22.) A particle moves along a straight line so that its velocity, v m s^{-1} at time t seconds is given by $v = 6e^{3t} + 4$. When $t = 0$, the displacement, s, of the particle is 7 metres. Find an expression for s in terms of t. **(Total 7 marks)**

[non-calc]

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10. *[Maximum mark: 15]*

[non-calc]

In this question, you are given that $\cos\frac{\pi}{3} = \frac{1}{2}$, *and* $\sin\frac{\pi}{3} = \frac{\sqrt{3}}{2}$.

The displacement of an object from a fixed point, O is given by $s(t) = t - \sin 2t$ for $0 \le t \le \pi$.

(a) Find $s'(t)$. *[3 marks]*

In this interval, there are only two values of t for which the object is not moving. One value is $t = \frac{\pi}{6}$.

(b) Find the other value. *[4 marks]*

(c) Show that $s'(t) > 0$ between these two values of t. *[3 marks]*

(d) Find the distance travelled between these two values of t. *[5 marks]*

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7.)

The displacement s metres of a car, t seconds after leaving a fixed point A, is given by

$$s = 10t - 0.5t^2.$$

(a) Calculate the velocity when $t = 0$.

(b) Calculate the value of t when the velocity is zero.

(c) Calculate the displacement of the car from A when the velocity is zero.

[non-calc]

13.

The acceleration, a m s^{-2}, of a particle at time t seconds is given by

$$a = \frac{1}{t} + 3\sin 2t, \text{ for } t \geq 1.$$

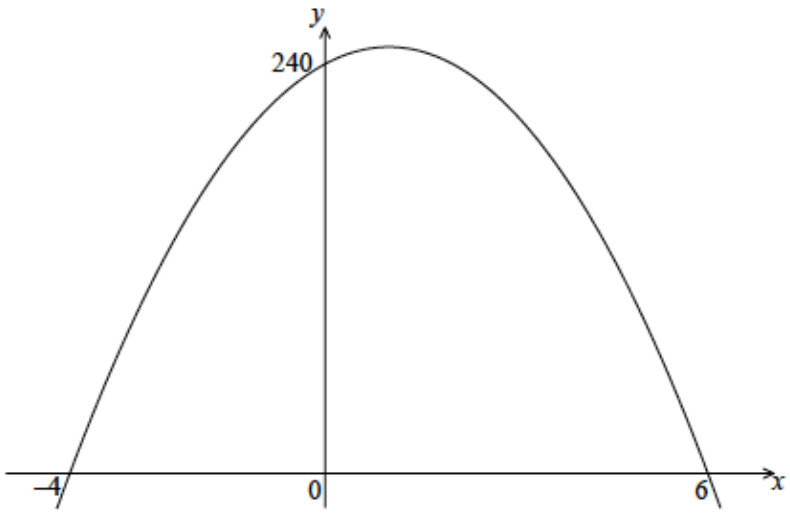
The particle is at rest when $t = 1$.

Find the velocity of the particle when $t = 5$.

[non-calc]

9. *[Maximum mark: 15]*

The following diagram shows part of the graph of a quadratic function f.



The x-intercepts are at $(-4, 0)$ and $(6, 0)$, and the y-intercept is at $(0, 240)$.

(a) Write down $f(x)$ in the form $f(x) = -10(x-p)(x-q)$. *[2 marks]*

(b) Find another expression for $f(x)$ in the form $f(x) = -10(x-h)^2 + k$. *[4 marks]*

(c) Show that $f(x)$ can also be written in the form $f(x) = 240 + 20x - 10x^2$. *[2 marks]*

A particle moves along a straight line so that its velocity, v m s^{-1}, at time t seconds is given by $v = 240 + 20t - 10t^2$, for $0 \le t \le 6$.

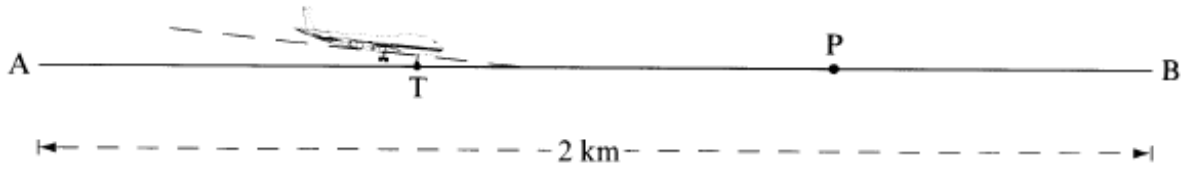
(d) (i) Find the value of t when the speed of the particle is greatest.

[non-calc]

(ii) Find the acceleration of the particle when its speed is zero. *[7 marks]*

2. *[Maximum mark: 15]*

The main runway at *Concordville* airport is 2 km long. An aeroplane, landing at *Concordville*, touches down at point T, and immediately starts to slow down. The point A is at the southern end of the runway. A marker is located at point P on the runway.



Not to scale

As the aeroplane slows down, its distance, s, from A, is given by

$$s = c + 100t - 4t^2,$$

where t is the time in seconds after touchdown, and c metres is the distance of T from A.

(a) The aeroplane touches down 800 m from A, (*i.e.* $c = 800$).

(i) Find the distance travelled by the aeroplane in the first 5 seconds after touchdown. *[2 marks]*

(ii) Write down an expression for the velocity of the aeroplane at time t seconds after touchdown, and hence find the velocity after 5 seconds. *[3 marks]*

The aeroplane passes the marker at P with a velocity of 36 m s^{-1}. Find

(iii) how many seconds after touchdown it passes the marker; *[2 marks]*

(iv) the distance from P to A. *[3 marks]*

(b) Show that if the aeroplane touches down before reaching the point P, it can stop before reaching the northern end, B, of the runway. *[5 marks]*

[calculator]

Answer key:

22.) evidence of anti-differentiation (M1)

$e.g.\ s = \int (6e^{3x} + 4)dx$

$s = 2e^{3t} + 4t + C$ A2A1

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substituting $t = 0$, (M1)

$7 = 2 + C$ A1

$C = 5$

$s = 2e^{3t} + 4t + 5$ A1 N3

[7]

10b) 5π/6 ; 10d) 2π/3 + √3

7a) 10, 10, 50

13) ln 5 – (3 cos(10))/2 + (3 cos (2))/2

9di) 1 sec; 9dii) –100 ms^{-2}

2ai) 400m; 2aii) derivative of distance; 2aiii) 8 seconds; 2aiv) 1344m
2b) when a plane is stopped, what is its velocity? How much time does it take for the plane to reach that velocity?