Time Allowed 20 Minutes	First Name	Surname	Marks 20 marks

Circle your Teacher's Name: Bestall   Goh   Fraser-Jones   Freer

Koulianos   Luzuk   Rudland   Tanday

Assessment Conditions: *(N.B. Sufficient working out must be shown to gain full marks)*

❖ Calculators: Not Allowed

❖ Formula Sheet: Provided

❖ Notes: Not Allowed

Question 1   **[3, 2 = 5 marks]**

An arithmetic sequence is such that: $T_{19} = 61$ and $T_{30} = 94$,

(a) Determine the first three terms of the sequence, and

(b) Determine S_{30} ?

Question 2 **[3 marks]**

Differentiate using the first pinciple definition $y = 3x^2 - 1$.

Question 3   **[1, 2, 3 = 6 marks]**

(a)   Determine $\dfrac{dy}{dx}$ for the following, leaving your answer in simplest form, with positive indices:

     (i) $y = 5x^4$
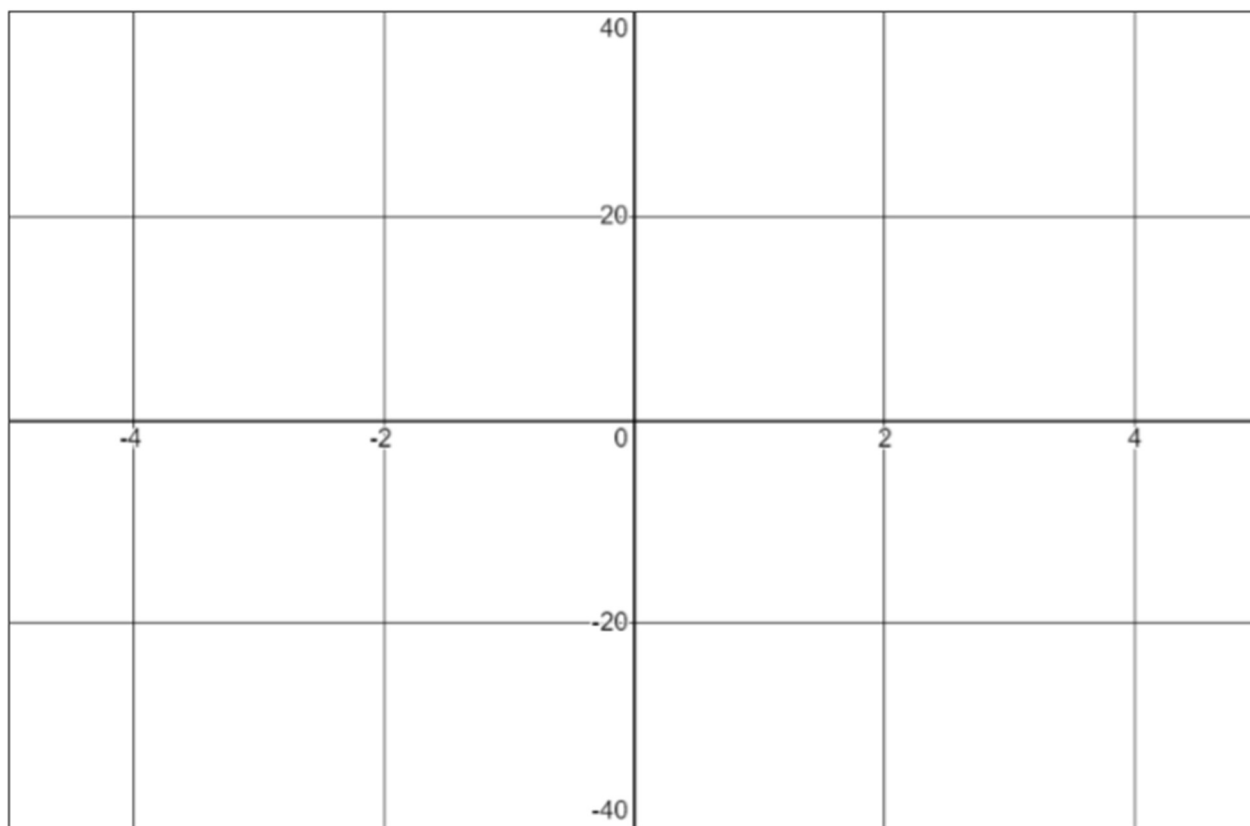
     (ii) $y = 12(\sqrt{x})^3$

(b)   Determine $\dfrac{dy}{dx}$ when $x = 1$, if $y = \dfrac{x^4}{4} - \dfrac{2}{x^2}$.

Question 4 [4, 2 = 6 marks]

(a) Use calculus techniques to determine the coordinates of both stationary points of
$y = (x + 2)^2(x - 4)$.

(b) Graph the function on the axes below showing all axes intercepts and the stationary points:

Time Allowed 25 Minutes	First Name	Surname	Marks 27 marks

Circle your Teacher's Name: Bestall   Goh   Fraser-Jones   Freer

Koulianos   Luzuk   Rudland   Tanday

Assessment Conditions: *(N.B. Sufficient working out must be shown to gain full marks)*

❖ Calculators: Allowed

❖ Formula Sheet: Provided

❖ Notes: Not Allowed

Question 5   **[4 marks]**
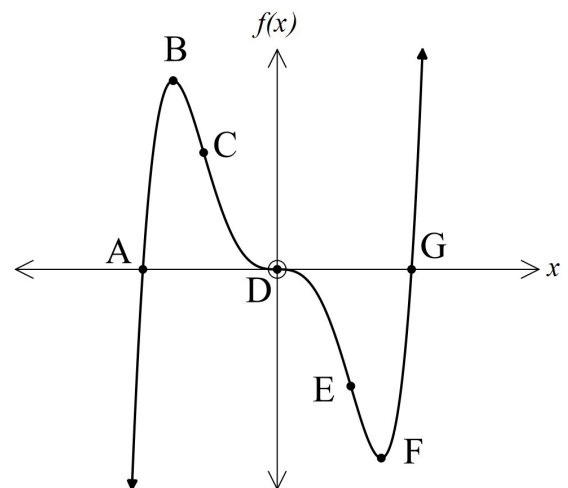
Study the diagram on the right.

Hence, name the point(s) using letters A to G,

(i)   where $f(x) = 0$

(ii)   where $f'(x) < 0$

(iii)   where $f'(x) = 0$ and there is a change in concavity.

(iv)   which would be the x intercepts on the graph of $y = f'(x)$.

Question 6 [3, 5 = 8 marks]

A closed rectangular block has a square base of side, x cm, and a height of y cm, and a volume $80\,cm^3$. The base and top are to be covered with paint costing $5\;cents/cm^2$ and the sides with paint costing $4\;cents/cm^2$.

(a) Show that the Cost function, C, is given by $C = 10x^2 + \dfrac{1280}{x}$ where C is measured in cents.

(b) Use calculus techniques to find the values for x and y that minimises the cost of painting the block, and state the minimum cost?

Question 7   **[3, 4 = 7 marks]**

A farmer estimates that if 75 pecan nut trees are planted per hectare, the average yield per tree will be 7kg.

For every tree less that he plants on the same acreage, the average yield per tree will increase by 0.2 kg per tree.

(a) Complete row 3 in the table below, and hence determine general expressions for **A** and **B** in the table:

Number of Trees	Number of kg	Yield
75	7	525
$75 - 1$	$7 + 0.2$	$(75 - 1)(7 + 0.2)$
$(75 - x)$	**A**	**B**

(b) Use calculus techniques to determine how many trees per hectare should the farmer plant to maximise yield?

Question 8   **[2, 2, 2, 2 = 8 marks]**

Thomas the Tank Engine is moving around a circular track of radius 1.4 m and at the end of the first minute had completed 12 laps of the track. In each subsequent minute, as the batteries run down, the train travels 90% of the distance travelled in the previous minute.

(a)   Determine the distance travelled by Thomas the Tank Engine during the fifth minute, to two decimal places.

(b)   During which minute does Thomas the Tank Engine first travel less than one complete lap of the circuit?

(c)   Determine the minimum time, to the nearest minute, that Thomas the Tank Engine takes to travel a total distance of 500 metres.

(d)   Show that the train will complete more than 115 laps of the circuit.

-END OF CALCULATOR ASSUMED SECTION-