$\therefore$ $l = \sqrt{64+225}=\sqrt{289}=17$ cm	1
	Surface area of the shape formed $= 2\pi r l$	
	$= 2\times\frac{22}{7}\times 8\times 17$	$\frac{1}{2}$
	= 854.85 cm^2	1
22.	BC $= \sqrt{6^2+8^2}=10$ cm	$\frac{1}{2}$
	Let A_1 = Area of semi-circle on diameter AB $= \frac{9\pi}{2}$ cm^2	$\frac{1}{2}$

	A_2 = Area of semi-circle on diameter AC = $\frac{16\pi}{2}$ cm^2	$\frac{1}{2}$
	A_3 = Area of semi-circle on diameter BC = $\frac{25\pi}{2}$ cm^2	$\frac{1}{2}$
	A_4 = Area of ΔABC = 24 cm^2	$\frac{1}{2}$
	Area of shaded region = $(A_1 + A_2 + A_4) - A_3$	
	$= \frac{9\pi}{2} + \frac{16\pi}{2} + 24 - \frac{25\pi}{2}$	
	= 24 cm^2	$\frac{1}{2}$
	SECTION D	
23.	Correct Given, To prove, construction, Figure	2
	Correct proof	2
24.	$a_m = \frac{1}{n} \Rightarrow a + (m-1)d = \frac{1}{n}$ ...(1)	$\frac{1}{2}$
	$a_n = \frac{1}{m} \Rightarrow a + (n-1)d = \frac{1}{m}$ ...(2)	$\frac{1}{2}$
	Solving (1) and (2), $d = \frac{1}{mn}$, $a = \frac{1}{mn}$	1+1
	Hence $a_{mn} = a + (mn-1)d$	
	$= \frac{1}{mn} + (mn-1) \times \frac{1}{mn}$	
	= 1	1
	OR	
	Numbers are 1, 3, 5, 7, ..., 49.	1
	$a = 1,\ d = 2,\ a_n = 49$	1
	$\therefore$ $49 = 1 + 2(n-1)$	
	$\Rightarrow$ $n = 25$	1
	Hence $S_{25} = \frac{25}{2}(1+49)$	
	= 625	1

25. $\frac{1}{x+1}+\frac{2}{x+2}=\frac{7}{x+5}$

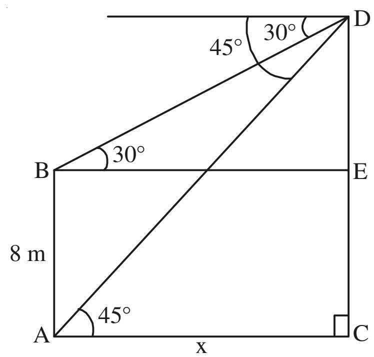
$\Rightarrow \quad \frac{(x+2)+2(x+1)}{(x+1)(x+2)}=\frac{7}{x+5}$ — 1

$\Rightarrow \quad 2x^2 + x - 3 = 0$ — 1

$\Rightarrow \quad (x - 1)(2x + 3) = 0$ — 1

$\Rightarrow \quad x = 1 \text{ or } x = -\frac{3}{2}$ — $\frac{1}{2}+\frac{1}{2}$

26.



Correct figure — 1

Let AB be the building and CD be the tower of height h

$\therefore$ CE = 8 m and DE = (h – 8) m

Taking ΔACD, $\tan 45° = \frac{h}{x} \Rightarrow 1=\frac{h}{x} \Rightarrow h = x$ — 1

Taking ΔDEB

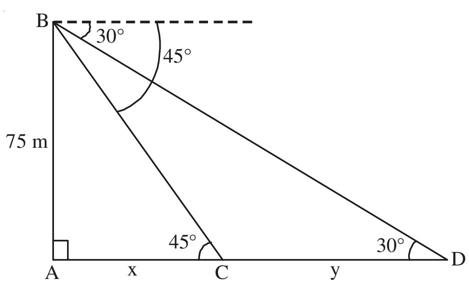
$\tan 30° = \frac{h-8}{x} \Rightarrow \frac{1}{\sqrt{3}}=\frac{h-8}{x} \Rightarrow \frac{x}{\sqrt{3}}=h-8$ — 1

Hence, $\frac{h}{\sqrt{3}} = h-8$ or $h(\sqrt{3}-1)=8\sqrt{3}$

$\Rightarrow h = \left(\frac{8\sqrt{3}}{\sqrt{3}-1}\right)$ m or $12+4\sqrt{3}$ m — 1

Height of the tower is $(12+4\sqrt{3})$ m

OR



Correct figure — 1

Let AB be the light house and C and D are positions of the two ships

Taking ΔBAC

$\tan 45° = \frac{75}{x} \Rightarrow 1=\frac{75}{x} \Rightarrow x = 75$ m — 1

	Taking ΔBAD, $\tan 30° = \frac{75}{x+y} \Rightarrow \frac{1}{\sqrt{3}} = \frac{75}{x+y}$	
	$\Rightarrow x + y = 75\sqrt{3}$	1
	Hence, $y = 75\sqrt{3} - 75 = 75(\sqrt{3}-1)$	1
	Distance between two ships = $75(\sqrt{3}-1)$ m	
27.	Correct Construction of circle and marking point A.	1
	Correct Construction of tangents.	3
28.	$m = \frac{\sin x}{\sin y},\ n = \frac{\tan x}{\tan y}$	
	$m^2 - 1 = \frac{\sin^2 x - \sin^2 y}{\sin^2 y}$	1
	$n^2 - 1 = \frac{\tan^2 x - \tan^2 y}{\tan^2 y} = \frac{\sin^2 x \cos^2 y - \cos^2 x \sin^2 y}{\cos^2 x \times \cos^2 y} \times \frac{\cos^2 y}{\sin^2 y}$	
	$= \frac{\sin^2 x(1-\sin^2 y) - (1-\sin^2 x)\sin^2 y}{\cos^2 x \cdot \sin^2 y}$	
	$= \frac{\sin^2 x - \sin^2 y}{\cos^2 x \cdot \sin^2 y}$	2
	$\therefore \frac{m^2-1}{n^2-1} = \cos^2 x$	1
	OR	
	$x \sin^3 \theta + y \cos^3 \theta = \cos \theta \sin \theta$ and $x \sin \theta = y \cos \theta$	
	Substituting $x \sin \theta = y \cos \theta$, we get	
	$\sin^2 \theta(y \cos \theta) + y \cos^3 \theta = \sin \theta \cos \theta$	1
	$\Rightarrow$ $y \cos \theta(\sin^2 \theta + \cos^2 \theta) = \sin \theta \cos \theta$	$\frac{1}{2}$
	$\Rightarrow$ $y \cos \theta = \sin \theta \cos \theta$	1
	$\Rightarrow$ $y = \sin \theta$	$\frac{1}{2}$

Q. No.	Value Points	Marks
	Hence $x = \cos\theta$	$\frac{1}{2}$
	Squaring and adding $x^2 + y^2 = 1$	$\frac{1}{2}$
29.		

C.I.	x	f	fx		
0–20	10	5	50		
20–40	30	8	240		
40–60	50	x	50x	Correct Table	2
60–80	70	12	840		
80–100	90	7	630		
100–120	110	8	880		
		40 + x	2640 + 50x		

$$\bar{x} = \frac{2640 + 50x}{40 + x} = 62.8$$ 1

$\Rightarrow$ x = 10 1

30. Here $r_1 = 28$ cm, $r_2 = 7$ cm, $h = 45$ cm

Volume of frustum of cone $= \frac{1}{3} \times \frac{22}{7} \times 45(28^2 + 7^2 + 28 \times 7)$ $\frac{1}{2}$

$= \frac{1}{3} \times \frac{22}{7} \times 45 \times 1029$

$= 48510 \text{ cm}^3$ 1

Now $l = \sqrt{45^2 + (28-7)^2} = \sqrt{2466} = 3\sqrt{274}$ cm 1

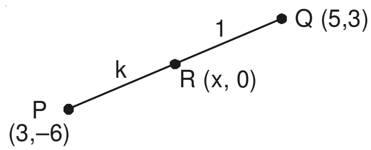
Surface Area $= \frac{22}{7}(28+7) \times 3\sqrt{274}$ 1

$= 330\sqrt{274} \text{ cm}^2$ $\frac{1}{2}$

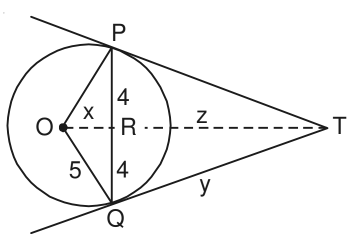
QUESTION PAPER CODE 30/1/2

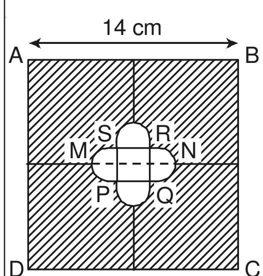
EXPECTED ANSWER/VALUE POINTS

SECTION A

1.	$D = 9a^2 - 36 = 0$	$\frac{1}{2}$
	$\Rightarrow a = \pm 2$	$\frac{1}{2}$
	OR	
	$2\left(-\frac{1}{3}\right)^2 + 2\left(-\frac{1}{3}\right) + k = 0$	$\frac{1}{2}$
	$\Rightarrow k = \frac{4}{9}$	$\frac{1}{2}$
2.	 Let the point of division be (x, 0)	
	$\frac{3k-6}{k+1} = 0 \Rightarrow k = 2$	$\frac{1}{2}$
	Required ratio is 2 : 1.	$\frac{1}{2}$
3.	LCM = 9 × HCF	$\frac{1}{2}$
	HCF = 50	$\frac{1}{2}$
4.	AE : EF = 3 : 7	$\frac{1}{2}$
	AE : AF = 3 : 10	$\frac{1}{2}$
5.	$\cot 54° = \tan 36°$	$\frac{1}{2}$
	$\therefore \frac{\tan 36°}{\cot 54°} = 1$	$\frac{1}{2}$
	OR	
	$\text{cosec}^2\theta \times \sin^2\theta = k$	$\frac{1}{2}$
	$\Rightarrow k = 1$	$\frac{1}{2}$

6.	$64 = 4 + (n - 1) \times 3$	$\frac{1}{2}$
	$\Rightarrow n = 21$	$\frac{1}{2}$
	SECTION B	
7.	Let $\frac{3+\sqrt{7}}{5}$ be a rational number	$\frac{1}{2}$
	$\frac{3+\sqrt{7}}{5} = \frac{p}{q}$, $q \neq 0$	
	$\Rightarrow \sqrt{7} = \frac{5p-3q}{q}$	$\frac{1}{2}$
	RHS is a rational no. whereas LHS is an irrational number which is wrong.	$\frac{1}{2}$
	$\therefore \frac{3+\sqrt{7}}{5}$ is an irrational number.	$\frac{1}{2}$
	OR	
	$n^2 + n = n(n + 1)$ which is product of two concecutive natural numbers.	1
	Hence, one of them has to be an even number.	
	$\therefore n(n + 1)$ is always divisible by 2.	1
8.	Substituting $x = 3$, $y = 1$	
	$3 - 4 + p = 0$, $6 + 1 - q - 2 = 0$	$\frac{1}{2}+\frac{1}{2}$
	$\Rightarrow p = 1$, $q = 5$	$\frac{1}{2}+\frac{1}{2}$
	Hence, $q = 5p$ or any other valid relation.	
9.	Total number of possible outcomes = 36.	
	(i) Favourable outcomes: (2, 2) (2, 4), (2, 6) (4, 2) (4, 4) (4, 6) (6, 2) (6, 4) (6, 6): 9 outcomes	
	P(getting even no. on each die) = $\frac{9}{36}$ or $\frac{1}{4}$	1
	(ii) Favourable outcomes: (3, 6) (4, 5) (5, 4) (6, 3): 4 outcomes.	

	P(getting a total of 9) = $\frac{4}{36}$ or $\frac{1}{9}$	1
10.	Total number of balls = 6x	1
	(i) P (selected ball is not red) = $\frac{3x}{6x}$ or $\frac{1}{2}$	1
	(ii) P (selected ball is white) = $\frac{x}{6x}$ or $\frac{1}{6}$	1
11.	$a = 7,\ d = 3,\ 46 = 7 + (n - 1) \times 3$	
	$\Rightarrow n = 14$	1
	$S_{14} = \frac{14}{2}(7+46) = 371$	1
	OR	
	$a + 8d = 0 \Rightarrow a = -8d$	$\frac{1}{2}$
	$a_{29} = a + 28d = 20d$	$\frac{1}{2}$
	$a_{19} = a + 18d = 10d$	$\frac{1}{2}$
	$\therefore\ a_{29} = 2 \times a_{19}$	$\frac{1}{2}$
12.	$(k + 2)^2 + 36 = (k - 5)^2 + 36 + 49$	1
	$\Rightarrow k = 5$	1
	SECTION C	
13.	 Let PT = QT = y, PR = QR = 4 cm	
	OR = $\sqrt{25-16} = 3$ cm	$\frac{1}{2}$
	$\Delta PRT \cong \Delta QRT$	
	$\therefore\ \angle PRT = \angle QRT = 90°$	
	Hence, $y^2 = (3 + z)^2 - 25$ ...(1)	1
	and $y^2 = 16 + z^2$ ...(2)	$\frac{1}{2}$

	Using equations (1) and (2) $(3 + z)^2 - 25 = 16 + z^2$ $\Rightarrow \quad z = \frac{16}{3}$ and $\quad y = \frac{20}{3}$ or length of tangent = $\frac{20}{3}$ cm	1
14.	Let p(x) = $2x^4 - 3x^3 - 3x^2 + 6x - 2$ $\because$ x = 1, $\frac{1}{2}$ are zeroes of polynomial p(x) $\because \ (x-1)\left(x-\frac{1}{2}\right) = \frac{1}{2}(2x^2 - 3x + 1)$ is a factor of p(x) Dividing p(x) by $(2x^2 - 3x + 1)$, quotient = $x^2 - 2$ Now, $x^2 - 2 = (x-\sqrt{2})(x+\sqrt{2})$ $\therefore$ other zeroes are $\sqrt{2}, -\sqrt{2}$ All zeroes are $1, \frac{1}{2}, \sqrt{2}, -\sqrt{2}$	1 1 $\frac{1}{2}$ $\frac{1}{2}$
15.	 Let r be the radius of semi-circles $\therefore$ 14 = 6 + 4r $\Rightarrow$ r = 2. Area of sq. PQRS $(A_1) = (2r)^2 = 16$ cm^2 Area of sq. ABCD $(A_2) = (14)^2 = 196$ cm^2 and Area of four semi-circles $(A_3) = 4 \times \frac{3.14}{2} \times 4$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$

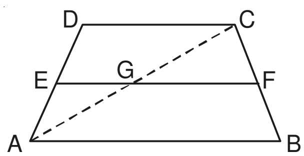
$\Rightarrow A_3 = 25.12 \text{ cm}^2.$ $\frac{1}{2}$

Area of shaded region $= A_2 - A_1 - A_3$

$= 196 - 16 - 25.12$

$= 154.88 \text{ cm}^2$ 1

16.



Join AC. $\frac{1}{2}$

In ΔCAB, $GF \parallel AB \Rightarrow \frac{CG}{GA} = \frac{CF}{FB}$ ....(1) 1

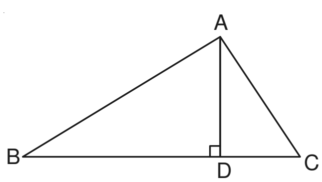
In ΔADC, $EG \parallel DC \Rightarrow \frac{AG}{GC} = \frac{AE}{ED}$ ....(2) 1

Using (1) & (2)

$\frac{CF}{FB} = \frac{ED}{AE}$

$\Rightarrow \frac{AE}{ED} = \frac{BF}{FC}$ $\frac{1}{2}$

OR



In ΔADC, $AD^2 = AC^2 - CD^2$ ...(1) $\frac{1}{2}$

In ΔADB, $AD^2 = AB^2 - BD^2$ ...(2) $\frac{1}{2}$

Also $BD = 3CD \Rightarrow CD = \frac{1}{4}BC$ ...(3) $\frac{1}{2}$

Using (1) and (2)

$AC^2 - CD^2 = AB^2 - BD^2$ $\frac{1}{2}$

$\Rightarrow AB^2 = AC^2 - CD^2 + BD^2$

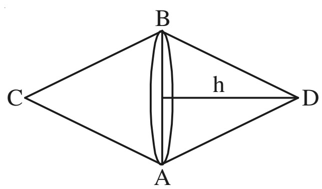
Using (3)

$AB^2 = AC^2 + \frac{BC^2}{2}$

$\Rightarrow 2AB^2 = 2AC^2 + BC^2$ 1

17.	LHS $= \dfrac{\tan A(1-\sec A) - \tan A(1+\sec A)}{1-\sec^2 A}$	1
	$= \dfrac{-2\tan A \sec A}{-\tan^2 A}$	1
	$= \dfrac{1}{\cos A} \times \dfrac{\cos A}{\sin A}$	
	$= \operatorname{cosec} A = \text{RHS}.$	1
	OR	
	LHS	
	$= 1 + \dfrac{\operatorname{cosec}^2\theta - 1}{1 + \operatorname{cosec}\theta}$	1
	$= 1 + \dfrac{(\operatorname{cosec}\theta - 1)(\operatorname{cosec}\theta + 1)}{1 + \operatorname{cosec}\theta}$	1
	$= 1 + \operatorname{cosec}\theta - 1$	
	$= \operatorname{cosec}\theta = \text{RHS}$	1
18.	AP : PB = 1 : 2 Let the pt P be (x_1, y_1)	$\frac{1}{2}$
	$x_1 = \dfrac{5+4}{3} = 3$	$\frac{1}{2}$
	$y_1 = \dfrac{-8+2}{3} = -2$	$\frac{1}{2}$
	$\because$ point P lies on $2x - y + k = 0$	
	$\Rightarrow 2x_1 - y_1 + k = 0$	$\frac{1}{2}$
	$\Rightarrow 6 + 2 = -k$	
	$\therefore k = -8$	1
	OR	
	Let A(a, a), B(–a, –a) and $C(-\sqrt{3}a, \sqrt{3}a)$ be vertices of ΔABC.	
	$AB = \sqrt{(a+a)^2 + (a+a)^2} = \sqrt{8a^2}$	1
	$BC = \sqrt{(-a+\sqrt{3}a)^2 + (-a-\sqrt{3}a)^2} = \sqrt{8a^2}$	1

	CA = $\sqrt{(a+\sqrt{3}a)^2+(a-\sqrt{3}a)^2}=\sqrt{8a^2}$	$\frac{1}{2}$
	$\therefore$ AB = BC = CA	
	Hence, ΔABC is an equilateral triangle.	$\frac{1}{2}$
19.	Roots of the given equation are equal.	
	$\therefore$ D = $4(ac + bd)^2 - 4(a^2 + b^2)(c^2 + d^2) = 0$	1
	$\Rightarrow 4[a^2c^2 + b^2d^2 + 2acbd - a^2c^2 - a^2d^2 - b^2c^2 - b^2d^2] = 0$	1
	$\Rightarrow 4(ad - bc)^2 = 0$	
	$\Rightarrow ad = bc$	1
20.	a = 12576, b = 4052	$\frac{1}{2}$
	Using Euclid's division algorithm	
	$12576 = 4052 \times 3 + 420$	
	$4052 = 420 \times 9 + 272$	
	$420 = 272 \times 1 + 148$	
	$272 = 148 \times 1 + 124$	2
	$148 = 124 \times 1 + 24$	
	$124 = 24 \times 5 + 4$	
	$24 = 4 \times 6 + 0$	
	Hence HCF of 12576 and 4052 is 4.	$\frac{1}{2}$
21.	Modal class is 201-202	$\frac{1}{2}$
	$\therefore$ $l = 201,\ h = 1,\ f_1 = 26,\ f_0 = 12,\ f_2 = 20$	1
	$\therefore$ Mode $= 201+\frac{26-12}{52-12-20}\times 1$	1
	$= 201+\frac{7}{10}$	
	$= 201.7$	$\frac{1}{2}$

22.	$r = \frac{3}{2}$ m	$\frac{1}{2}$
	Volume of tank = $\frac{2}{3}\times\frac{22}{7}\times\frac{3}{2}\times\frac{3}{2}\times\frac{3}{2}$	
	$= \frac{99}{14}$ m^3	1
	Capacity of tank = $\frac{99}{14}\times 1000$ litre	$\frac{1}{2}$
	Time taken to empty the tank = $\frac{7}{25}\times\frac{99}{14}\times 1000$ sec.	
	= 1980 sec. or 33 minutes	1
	OR	
		
	Diameter AB = 16 cm	
	$\therefore$ r = 8 cm	
	h = 15 cm	$\frac{1}{2}$
	$\therefore$ $l = \sqrt{64+225} = \sqrt{289} = 17$ cm	1
	Surface area of the shape formed = $2\pi rl$	
	$= 2\times\frac{22}{7}\times 8\times 17$	$\frac{1}{2}$
	= 854.85 cm^2	1
	SECTION D	
23.	Correct given, to prove, const, figure	$\frac{1}{2}\times 4=2$
	Correct proof	2
24.	Here, r_1 = 20 cm, r_2 = 8 cm, h = 16 cm	
	Volume of container = $\frac{1}{3}\times 3.14\times 16[400+64+160]$ cm^3	
	= 10449.92 cm^3.	1
	Capacity of container = 10.45 litre.	$\frac{1}{2}$

	Cost of milk = 10.45 × 40 = Rs. 418	$\frac{1}{2}$
	Now, $l = \sqrt{256+144} = 20\,\text{cm}$	$\frac{1}{2}$
	∴ Surface area of metal sheet used	
	= 3.14 × 20 × 28 + 3.14 × 64	
	= 3.14(560 + 64)	
	= 3.14 × 624 cm^2.	1
	Cost of Metal Sheet = $\frac{3.14 \times 624 \times 10}{100}$	
	= Rs. 195.94.	$\frac{1}{2}$
25.	Correct construction of two circles.	1
	Correct construction of tangents.	3
26.		

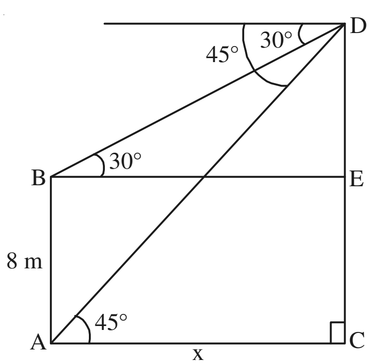
C.I.	x	f	fx	
0–20	10	5	50	
20–40	30	8	240	
40–60	50	x	50x	Correct Table 2
60–80	70	12	840	
80–100	90	7	630	
100–120	110	8	880	
		40 + x	2640 + 50x	

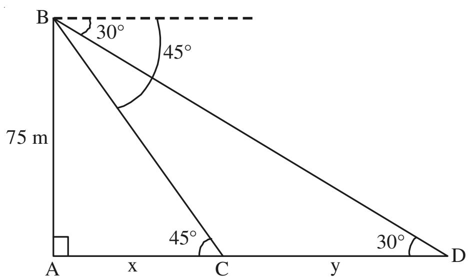
$$\bar{x} = \frac{2640 + 50x}{40 + x} = 62.8$$ 1

⇒ x = 10 1

27. $m = \frac{\sin x}{\sin y}$, $n = \frac{\tan x}{\tan y}$

$$m^2 - 1 = \frac{\sin^2 x - \sin^2 y}{\sin^2 y}$$ 1

	$n^2 - 1 = \dfrac{\tan^2 x - \tan^2 y}{\tan^2 y} = \dfrac{\sin^2 x \cos^2 y - \cos^2 x \sin^2 y}{\cos^2 x \times \cos^2 y} \times \dfrac{\cos^2 y}{\sin^2 y}$	
	$= \dfrac{\sin^2 x(1-\sin^2 y) - (1-\sin^2 x)\sin^2 y}{\cos^2 x \cdot \sin^2 y}$	
	$= \dfrac{\sin^2 x - \sin^2 y}{\cos^2 x \cdot \sin^2 y}$	2
	$\therefore \dfrac{m^2-1}{n^2-1} = \cos^2 x$	1
	OR	
	$x \sin^3 \theta + y \cos^3 \theta = \cos \theta \sin \theta$ and $x \sin \theta = y \cos \theta$	
	Substituting $x \sin \theta = y \cos \theta$, we get	
	$\sin^2 \theta(y \cos \theta) + y \cos^3 \theta = \sin \theta \cos \theta$	1
	$\Rightarrow y \cos \theta(\sin^2 \theta + \cos^2 \theta) = \sin \theta \cos \theta$	$\frac{1}{2}$
	$\Rightarrow y \cos \theta = \sin \theta \cos \theta$	1
	$\Rightarrow y = \sin \theta$	$\frac{1}{2}$
	Hence $x = \cos \theta$	$\frac{1}{2}$
	Squaring and adding $x^2 + y^2 = 1$	$\frac{1}{2}$
28.	 Correct figure	1
	Let AB be the building and CD be the tower of height h	
	$\therefore$ CE = 8 m and DE = (h – 8) m	
	Taking ΔACD, $\tan 45° = \dfrac{h}{x} \Rightarrow 1 = \dfrac{h}{x} \Rightarrow h = x$	1
	Taking ΔDEB	
	$\tan 30° = \dfrac{h-8}{x} \Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{h-8}{x} \Rightarrow \dfrac{x}{\sqrt{3}} = h - 8$	1

	Hence, $\frac{h}{\sqrt{3}} = h - 8$ or $h(\sqrt{3}-1) = 8\sqrt{3}$	
	$\Rightarrow h = \left(\frac{8\sqrt{3}}{\sqrt{3}-1}\right)$ m or $12 + 4\sqrt{3}$ m	1
	Height of the tower is $(12+4\sqrt{3})$ m	
	OR	
	 Correct figure	1
	Let AB be the light house and C and D are positions of the two ships	
	Taking ΔBAC	
	$\tan 45° = \frac{75}{x} \Rightarrow 1 = \frac{75}{x} \Rightarrow x = 75$ m	1
	Taking ΔBAD, $\tan 30° = \frac{75}{x+y} \Rightarrow \frac{1}{\sqrt{3}} = \frac{75}{x+y}$	
	$\Rightarrow x + y = 75\sqrt{3}$	1
	Hence, $y = 75\sqrt{3} - 75 = 75(\sqrt{3}-1)$	1
	Distance between two ships = $75(\sqrt{3}-1)$ m	
29.	$\frac{1}{x+1} + \frac{2}{x+2} = \frac{7}{x+5}$	
	$\Rightarrow \frac{(x+2)+2(x+1)}{(x+1)(x+2)} = \frac{7}{x+5}$	1
	$\Rightarrow 2x^2 + x - 3 = 0$	1
	$\Rightarrow (x-1)(2x+3) = 0$	1
	$\Rightarrow x = 1$ or $x = -\frac{3}{2}$	$\frac{1}{2}+\frac{1}{2}$
30.	$a_m = \frac{1}{n} \Rightarrow a + (m-1)d = \frac{1}{n}$ ...(1)	$\frac{1}{2}$
	$a_n = \frac{1}{m} \Rightarrow a + (n-1)d = \frac{1}{m}$ ...(2)	$\frac{1}{2}$

	Solving (1) and (2), $d = \frac{1}{mn}, a = \frac{1}{mn}$	1+1
	Hence $a_{mn} = a + (mn - 1)d$	
	$= \frac{1}{mn} + (mn - 1) \times \frac{1}{mn}$	
	$= 1$	1
	OR	
	Numbers are 1, 3, 5, 7, ..., 49.	1
	$a = 1, d = 2, a_n = 49$	1
	$\therefore$ $49 = 1 + 2(n - 1)$	
	$\Rightarrow$ $n = 25$	1
	Hence $S_{25} = \frac{25}{2}(1 + 49)$	
	$= 625$	1

QUESTION PAPER CODE 30/1/3

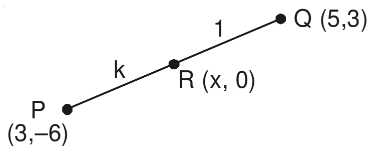
EXPECTED ANSWER/VALUE POINTS

SECTION A

1. $-41 = 10 + (n-1)(-3)$ $\frac{1}{2}$

$\Rightarrow n = 18$ $\frac{1}{2}$

2.



Let the point of division be (x, 0)

$\frac{3k-6}{k+1} = 0 \Rightarrow k = 2$ $\frac{1}{2}$

Required ratio is 2 : 1. $\frac{1}{2}$

3. LCM = 9 × HCF $\frac{1}{2}$

HCF = 50 $\frac{1}{2}$

4. AE : EF = 3 : 7 $\frac{1}{2}$

AE : AF = 3 : 10 $\frac{1}{2}$

5. $D = 9a^2 - 36 = 0$ $\frac{1}{2}$

$\Rightarrow a = \pm 2$ $\frac{1}{2}$

OR

$2\left(-\frac{1}{3}\right)^2 + 2\left(-\frac{1}{3}\right) + k = 0$ $\frac{1}{2}$

$\Rightarrow k = \frac{4}{9}$ $\frac{1}{2}$

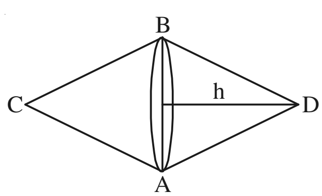
6. $\cot 54° = \tan 36°$ $\frac{1}{2}$

$\therefore \frac{\tan 36°}{\cot 54°} = 1$ $\frac{1}{2}$

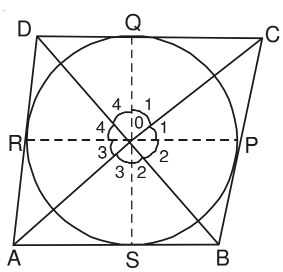
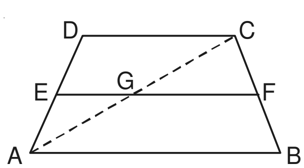
	OR	
	$\text{cosec}^2 \theta \times \sin^2 \theta = k$	$\frac{1}{2}$
	$\Rightarrow k = 1$	$\frac{1}{2}$
	SECTION B	
7.	$\sqrt{(x-7)^2+(y-1)^2} = \sqrt{(x-3)^2+(y-5)^2}$	$\frac{1}{2}$
	$\Rightarrow x^2+49-14x+y^2+1-2y = x^2+9-6x+y^2+25-10y$	1
	$\Rightarrow -x + y + 2 = 0$	$\frac{1}{2}$
8.	Substituting x = 3, y = 1	
	$3 - 4 + p = 0,\ 6 + 1 - q - 2 = 0$	$\frac{1}{2}+\frac{1}{2}$
	$\Rightarrow p = 1,\ q = 5$	$\frac{1}{2}+\frac{1}{2}$
	Hence, q = 5p or any other valid relation.	
9.	Total number of possible outcomes = 36.	
	(i) Favourable outcomes: (2, 2) (2, 4), (2, 6) (4, 2) (4, 4) (4, 6) (6, 2) (6, 4) (6, 6): 9 outcomes	
	P(getting even no. on each die) = $\frac{9}{36}$ or $\frac{1}{4}$	1
	(ii) Favourable outcomes: (3, 6) (4, 5) (5, 4) (6, 3): 4 outcomes.	
	P(getting a total of 9) = $\frac{4}{36}$ or $\frac{1}{9}$	1
10.	Total number of balls = 6x	1
	(i) P (selected ball is not red) = $\frac{3x}{6x}$ or $\frac{1}{2}$	1
	(ii) P (selected ball is white) = $\frac{x}{6x}$ or $\frac{1}{6}$	1
11.	Let $\frac{3+\sqrt{7}}{5}$ be a rational number	$\frac{1}{2}$

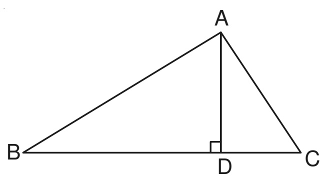
	$\frac{3+\sqrt{7}}{5} = \frac{p}{q}$, q ≠ 0	
	$\Rightarrow \sqrt{7} = \frac{5p-3q}{q}$	$\frac{1}{2}$
	RHS is a rational no. whereas LHS is an irrational number which is wrong.	$\frac{1}{2}$
	$\therefore \frac{3+\sqrt{7}}{5}$ is an irrational number.	$\frac{1}{2}$
	OR	
	$n^2 + n = n(n + 1)$ which is product of two concecutive natural numbers.	1
	Hence, one of them has to be an even number.	
	$\therefore$ n(n + 1) is always divisible by 2.	1
12.	$a = 7, d = 3, 46 = 7 + (n - 1) \times 3$	
	$\Rightarrow n = 14$	1
	$S_{14} = \frac{14}{2}(7+46) = 371$	1
	OR	
	$a + 8d = 0 \Rightarrow a = -8d$	$\frac{1}{2}$
	$a_{29} = a + 28d = 20d$	$\frac{1}{2}$
	$a_{19} = a + 18d = 10d$	$\frac{1}{2}$
	$\therefore a_{29} = 2 \times a_{19}$	$\frac{1}{2}$
	SECTION C	
13.	Let p(x) = $x^4 + 2x^3 - 17x^2 - 4x + 30$	
	$\because$ x = 3, –5 are zeroes of p(x)	
	$\therefore (x - 3)(x + 5) = x^2 + 2x - 15$ is a factor of p(x)	1
	On dividing p(x) by $(x^2 + 2x - 15)$,	
	quotient = $x^2 - 2$	

	$= (x-\sqrt{2})(x+\sqrt{2})$	1
	$\therefore$ Other zeroes are $x=\sqrt{2},-\sqrt{2}$	$\frac{1}{2}$
	All zeroes are $3,-5,\sqrt{2},-\sqrt{2}$	$\frac{1}{2}$
14.	For equal roots	
	$D = 36(k+1)^2 - 4(k+1)\times 3(k+9) = 0$	1
	$\Rightarrow 12(k+1)\,[3(k+1)-(k+9)] = 0$	$\frac{1}{2}$
	$\Rightarrow 12(k+1)\,(2k-6) = 0$	$\frac{1}{2}$
	$\Rightarrow k = -1, 3$	$\frac{1}{2}$
	Rejecting $k=-1$, $k=3$	$\frac{1}{2}$
15.	Let us take two positive integers a and b where b = 6	
	$\therefore$ Using Euclid's division Lemma	
	$a = 6q + r$, $r = 0, 1, 2, 3, 4, 5.$	1
	$\therefore$ $a = 6q$ – even integer	
	$a = 6q + 1$ – odd integer	
	$a = 6q + 2$ – even integer	
	$a = 6q + 3$ – odd integer	
	$a = 6q + 4$ – even integer	
	$a = 6q + 5$ – odd integer.	
	Hence, 6q + 1, 6q + 3, 6q + 5 are positive odd integers.	2
16.	$BC = \sqrt{6^2+8^2} = 10\,cm$	$\frac{1}{2}$
	Let A_1 = Area of semi-circle on diameter AB = $\frac{9\pi}{2}\,cm^2$	$\frac{1}{2}$
	A_2 = Area of semi-circle on diameter AC = $\frac{16\pi}{2}\,cm^2$	$\frac{1}{2}$

	A_3 = Area of semi-circle on diameter BC = $\frac{25\pi}{2}$ cm^2	$\frac{1}{2}$
	A_4 = Area of ΔABC = 24 cm^2	$\frac{1}{2}$
	Area of shaded region = $(A_1 + A_2 + A_4) - A_3$	
	$= \frac{9\pi}{2} + \frac{16\pi}{2} + 24 - \frac{25\pi}{2}$	
	= 24 cm^2	$\frac{1}{2}$
17.	r = $\frac{3}{2}$ m	$\frac{1}{2}$
	Volume of tank = $\frac{2}{3} \times \frac{22}{7} \times \frac{3}{2} \times \frac{3}{2} \times \frac{3}{2}$	
	$= \frac{99}{14}$ m^3	1
	Capacity of tank = $\frac{99}{14} \times 1000$ litre	$\frac{1}{2}$
	Time taken to empty the tank $= \frac{7}{25} \times \frac{99}{14} \times 1000$ sec.	
	= 1980 sec. or 33 minutes	1
	OR	
	 Diameter AB = 16 cm	
	$\therefore$ r = 8 cm	
	h = 15 cm	$\frac{1}{2}$
	$\therefore$ $l = \sqrt{64 + 225} = \sqrt{289} = 17$ cm	1
	Surface area of the shape formed $= 2\pi r l$	
	$= 2 \times \frac{22}{7} \times 8 \times 17$	$\frac{1}{2}$
	= 854.85 cm^2	1

18.	Modal class is 201-202	$\frac{1}{2}$
	$\therefore \quad l = 201,\ h = 1,\ f_1 = 26,\ f_0 = 12,\ f_2 = 20$	1
	$\therefore \quad \text{Mode} = 201 + \frac{26-12}{52-12-20} \times 1$	1
	$= 201 + \frac{7}{10}$	
	$= 201.7$	$\frac{1}{2}$
19.	AP : PB = 1 : 2 Let the pt P be (x_1, y_1)	$\frac{1}{2}$
	$x_1 = \frac{5+4}{3} = 3$	$\frac{1}{2}$
	$y_1 = \frac{-8+2}{3} = -2$	$\frac{1}{2}$
	$\because$ point P lies on $2x - y + k = 0$	
	$\Rightarrow 2x_1 - y_1 + k = 0$	$\frac{1}{2}$
	$\Rightarrow 6 + 2 = -k$	
	$\therefore k = -8$	1
	OR	
	Let A(a, a), B(–a, –a) and $C(-\sqrt{3}a, \sqrt{3}a)$ be vertices of ΔABC.	
	$AB = \sqrt{(a+a)^2 + (a+a)^2} = \sqrt{8a^2}$	1
	$BC = \sqrt{(-a+\sqrt{3}a)^2 + (-a-\sqrt{3}a)^2} = \sqrt{8a^2}$	1
	$CA = \sqrt{(a+\sqrt{3}a)^2 + (a-\sqrt{3}a)^2} = \sqrt{8a^2}$	$\frac{1}{2}$
	$\therefore$ AB = BC = CA	
	Hence, ΔABC is an equilateral triangle.	$\frac{1}{2}$
20.	$\text{LHS} = \frac{\tan A(1-\sec A) - \tan A(1+\sec A)}{1-\sec^2 A}$	1

	$= \dfrac{-2\tan A \sec A}{-\tan^2 A}$	1
	$= \dfrac{1}{\cos A} \times \dfrac{\cos A}{\sin A}$	
	$= \text{cosec } A = \text{RHS}.$	1
	OR	
	LHS	
	$= 1 + \dfrac{\text{cosec}^2\theta - 1}{1 + \text{cosec } \theta}$	1
	$= 1 + \dfrac{(\text{cosec } \theta - 1)(\text{cosec } \theta + 1)}{1 + \text{cosec } \theta}$	1
	$= 1 + \text{cosec } \theta - 1$	
	$= \text{cosec } \theta = \text{RHS}$	1
21.	 Correct Fig.	$\frac{1}{2}$
	$\Delta OCQ \cong \Delta OCP$ (SSS)	$\frac{1}{2}$
	$\angle COP = \angle COQ = \angle 1$ Similarly $\angle BOP = \angle BOS = \angle 2$ $\angle AOS = \angle AOR = \angle 3$ and $\angle DOR = \angle DOQ = \angle 4$	1
	Since $\angle DOC + \angle COB + \angle BOA + \angle AOD = 360°$	$\frac{1}{2}$
	$\Rightarrow 2(\angle 1 + \angle 2 + \angle 3 + \angle 4) = 180°$	
	Hence, $\angle AOB + \angle DOC = \angle BOC + \angle AOD = 180°$	$\frac{1}{2}$
22.	 Join AC.	$\frac{1}{2}$
	In ΔCAB, $GF \parallel AB \Rightarrow \dfrac{CG}{GA} = \dfrac{CF}{FB}$ ....(1)	1
	In ΔADC, $EG \parallel DC \Rightarrow \dfrac{AG}{GC} = \dfrac{AE}{ED}$ ....(2)	1

	Using (1) & (2)	
	$\frac{CF}{FB} = \frac{ED}{AE}$	
	$\Rightarrow \frac{AE}{ED} = \frac{BF}{FC}$	$\frac{1}{2}$
	OR	
		
	In ΔADC, $AD^2 = AC^2 - CD^2$ ...(1)	$\frac{1}{2}$
	In ΔADB, $AD^2 = AB^2 - BD^2$ ...(2)	$\frac{1}{2}$
	Also $BD = 3CD \Rightarrow CD = \frac{1}{4}BC$ ...(3)	$\frac{1}{2}$
	Using (1) and (2)	
	$AC^2 - CD^2 = AB^2 - BD^2$	$\frac{1}{2}$
	$\Rightarrow AB^2 = AC^2 - CD^2 + BD^2$	
	Using (3)	
	$AB^2 = AC^2 + \frac{BC^2}{2}$	
	$\Rightarrow 2AB^2 = 2AC^2 + BC^2$	1
	SECTION D	
23.	Correct given, to prove, fig., construction	$\frac{1}{2} \times 4 = 2$
	Correct proof	2
24.	Let the speed of the stream be x km/hr.	
	According to the question	
	$\frac{36}{18-x} - \frac{36}{18+x} = \frac{3}{2}$	2
	$\Rightarrow x^2 + 48x - 324 = 0$	1
	$\Rightarrow (x + 54)(x - 6) = 0$	
	$\Rightarrow x = 6, x \neq -54$	
	$\therefore$ Speed of stream = 6 km/hr.	1

25. Volume of earth dug out $= \pi \times \frac{9}{4} \times 14 \text{ m}^3$. — 1

Radii of circular ring formed $= 4 + \frac{3}{2}, \frac{3}{2} \text{ m} = \frac{11}{2} \text{ m}, \frac{3}{2} \text{ m}$ — $\frac{1}{2}$

Let height of embankment = h

$\therefore \quad \pi h\left(\frac{121}{4} - \frac{9}{4}\right) = \pi \times \frac{9}{4} \times 14$ — 2

$\Rightarrow \quad h = \frac{9}{8} \text{ m} \text{ or } 1\frac{1}{8} \text{ m}$ — $\frac{1}{2}$

26.

C.I.	x	f	fx
0–20	10	5	50
20–40	30	8	240
40–60	50	x	50x
60–80	70	12	840
80–100	90	7	630
100–120	110	8	880
		40 + x	2640 + 50x

Correct Table — 2

$\bar{x} = \frac{2640 + 50x}{40 + x} = 62.8$ — 1

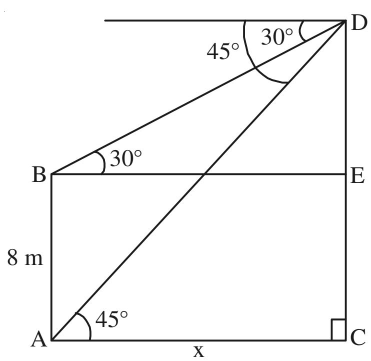
$\Rightarrow \quad x = 10$ — 1

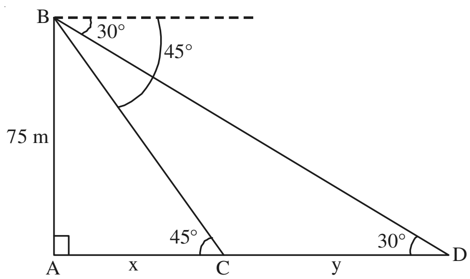
27. $m = \frac{\sin x}{\sin y}, \; n = \frac{\tan x}{\tan y}$

$m^2 - 1 = \frac{\sin^2 x - \sin^2 y}{\sin^2 y}$ — 1

$n^2 - 1 = \frac{\tan^2 x - \tan^2 y}{\tan^2 y} = \frac{\sin^2 x \cos^2 y - \cos^2 x \sin^2 y}{\cos^2 x \times \cos^2 y} \times \frac{\cos^2 y}{\sin^2 y}$

$= \frac{\sin^2 x(1 - \sin^2 y) - (1 - \sin^2 x)\sin^2 y}{\cos^2 x \cdot \sin^2 y}$

	$= \dfrac{\sin^2 x - \sin^2 y}{\cos^2 x \cdot \sin^2 y}$	2
	$\therefore \dfrac{m^2 - 1}{n^2 - 1} = \cos^2 x$	1
	OR	
	$x \sin^3 \theta + y \cos^3 \theta = \cos \theta \sin \theta$ and $x \sin \theta = y \cos \theta$	
	Substituting $x \sin \theta = y \cos \theta$, we get	
	$\sin^2 \theta(y \cos \theta) + y \cos^3 \theta = \sin \theta \cos \theta$	1
	$\Rightarrow \quad y \cos \theta(\sin^2 \theta + \cos^2 \theta) = \sin \theta \cos \theta$	$\frac{1}{2}$
	$\Rightarrow \quad y \cos \theta = \sin \theta \cos \theta$	1
	$\Rightarrow \quad y = \sin \theta$	$\frac{1}{2}$
	Hence $x = \cos \theta$	$\frac{1}{2}$
	Squaring and adding $x^2 + y^2 = 1$	$\frac{1}{2}$
28.	Correct Construction of circle and marking point A.	1
	Correct Construction of tangents.	3
29.	 Correct figure	1
	Let AB be the building and CD be the tower of height h	
	$\therefore$ CE = 8 m and DE = (h – 8) m	
	Taking ΔACD, $\tan 45° = \dfrac{h}{x} \Rightarrow 1 = \dfrac{h}{x} \Rightarrow h = x$	1
	Taking ΔDEB	
	$\tan 30° = \dfrac{h-8}{x} \Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{h-8}{x} \Rightarrow \dfrac{x}{\sqrt{3}} = h - 8$	1
	Hence, $\dfrac{h}{\sqrt{3}} = h - 8$ or $h(\sqrt{3} - 1) = 8\sqrt{3}$	

	$\Rightarrow h = \left(\frac{8\sqrt{3}}{\sqrt{3}-1}\right)$ m or $12+4\sqrt{3}$ m	1
	Height of the tower is $(12+4\sqrt{3})$ m	
	OR	
	 Correct figure	1
	Let AB be the light house and C and D are positions of the two ships	
	Taking ΔBAC	
	$\tan 45° = \frac{75}{x} \Rightarrow 1 = \frac{75}{x} \Rightarrow x = 75$ m	1
	Taking ΔBAD, $\tan 30° = \frac{75}{x+y} \Rightarrow \frac{1}{\sqrt{3}} = \frac{75}{x+y}$	
	$\Rightarrow x + y = 75\sqrt{3}$	1
	Hence, $y = 75\sqrt{3} - 75 = 75(\sqrt{3}-1)$	1
	Distance between two ships = $75(\sqrt{3}-1)$ m	
30.	$a_m = \frac{1}{n} \Rightarrow a + (m-1)d = \frac{1}{n}$ ...(1)	$\frac{1}{2}$
	$a_n = \frac{1}{m} \Rightarrow a + (n-1)d = \frac{1}{m}$ ...(2)	$\frac{1}{2}$
	Solving (1) and (2), $d = \frac{1}{mn}, a = \frac{1}{mn}$	1+1
	Hence $a_{mn} = a + (mn-1)d$	
	$= \frac{1}{mn} + (mn-1) \times \frac{1}{mn}$	
	$= 1$	1
	OR	
	Numbers are 1, 3, 5, 7, ..., 49.	1
	$a = 1, d = 2, a_n = 49$	1

	$\therefore \quad 49 = 1 + 2(n - 1)$	
	$\Rightarrow \quad n = 25$	1
	Hence $S_{25} = \frac{25}{2}(1+49)$	
	$= 625$	1