

Revision 5

Year 11 Examination

Question/Answer Booklet

MATHEMATICS SPECIALIST UNITS 1 AND 2

Section Two:
Calculator-assumed

Student Number: In figures

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In words

Teacher name

Materials required/recommended for this section

To be provided by the supervisor

This Question/Answer Booklet
Formula Sheet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,
correction fluid/tape, eraser, ruler, highlighters

Special items: nil

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Section Two: Calculator-assumed**65% (69 Marks)**

This section has **nine (9)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 70 minutes.

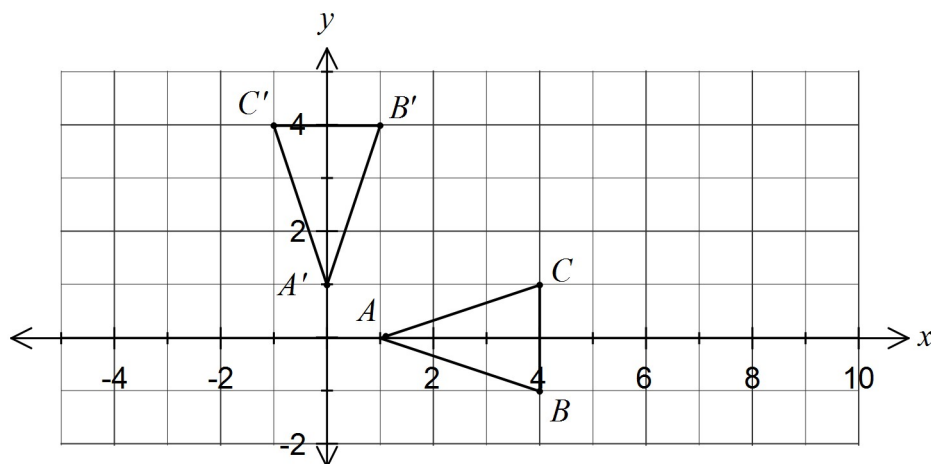
Question 1**(6 marks)**

The work done, in joules, by a force $\mathbf{F}$ Newtons in changing the displacement of an object s metres is given by the scalar product of $\mathbf{F}$ and s .

- (a) Determine the work done by a force of 200 N that moves an object 2.7 m, given that the force acts at an angle of 17° to the direction of movement. (1 mark)
- (b) When an object is moved $0.8\mathbf{i} - 0.6\mathbf{j}$ m by a force of 130 N, the work done is 126 J.
- (i) Show that one possible force is $120\mathbf{i} - 50\mathbf{j}$ N. (2 marks)
- (ii) Another possible force is $x\mathbf{i} + y\mathbf{j}$ N. Determine the values of x and y . (3 marks)

Question 2**(7 marks)**

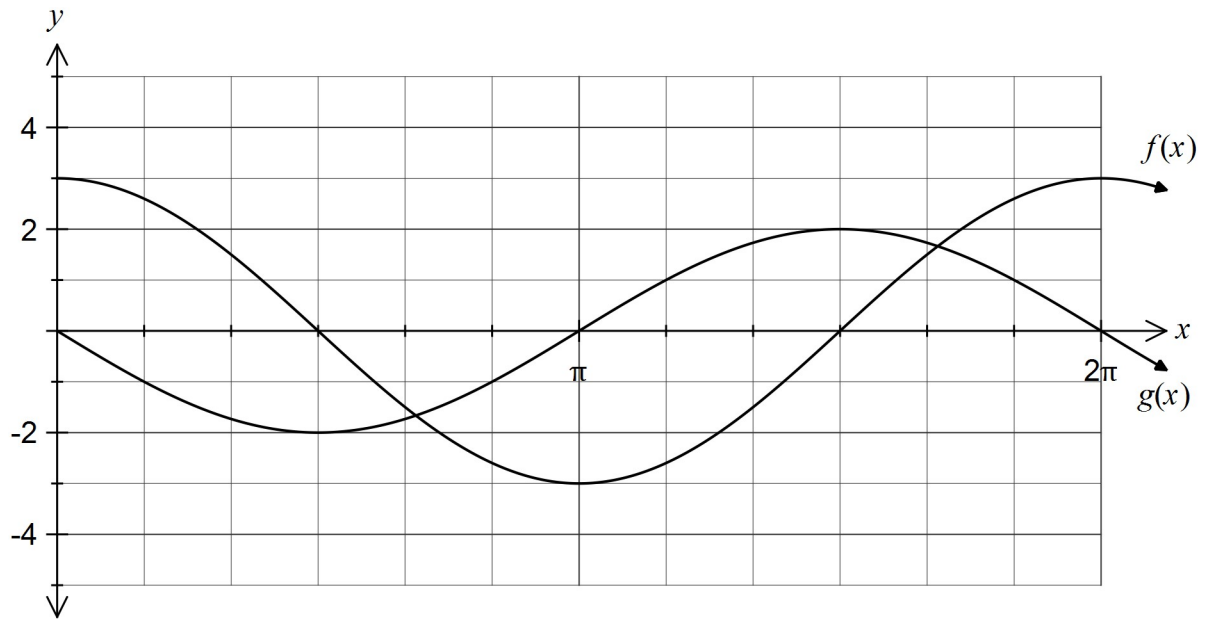
On the axes below, triangle ABC is transformed to $A'B'C'$ by a linear transformation.



- (a) State the appropriate transformation matrix. (1 mark)
- (b) Following a second transformation, $A'(0, 1)$ and $B'(1, 4)$ are transformed to $A''(0, 2)$ and $B''(3, 8)$.
- (i) Determine the matrix for this second transformation. (2 marks)
- (ii) Calculate the area of triangle $A''B''C''$. (2 marks)
- (c) Determine the transformation matrix that will transform triangle $A''B''C''$ back to ABC . (2 marks)

Question 3**(9 marks)**

(a) The graphs of $y = f(x)$ and $y = g(x)$ are shown below for $0 \leq x \leq 2\pi$.

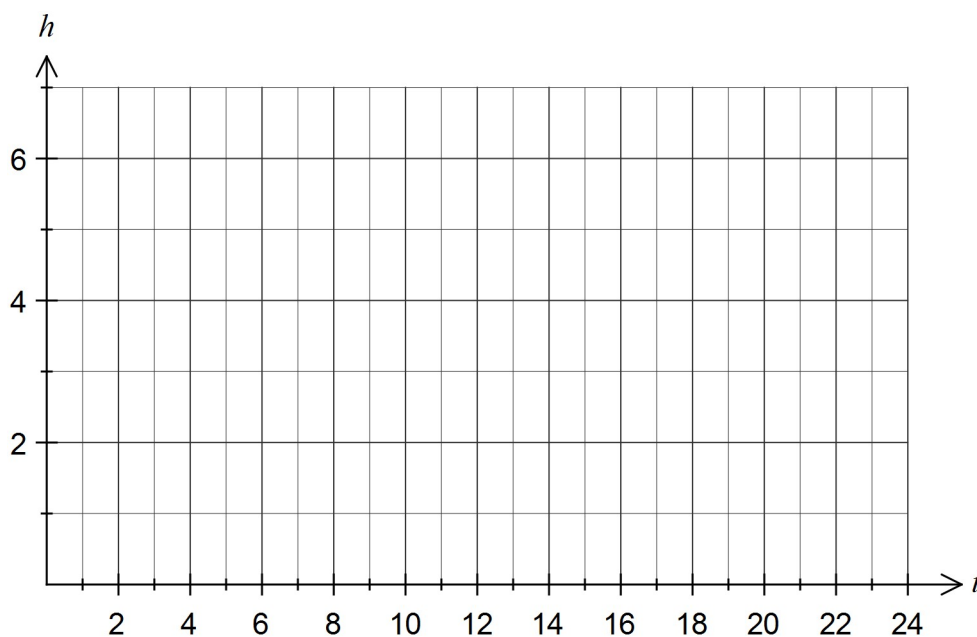


(i) If $f(x) = a \cos x$ and $g(x) = b \sin x$, state the values of a and b . (1 mark)

(ii) If $h(x) = f(x) + g(x)$ express $h(x)$ in the form $R \cos(x + \alpha)$. (3 marks)

- (b) The clearance, h metres, under a bridge spanning a river estuary varies with the time since midnight, t hours, and is given by $h = 3.6 + 2.7 \sin\left(\frac{\pi t}{6}\right)$.

- (i) Sketch the graph of the clearance against time on the axes below. (3 marks)



- (ii) Determine the percentage of any 24-hour period during which the clearance under the bridge is no more than two metres. (2 marks)

Question 4**(8 marks)**

- (a) A committee of eight people is to be selected from 10 junior, 14 adult and 11 senior nominations from the members of a club. Determine the number of ways the committee can be selected if
- (i) there are no restrictions. (1 mark)
- (ii) there must be five adults and more seniors than juniors. (3 marks)
- (b) Six books are to be selected for promotion in a newsletter from a choice of nine crime, seven fantasy and six romance novels. Determine the number of selections that include three fantasy or three romance novels. (4 marks)

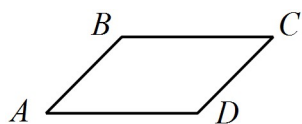
Question 5**(7 marks)**

A cyclist pedals at a speed of 25 km/h along a road on a bearing of 300° . Relative to the cyclist, the wind appears to be blowing from 280° with a speed of 30 km/h.

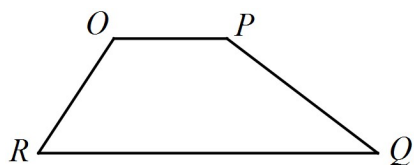
- (a) Sketch a labelled diagram to show the relationship between the velocities of the cyclist, the wind and the wind relative to the cyclist. (2 marks)
- (b) Express the velocities of the cyclist and the wind relative to the cyclist in the component form, rounding coefficients to two decimal places. (2 marks)
- (c) Determine the true speed of the wind and the bearing from which it is blowing. (3 marks)

Question 6**(9 marks)**

- (a) Figure $ABCD$ is a parallelogram. Let $\overrightarrow{AB} = \mathbf{b}$ and $\overrightarrow{AD} = \mathbf{d}$. Prove that the diagonals AC and BD are perpendicular only when $|\mathbf{b}| = |\mathbf{d}|$. (4 marks)



- (b) Figure $OPQR$ is a trapezium, with OP parallel to RQ and $RQ = 3OP$. If M is the point of intersection of OQ and PR , $\overrightarrow{OP} = \mathbf{p}$, $\overrightarrow{OR} = \mathbf{r}$, $\overrightarrow{OM} = \lambda \overrightarrow{OQ}$ and $\overrightarrow{RM} = \mu \overrightarrow{RP}$ show that $\overrightarrow{OM} = \frac{1}{4}\mathbf{r} + \frac{3}{4}\mathbf{p}$. (5 marks)

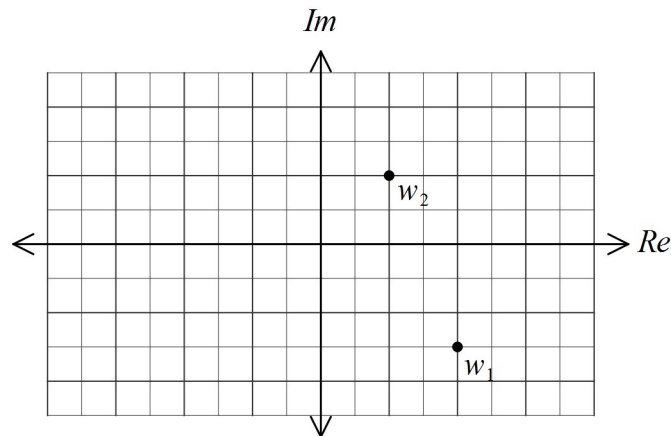


Question 7**(8 marks)**

(a) Solve $2(z - 3)^2 + 2 = 0$.

(2 marks)

(b) The complex numbers w_1 and w_2 are shown in the Argand plane below.



Plot and label the complex numbers given by

(i) $z_1 = \bar{w}_1$. (1 mark)

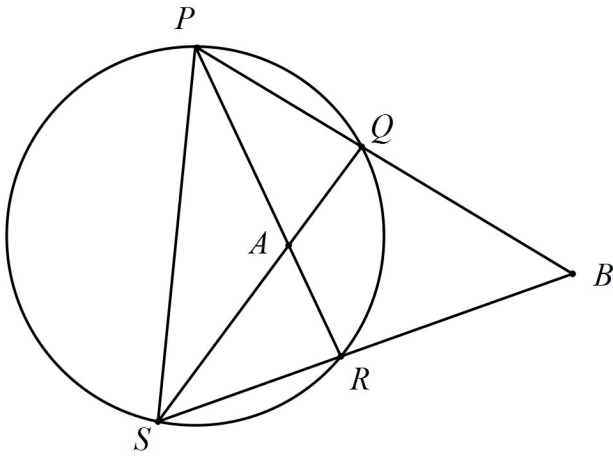
(ii) $z_2 = w_2 - w_1$. (1 mark)

(iii) $z_3 = \overline{w_1 + w_2}$. (1 mark)

(c) One solution of the quadratic equation $x^2 + bx + c = 0$ is $x = 3 - 2i$. Determine the values of the real coefficients b and c . (3 marks)

Question 8**(8 marks)**

The points P , Q , R and S lie on a circle of radius r . PR and QS meet at A . PQ and SR are produced to meet at B , and $AQBR$ is a cyclic quadrilateral.



(a) Prove that BS is perpendicular to PR .

(6 marks)

(b) Prove that the length of PS is $2r$.

(2 marks)

Question 9**(7 marks)**

Let $P(n) = 10^n + 18n - 1$.

(a) If $P(1) = 9a$ and $P(2) = 9b$, evaluate a and b .

(2 marks)

(b) Prove by induction that $P(n)$ is always a multiple of nine when n is a positive integer.

(5 marks)