$2\frac{1}{2}$ jam

MAKTAB RENDAH SAINS MARA

PEPERIKSAAN AKHIR SIJIL PENDIDIKAN MRSM 2019

MATEMATIK TAMBAHAN

Kertas 2

Dua jam tiga puluh minit

JANGAN BUKA KERTAS PEPERIKSAAN INI SEHINGGA DIBERITAHU

1. *Kertas peperiksaan ini adalah dalam dwibahasa.*
2. *Soalan dalam bahasa Inggeris mendahului soalan yang sepadan dalam bahasa Melayu.*
3. *Calon dikehendaki membaca maklumat di halaman belakang Kertas peperiksaan ini.*
4. *Calon dikehendaki menceraikan halaman* **27** *dan ikat sebagai muka hadapan bersama-sama dengan buku jawapan.*

Kertas peperiksaan ini mengandungi 28 halaman bercetak.

The following formulae may be helpful in answering the questions. The symbols given are the ones commonly used.

Rumus-rumus berikut boleh membantu anda menjawab soalan. Simbol-simbol yang diberi adalah yang biasa digunakan.

ALGEBRA

1 $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

2 $a^m \times a^n = a^{m+n}$

3 $a^m \div a^n = a^{m-n}$

4 $(a^m)^n = a^{mn}$

5 $\log_a mn = \log_a m + \log_a n$

6 $\log_a \dfrac{m}{n} = \log_a m - \log_a n$

7 $\log_a m^n = n \log_a m$

8 $\log_a b = \dfrac{\log_c b}{\log_c a}$

9 $T_n = a + (n-1)d$

10 $S_n = \dfrac{n}{2}[2a + (n-1)d]$

11 $T_n = ar^{n-1}$

12 $S_n = \dfrac{a(r^n - 1)}{r - 1} = \dfrac{a(1 - r^n)}{1 - r}, r \neq 1$

13 $S_\infty = \dfrac{a}{1 - r}, |r| < 1$

CALCULUS
KALKULUS

1 $y = uv, \dfrac{dy}{dx} = u\dfrac{dv}{dx} + v\dfrac{du}{dx}$

2 $y = \dfrac{u}{v}, \dfrac{dy}{dx} = \dfrac{v\dfrac{du}{dx} - u\dfrac{dv}{dx}}{v^2}$

3 $\dfrac{dy}{dx} = \dfrac{dy}{du} \times \dfrac{du}{dx}$

4 Area under a curve

Luas di bawah lengkung

$= \int_a^b y\,dx$ or (*atau*)

$= \int_a^b x\,dy$

5 Volume of revolution

Isi padu kisaran

$= \int_a^b \pi y^2\,dx$ or (*atau*)

$= \int_a^b \pi x^2\,dy$

STATISTICS
STATISTIK

1 $\bar{x} = \dfrac{\sum x}{N}$

2 $\bar{x} = \dfrac{\sum fx}{\sum f}$

3 $\sigma = \sqrt{\dfrac{\sum (x-\bar{x})^2}{N}} = \sqrt{\dfrac{\sum x^2}{N} - \bar{x}^2}$

4 $\sigma = \sqrt{\dfrac{\sum f(x-\bar{x})^2}{\sum f}} = \sqrt{\dfrac{\sum fx^2}{\sum f} - \bar{x}^2}$

5 $m = L + \left(\dfrac{\frac{1}{2}N - F}{f_m} \right) C$

6 $I = \dfrac{Q_1}{Q_0} \times 100$

7 $\bar{I} = \dfrac{\sum W_i I_i}{\sum W_i}$

8 ${}^nP_r = \dfrac{n!}{(n-r)!}$

9 ${}^nC_r = \dfrac{n!}{(n-r)!r!}$

10 $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

11 $P(X = r) = {}^nC_r \, p^r \, q^{n-r}, \; p + q = 1$

12 Mean / *Min* , $\mu = np$

13 $\sigma = \sqrt{npq}$

14 $Z = \dfrac{X - \mu}{\sigma}$

GEOMETRY
GEOMETRI

1 Distance / *Jarak*

$= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

2 Midpoint / *Titik tengah*

$(x, y) = \left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2} \right)$

3 A point dividing a segment of a line
Titik yang membahagi suatu tembereng garis

$(x, y) = \left(\dfrac{nx_1 + mx_2}{m+n}, \dfrac{ny_1 + my_2}{m+n} \right)$

4 Area of triangle / *Luas segi tiga*

$= \dfrac{1}{2} \left| (x_1 y_2 + x_2 y_3 + x_3 y_1) - (x_2 y_1 + x_3 y_2 + x_1 y_3) \right|$

5 $|\underline{\mathbf{r}}| = \sqrt{x^2 + y^2}$

6 $\hat{\underline{\mathbf{r}}} = \dfrac{x\underline{i} + y\underline{j}}{\sqrt{x^2 + y^2}}$

[Lihat halaman sebelah

TRIGONOMETRY
TRIGONOMETRI

1 Arc length, $s = r\theta$

Panjang lengkok, $s = j\theta$

2 Area of sector, $A = \frac{1}{2} r^2 \theta$

Luas sektor, $L = \frac{1}{2} j^2 \theta$

3 $\sin^2 A + \cos^2 A = 1$
$\sin^2 A + \text{kos}^2 A = 1$

4 $\sec^2 A = 1 + \tan^2 A$

$\text{sek}^2 A = 1 + \tan^2 A$

5 $\text{cosec}^2 A = 1 + \cot^2 A$

$\text{kosek}^2 A = 1 + \text{kot}^2 A$

6 $\sin 2A = 2 \sin A \cos A$
$\sin 2A = 2 \sin A \text{ kos } A$

7 $\cos 2A = \cos^2 A - \sin^2 A$
$= 2\cos^2 A - 1$
$= 1 - 2\sin^2 A$

$\text{kos } 2A = \text{kos}^2 A - \sin^2 A$
$= 2\,\text{kos}^2 A - 1$
$= 1 - 2\sin^2 A$

8 $\tan 2A = \frac{2\tan A}{1 - \tan^2 A}$

9 $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$

$\sin(A \pm B) = \sin A \text{ kos } B \pm \text{kos } A \sin B \tan 2A$

10 $\cos(A \pm B) = \cos A \text{ kos } B \mp \sin A \sin B$
$\text{kos}(A \pm B) = \text{kos } A \text{ kos } B \mp \sin A \sin B$

11 $\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$

12 $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

13 $a^2 = b^2 + c^2 - 2bc\cos A$
$a^2 = b^2 + c^2 - 2bc\,\text{kos } A$

14 Area of triangle / *Luas segi tiga*
$= \frac{1}{2} ab \sin C$

Section A
Bahagian A

[40 *marks*]
[40 *markah*]

Answer **all** questions.
Jawab **semua** *soalan.*

1 (*a*) Sketch the graph of $y = 1 - 2\tan x$ for $0 \le x \le 2\pi$. [3 *marks*]

Lakarkan graf bagi $y = 1 - 2\tan x$ *untuk* $0 \le x \le 2\pi$. [3 *markah*]

(*b*) Hence, using the same axes, sketch a suitable straight line to find the number of solutions for the equation $2\pi \tan x = -x$.

State the number of solutions. [3 *marks*]

Seterusnya, dengan menggunakan paksi yang sama, lakar satu garis lurus yang sesuai untuk mencari bilangan penyelesaian bagi persamaan $2\pi \tan x = -x$.

Nyatakan bilangan penyelesaian itu. [3 *markah*]

2 Solve the equation

Selesaikan persamaan

$$\log_9 x^2 - \log_3 (x-4) = \log_3 5.$$

[5 *marks*]
[5 *markah*]

3 Diagram 1 shows a plan of 5 terraced houses to be built on Encik Azman's land.

Rajah 1 *menunjukkan pelan bagi* 5 *buah rumah teres yang akan dibina di atas tanah Encik Azman.*

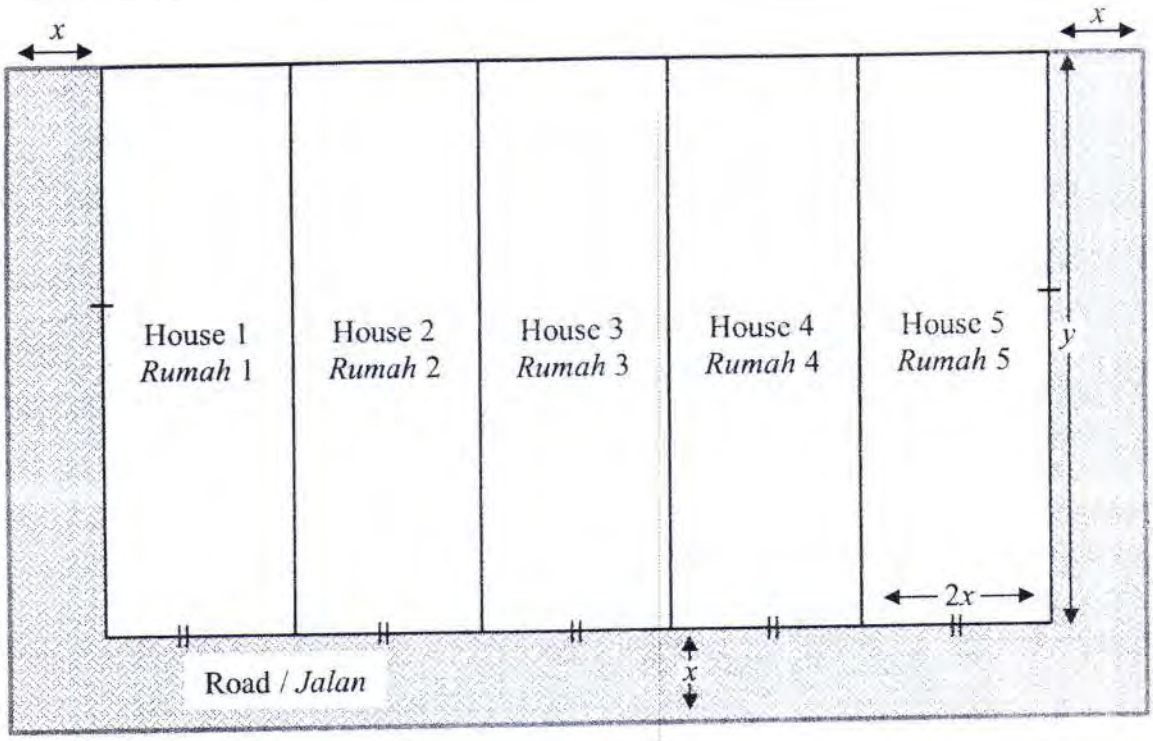


Diagram 1
Rajah 1

The perimeter of the whole 5 houses is 160 metre. He allocated an area of 600 metre^2 to construct a road in front of the houses and on both sides of the end lot as in Diagram 1. The width of the road is x metre.

Find the length and width, in metre, of each house. [6 *marks*]

Perimeter kesemua 5 *buah rumah ialah* 160 *meter. Dia memperuntukkan luas sebanyak* 600 *meter*^{2} *untuk membina jalan di hadapan dan kedua-dua sisi rumah lot hujung seperti Rajah* 1. *Lebar jalan ialah* x *meter.*

Cari panjang dan lebar, dalam meter, setiap rumah. [6 *markah*]

4 Diagram 2 shows a parallelogram $PQRS$. The straight line PT intersects with the straight line SR at point U.

Rajah 2 menunjukkan sebuah segi empat selari PQRS. Garis lurus PT bersilang dengan garis lurus SR di titik U.

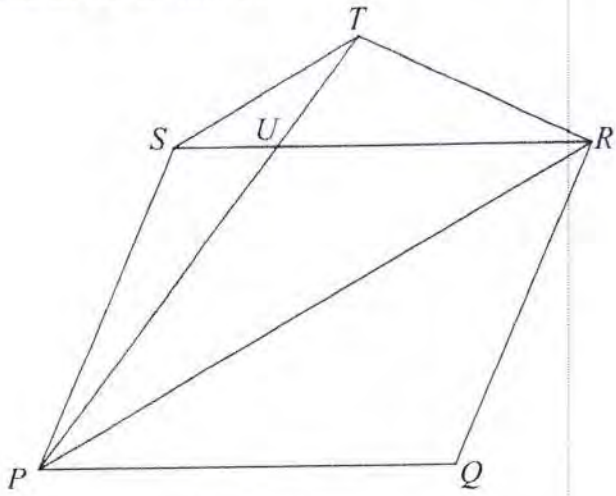


Diagram 2
Rajah 2

It is given that $\overrightarrow{PQ} = 8\underline{p}$, $\overrightarrow{PS} = 2\underline{q}$ and $\overrightarrow{SU} = \frac{1}{4}\overrightarrow{SR}$.

Diberi bahawa $\overrightarrow{PQ} = 8\underline{p}$, $\overrightarrow{PS} = 2\underline{q}$ *dan* $\overrightarrow{SU} = \frac{1}{4}\overrightarrow{SR}$.

(*a*) Express in terms of $\underline{p}$ and / or $\underline{q}$:

Ungkapkan dalam sebutan $\underline{p}$ *dan / atau* $\underline{q}$:

(i) $\overrightarrow{SU}$,

(ii) $\overrightarrow{PR}$.

[3 *marks*]
[3 *markah*]

(*b*) Given $\overrightarrow{PT} = m\overrightarrow{PU}$, where m is a constant, express $\overrightarrow{ST}$ in terms of m, p and q.

Diberi $\overrightarrow{PT} = m\overrightarrow{PU}$, *dengan keadaan m ialah pemalar, ungkapkan* $\overrightarrow{ST}$ *dalam sebutan m, p dan q.*

[1 *mark*]
[1 *markah*]

(*c*) Given $PRTS$ is a trapezium, find the value of m.

Diberi PRTS adalah trapezium, cari nilai m.

[4 *marks*]
[4 *markah*]

[Lihat halaman sebelah

5 Diagram 3 shows pictures of a manufacturer, a retailer and a customer. The handbags produced by the manufacturer will be sent to retailer before selling them to customers.

Rajah 3 *menunjukkan gambar-gambar pengilang, peruncit dan pelanggan. Beg tangan yang telah dihasilkan oleh pengilang akan dihantar kepada peruncit sebelum dijual kepada pelanggan.*

Manufacturer *Pengilang* | Retailer *Peruncit* | Customer *Pelanggan*

Diagram 3
Rajah 3

During a sales promotion, the manufacturer offers a RM75 rebate from RMx to the retailer. While the retailer offers a 5% discount from RMx to the customers.

Semasa promosi jualan, pengilang menawarkan rebat RM75 *daripada* RMx *kepada peruncit. Manakala peruncit pula menawarkan diskaun* 5 % *daripada* RMx *kepada pelanggan.*

(*a*) Find the price that the customer has to pay for a handbag in terms of x. [3 *marks*]

Cari harga yang perlu pelanggan bayar untuk sebuah beg tangan dalam sebutan x. [3 *markah*]

(*b*) If a customer buys a new handbag at the price of RM 499.90,

Jika pelanggan membeli beg tangan baharu dengan harga RM 499.90,

(i) find the price from the manufacturer,

cari harga dari pengilang,

(ii) calculate the profit gained by the retailer.

hitung keuntungan yang diperoleh oleh peruncit.

[4 *marks*]
[4 *markah*]

6 Diagram 4 shows an open container in the shape of half cylinder with wood supports. The radius of each semicircle is r metre and the length of the container is p metre.

Rajah 4 menunjukkan sebuah bekas terbuka berbentuk separuh silinder dengan kayu penyokong. Jejari setiap semibulatan ialah r meter dan panjang bekas ialah p meter.

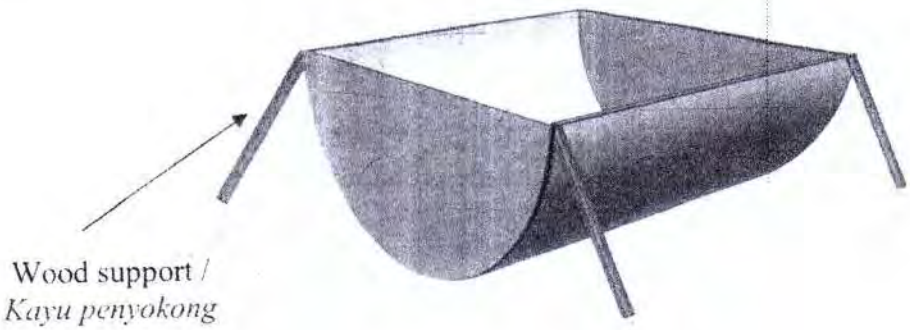


Diagram 4
Rajah 4

It is given that 160 metre^2 of thin metal sheet is used to build the container.

Diberi bahawa 160 meter^2 kepingan besi nipis digunakan untuk membina bekas tersebut.

(*a*) Show that the volume, V metre^3, of the container is given by

Tunjukkan bahawa isipadu, V meter^3, bekas diberi oleh

$$V = 80r - \frac{\pi r^3}{2}$$

[3 *marks*]
[3 *markah*]

(*b*) If the container is completely filled with water, find the volume, in metre^3, of the water.

Jika bekas tersebut diisi sepenuhnya dengan air, cari isipadu, dalam meter^3, air tersebut.

[5 *marks*]
[5 *markah*]

Section B
Bahagian B

[40 *marks*]
[40 *markah*]

Answer any **four** questions from this section.
Jawab mana-mana **empat** *soalan daripada bahagian ini.*

7 (*a*) A box contains two types of oranges, M and N in the ratio of 3 : 4. If 7 oranges are picked at random from the box, find the probability that

Sebuah kotak mengandungi dua jenis oren, M dan N dengan nisbah 3 : 4. *Jika* 7 *biji oren dipilih secara rawak daripada kotak itu, cari kebarangkalian bahawa*

(i) 6 chosen oranges are type N,

6 *biji oren yang dipilih adalah jenis* N,

(ii) at least 2 oranges of type M are picked.

sekurang-kurangnya 2 *biji oren jenis* M *dipilih.*

[5 *marks*]
[5 *markah*]

(*b*) The time taken to answer the formative test of Additional Mathematics Form 5 follows a normal distribution with a mean of 90 minutes and a standard deviation of 12 minutes.

Masa yang diambil untuk menjawab ujian formatif Matematik Tambahan Tingkatan 5 mengikut taburan normal dengan min 90 *minit dan sisihan piawai* 12 *minit.*

(i) If a student is randomly selected, find the probability that he takes less than 81 minutes or more than 108 minutes to answer the test.

Jika seorang pelajar dipilih secara rawak, cari kebarangkalian bahawa pelajar tersebut mengambil masa kurang daripada 81 *minit atau lebih daripada* 108 *minit untuk menjawab ujian tersebut.*

(ii) It is found that 5% of students take less than t minutes to answer the test, find the value of t.

Didapati bahawa 5% *daripada pelajar itu mengambil masa kurang daripada t minit untuk menjawab ujian tersebut, cari nilai t.*

[5 *marks*]
[5 *markah*]

8 Diagram 5 shows a straight line DP which is normal to the curve at point $P(4, 12)$.

Rajah 5 menunjukkan garis lurus DP yang merupakan normal kepada lengkung pada titik $P(4, 12)$.

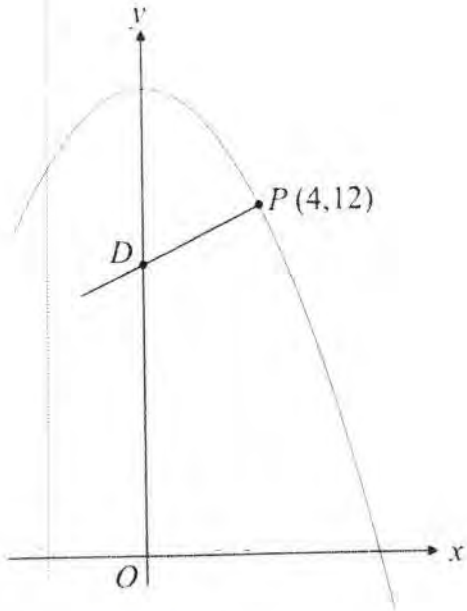


Diagram 5
Rajah 5

The gradient function of the curve is $-\frac{1}{2}x$.

Fungsi kecerunan bagi lengkung tersebut ialah $-\frac{1}{2}x$.

(*a*) Find

Cari

(i) the y-coordinate of point D,

koordinat y bagi titik D,

(ii) the equation of the curve.

persamaan lengkung tersebut.

[6 *marks*]
[6 *markah*]

(*b*) The volume generated when the region bounded by the curve, the y-axis and the straight line $y = k$ is revolved through $360°$ about the y-axis is 50π unit^3.
Find the value of k.

[4 *marks*]

Isipadu yang dijanakan apabila rantau yang dibatasi oleh lengkung, paksi-y dan garis lurus $y = k$ dikisarkan melalui $360°$ pada paksi-y ialah 50π unit^3.
Cari nilai k.

[4 *markah*]

[Lihat halaman sebelah

9 Solution by scale drawing is not accepted.

Penyelesaian secara lukisan berskala tidak diterima.

Diagram 6 shows a triangle ABC.

Rajah 6 menunjukkan segi tiga ABC.

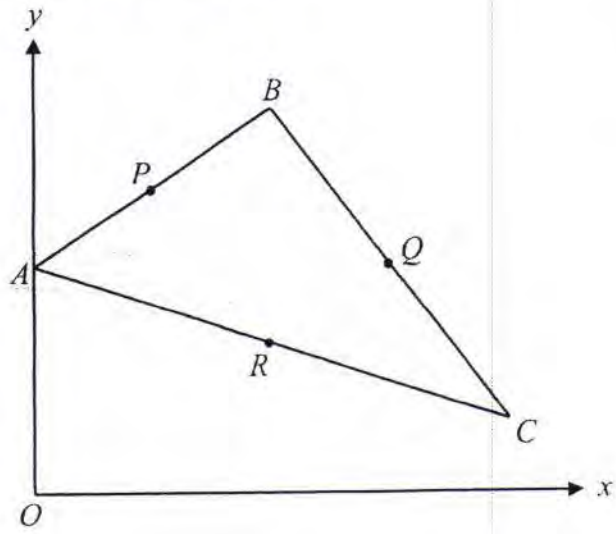


Diagram 6
Rajah 6

The points $P(3, 8)$, $Q(9, 6)$ and $R(6, 4)$ are midpoints of straight lines AB, BC and AC respectively, such that $APQR$ forms a parallelogram. The straight line AB intersects the y-axis at point A and the equation of straight line AB is $3y = 2x + 18$.

Titik-titik $P(3, 8)$, $Q(9, 6)$ dan $R(6, 4)$ masing-masing adalah titik tengah garis lurus AB, BC dan AC, di mana APQR membentuk sebuah segi empat selari. Garis lurus AB menyilang paksi-y di titik A dan persamaan garis lurus AB ialah $3y = 2x + 18$.

(*a*) Straight line AB is extended until it intersects with the perpendicular bisector of straight line AC at point M.

Garis lurus AB dipanjangkan sehingga bersilang dengan pembahagi dua sama serenjang garis lurus AC pada titik M.

Find

Cari

(i) the equation of the perpendicular bisector of straight line AC,

persamaan pembahagi dua sama serenjang garis lurus AC,

(ii) the coordinates of M.

koordinat M.

[5 *marks*]
[5 *markah*]

(*b*) If the straight line AQ is extended to a point G such that $AQ : QG = 2 : 3$, find the coordinates of G. [2 *marks*]

Jika garis lurus AQ dipanjangkan ke titik G dengan keadaan $AQ : QG = 2 : 3$, *cari koordinat G.* [2 *markah*]

(*c*) Calculate the area of the triangle AGC. [3 *marks*]

Hitung luas segi tiga AGC. [3 *markah*]

10 Use the graph paper provided on page **23** to answer this question. Detach the graph paper and tie together with your answer booklet.

Gunakan kertas graf yang disediakan pada halaman **23** *untuk menjawab soalan ini. Ceraikan kertas graf itu dan ikat bersama-sama buku jawapan anda.*

Table 1 shows the values of two variables, x and y, obtained from an experiment. Variable x and y are related by the equation $y = rx^2 + \frac{s}{x}$, where r and s are constants.

Jadual 1 *menunjukkan nilai-nilai bagi dua pembolehubah,* x *dan* y *yang diperoleh daripada satu eksperimen. Pembolehubah* x *dan pembolehubah* y *dihubungkan oleh persamaan* $y = rx^2 + \frac{s}{x}$, *dengan keadaan* r *dan* s *ialah pemalar.*

x	0·82	1.00	1·15	1·30	1·45	1·54
y	106·10	80.00	63·48	48·46	35·17	27·27

Table 1
Jadual 1

(*a*) Plot xy against x^3, by using a scale of 2 cm to 0·5 unit on the x^3-axis and 2 cm to 10 units on the xy-axis. Hence, draw the line of best fit. [5 *marks*]

Plot xy *melawan* x^3, *dengan menggunakan skala* 2 cm *kepada* 0.5 *unit pada paksi-*x^3 *dan* 2 cm *kepada* 10 *unit pada paksi-*xy. *Seterusnya, lukis graf garis lurus penyuaian terbaik.* [5 *markah*]

(*b*) Use your graph from **10**(*a*) to find the value of

Gunakan graf anda dari **10**(*a*) *untuk mencari nilai*

(i) r,

(ii) s,

(iii) x if $y = \frac{45}{x}$.

x *jika* $y = \frac{45}{x}$.

[5 *marks*]
[5 *markah*]

11 Diagram 7 shows two sectors XPR and OPR with centres X and O respectively.

Rajah 7 menunjukkan dua sektor XPR dan OPR dengan pusat masing-masing ialah X dan O.

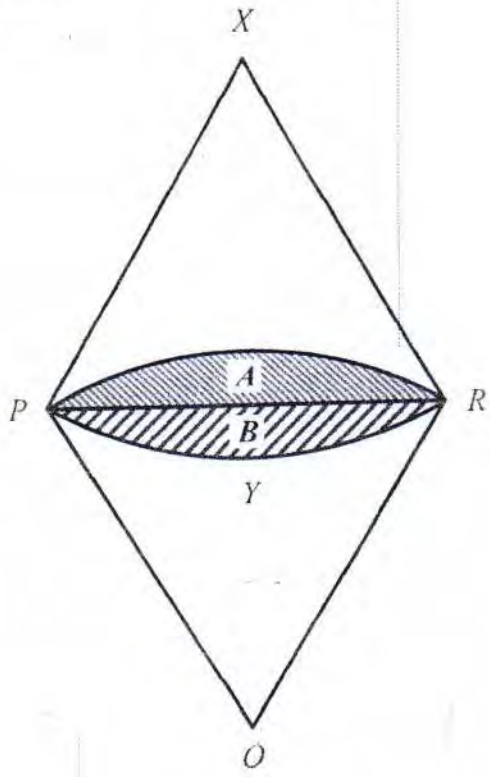


Diagram 7
Rajah 7

It is given that the length of OR is 10 cm, $\angle PXR = 1{\cdot}039$ radians, $\angle POR = 1{\cdot}094$ radians and the length of arc PYR is 10·89 cm.

Diberi bahawa panjang OR ialah 10 cm, $\angle PXR = 1{\cdot}039$ *radian*, $\angle POR = 1{\cdot}094$ *radian dan panjang lengkok PYR ialah* 10·89 cm.

[Use / *Guna* $\pi = 3{\cdot}142$]

Find

Cari

(*a*) the perimeter, in cm, of the shaded region A, [5 *marks*]

perimeter, dalam cm, *kawasan berlorek A,* [5 *markah*]

(*b*) the area, in cm^2, of region B. [5 *marks*]

luas, dalam cm^2, *kawasan berlorek B.* [5 *markah*]

[Lihat halaman sebelah

Section C
Bahagian C

[20 *marks*]

[20 *markah*]

Answer any **two** questions from this section.

Jawab mana-mana **dua** *soalan daripada bahagian ini.*

12 Solution by scale drawing is not accepted.

Penyelesaian secara lukisan berskala tidak diterima.

Diagram 8 shows a triangle *PRS*.

Rajah 8 *menunjukkan sebuah segi tiga PRS.*

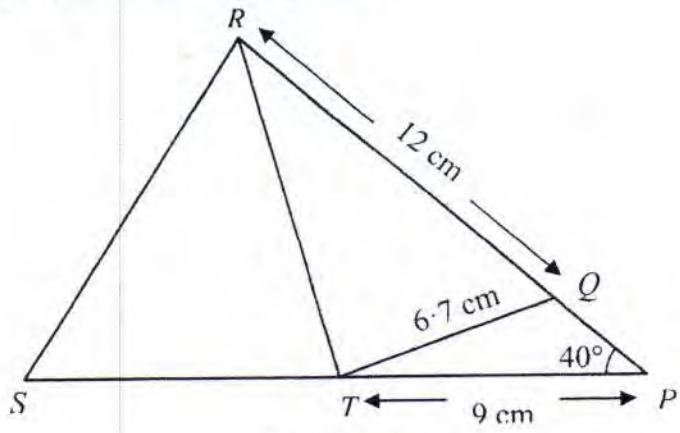


Diagram 8
Rajah 8

It is given that *PQR* and *PTS* are straight lines and $\angle PQT$ is an obtuse angle.

Diberi bahawa PQR dan PTS ialah garis lurus dan $\angle PQT$ *ialah sudut cakah.*

(*a*) Find

(i) the length, in cm, of *RT*,

Cari panjang, dalam cm, *bagi RT*,

(ii) $\angle QTR$. [6 *marks*]
[6 *markah*]

(*b*) If the area of triangle *RST* is 45 cm^2, calculate the length, in cm, of *ST*. [3 *marks*]

Jika luas segi tiga RST ialah 45 cm^2, *hitung panjang, dalam* cm, *bagi ST*.
[3 *markah*]

(*c*) Point *Q*' lies on *RP* such that *TQ*' = *TQ*. Sketch the triangle *PTQ*'. [1 *mark*]

Titik Q' berada pada RP dengan keadaan TQ' = TQ. Lakarkan segi tiga PTQ'.
[1 *markah*]

13 A particle X moves along a straight line and passes through a fixed point O with a velocity of v ms^{-1}, given by $v = 2t^2 - 5t - 3$, where t is the time in seconds after leaving the point O.

Suatu zarah X bergerak pada satu garis lurus dan melalui titik tetap O dengan halaju v ms^{-1}, diberi oleh $v = 2t^2 - 5t - 3$, di mana t ialah masa dalam saat selepas meninggalkan titik O.

[Assume motion to the right is positive]

[*Anggap gerakan ke arah kanan sebagai positif*]

(*a*) Find

Cari

(i) the displacement, in metre, when the particle stops instantaneously,

sesaran, dalam meter, apabila zarah itu berhenti seketika,

(ii) the range of time, in seconds, when the particle decelerates.

julat masa, dalam saat, apabila zarah itu mengalami nyahpecutan.

[6 *marks*]
[6 *markah*]

(*b*) Sketch the velocity–time graph of the particle for $0 \le t \le 5$.
Hence or otherwise, find the total distance travelled, in metre, by the particle in the first 5 seconds. [4 *marks*]

Lakarkan graf halaju-masa bagi zarah itu untuk $0 \le t \le 5$.
Seterusnya atau dengan kaedah lain, cari jumlah jarak, dalam meter, yang dilalui oleh zarah itu dalam 5 saat pertama. [4 *markah*]

14 Use the graph paper provided on page **25** to answer this question. Detach the graph paper and tie it together with your answer booklet.

Gunakan kertas graf yang disediakan pada halaman **25** *untuk menjawab soalan ini. Ceraikan kertas graf itu dan ikat bersama-sama buku jawapan anda.*

Latifah earns a salary of RM3 000 per month. She saves RMx of her salary on children's education and RMy on family recreational activities. She allocates her monthly saving based on the following constraints:

Latifah mendapat gaji sebanyak RM3 000 *sebulan. Dia menyimpan* RMx *dari gajinya untuk pendidikan anak-anak dan* RMy *untuk aktiviti rekreasi keluarga. Dia memperuntukkan simpanan bulanannya berdasarkan kekangan berikut:*

I The monthly saving for her family recreational activities is at most twice the monthly saving for her children's education.

Simpanan bulanan untuk aktiviti rekreasi keluarga adalah selebih-lebihnya dua kali simpanan bulanan untuk pendidikan anak-anaknya.

II The monthly saving for her family recreational activities is at least RM100 more than the monthly saving for her children's education.

Simpanan bulanan untuk aktiviti rekreasi keluarga adalah sekurang-kurangnya RM100 *lebih daripada simpanan bulanan untuk pendidikan anak-anaknya.*

III The total monthly saving for her children's education and family recreational activities does not exceed 25 % of her monthly salary.

Jumlah simpanan bulanan untuk pendidikan anak-anak dan aktiviti rekreasi keluarga tidak melebihi 25 % daripada gaji bulanannya.

(*a*) Write three inequalities, other than $x \geq 0$ and $y \geq 0$, which satisfy all the above constraints. [3 *marks*]

Tulis tiga ketaksamaan, selain $x \geq 0$ *dan* $y \geq 0$, *yang memenuhi semua kekangan di atas.* [3 *markah*]

(*b*) Using a scale of 2 cm to RM50 on both axes, construct and shade the region R which satisfies all the above constraints. [3 *marks*]

Dengan menggunakan skala 2 cm *kepada* RM50 *pada kedua-dua paksi, bina dan lorek rantau R yang memenuhi semua kekangan di atas.* [3 *markah*]

(*c*) Using the graph constructed in **14**(*b*), find

Menggunakan graf yang dibina di **14**(*b*), *cari*

(i) the range of her saving for family recreational activities if she spends RM200 a month on her children's education,

julat simpanan untuk aktiviti rekreasi keluarga jika dia menyimpan RM200 *sebulan untuk pendidikan anak-anaknya,*

(ii) the minimum total saving for her children's education and family recreational activities in a year.

jumlah simpanan minima untuk pendidikan anak-anaknya dan aktiviti rekreasi keluarga dalam setahun.

[4 *marks*]
[4 *markah*]

15 Diagram 9 shows a bar chart on the average monthly number of pairs of tennis, badminton, football and golf shoes sold in the year 2015.

Rajah 9 menunjukkan carta palang purata bulanan bilangan pasang kasut tenis, badminton, bola sepak dan golf yang dijual pada tahun 2015.

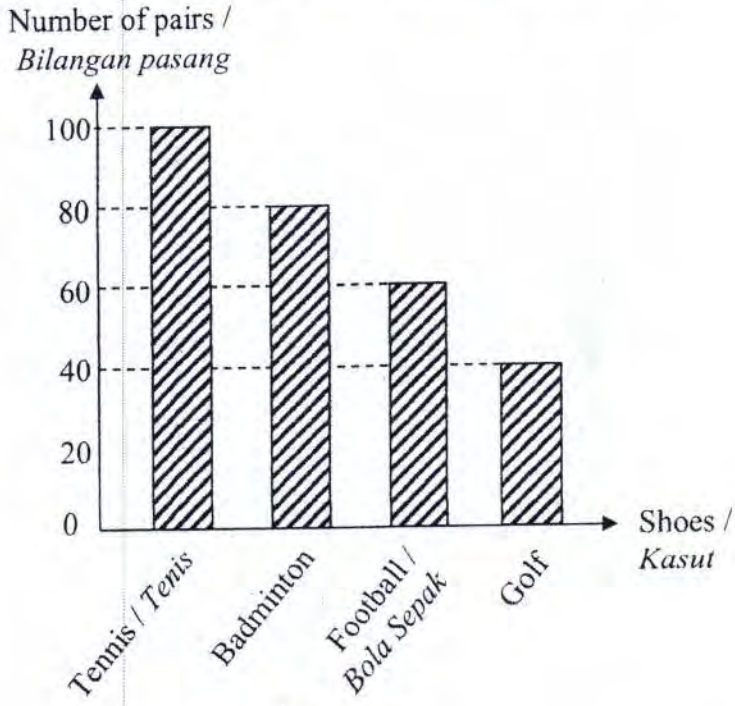


Diagram 9
Rajah 9

Table 2 shows the prices and price indices of each pair of tennis, badminton, football and golf shoes in the year 2017 based on 2015.

Jadual 2 menunjukkan harga dan indeks harga bagi setiap pasang kasut tenis, badminton, bola sepak dan golf pada tahun 2017 *berasaskan* 2015.

Types of shoes ***Jenis-jenis kasut***	**Price per pair (RM)** ***Harga untuk satu pasang (RM)***		**Price index in 2017 based on 2015** ***Index harga pada 2017 berasaskan 2015***
	Year 2015 ***Tahun 2015***	**Year 2017** ***Tahun 2017***	
Tennis / *Tenis*	*r*	220.00	110
Badminton	150.00	187.50	*s*
Football / *Bola sepak*	180.00	189.00	105
Golf	400.00	*t*	130

Table 2
Jadual 2

(*a*) Find the value of r, s and t. [3 *marks*]

Cari nilai r, s *dan* t. [3 *markah*]

(*b*) Using the data in Diagram 9 as the weightage, calculate the composite index of the four types of shoes in the year 2017 based on 2015. [2 *marks*]

Dengan menggunakan data dalam Rajah 9 *sebagai pemberat, hitung indeks gubahan bagi keempat-empat jenis kasut pada tahun* 2017 *berasaskan* 2015. [2 *markah*]

(*c*) If the total monthly sales for these four types of shoes in January 2015 is RM75 000, find the corresponding total monthly sales in January 2017.
Hence, calculate the average daily sales for that month. [3 *marks*]

Jika jumlah jualan bulanan bagi empat jenis kasut itu pada Januari 2015 *ialah* RM75 000, *cari jumlah jualan bulanan yang sepadan pada Januari* 2017.
Seterusnya, kira purata jualan harian bagi bulan tersebut. [3 *markah*]

(*d*) The average prices of the shoes are expected to rise by 40% from the year 2015 to the year 2019.
Calculate the composite index of the year 2019 based on 2017. [2 *marks*]

Harga purata kasut-kasut dijangkakan akan naik sebanyak 40% *dari tahun* 2015 *ke tahun* 2019.
Hitung indeks gubahan tahun 2019 *berasaskan* 2017. [2 *markah*]

END OF QUESTION PAPER
KERTAS SOALAN TAMAT

[Lihat halaman sebelah
SULIT

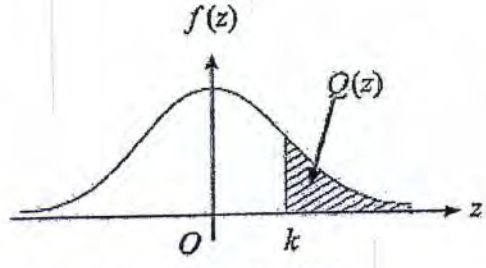
THE UPPER TAIL PROBABILITY Q(z) FOR THE NORMAL DISTRIBUTION N(0,1)
KEBARANGKALIAN HUJUNG ATAS Q(z) BAGI TABURAN NORMAL N(0,1)

z	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
											TOLAK								
0.0	**.5000**	**.4960**	**.4920**	**.4880**	**.4840**	**.4801**	**.4761**	**.4721**	**.4681**	**.4641**	**4**	**8**	**12**	**16**	**20**	**24**	**28**	**32**	**36**
0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247	4	8	12	16	20	24	28	32	36
0.2	**.4207**	**.4168**	**.4129**	**.4090**	**.4052**	**.4013**	**.3974**	**.3936**	**.3897**	**.3859**	**4**	**8**	**12**	**15**	**19**	**23**	**27**	**31**	**35**
0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483	4	7	11	15	19	22	26	30	34
0.4	**.3446**	**.3409**	**.3372**	**.3336**	**.3300**	**.3264**	**.3228**	.3192	**.3156**	**.3121**	**4**	**7**	**11**	**14**	**18**	**22**	**25**	**29**	**32**
0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776	3	7	10	14	17	20	24	27	31
0.6	**.2743**	**.2709**	**.2676**	**.2643**	**.2611**	**.2578**	**.2546**	**.2514**	**.2483**	**.2451**	**3**	**7**	**10**	**13**	**16**	**19**	**23**	**26**	**29**
0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148	3	6	9	12	15	18	21	24	27
0.8	**.2119**	**.2090**	**.2061**	**.2033**	**.2005**	**.1977**	**.1949**	**.1922**	**.1894**	**.1867**	**3**	**5**	**8**	**11**	**14**	**16**	**19**	**22**	**25**
0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611	3	5	8	10	13	15	18	20	23
1.0	**.1587**	**.1562**	**.1539**	**.1515**	**.1492**	**.1469**	**.1446**	**.1423**	**.1401**	**.1379**	**2**	**5**	**7**	**9**	**12**	**14**	**16**	**19**	**21**
1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170	2	4	6	8	10	12	14	16	18
1.2	**.1151**	**.1131**	**.1112**	**.1093**	**.1075**	**.1056**	**.1038**	**.1020**	**.1003**	**.0985**	**2**	**4**	**6**	**7**	**9**	**11**	**13**	**15**	**17**
1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823	2	3	5	6	8	10	11	13	14
1.4	**.0808**	**.0793**	**.0778**	**.0764**	**.0749**	**.0735**	**.0721**	**.0708**	**.0694**	**.0681**	**1**	**3**	**4**	**6**	**7**	**8**	**10**	**11**	**13**
1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559	1	2	4	5	6	7	8	10	11
1.6	**.0548**	**.0537**	**.0526**	**.0516**	**.0505**	**.0495**	**.0485**	**.0475**	**.0465**	**.0455**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367	1	2	3	4	4	5	6	7	8
1.8	**.0359**	**.0351**	**.0344**	**.0336**	**.0329**	**.0322**	**.0314**	**.0307**	**.0301**	**.0294**	**1**	**1**	**2**	**3**	**4**	**4**	**5**	**6**	**6**
1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233	1	1	2	2	3	4	4	5	5
2.0	**.0228**	**.0222**	**.0217**	**.0212**	**.0207**	**.0202**	**.0197**	**.0192**	**.0188**	**.0183**	**0**	**1**	**1**	**2**	**2**	**3**	**3**	**4**	**4**
2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143	0	1	1	2	2	2	3	3	4
2.2	**.0139**	**.0136**	**.0132**	**.0129**	**.0125**	**.0122**	**.0119**	**.0116**	**.0113**	**.0110**	**0**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**3**
2.3	.0107	.0104	.0102								0	1	1	1	1	2	2	2	2
				$.0^{3}990$	**$.0^{3}964$**	**$.0^{3}939$**	**$.0^{3}914$**				**3**	**5**	**8**	**10**	**13**	**15**	**18**	**20**	**23**
								$.0^{3}889$	$.0^{3}866$	$.0^{3}842$	2	5	7	9	12	14	16	18	21
											2	**4**	**6**	**8**	**11**	**13**	**15**	**17**	**19**
2.4	**$.0^{3}820$**	**$.0^{3}798$**	**$.0^{3}776$**	**$.0^{3}755$**	**$.0^{3}734$**						2	4	6	7	9	11	13	15	17
						$.0^{3}714$	$.0^{3}695$	$.0^{3}676$	$.0^{3}657$	$.0^{3}639$									
2.5	**$.0^{3}621$**	**$.0^{3}604$**	**$.0^{3}587$**	**$.0^{3}570$**	**$.0^{3}554$**	**$.0^{3}539$**	**$.0^{3}523$**	**$.0^{3}508$**	**$.0^{3}494$**	**$.0^{3}480$**	**2**	**3**	**5**	**6**	**8**	**9**	**11**	**12**	**14**
2.6	$.0^{3}466$	$.0^{3}453$	$.0^{3}440$	$.0^{3}427$	$.0^{3}415$	$.0^{3}402$	$.0^{3}391$	$.0^{3}379$	$.0^{3}368$	$.0^{3}357$	1	2	3	5	6	7	8	9	10
2.7	**$.0^{3}347$**	**$.0^{3}336$**	**$.0^{3}326$**	**$.0^{3}317$**	**$.0^{3}307$**	**$.0^{3}298$**	**$.0^{3}289$**	**$.0^{3}280$**	**$.0^{3}272$**	**$.0^{3}264$**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
2.8	$.0^{3}256$	$.0^{3}248$	$.0^{3}240$	$.0^{3}233$	$.0^{3}226$	$.0^{3}219$	$.0^{3}212$	$.0^{3}205$	$.0^{3}199$	$.0^{3}193$	1	1	2	3	4	4	5	6	6
2.9	**$.0^{3}187$**	**$.0^{3}181$**	**$.0^{3}175$**	**$.0^{3}169$**	**$.0^{3}164$**	**$.0^{3}159$**	**$.0^{3}154$**	**$.0^{3}149$**	**$.0^{3}144$**	**$.0^{3}139$**	**0**	**1**	**1**	**2**	**2**	**3**	**3**	**4**	**4**
3.0	$.0^{3}135$	$.0^{3}131$	$.0^{3}126$	$.0^{3}122$	$.0^{3}118$	$.0^{3}114$	$.0^{3}111$	$.0^{3}107$	$.0^{3}104$	$.0^{3}100$	0	1	1	2	2	2	3	3	4

For negative z use relation:
Bagi z negatif guna hubungan:
$Q(z) = 1 - Q(-z) = P(-z)$

$$f(z) = \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}z^2\right)$$

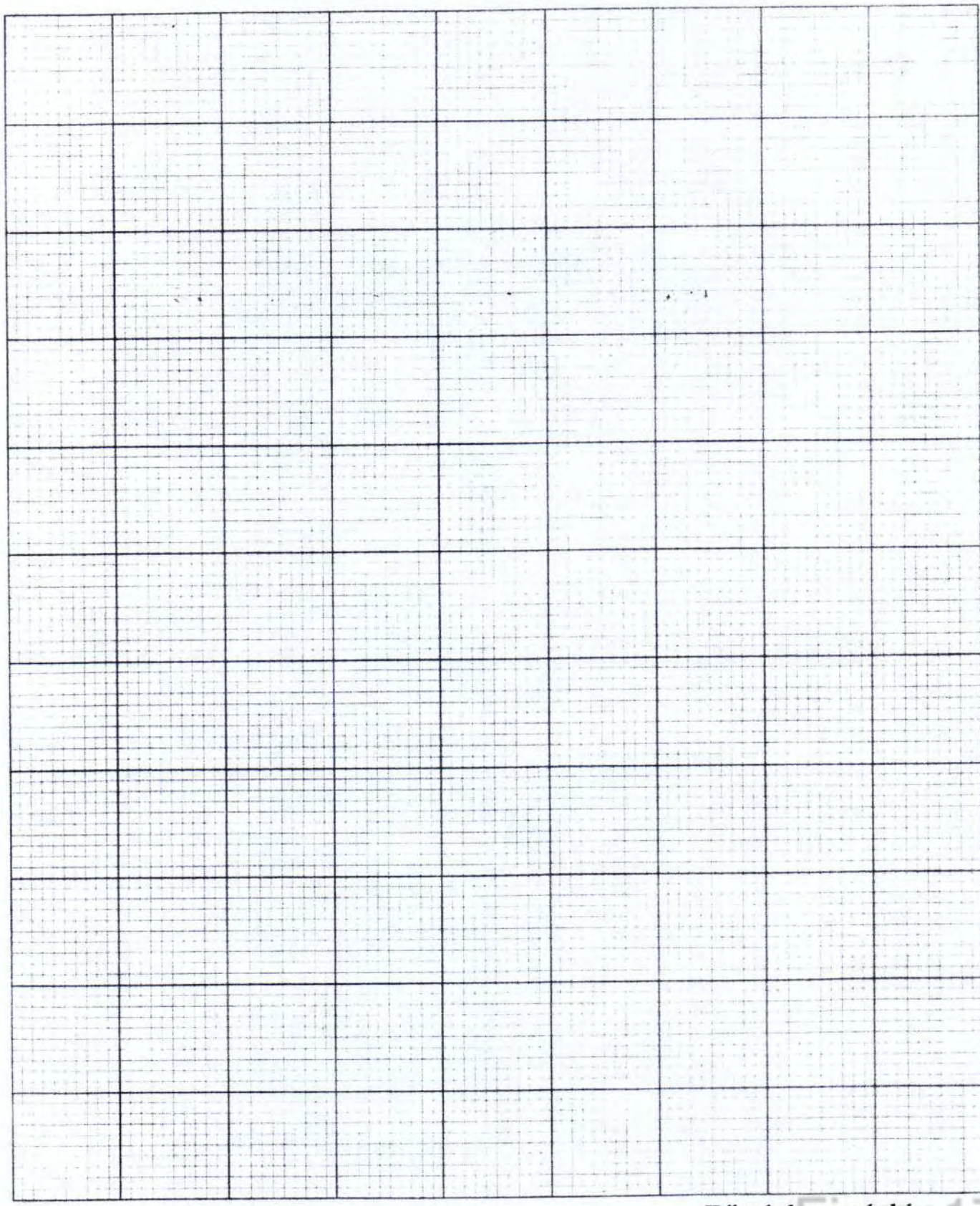
$$Q(z) = \int_{k}^{\infty} f(z)\, dz$$



Example / *Contoh*:
If $X \sim N(0, 1)$, then
Jika $X \sim N(0, 1)$, *maka*
$P(X > k) = Q(k)$
$P(X > 2.1) = Q(2.1) = 0.0179$

Nama : ..... Kelas : .....

Graph paper for Question 10 (Detach and tie this page together with your answer booklet)
***Kertas graf untuk Soalan* 10 (*Ceraikan dan ikat halaman ini bersama-sama buku jawapan anda*)**



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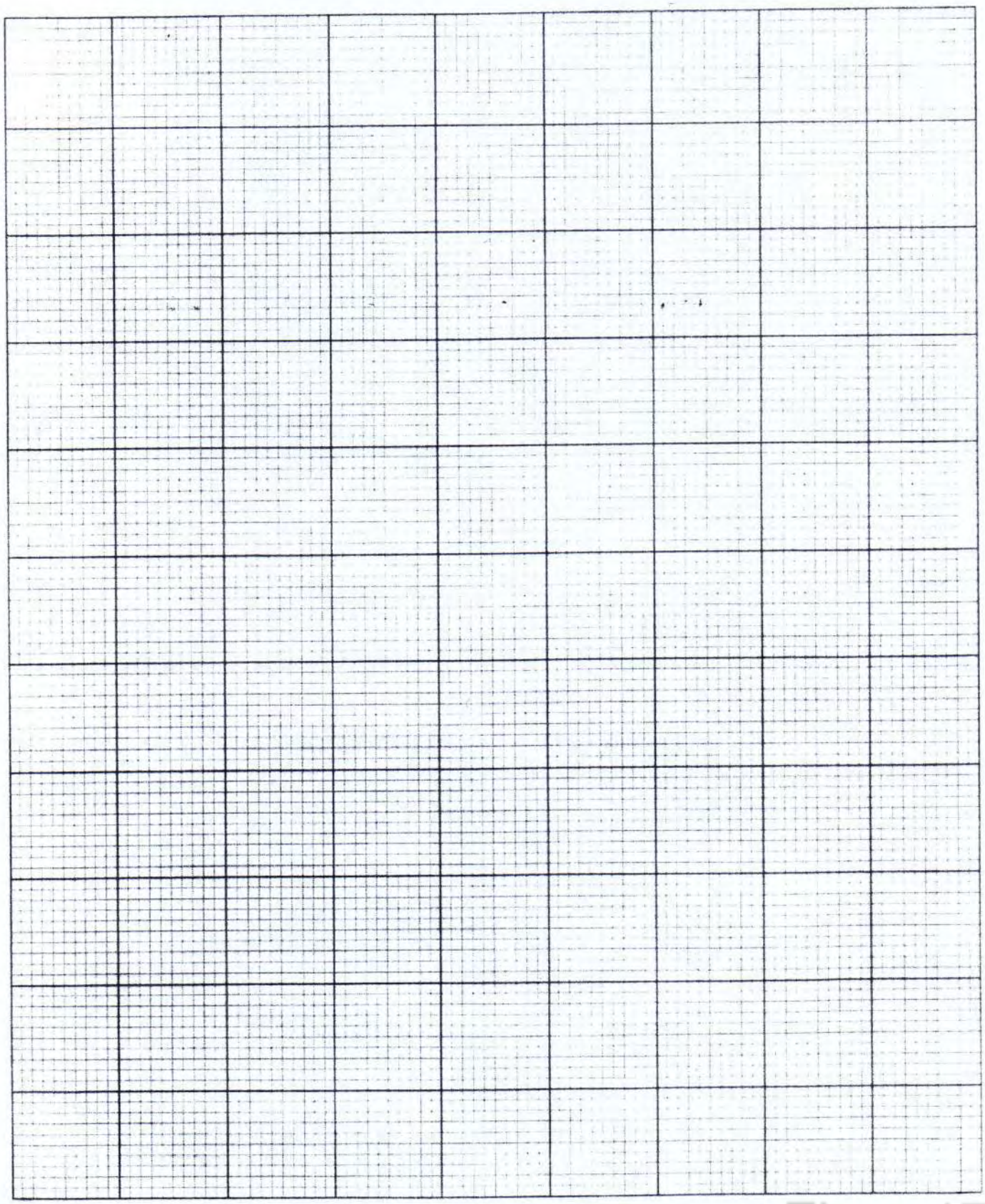
Nama : .....Kelas : .....

Graph paper for Question 14 (Detach and tie this page together with your answer booklet)
***Kertas graf untuk Soalan* 14 (*Ceraikan dan ikat halaman ini bersama-sama buku jawapan anda*)**



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$2\frac{1}{2}$ jam

MAKTAB RENDAH SAINS MARA

PEPERIKSAAN AKHIR SIJIL PENDIDIKAN MRSM 2019

3
4
7
2
2

PERATURAN PEMARKAHAN

MATEMATIK TAMBAHAN

Kertas 2

Dua jam tiga puluh minit

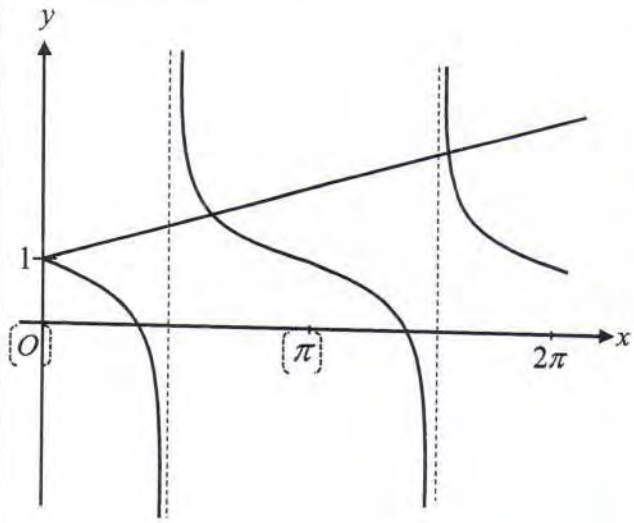
UNTUK KEGUNAAN PEMERIKSA SAHAJA

AMARAN

Kertas soalan ini mengandungi 16 halaman bercetak.

Additional Mathematics Paper 2
SPMRSM 2019

Answer Scheme

No	Solution	Scheme	Sub marks	Marks
1 (a)		P1 Shape of tangent graph P1 Shape of negative tangent graph P1 Shift upward +1. Note : 1. Do not accept sine and cosine graph. 2. Ignore graph outside the range.	3	
(b)	$y=\frac{x}{\pi}+1$ Number of solutions = 3	N1 $y=\frac{x}{\pi}+1$ K1 Sketch straight line $*y=\frac{x}{\pi}+1$ with *gradient property or *y-intercept property correct. N1 3	3	6

No	Solution	Scheme	Sub marks	Marks
2	$\log_9 x^2 - \log_3 (x-4) = \log_3 5$ $\dfrac{\log_3 x^2}{\log_3 9} - \log_3 (x-4) = \log_3 5$ $\dfrac{\log_3 x^2}{2} - \log_3 (x-4) = \log_3 5$ $\log_3 x - \log_3 (x-4) = \log_3 5$ $\log_3 \left(\dfrac{x}{x-4} \right) = \log_3 5$ $\dfrac{x}{x-4} = 5$ $x = 5$	K1 Use change base formula $\log_a b = \dfrac{\log_c b}{\log_c a}$. K1 Use law $\log_a m^n = n \log_a m$. K1 Use law $\log_a \dfrac{m}{n} = \log_a m - \log_a n$ or $\log_a mn = \log_a m + \log_a n$. K1 Equate LHS to RHS OR change logarithm form to index form. N1 $x = 5$	5	5

No	Solution	Scheme	Sub marks	Marks
3	$2y+20x=160$ or $12x^2+2xy=600$ $y=80-10x$ or $x=8-\frac{y}{10}$ or $y=\frac{300}{x}-6x$ $12x^2+2x^*(80-10x)=600$ or $12^*\left(8-\frac{y}{10}\right)^2+2^*\left(8-\frac{y}{10}\right)y=600$ or $2\left(\frac{300}{x}-6x\right)+20x=160$ **Factorization** $(x-5)(x-15)=0$ or $(y+10)(y-30)=0$ OR **Formula** $x=\frac{-(-20)\pm\sqrt{(-20)^2-4(1)(75)}}{2(1)}$ or $y=\frac{-(40)\pm\sqrt{(40)^2-4(1)(2100)}}{2(1)}$ OR **Completing the square** $8\left[(x-10)^2-(-10)^2-75\right]=0$ or $2\left[(y+20)^2-(20)^2-2100\right]=0$ $x=5,\ \{x=15\}$ $y=30,\ \{y=-10\}$ Length = 30 meter Width =10 meter	P1 $2y+20x=160$ or $12x^2+2xy=600$ P1 seen or implied K1 Eliminate x or y. K1 Solve quadratic equation using factorization, formula or completing the square. N1 First set value x or y. N1 Length = 30 meter Width =10 meter Note: 1. OW-1 it steps to solve the quadratic equation is not shown. 2. SS-1 improper factorization is shown.	6	6

No	Solution	Scheme	Sub marks	Marks
4				
(a)	(i) $\overrightarrow{SU} = 2\underline{p}$	N1 $2\underline{p}$		
	(ii) $\overrightarrow{PR} = \overrightarrow{PQ} + \overrightarrow{QR}$	K1 Use triangle law or parallelogram law to find $\overrightarrow{PR}$		
	$= 8\underline{p} + 2\underline{q}$	N1 $8\underline{p} + 2\underline{q}$	3	
(b)	$\overrightarrow{PU} = 2\underline{p} + 2\underline{q}$	K1 Use $\overrightarrow{PU} = \overrightarrow{PS} + \overrightarrow{SU}$ or $\overrightarrow{ST} = \overrightarrow{SP} + m\overrightarrow{PU}$.		
	$\overrightarrow{ST} = -2\underline{q} + m(2\underline{p} + 2\underline{q})$			
	$= 2m\underline{p} + (2m-2)\underline{q}$	N1 $2m\underline{p} + (2m-2)\underline{q}$	2	
(c)	$^*2m\underline{p} + (2m-2)\underline{q} = \lambda^*(8\underline{p} + 2\underline{q})$	K1 Use $^*\overrightarrow{ST} = \lambda^*\overrightarrow{PR}$ or $^*\overrightarrow{PR} = \lambda^*\overrightarrow{ST}$.		
	$^*2m = {}^*8\lambda$ $\quad$ $^*2m - 2 = {}^*2\lambda$	K1 Equate the coefficient of $\underline{p}$ and of $\underline{q}$ and solve.		
	$m = \frac{4}{3}$	N1 $\frac{4}{3}$	3	8

No	Solution	Scheme	Sub marks	Marks
5 (a)	$f(x)=x-75$ $\quad gf(x)=0.95x$	P1 $x-75$ or $0.95x$		
	Let $y=x-75$	K1 Find f^{-1}.		
	$x=y+75$			
	$g(y)=0.95(y+75)$			
	$g(x)=0.95(x+75)$	N1 $0.95(x+75)$	3	
(b)				
	(i) $0.95x=499.90$	K1 Equate $0.95x=499.90$.		
	$x=526.21$	N1 $x=526.21$		
	(ii) $499.90-(*526.21-75)$	K1 $499.90-(*526.21-75)$		
	48.69	N1 48.69	4	7
		Note: For correct answer only, award K1N1.		

No	Solution	Scheme	Sub marks	Marks
6				
(a)	$A = \pi r^2 + \pi rp$ $\pi r^2 + \pi rp = 160$	P1 $\pi r^2 + \pi rp = 160$		
	$p = \dfrac{160 - \pi r^2}{\pi r}$	K1 Subtitute $p = \dfrac{160 - \pi r^2}{\pi r}$ into V.		
	$V = \dfrac{1}{2}\pi r^2\left(\dfrac{160 - \pi r^2}{\pi r}\right)$			
	$V = 80r - \dfrac{\pi r^3}{2}$	N1 $V = 80r - \dfrac{\pi r^3}{2}$	3	
(b)	$\dfrac{dV}{dr} = 80 - \dfrac{3}{2}\pi r^2$	K1 Differentiate V w.r.t r.		
	$80 - \dfrac{3}{2}\pi r^2 = 0$	K1 Equate $\dfrac{dV}{dr}$ to 0		
	$r = \sqrt{\dfrac{160}{3\pi}}$ or equivalent	N1 $r = \sqrt{\dfrac{160}{3\pi}}$ or equivalent		
	$V = 80\left(\sqrt{\dfrac{^*160}{3\pi}}\right) - \dfrac{\pi\left(\sqrt{\dfrac{^*160}{3\pi}}\right)^3}{2}$	K1 Substitute $^*r$ into V		
	219.7 // 219.75	N1 219.7 // 219.75	5	8

No	Solution	Scheme	Sub marks	Marks
7 (a)	(i) $^7C_6\left(\frac{4}{7}\right)^6\left(\frac{3}{7}\right)^1$	K1 Use $^7C_r p^r q^{7-r}$.		
	0.1044	N1 0.1044		
	(ii) $^7C_0\left(\frac{3}{7}\right)^0\left(\frac{4}{7}\right)^7$ or $^7C_1\left(\frac{3}{7}\right)^1\left(\frac{4}{7}\right)^6$	K1 Use $^7C_r p^r q^{7-r}$.		
	$1-{}^7C_0\left(\frac{3}{7}\right)^0\left(\frac{4}{7}\right)^7-{}^7C_1\left(\frac{3}{7}\right)^1\left(\frac{4}{7}\right)^6$ or $^7C_2\left(\frac{3}{7}\right)^2\left(\frac{4}{7}\right)^5+{}^7C_3\left(\frac{3}{7}\right)^3\left(\frac{4}{7}\right)^4+\ldots+{}^7C_7\left(\frac{3}{7}\right)^7\left(\frac{4}{7}\right)^0$	K1 $1-P(X=0)-P(X=1)$ or $P(X=2)+P(X=3)+\ldots+P(X=7)$		
	0.8757	N1 0.8757	5	
(b)	(i) $\frac{81-90}{12}$ or $\frac{108-90}{12}$	K1 Use of $Z=\frac{X-\mu}{\sigma}$.		
	0.2934	N1 0.2934		
	(ii) $(-)1.645$	P1 seen or implied		
	$\frac{t-90}{12}=-1.645$	K1 Equate $\frac{t-90}{12}=-1.645$.		
	70.26	N1 70.26	5	10

No	Solution	Scheme	Sub marks	Marks
8 (a)	(i) $-2\times m_2=-1$ $\frac{y-12}{0-4}=\frac{1}{2}$ $y=10$	K1 Use $m_1\times m_2=-1$. K1 Use any valid method to find y-coordinate. N1 $y=10$	3	
	(ii) $y=-\frac{1}{2}\left(\frac{x^2}{2}\right)+c$ $12=-\frac{1}{2}\left(\frac{4^2}{2}\right)+c$ $y=-\frac{x^2}{4}+16$	K1 Integrate $-\frac{1}{2}x$ w.r.t. x. K1 Find the value of c. N1 $y=-\frac{x^2}{4}+16$	3	
(b)	$\pi\int_{12}^{k}(64y-4y)\,dy=50\pi$ $\left[64y-\frac{4y^2}{2}\right]_k^{16}=50$ $\left[64(16)-2(16)^2\right]-\left[64k-2k^2\right]=50$ $k^2-32k+231=0$ $(k-21)(k-11)=0$ $k=11$	K1 Integrate $\pi^{*}(64-4y)$ and equate to 50π K1 Use limit $\int_k^{*16}$ K1 Solve quadratic equation. N1 $k=11$	4	10

No	Solution	Scheme	Sub marks	Marks
9 (a) (i)	$-\frac{1}{3}\times m_2=-1$ $y-4=3(x-6)$ $y=3x-14$	K1 Use $m_1\times m_2=-1$. K1 Use $y-y_1=m(x-x_1)$ or any valid method. N1 $y=3x-14$		
(a) (ii)	$\frac{2}{3}x+6=3x-14$ $\left(\frac{60}{7},\frac{82}{7}\right)$	K1 Simultaneous equation. N1 $\left(\frac{60}{7},\frac{82}{7}\right)$	5	
(b)	$\frac{0(3)+2x}{5}=9$ or $\frac{6(3)+2y}{5}=6$ $\left(\frac{45}{2},6\right)$	K1 Use ratio formulae. N1 $\left(\frac{45}{2},6\right)$ Note: For correct answer only, award K1N1.	2	
(c)	$C(12, 2)$ $\frac{1}{2}\begin{vmatrix}0 & \frac{45}{2} & 12 & 0\\ 6 & 6 & 2 & 6\end{vmatrix}$ $\frac{1}{2}\lvert(45+72)-(135+72)\rvert$ 45	N1 $C(12, 2)$ K1 Use area formula. N1 45	3	10

No	Solution	Scheme	Sub marks	Marks
10 (a)				

x^3	0.55	1.00	1.52	2.20	3.05	3.65
xy	87	80	73	63	51	42

N1 Note: at least two d.p

N1

Plot xy against x^3

K1 Plot xy against x^3 with correct axes and uniform scales.

*6 points plotted correctly

N1

Draw line of best fit

N1 Line of best fit. 5

(b) $xy = rx^3 + s$

P1 $xy = rx^3 + s$ seen or implied

(i) $r = -15.4 \leftrightarrow -13.4$

K1 Use $^*m = r$.

N1 $-15.4 \leftrightarrow -13.4$

(ii) $s = 93.7 \leftrightarrow 95.7$

N1 $93.7 \leftrightarrow 95.7$

(iii) $x = 1.46 \leftrightarrow 1.56$

N1 $1.46 \leftrightarrow 1.56$ 5 10

Note :

SS – 1 if,

part of the scale is not uniform at the xy–axis and/or the x^3–axis from the first point to the last point

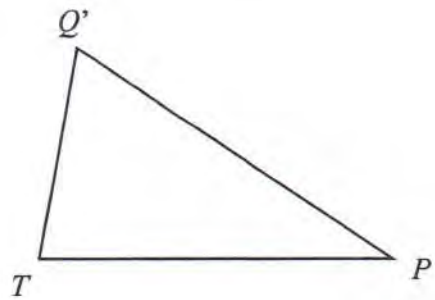
<u>or</u>

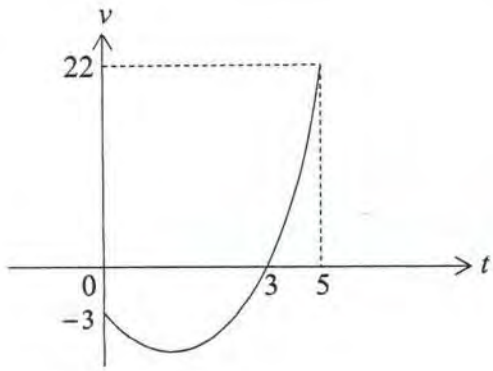
does not use the given scale

<u>or</u>

does not use graph paper.

No	Solution	Scheme	Sub marks	Marks
11 (a)	$\angle POR = 62.67°$ or $\angle PXR = 59.52°$	P1 $\angle POR = 62.67°$ or $\angle PXR = 59.52°$ seen or implied		
	$PR^2 = 10^2 + 10^2 - 2(10)(10)\cos 62.67°$ $PR = 10.40$	K1 Use cosine rule or any valid method to find PR.		
	$Arc_{PR} = 10(1.094)$	K1 Use $s = r\theta$ to find arc PR.		
	Perimeter A $= {}^{*}10.40 + 10(1.094)$	K1 PR + arc PR.		
	21.34 // 21.35	N1 21.34 // 21.35	5	
(b)	$\cos 60.23° = \frac{5.2}{XR}$ $XR = 10.48$	K1 Use any valid method to find XR or XP.		
	$\frac{1}{2} {}^{*}(10.48)^2 {}^{*}(1.039)$	K1 Use any valid method to find area of sector $XPYR$.		
	$\frac{1}{2} {}^{*}(10.48)^2 {}^{*}\sin 59.52°$	K1 Use any valid method to find area of ΔXPR.		
	Area B $\left[\frac{1}{2} {}^{*}(10.48)^2 {}^{*}(1.039)\right] - \left[\frac{1}{2} {}^{*}(10.48)^2 {}^{*}\sin 59.52°\right]$	K1 *Area of sector $XPYR$ − *area of ΔXPR		
	$9.72 \leftrightarrow 9.78$	N1 $9.72 \leftrightarrow 9.78$	5	10

No	Solution	Scheme	Sub marks	Marks
12 (a)	(i) $\frac{6.7}{\sin 40^\circ} = \frac{9}{\sin \angle PQT}$	K1 Use sine rule.		
	$\angle PQT = 120.29^\circ$ // $120^\circ 17'$	N1 59.71°		
	$\angle RQT = 180^\circ - 120.29^\circ = 59.71^\circ$			
	$RT^2 = 12^2 + 6.7^2 - 2(12)(6.7)\cos 59.71^\circ$	K1 Use cosine rule.		
	$RT = 10.38$	N1 $RT = 10.38$		
	(ii) $\frac{10.38}{\sin 59.71^\circ} = \frac{12}{\sin \angle QTR}$	K1 Use sine rule.		
	$\angle QTR = 86.61^\circ$ // $86^\circ 36'$	N1 86.61°	6	
(b)	$\angle RTS = 180^\circ - 86.61^\circ - 19.71^\circ = 73.68^\circ$	P1 73.68°		
	$\frac{1}{2}(10.38)(ST)\sin^* 73.68^\circ = 45$	K1 Use $\frac{1}{2}ab\sin C = 45$		
	9.035	N1 $9.028 \leftrightarrow 9.035$	3	
(c)		N1 Triangle with $\angle PQ'T$ must be acute.	1	10

No	Solution	Scheme	Sub marks	Marks
13 (a)	$2t^2-5t-3=0$	K1 Use $v=0$ and solve.		
	$t=-\frac{1}{2},t=3$			
	$s=\frac{2t^3}{3}-\frac{5t^2}{2}-3t(+c)$	K1 Integrate v w.r.t. t.		
	${}^*s=\frac{2({}^*3)^3}{3}-\frac{5({}^*3)^2}{2}-3({}^*3)$	K1 Substitute ${}^*t$ into ${}^*s$.		
	$-\frac{27}{2}//-13\frac{1}{2}//-13.5$	N1 $-\frac{27}{2}//-13\frac{1}{2}//-13.5$	4	
(b)	$4t-5<0$	K1 Use $a<0$.		
	$0\le t<\frac{5}{4}$	N1 $0\le t<\frac{5}{4}$	2	
(c)		P1 Minimum shape graph.		
		P1 Label at least ^{*3} points.		
	$\left\lvert\frac{2({}^*3)^3}{3}-\frac{5({}^*3)^2}{2}-3({}^*3)-0\right\rvert+$ $\left[\frac{2(5)^3}{3}-\frac{5(5)^2}{2}-3(5)-\left(\frac{2({}^*3)^3}{3}-\frac{5({}^*3)^2}{2}-3({}^*3)\right)\right]$	K1 Use $\left\lvert\int_0^{*3} v\,dt\right\rvert+\int_{*3}^{5} v\,dt$ or equivalent.		
	$\frac{197}{6}//32\frac{5}{6}//32.83$	N1 $\frac{197}{6}//32\frac{5}{6}//32.83$		

No	Solution	Scheme	Sub marks	Marks
	OR $t=0\rightarrow s=0$ $t={}^{*}3\rightarrow s=\frac{2\left({}^{*}3\right)^{3}}{3}-\frac{5\left({}^{*}3\right)^{2}}{2}-3\left({}^{*}3\right)=-13.5$ $t=5\rightarrow s=\frac{2(5)^{3}}{3}-\frac{5(5)^{2}}{2}-3(5)=5\frac{5}{6}$ $\left\|s_{*_3}-s_0\right\|+\left\|s_5-s_{*_3}\right\|=\left\|-13.5-0\right\|+\left\|5\frac{5}{6}-(-13.5)\right\|$ $\frac{197}{6}//32\frac{5}{6}//32.83$	K1 Use $\left\|s_{*_3}-s_0\right\|+\left\|s_5-s_{*_3}\right\|$ or equivalent N1 $\frac{197}{6}//32\frac{5}{6}//32.83$	4	10

No	Solution	Scheme	Sub marks	Marks
14 (a)	$y \le 2x$	N1 $y \le 2x$		
	$y - x \ge 100$ or equivalent	N1 $y - x \ge 100$ or equivalent		
	$x + y \le 750$ or equivalent	N1 $x + y \le 750$ or equivalent	3	
(b)	Refer graph.	K1 Draw correctly at least one straight line from the *inequalities involves x and y. N1 Draw correctly all *straight lines. N1 Region shaded correctly.	3	
(c) (i)	$300 \le y \le 400$	N1 $300 \le y \le 400$		
(ii)	Minimum point (100, 200)	N1 (100, 200)		
	$(100 + 200)(12)$	K1 Substitute any point in *shaded region into $(x + y)$.		
	RM3600	N1 3600		
		Note : SS-1 only once if in (a)(i) the symbol '=' is not used at all (ii) more than 3 inequalities given OR in (b)(i) does not use given scale (ii) axes interchanged (iii) not using graph paper.	4	10

No	Solution	Scheme	Sub marks	Marks
15 (a)	$\frac{220}{r}\times 100 = 110$ $r = 200$ $s = \frac{187.5}{150}\times 100$ $s = 125$ $\frac{t}{400}\times 100 = 130$ $t = 520$	K1 Use $\frac{P_1}{P_0}\times 100$ N2, 1, 0 $r = 200$, $s = 125$, $t = 520$	3	
(b)	$\frac{(110\times 100)+(^{*}125\times 80)+(105\times 60)+(130\times 40)}{280}$ 116.07	K1 Use $\bar{I} = \frac{\sum Iw}{\sum w}$ N1 116.07	2	
(c)	$\frac{U}{75000}\times 100 = {}^{*}116.07$ $U = 87052.50$ 2808.15	K1 Use $\frac{U}{75000}\times 100 = {}^{*}116.07$ N1 87052.50 N1 2808.15	3	
(d)	$\frac{140}{{}^{*}116.07}\times 100$ 120.62	K1 Use $\frac{140}{{}^{*}116.07}\times 100$ N1 120.62	2	10

Graph for Question 10

x^3	0.55	1.00	1.52	2.20	3.05	3.65
xy	87	80	73	63	51	42

Graph for Question 14