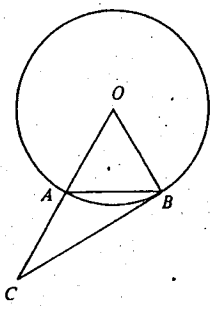
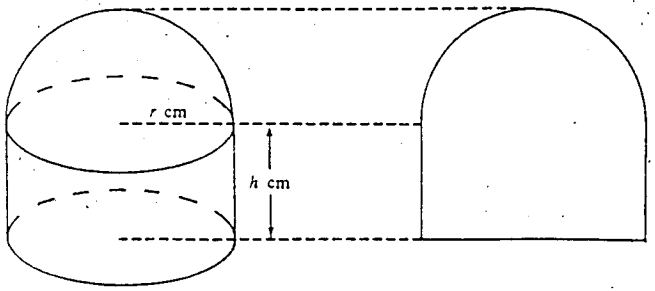
| SOLUTIONS STEPS | MARKS | NOTES |
|---|---|---|
| TION A | | |
| $(x^2 + 4x + 4) - (y - 1)^2$ | | |
| $= (x + 2)^2 - (y - 1)^2$ | 1A | For factorizing $x^2 + 4x + 4$. |
| $= [(x + 2) + (y - 1)][(x + 2) - (y - 1)]$ | 2M | |
| $= (x + y + 1)(x - y + 3)$ | 2A | |
| If a cand. wrote $(x+2)^2 - (y-1)^2=0$ etc, withhold last 2A. | | If equality signs omitted, -1 for pp. If "⇒" used, -1 for pp. |
| (a)   (a) Correct reason for $\angle ABC = 30°$. | 3M | Incomplete reason for $\angle ABC = 30°$. 1M or 2M |
| (b) Correct reason to establish CB is a tangent. | 2M | |
| (a) 54.5 | 1A | |
| (b) Mean $= \frac{44.5(100) + 54.5(300) + 64.5(400) + 74.5(200)}{1000}$ | 1M | For $\sum x_i f_i$ |
| | 1M | For dividing by 1000 |
| $= 61.5$ | 2A | Full marks for giving correct answer without any step. |



| SOLUTIONS STEPS | MARKS | NOTES |
|---|---|---|
| 4. (a) $a : b = 3 : 4 = 6 : 8$ | 1A | |
| $a : c = 2 : 5 = 6 : 15$ | 1A | |
| $a : b : c = 6 : 8 : 15$ | 1A | |
| (b) Let $\frac{a}{6} = \frac{b}{8} = \frac{c}{15} = k$ | | ALTERNATIVELY, $\frac{ac}{a^2 + b^2} = \frac{\frac{c}{a}}{1 + \frac{b^2}{a^2}}$ 2M |
| $\frac{ac}{a^2 + b^2} = \frac{(6k)(15k)}{6^2k^2 + 8^2k^2}$ | 2M | |
| $= 0.9$ | 1A | $= 0.9$ 1A |
| 5. (a) $OC = 30 - 15 = 15$ | 1A | |
| $\cos\angle AOC = \frac{15}{30}$ | 1M | This may be omitted provided OC is correct. |
| $\angle AOC = 60°$ or $\frac{\pi}{3}$ | 1A | Or any figure which rounded to 60. |
| (b) $\overset{\frown}{AB} = \frac{60}{360} \times 2\pi(30)$ or $30 \times \frac{\pi}{3}$ | 1M+1A | |
| $= 10\pi$ | 1A | Accept $9.9\pi$ to $10.1\pi$ |
| 6. $1000[(1.1)^3 - 1] = 1000 \times \frac{r}{100} \times 3$ | 2A+1A+1A | 2A for "=". 1A for R.S., 1A for L.S. |
| $1000[0.331] = 1000 \times \frac{r}{100} \times 3$ | | If a cand. wrote compound int.=$1000(1.1)^3, deduct 1 mark. If a cand. wrote simple interest = $1000(1+r%×3), deduct 1 mark. |
| $3r = 33.1$ | | |
| $r = 11.033\,3$ | 1A | Or any figure which rounded to 11.03. |
| $\approx 11.03$ | 1A | Accept 11.03%. |
| $2\cos^2\theta + 5\sin\theta + 1 = 0$ | | |
| $2(1 - \sin^2\theta) + 5\sin\theta + 1 = 0$ | 1M | For $\cos^2\theta = 1 - \sin^2\theta$ |
| $2\sin^2\theta - 5\sin\theta - 3 = 0$ | 1A | |
| $(2\sin\theta + 1)(\sin\theta - 3) = 0$ | | |
| $\sin\theta = 3$ or $-\frac{1}{2}$ | 1A | If a candidate wrote $\sin\theta = -\frac{1}{2}$ only, award 2 marks. |
| Rejecting $\sin\theta = 3$ | 1A | |
| $\theta = 210°$ or $330°$ | 1A+1A | Accept "$\theta = 210°, 330°$," or "$\theta = 210°$ and $330°$". |
| For answers in radian measure: $\theta = \frac{7\pi}{6}$ or $\frac{11\pi}{6}$ | | |
| (or any figure which rounded to 3.67 or 5.76) | | |
| If more than 2 answers given, deduct 1 mark for each wrong answer from the marks scored in the answer only. | | General solution, no marks. |

| SOLUTIONS STEPS | MARKS | NOTES |
|---|---|---|
| SECTION B | | |
| 8. (a) (3 marks) | | Write r:h = 3:2 only award 1 mark |
| Volume of hemisphere = $\frac{1}{2} \times \frac{4}{3}\pi r^3$ | 1A | |
| $\pi r^2 h = \frac{1}{2} \times \frac{4}{3}\pi r^3$ | 1A | |
| $2r = 3h$ | | |
| $r : h = 3 : 2$ | 1A | Accept $r : h = \frac{3}{2} : 1$ or $1 : \frac{2}{3}$ or $\frac{3}{2}$ or $\frac{r}{h} = \frac{3}{2}$ or 3 : 2 |
| 6 : 4 No mark | | |
| (b) (9 marks) | | |
| (i) Perimeter of section = $\pi r + 2h + 2r$ | 2A | |
| $\pi r + 2h + 2r = 136$ | 1M | For perimeter = 136 |
| $\pi r + \frac{4}{3} r + 2r = 136$ | 1M | For sub. $h = \frac{2}{3} r$ or sub. $r = \frac{3h}{2}$ |
| $r(\pi + \frac{4}{3} + 2) = 136$ | | |
| $r = \frac{136}{\pi + \frac{4}{3} + 2}$ | 1A | Or any figure which rounded to 21. |
| $\doteqdot 21$ | 1A | Accept r = 21 cm. |
| (ii) Total external surface area | | |
| $= 2\pi r^2 + 2\pi rh + \pi r^2$ | 2M | For 2 correct terms, award 1 mark. |
| $= 3\pi r^2 + 2\pi r \cdot \frac{2}{3} r$ | | |
| $= 3\pi r^2 + \frac{4}{3}\pi r^2$ | | |
| $= \frac{13}{3}\pi r^2$ | | |
| $\doteqdot 6000\ cm^2$ | 1A | Accept area = 6000. Accept area $\doteqdot$ 6000. For wrong unit, do not award this mark. |

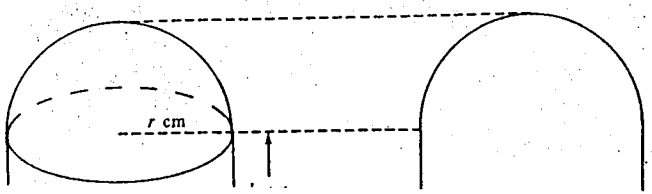







| SOLUTIONS STEPS | MARKS | NOTES |
|---|---|---|
| 9. For (a), (b), and (c), if a cand. mentioned $\angle ABC = 45°$ or $\angle ACB = 45°$ or $\angle ODC = 45°$, accept answers without any intermediate step. | | |
| (a) (2 marks) | | ALTERNATIVELY, |
| Let B = (h, 0) | | AB : $\frac{y - 2}{x - 8} = 1$ 1M |
| $\frac{2 - 0}{8 - h} = 1$ | 1M | $x - y - 6 = 0$ |
| $h = 6$ | 1A | When y = 0, x = 6, B = (6, 0) 1A |
| [Note: If a cand. wrote $\angle ABC = 45°$ only, award 1M.] | | |
| (b) (2 marks) | | ALTERNATIVELY, |
| Let C = (k, 0) | | By symmetry, C = (10, 0) 1M+1A |
| $(8 - k)^2 + (2 - 0)^2 = (8 - 6)^2 + (2 - 0)^2$ | 1M | |
| $(8 - k)^2 = 4$ | | |
| $8 - k = \pm 2$ | | |
| $k = 10$ or 6 | | |
| C = (10, 0) | 1A | |
| (c) (3 marks) | | |
| AC : $\frac{y - 0}{x - 10} = \frac{2 - 0}{8 - 10}$ | 1M | |
| $x + y - 10 = 0$ | 1A | |
| Put x = 0, y = 10, D = (0, 10) | 1A | |
| (d) (5 marks) | | |
| $\angle BOD = 90°$, ∴ BD is a diameter, Centre of circle = (3, 5) | 1A | |
| Radius = $\sqrt{3^2 + 5^2}$ | 1A | |
| Equation: $(x - 3)^2 + (y - 5)^2 = 34$ | 1M+1A | |
| ALTERNATIVELY, Let the equation of circle be $x^2 + y^2 + 2gx + 2fy + c = 0$, | 1M | |
| this passes through (0, 0), $c = 0$ | 1A | |
| this passes through (6, 0), $36 + 12g = 0$, $g = -3$ | 1A | |
| this passes through (0, 10), $100 + 20f = 0$, $f = -5$ | 1A | |
| Equation : $x^2 + y^2 - 6x - 10y = 0$ | | |

| SOLUTIONS STEPS | MARKS | NOTES |
|---|---|---|
| TION B | | |
| (a) (3 marks) | | With r : h = 3:2 only awarded 1 mark |
| Volume of hemisphere = $\frac{1}{2} \times \frac{4}{3}\pi r^3$ ——— | 1A | |
| $\pi r^2 h = \frac{1}{2} \times \frac{4}{3}\pi r^3$ ——— | 1A | |
| $2r = 3h$<br>$r : h = 3 : 2$ ——— | 1A | Accept $r : h = \frac{3}{2} : 1$<br>or $1 : \frac{2}{3}$ or $\frac{3}{2}$<br>or $\frac{r}{h} = \frac{3}{2}$ or 3 : 2 |
| 6 : 4 No mark | | |
| (b) (9 marks) | | |
| (i) Perimeter of section = $\pi r + 2h + 2r$ ——— | 2A | |
| $\pi r + 2h + 2r = 136$ ——— | 1M | For perimeter = 136 |
| $\pi r + \frac{4}{3} r + 2r = 136$ ——— | 1M | For sub. $h = \frac{2}{3} r$<br>or sub. $r = \frac{3h}{2}$ |
| $r(\pi + \frac{4}{3} + 2) = 136$ | | |
| $r = \frac{136}{\pi + \frac{4}{3} + 2}$ ——— | 1A | Or any figure which rounded to 21. |
| $\doteq 21$ ——— | 1A | Accept r = 21 cm. |
| (ii) Total external surface area | | |
| $= 2\pi r^2 + 2\pi rh + \pi r^2$ ——— | 2M | For 2 correct terms, award 1 mark. |
| $= 3\pi r^2 + 2\pi r \cdot \frac{2}{3} r$ | | |
| $= 3\pi r^2 + \frac{4}{3}\pi r^2$ | | |
| $= \frac{13}{3}\pi r^2$ | | Accept area ≒ 6000 |
| $\doteq 6000$ cm² ——— | 1A | Accept area ≒ 6000. For wrong unit, do not award this mark. |






| SOLUTIONS STEPS | MARKS | NOTES |
|---|---|---|
| ). If unit omitted in answer of any part, deduct at most 1 mark (NOT as pp) from answer. | | |
| (a) (3 marks) | | |
| Distance travelled = $(10 + 10 \times \frac{3}{4} \times 2)$ m ——— | 2A | |
| = 25 m ——— | 1A | |
| (b) (6 marks) | | |
| Distance travelled = | | |
| $\underset{\text{1M}}{10} + 2 \times 10 \times \frac{3}{4} + 2 \times 10 \times (\frac{3}{4})^2 + \ldots + 2 \times 10 \times (\frac{3}{4})^k$ | 1M+1M+1A | 1M For counting "10" once.<br>1M For counting some other terms twice |
| $= 10 + \frac{2 \times 10 \times \frac{3}{4}[1 - (\frac{3}{4})^k]}{1 - \frac{3}{4}}$ ——— | 1M | For $S_n = \frac{a(1 - r^n)}{1 - r}$ |
| $= 10 + 60[1 - (\frac{3}{4})^k]$ m ——— | 2A | |
| or $[70 - 60 (\frac{3}{4})^k]$ m<br>or $[70 - 80(\frac{3}{4})^{k+1}]$ m | | |
| (c) (3 marks) | | |
| Distance travelled | | |
| $10 + \frac{a}{1 - r}$ ——— | 1M+1M | 1M For "10";<br>1M For $\frac{a}{1 - r}$ |
| $= 10 + \frac{2 \times 10 \times \frac{3}{4}}{1 - \frac{3}{4}}$ | | |
| = 70 m ——— | 1A | |
| NOTE: | | |
| If a cand. wrote | | |
| Dist. travelled = $70 - 60(\frac{3}{4})^{k+1}$ or $80 - 60(\frac{3}{4})^k$ | | |
| in (b) and obtained 70 or 80 as answer in (c) by letting $k \to \infty$, award 2M. | | |

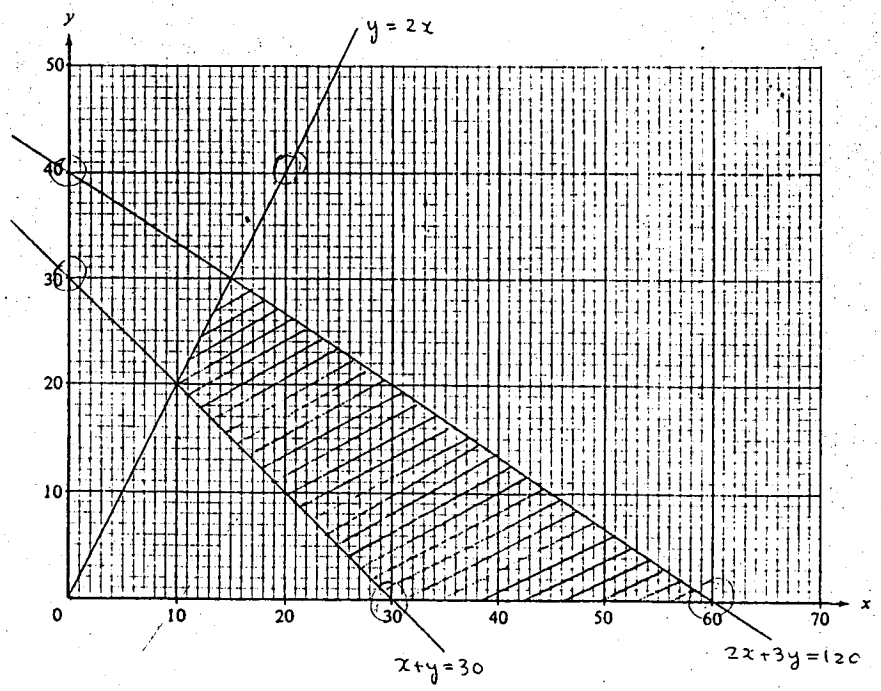
| SOLUTIONS STEPS | MARKS | NOTES |
|---|---|---|
| 11. (a) (3 marks) | | |
| Required probability = $(0.6)^3$ ——— (may be omitted) | 2A | |
| = 0.216 ——— | 1A | Accept $\frac{216}{1000}$ or $\frac{27}{125}$. |
| (b) (3 marks) | | |
| Probability of answering a question wrongly = 0.4 ——— | 1A | |
| Required probability = $(0.4)^3$ ——— | 1M | |
| = 0.064 ——— | 1A | Accept $\frac{8}{125}$ or $\frac{64}{1000}$. |
| (c) (4 marks) | | |
| Probability of answering Q.1 correctly but Q.2, Q.3 wrongly = $(0.6)(0.4)^2$ ——— | 2A | If $(0.6)(0.4)^2$ is given as the answer, award 2 marks. |
| Required Probability = $3\,(0.6)(0.4)^2$ ——— | 1M | |
| = 0.288 ——— | 1A | Accept $\frac{36}{125}$ or $\frac{288}{1000}$. |
| (d) (2 marks) | | |
| Required Probability = $3\,(0.6)^2\,0.4$ ——— | 1M | |
| = 0.432 ——— | 1A | Accept $\frac{54}{125}$ or $\frac{432}{1000}$. |
| ALTERNATIVELY, | | |
| Probability = 1 − 0.216 − 0.064 − 0.288 ——— | 1M | |
| = 0.432 ——— | 1A | |

NOTE:

If "required probability " or "P" omitted in all the four parts, deduct one mark as pp.



| SOLUTIONS STEPS | MARKS | NOTES |
|---|---|---|
| 12. (a) (3 marks) | | |
| Graphs of the 3 lines ——— | 1A+1A+1A | Labelling may be omitted. Accuracy of lines: accept deviation of 1 unit. |
| (b) (3 marks) | | |
| Correct region ——— | 3A | Award 3 or 0 marks. Accuracy of line : if deviation > 2 units, deduct 2 marks for ~~1 line~~ each extremity |
| (c) (6 marks) | | |
| (i) Testing optimization by either substituting (10, 20), (30, 0), (60, 0), (15, 30) in P or drawing the line $3x + 2y = k$ | 2M | If testing of some of the vertices omitted, award 1 mark. |
| Maximum of P = 180 ——— | 1A | |
| Minimum of P = 70 ——— | 1A | |
| (ii) If $x \leqslant 45$, | | |
| Maximum of P = 155 ——— | 1A | |
| Minimum of P = 70 ——— | 1A | |



| SOLUTIONS STEPS | MARKS | NOTES |
|---|---|---|
| (a) (6 marks) | | |
| For answer without unit, deduct 1 mark. | | |
| $AC = 50$ | 1A | may be in part (b) |
| In $\triangle BCH$, $\tan 30° = \frac{50}{BC}$ | 1M | |
| $BC = 50\sqrt{3}$ | 1A | Or any figure which lies between 86.6 to 87. |
| In $\triangle ABC$, $AB^2 = AC^2 + BC^2$ | 1M | For Pythagoras' Theorem |
| $= 50^2 + (50\sqrt{3})^2$ | 1M | |
| $= 10\,000$ | | |
| $AB = 100$ m | 1A | |
| (b) (6 marks) | | |
| Do not deduct marks for answers with no unit. | | |
| (i) Area of $\triangle ABC = \frac{1}{2}$ AC x BC | | |
| $= \frac{1}{2} \times 50(50\sqrt{3})$ | | |
| Area of $\triangle ABC = \frac{1}{2}(AB)(CP)$ | | |
| $= \frac{1}{2}(100)CP$ | | |
| $\frac{1}{2}(100)(CP) = \frac{1}{2}(50)(50)(\sqrt{3})$ | 2M | |
| $CP = 25\sqrt{3}$ | 1A | Or any figure which rounded to 43. |
| $= 43$ (m) | 1A | |
| ALTERNATIVELY, | | ALTERNATIVELY, |
| In $\triangle ABC$, | | |
| $\cos\angle A = \frac{50}{100}$ or $\tan\angle A = \frac{50\sqrt{3}}{50}$, $\sin\angle A = \frac{50\sqrt{3}}{100}$ | 1M | $\tan\angle B = \frac{50}{50\sqrt{3}}$, ... 1M |
| $\angle A = 60°$ | | $\angle B = 30°$ |
| In $\triangle CPA$, $\sin\angle A = \frac{CP}{AC}$ | 1M | In $\triangle CPB$, |
| $\sin 60° = \frac{CP}{50}$ | | $\sin\angle B = \frac{CP}{BC}$ — 1M |
| $CP = 50\frac{\sqrt{3}}{2}$ | | $CP = 25\sqrt{3}$ — 1A |
| | | $= 43$ — 1A |
| $= 25\sqrt{3}$ | 1A | Or any figure which rounded to 43. |
| $= 43$ (m) | 1A | |
| (ii) In $\triangle PCH$, $\tan\angle CPH = \frac{50}{25\sqrt{3}}$ | 1M | |
| $= \frac{2}{\sqrt{3}}$ | | |
| $\angle CPH = 49.106\,6°$ | | |
| $\approx 49°$ | 1A | |





| SOLUTIONS STEPS | MARKS | NOTES |
|---|---|---|
| 14. (a) (5 marks) | | |
| $\alpha + \beta = 2m$ | 1A | |
| $\alpha\beta = n$ | 1A | |
| (i) $(m - \alpha) + (m - \beta)$ | | |
| $= 2m - (\alpha + \beta)$ | | |
| $= 2m - 2m$ | | |
| $= 0$ | 1A | |
| (ii) $(m - \alpha) \times (m - \beta)$ | | |
| $= m^2 - (\alpha + \beta)m + \alpha\beta$ | 1M | |
| $= m^2 - 2m^2 + n$ | | |
| $= -m^2 + n$ | 1A | |
| (b) (3 marks) | | may be omitted |
| The equation is $[x-(m-\alpha)][x-(m-\beta)] = 0$ | 1M | Or $x^2$ - (sum of roots)x + (prod. of roots) = 0 |
| $x^2 - [(m - \alpha) + (m - \beta)]x + (m - \alpha)(m - \beta) = 0$ | 1M | |
| $x^2 - m^2 + n = 0$ | 1A | |
| (c) (4 marks) | | |
| $n = 4$ | | |
| For real roots, $4m^2 - 16 \geq 0$ | 1M+1A | 1M for $\Delta \geq 0$ |
| $m^2 - 4 \geq 0$ | | |
| $m \geq 2$ or $m \leq -2$ | 2A | If a cand. wrote $m > 2$ or $m < -2$, award 1 mark. |