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SPECIALIST MATHEMATICS

TRIAL EXAMINATION 2

2009

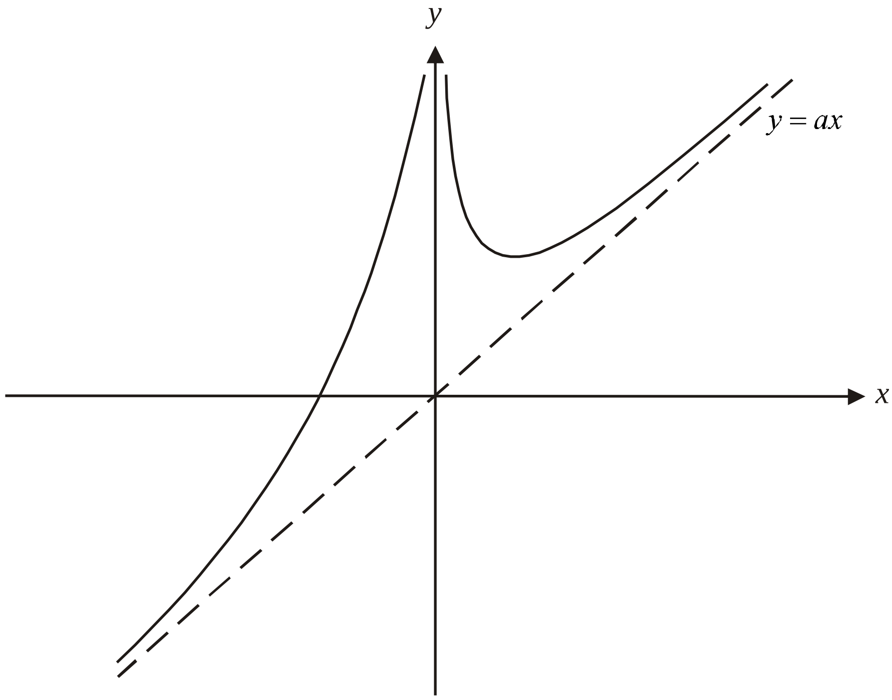
Reading Time: 15 minutes
Writing time: 2 hours

Instructions to students

This exam consists of Section 1 and Section 2.
Section 1 consists of 22 multiple-choice questions and should be answered on the detachable answer sheet on page 33 of this exam. This section of the paper is worth 22 marks.
Section 2 consists of 5 extended-answer questions, all of which should be answered in the spaces provided. Section 2 begins on page 13 of this exam. This section of the paper is worth 58 marks.
There is a total of 80 marks available.
Where more than one mark is allocated to a question, appropriate working must be shown.
Where an exact value is required to a question a decimal approximation will not be accepted.
Unless otherwise stated, diagrams in this exam are not drawn to scale.
The acceleration due to gravity should be taken to have magnitude g m/s^2 where $g = 9.8$
Students may bring one bound reference into the exam.
Students may bring an approved graphics or CAS calculator into the exam.
Formula sheets can be found on pages 30 - 32 of this exam.

SECTION 1

Question 1



The graph shown above could have the equation

A. $y = \dfrac{ax^3 + 1}{x}, \ a < 0$

B. $y = \dfrac{ax^3 + 1}{x^2}, \ a > 0$

C. $y = \dfrac{x^3 + a}{x^2}, \ a > 0$

D. $y = \dfrac{ax^4 + a}{x}, \ a > 0$

E. $y = \dfrac{ax^4 + 1}{x^2}, \ a < 0$

Question 2

The graph of the function $f:[0,\infty) \to R,\ f(x) = \text{cosec}(ax), a > 0$ has asymptotes located at

A. $x = 0, \dfrac{2\pi}{a}, \dfrac{4\pi}{a}, \dfrac{6\pi}{a}, \ldots$

B. $x = \dfrac{\pi}{2a}, \dfrac{3\pi}{2a}, \dfrac{5\pi}{2a}, \dfrac{7\pi}{2a}, \ldots$

C. $x = 0, \dfrac{\pi}{a}, \dfrac{2\pi}{a}, \dfrac{3\pi}{a}, \ldots$

D. $x = \dfrac{\pi}{a}, \dfrac{3\pi}{a}, \dfrac{5\pi}{a}, \dfrac{7\pi}{a}, \ldots$

E. $x = 0, \ \pi a, \ 2\pi a, \ 3\pi a, \ldots$

Question 3

The domain and range of the function $y = 2\arcsin(2x+1) - \pi$ are given respectively by

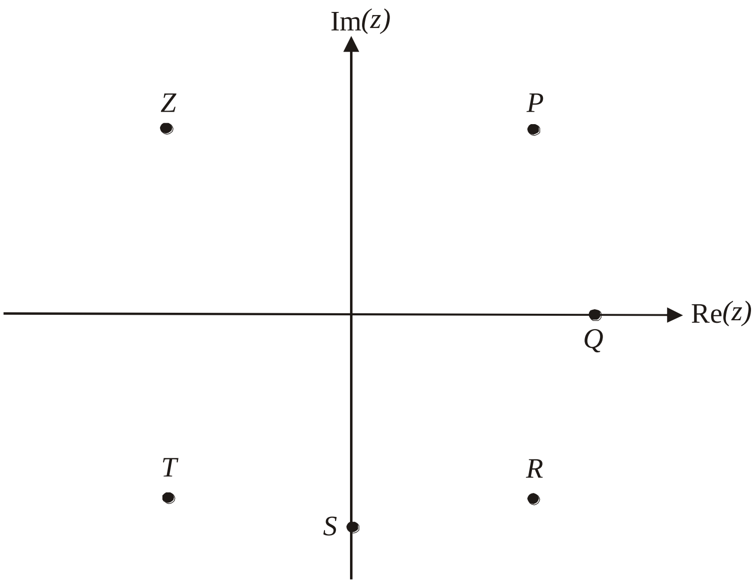
A. $\left[-\frac{1}{2}, \frac{1}{2}\right]$ and $[-\pi, \pi]$
B. $[-\pi, \pi]$ and $[-1, 0]$
C. $[0,1]$ and $[-\pi, 0]$
D. $[-\pi, 0]$ and $\left[-\frac{1}{2}, 0\right]$
E. $[-1, 0]$ and $[-2\pi, 0]$

Question 4

If $z = \sqrt{3}\text{cis}\left(-\frac{\pi}{2}\right)$ then $\text{Arg}(z^6)$ is equal to

A. -3π
B. $-\pi$
C. $-\frac{\pi}{12}$
D. $\frac{\pi}{2}$
E. π

Question 5



The point Z on the Argand diagram above represents the complex number z.
The complex number $\bar{z}i$ could be represented by the point

A. P
B. Q
C. R
D. S
E. T

Question 6

The relation $|z-ai|=|z+a|$, $a>0$, is represented on an Argand diagram. The graph shows a straight line. That line passes through the point representing the complex number

A. $-a-ai$ and has a gradient of 1
B. $-a+ai$ and has a gradient of – 1
C. ai and has a gradient of 1
D. $a+ai$ and has a gradient of – 1
E. $a+ai$ and has a gradient of 1

Question 7

$p(z)$ is a cubic polynomial with real coefficients and $z \in C$.
If $z=-ai, a \in R$, is a root of $p(z)=0$ then $p(z)$ could be given by

A. z^2+a^2
B. z^3+a^3
C. z^3-a^3
D. $z^3-z^2+a^2z-a^2$
E. $z^3-z^2+a^2z+a^2$

Question 8

Using a suitable substitution $\int_0^{\frac{\pi}{2}} \sin(x)\cos^3(x)\,dx$ can be expressed as

A. $-\int_0^{\frac{\pi}{2}} u^3 du$
B. $\int_0^{\frac{\pi}{2}} u^3 du$
C. $-\int_0^{1} u^3 du$
D. $\int_1^{0} u^3 du$
E. $\int_0^{1} u^3 du$

Question 9

If $f'(t) = \ln(t+1)$ and $f(0) = 2$ then the solution to this differential equation when $t = 1$ can be found by evaluating

A. $\int_0^1 \ln(t+1)\,dt$

B. $\int_0^1 \ln(t+1)\,dt - 2$

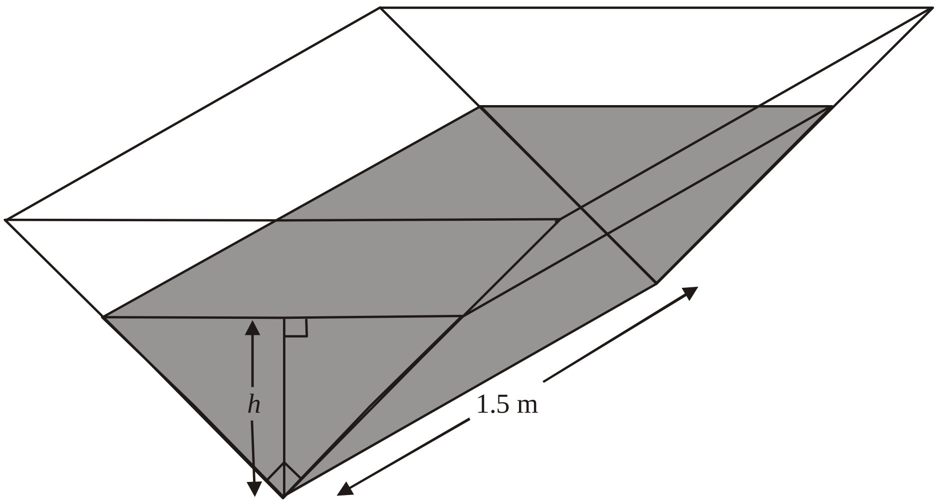
C. $\int_0^1 \ln(t+1)\,dt + 2$

D. $\int_0^1 (2 + \ln(t+1))\,dt$

E. $\int_0^1 (-2 + \ln(t+1))\,dt$

Question 10

A water trough is in the shape of a triangular prism of length 1.5m. The cross-section of the trough is a right isosceles triangle.



The trough is being filled at the rate of 300cm^3/min.
Let *h* cm be the height of the water in the trough *t* minutes after it has started to be filled.
The rate in cm/min, at which the height of the water is increasing when $h = 20$ is

A. 0.0025
B. 0.005
C. 0.05
D. 0.25
E. 5

Question 11

Using a suitable substitution, $\int_0^2 \frac{2x-1}{\sqrt{3-x}}\,dx$ can be expressed as

A. $\int_0^2 (7-2u)\,du$

B. $\int_0^2 (5u^{-\frac{1}{2}}-2u^{\frac{1}{2}})\,du$

C. $\int_1^3 (7u^{-\frac{1}{2}}-2u)\,du$

D. $-\int_1^3 (5u^{-\frac{1}{2}}-2u^{\frac{1}{2}})\,du$

E. $\int_1^3 (5u^{-\frac{1}{2}}-2u^{\frac{1}{2}})\,du$

Question 12

A 200 litre gas cylinder contains 40% hydrogen by volume. To increase this level, pure hydrogen is pumped into the cylinder at a constant rate of 5 litres/minute whilst the mixture in the cylinder, which has been uniformly mixed, is pumped out at a rate of 5 litres/minute.
Let H represent the volume of hydrogen in litres present in the cylinder t minutes after the pumping in and out begins.
A differential equation for H in terms of t is

A. $\frac{dH}{dt}=\frac{H-80}{200}, \quad t=0, H=80$

B. $\frac{dH}{dt}=\frac{H-80}{200}, \quad t=0, H=200$

C. $\frac{dH}{dt}=\frac{H}{40}, \quad t=0, H=200$

D. $\frac{dH}{dt}=\frac{200-H}{40}, \quad t=0, H=80$

E. $\frac{dH}{dt}=\frac{195-H}{40}, \quad t=0, H=80$

Question 13

The position vectors of two particles R and S at time t, $t \geq 0$, are given by

$$\underset{\sim}{r} = t^2\,\underset{\sim}{i} + (3t-4)\,\underset{\sim}{j}$$

$$\text{and }\ \underset{\sim}{s} = (7t-10)\,\underset{\sim}{i} + 11\,\underset{\sim}{j}$$

The particles are in the same position when

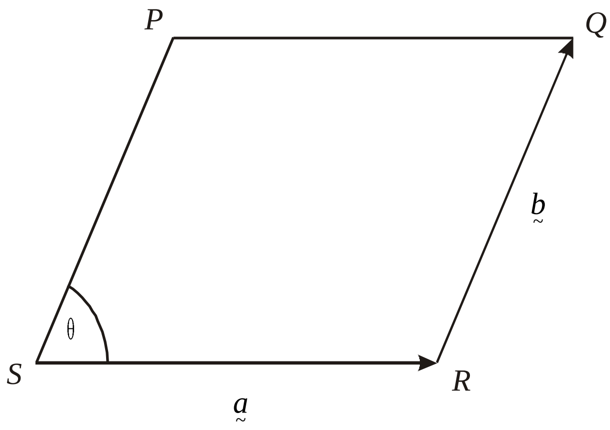
A. $t = 2$
B. $t = 5$
C. $t = 2$ and $t = 5$
D. $t = 2$ or $t = 10$
E. $t = 10$

Question 14

If $\underset{\sim}{a} = \underset{\sim}{i} + 2\,\underset{\sim}{j} + 2\,\underset{\sim}{k}$ and $\underset{\sim}{b} = 2\underset{\sim}{i} - \underset{\sim}{j} + 2\,\underset{\sim}{k}$ then the angle between $\underset{\sim}{a}$ and $\underset{\sim}{b}$ is closest to

A. $26°$
B. $27°$
C. $64°$
D. $76°$
E. $87°$

Question 15



In the rhombus *PQRS*, $\overrightarrow{SR} = \underset{\sim}{a}$, $\overrightarrow{RQ} = \underset{\sim}{b}$, $\angle PSR = \theta$, $\theta \neq 90^\circ$ and $|\underset{\sim}{a}| = 1$.

Which one of the following statements is false?

A. $\underset{\sim}{a} \bullet \underset{\sim}{a} = \underset{\sim}{b} \bullet \underset{\sim}{b}$

B. $|\underset{\sim}{a}| = |\underset{\sim}{b}|$

C. $\underset{\sim}{a} \bullet \underset{\sim}{b} = \cos(\theta)$

D. $\underset{\sim}{a} \bullet \underset{\sim}{b} = \cos(180 - \theta)$

E. $\underset{\sim}{a} \bullet \underset{\sim}{b} \neq 0$

Question 16

The position vector of a particle at time *t*, $t \geq 0$, is given by $\underset{\sim}{r} = 2\sqrt{t}\,\underset{\sim}{i} + (5 - t)\,\underset{\sim}{j}$.

The particle is closest to the origin when

A. $t = 0$
B. $t = 1$
C. $t = 3$
D. $t = 4$
E. $t = 5$

Question 17

Three forces $\underset{\sim}{P}, \underset{\sim}{Q}$ and $\underset{\sim}{R}$ act on a body of mass 8kg. The forces are all measured in newtons and $\underset{\sim}{P} = 4\underset{\sim}{i} - \underset{\sim}{j}$, $\underset{\sim}{Q} = -3\underset{\sim}{i} + 2\underset{\sim}{j}$ and $\underset{\sim}{R} = 2\underset{\sim}{i} + 3\underset{\sim}{j}$.

The magnitude of the acceleration of the body in m/s^2 is

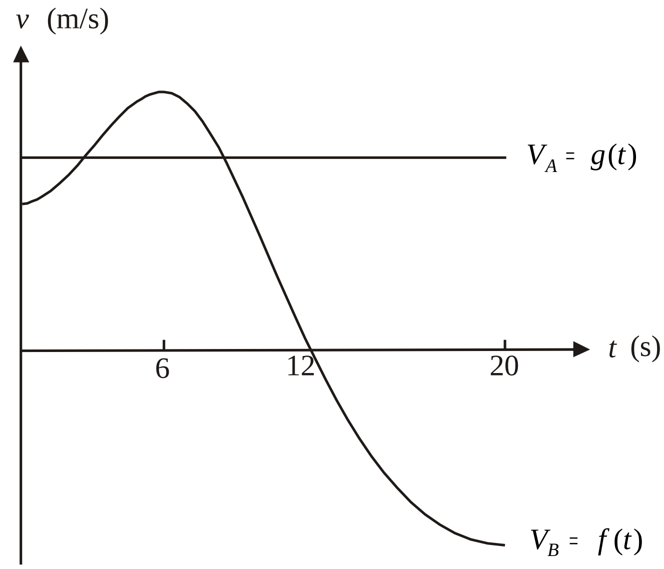
A. $\frac{5}{8}$
B. $\frac{3}{4}$
C. $\frac{7}{8}$
D. $\frac{4}{3}$
E. $\frac{5}{2}$

Question 18

A mass travels in a straight line at 4m/s and has a momentum of 20kg m/s.
A force acts on the mass in the same direction of motion so that the mass accelerates at 0.5m/s^2 until it has a momentum of 45kg m/s.
The distance in metres covered by the mass during this time is

A. 25
B. 26.25
C. 47
D. 65
E. 125

Question 19



Particles *A* and *B* move from the same point in a straight line with velocities in m/s given respectively by $V_A = g(t)$ and $V_B = f(t)$ where *t* is in seconds and $t \geq 0$.
The velocity-time graphs for the particles are shown above.
At $t = 20$ seconds, the distance in metres between the particle *A* and particle *B* is given by

A. $\left|\int_0^{20} f(t)dt - 20g(20)\right|$

B. $\left|\int_0^{20} f(t)dt - g(t)\right|$

C. $\left|\int_0^{6} f(t)dt - \int_6^{20} f(t)dt - 20g(t)\right|$

D. $\left|\int_0^{12} f(t)dt - \int_{12}^{20} f(t)dt - 20g(20)\right|$

E. $\left|\int_0^{12} f(t)dt - \int_{12}^{20} f(t)dt - 20g(t)\right|$

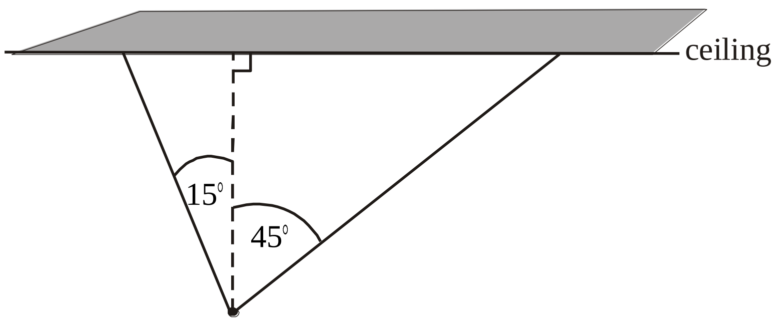
Question 20

The acceleration a m/s^2 of a body moving in a straight line when it is x m from a fixed origin is given by $a = \dfrac{1}{\sqrt{4 - x^2}}$.
When the body passes through the origin its velocity v m/s is 4 m/s.
The function x expressed in terms of v is given by

A. $x = 2\sin(v - 4)$
B. $x = 2\cos(v^2 - 4)$
C. $x = 2\sin\left(\dfrac{v^2 - 8}{2}\right)$
D. $x = 2\cos\left(\dfrac{v^2 - 8}{2}\right)$
E. $x = 2\sin\left(\dfrac{v^2 - 16}{2}\right)$

Question 21

A mass of 12kg is suspended from a horizontal ceiling by two light inextensible strings of different lengths. The shorter string makes an angle of 15° with the vertical and the longer string makes an angle of 45° with the vertical as shown below in the diagram.

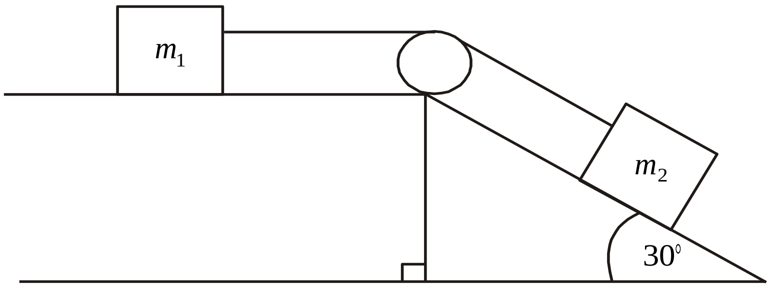


The magnitude in newtons of the tension in the shorter string is

A. $\sqrt{6}$
B. $4\sqrt{6}$
C. $\sqrt{6}$g
D. $4\sqrt{6}$g
E. $6\sqrt{6}$g

Question 22

A mass of m_1 kg rests on a rough horizontal surface and is connected by a light string that passes over a smooth pulley and is connected to a second mass m_2 kg.
This second mass rests on a plane with a rough surface inclined at an angle of 30° to the horizontal.
The coefficient of friction between the m_1 kg mass and the horizontal surface is μ as is the coefficient of friction between the m_2 kg mass and the inclined plane. The m_2 kg mass is on the point of slipping down the plane.



The ratio $\frac{m_1}{m_2}$ is equal to

A. $\frac{1}{2\mu}$

B. $\frac{1-\sqrt{3}\mu}{2\mu}$

C. $\frac{1+\sqrt{3}\mu}{2\mu}$

D. $\frac{\sqrt{3}-\mu}{2\mu}$

E. $\frac{\sqrt{3}+\mu}{2\mu}$

SECTION 2

Question 1

A red light moves around a closed shape in a lighting display. It has a position vector given by

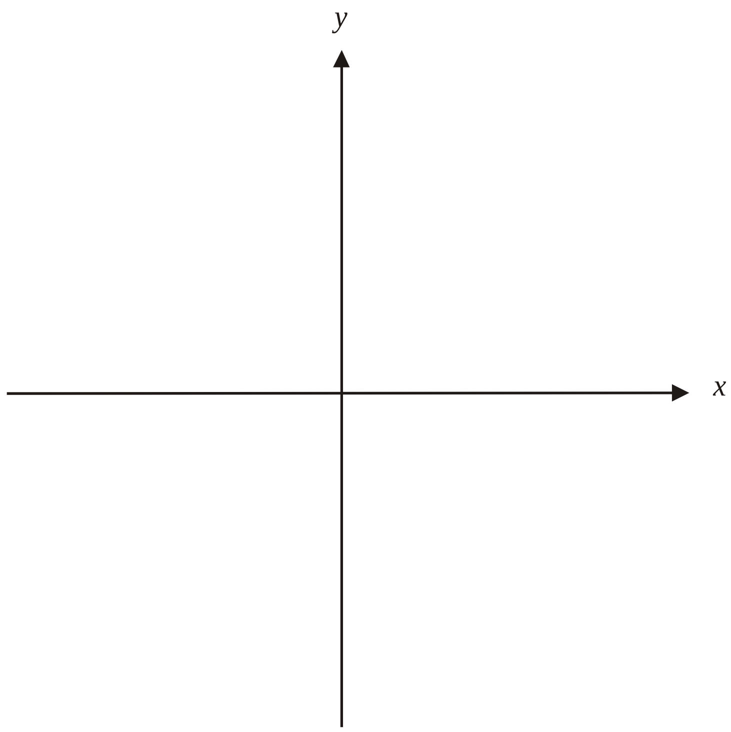
$$\underset{\sim}{r}(t) = 2\cos(t)\,\underset{\sim}{i} + 3\sin(t)\,\underset{\sim}{j}, \quad t \geq 0$$

where t represents time in seconds and the displacement components are measured in metres.

a. Find the Cartesian equation of the path of the red light.

1 mark

b. Sketch the path of the red light on the set of axes below.



1 mark

c. Describe the path of the red light including its starting point and the direction it travels in.

2 marks

d. How long does it take the red light to complete one complete circuit of the closed shape? Express your answer in exact form.

1 mark

e. Show that the speed of the red light is given by $\sqrt{4\sin^2(t)+9\cos^2(t)}$.

2 marks

f. It is known that $\frac{d}{dt}\left(\sqrt{4\sin^2(t)+9\cos^2(t)}\right)=\frac{-5\sin(t)\cos(t)}{\sqrt{5\cos^2(t)+4}}$.

i. Hence or otherwise find the time(s) when the speed of the red light is a maximum for $0<t\leq 2\pi$.

ii. What is the maximum speed of the red light?

$2+1=3$ marks
Total 10 marks

Question 2

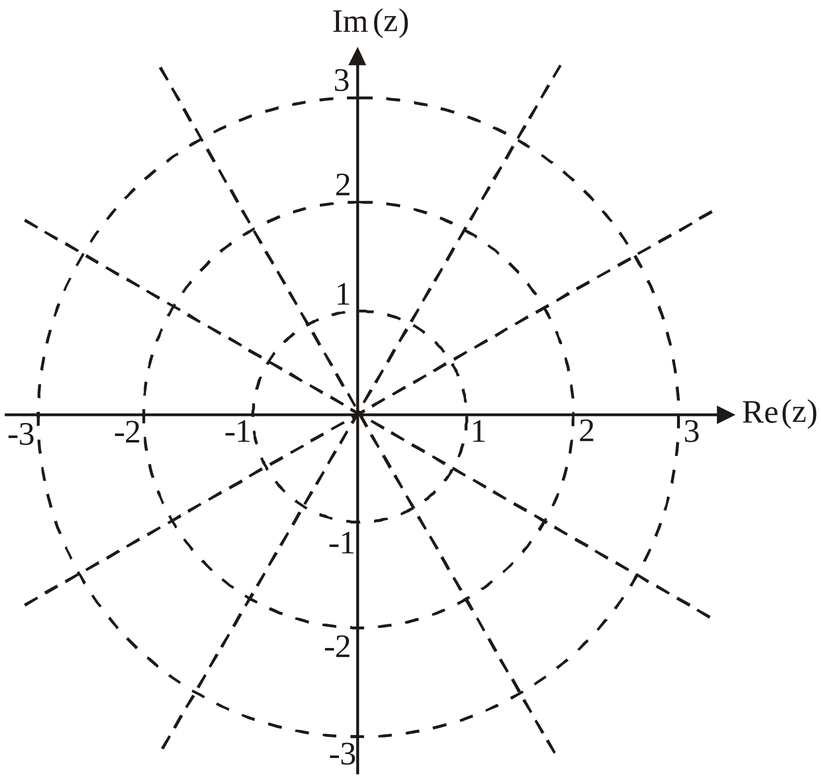
Let $z_1 = \sqrt{3} + i$.

a. Express z_1 in polar form.

1 mark

z_1 is a root of the equation $z^3 = 8i$.

b. Plot z_1 and the other roots of this equation on the Argand diagram below. Label each one clearly, expressing them in polar form.



3 marks

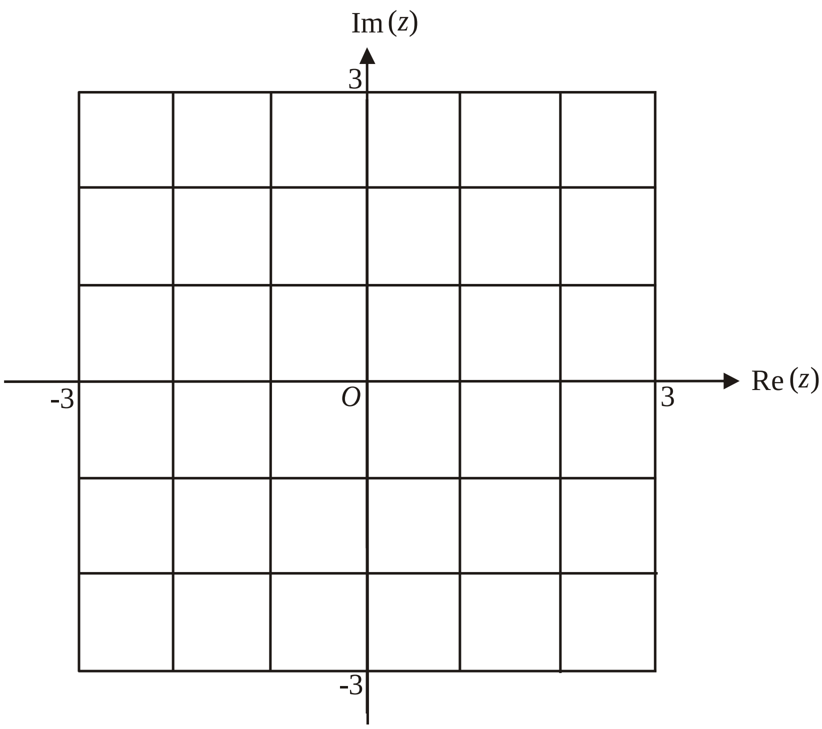
Let $z = x + iy,\ x, y \in R$ and $z_1 = \sqrt{3} + i$ (from part **a.**)

c. Show that the Cartesian equation for the relation $z\bar{z} + |z_1| \times \mathrm{Re}(i^2 z) - 2\mathrm{Im}(z) = -1$ is given by $(x-1)^2 + (y-1)^2 = 1$.

2 marks

Let $S = \{z : z\bar{z} + |z_1| \times \mathrm{Re}(i^2 z) - 2\mathrm{Im}(z) \le -1\} \cap \left\{0 \le \mathrm{Arg}(z) \le \frac{\pi}{4}\right\}$.

d. Sketch the region described by S on the Argand diagram below.



3 marks

e. If $z_2 \in S$, find the maximum and minimum values of $|z_2|$. Express your values in exact form.

3 marks
Total 12 marks

Question 3

A hot air balloon of mass 700kg lifts off the ground with a lift force of L newtons acting vertically upwards. The only other force acting on the hot air balloon during this time is the gravitational force. The balloon accelerates at 0.5m/s^2.

a. Find the value of L.

1 mark

b. How long does it take for the balloon to be 50m above the ground?

1 mark

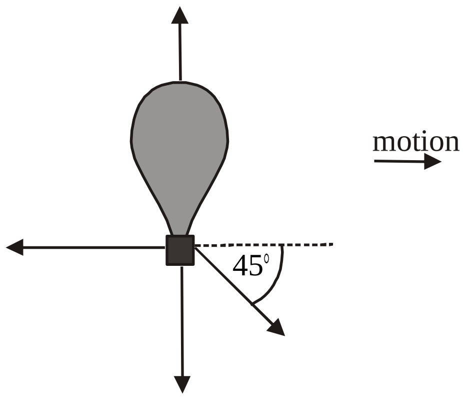
c. What is the velocity of the balloon at this altitude?

1 mark

After the hot air balloon has completed its flight it prepares to land. A rope is dropped from the balloon to the crew below who anchor the rope to a vehicle. The pilot of the balloon maintains the balloon at a constant altitude whilst it is towed in a straight line by the vehicle to a safe landing spot. The horizontal velocity of the balloon is v m/s.

During this phase, the forces acting on the balloon are a lift force L newtons, the towing force of 1200 newtons, the resistance force of $\frac{v}{50}$ newtons and the gravitational force.
The rope used to tow the balloon makes an angle of 45° to the horizontal.

d. On the diagram below label the forces acting on the hot air balloon.



1 mark

Whilst the pilot of the balloon maintains a constant altitude, the balloon is towed horizontally at a m/s^2.

e. Write down the equation of motion for the balloon during this phase and express a in terms of v.

2 marks

f. Find the distance covered by the balloon when $v = 5\text{m/s}$ given that $v = 0$ when the vehicle began towing the balloon. Express your answer in metres correct to 2 decimal places.

2 marks

In order to land safely the balloon needs to be towed 100m.

g. Using an appropriate integral, verify that when $v = 15 \cdot 5685\,\text{m/s}$, the balloon has been towed 100m; to the nearest whole number, by the vehicle.

1 mark

h. Hence how long will it take to tow the balloon to safety? Express your answer correct to 2 decimal places.

3 marks
Total 12 marks

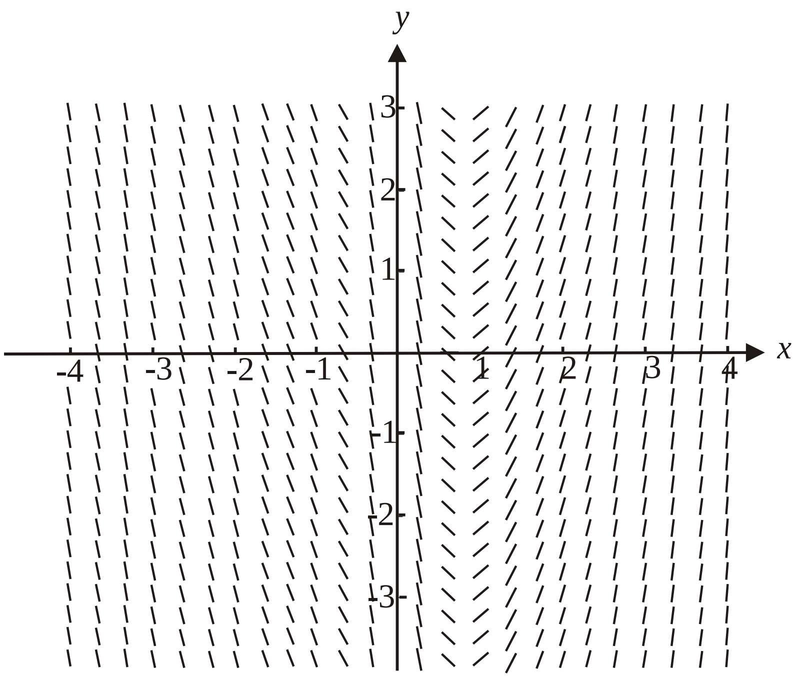
Question 4

Consider the differential equation

$$\frac{dy}{dx} = 2x - \frac{1}{x^2}.$$

One of the branches of the graph of one of the solutions to this differential equation passes through the point $(-1,-2)$.

a. On the direction (slope) field for this differential equation below, sketch both branches of the graph of this particular solution.



3 marks

b. For the particular solution to the differential equation that passes through the point $(-1,-2)$ use Eulers method with a step size of 0.25 to find an approximate value of y when $x = -\frac{1}{2}$. Express your answer correct to 2 decimal places.

2 marks

c. Verify that one of the branches of the graph of each of the solutions to this differential equation has a point of inflection and find the x-coordinate of the point of inflection.

3 marks

Let c be a constant of antidifferentiation obtained when the differential equation is solved.

d. For $x > 0$, find the value of c for which the graph of the solution to the differential equation touches but does not cut the x-axis. Express your answer correct to 4 decimal places.

2 marks
Total 10 marks

Question 5

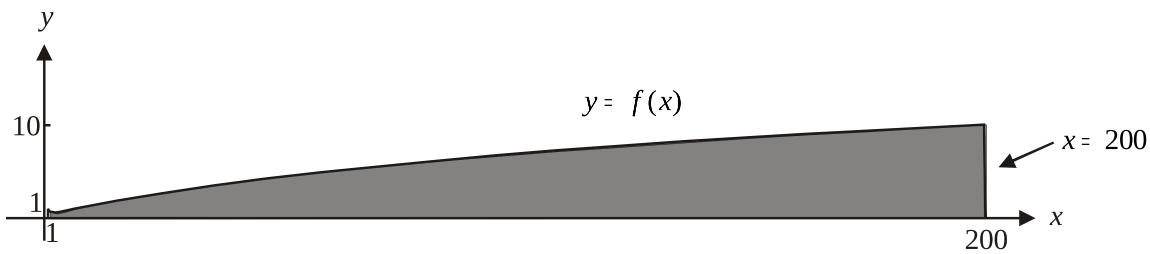
A function f has a rule given by $f(x)=\sqrt{\dfrac{x^3}{2x^2-1}}$.

a. Write down the maximal domain of the function *f*.

1 mark

A bridge that spans a harbour is constructed with pylons. Each pylon is constructed by rotating the region enclosed by the graph of the function $y=f(x)$, the x-axis and the lines $x=1$ and $x=200$ around the x-axis.

This region is indicated by the shaded area shown below.



The unit of measurement is the metre.

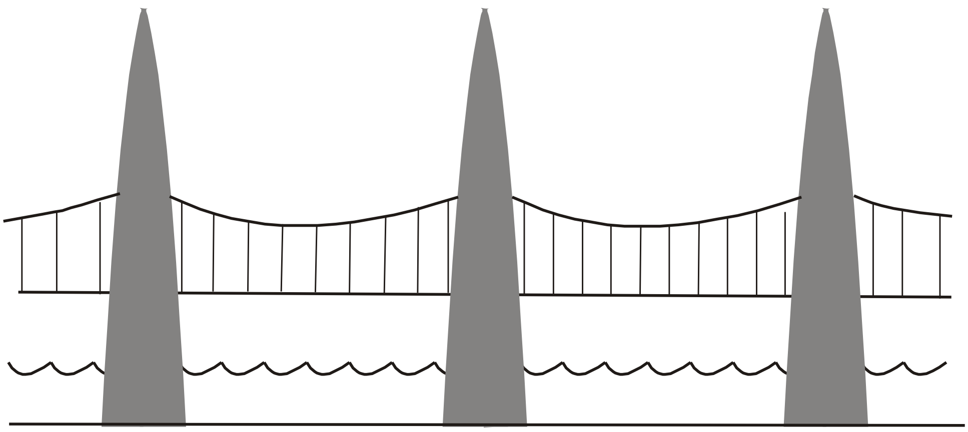
b. **i.** Write down an expression for V, the volume of the solid of rotation formed.

ii. Use a suitable substitution of $u = g(x)$ to write an integral expression for V in terms in u.

iii. Hence use calculus to find V in exact form.

$1+2+2=5$ marks

A cross-section of the bridge is shown below with the pylons standing vertically.



c. What is the height of each pylon?

1 mark

d. What is the diameter of each pylon at its base? Express your answer to the nearest whole metre.

1 mark

For the function $f(x)=\sqrt{\dfrac{x^3}{2x^2-1}}$, the first and second derivatives are given by

$$f'(x)=\frac{x^2(2x^2-3)}{2(2x^2-1)^2\sqrt{\dfrac{x^3}{2x^2-1}}} \text{ and } f''(x)=\frac{-x(4x^4-20x^2-3)}{4(2x^2-1)^3\sqrt{\dfrac{x^3}{2x^2-1}}}$$

e. Use $f'(x)$ to find the minimum radius of each of the pylons. Express your answer in metres correct to 2 decimal places.

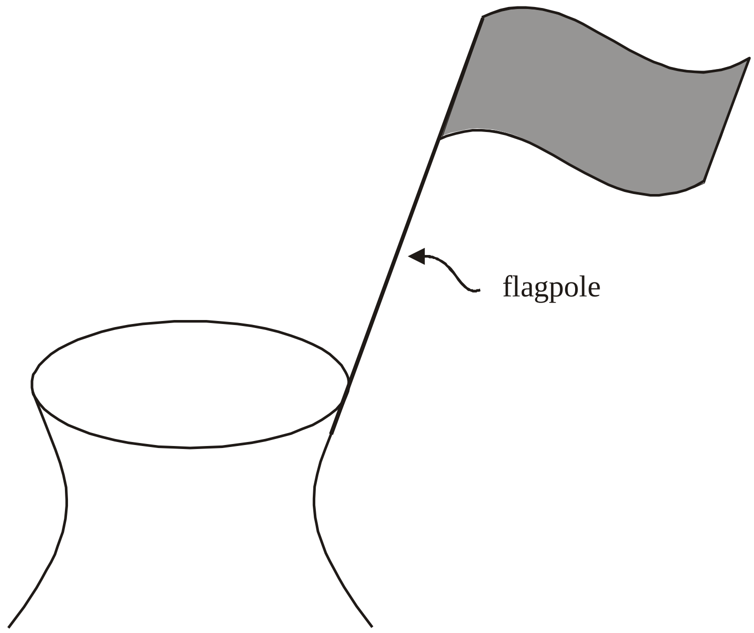
2 marks

Aircraft hazard lights are installed on the pylons at a point that coincides with the point of inflection on the graph of $y=f(x)$.

f. Find the vertical distance of these lights from the top of one of the pylons. Express your answer in metres correct to 2 decimal places.

2 marks

A flagpole is attached to the side of one of the pylons. The flagpole is a tangent to the outside of the pylon at the pylon's highest point.



g. Find the angle that the flagpole makes with the vertical. Express your answer in degrees correct to one decimal place.

2 marks
Total 14 marks

Specialist Mathematics Formulas

Mensuration

area of a trapezium:	$\frac{1}{2}(a+b)h$
curved surface area of a cylinder:	$2\pi rh$
volume of a cylinder:	$\pi r^2 h$
volume of a cone:	$\frac{1}{3}\pi r^2 h$
volume of a pyramid:	$\frac{1}{3}Ah$
volume of a sphere:	$\frac{4}{3}\pi r^3$
area of a triangle:	$\frac{1}{2}bc\sin A$
sine rule:	$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
cosine rule:	$c^2 = a^2 + b^2 - 2ab\cos C$

Coordinate geometry

ellipse: $\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$ hyperbola: $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$

Circular (trigonometric) functions

$\cos^2(x) + \sin^2(x) = 1$

$1 + \tan^2(x) = \sec^2(x)$ $\cot^2(x) + 1 = \operatorname{cosec}^2(x)$

$\sin(x+y) = \sin(x)\cos(y) + \cos(x)\sin(y)$ $\sin(x-y) = \sin(x)\cos(y) - \cos(x)\sin(y)$

$\cos(x+y) = \cos(x)\cos(y) - \sin(x)\sin(y)$ $\cos(x-y) = \cos(x)\cos(y) + \sin(x)\sin(y)$

$\tan(x+y) = \frac{\tan(x)+\tan(y)}{1-\tan(x)\tan(y)}$ $\tan(x-y) = \frac{\tan(x)-\tan(y)}{1+\tan(x)\tan(y)}$

$\cos(2x) = \cos^2(x) - \sin^2(x) = 2\cos^2(x) - 1 = 1 - 2\sin^2(x)$

$\sin(2x) = 2\sin(x)\cos(x)$ $\tan(2x) = \frac{2\tan(x)}{1-\tan^2(x)}$

function	$\sin^{-1}$	$\cos^{-1}$	$\tan^{-1}$
domain	$[-1, 1]$	$[-1, 1]$	R
range	$\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$	$[0, \pi]$	$\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

Algebra (Complex numbers)

$z = x + yi = r(\cos\theta + i\sin\theta) = r\operatorname{cis}\theta$

$|z| = \sqrt{x^2+y^2} = r$ $-\pi < \operatorname{Arg} z \le \pi$

$z_1 z_2 = r_1 r_2 \operatorname{cis}(\theta_1 + \theta_2)$ $\frac{z_1}{z_2} = \frac{r_1}{r_2}\operatorname{cis}(\theta_1 - \theta_2)$

$z^n = r^n \operatorname{cis}(n\theta)$ (de Moivre's theorem)

Calculus

$\frac{d}{dx}\left(x^n\right) = nx^{n-1}$

$\frac{d}{dx}\left(e^{ax}\right) = ae^{ax}$

$\frac{d}{dx}\left(\log_e(x)\right) = \frac{1}{x}$

$\frac{d}{dx}\left(\sin(ax)\right) = a\cos(ax)$

$\frac{d}{dx}\left(\cos(ax)\right) = -a\sin(ax)$

$\frac{d}{dx}\left(\tan(ax)\right) = a\sec^2(ax)$

$\frac{d}{dx}\left(\sin^{-1}(x)\right) = \frac{1}{\sqrt{1-x^2}}$

$\frac{d}{dx}\left(\cos^{-1}(x)\right) = \frac{-1}{\sqrt{1-x^2}}$

$\frac{d}{dx}\left(\tan^{-1}(x)\right) = \frac{1}{1+x^2}$

$\int x^n\,dx = \frac{1}{n+1}x^{n+1} + c,\ n \neq -1$

$\int e^{ax}\,dx = \frac{1}{a}e^{ax} + c$

$\int \frac{1}{x}\,dx = \log_e|x| + c$

$\int \sin(ax)\,dx = -\frac{1}{a}\cos(ax) + c$

$\int \cos(ax)\,dx = \frac{1}{a}\sin(ax) + c$

$\int \sec^2(ax)\,dx = \frac{1}{a}\tan(ax) + c$

$\int \frac{1}{\sqrt{a^2-x^2}}\,dx = \sin^{-1}\left(\frac{x}{a}\right) + c,\ a > 0$

$\int \frac{-1}{\sqrt{a^2-x^2}}\,dx = \cos^{-1}\left(\frac{x}{a}\right) + c,\ a > 0$

$\int \frac{a}{a^2+x^2}\,dx = \tan^{-1}\left(\frac{x}{a}\right) + c$

product rule: $\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$

quotient rule: $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

chain rule: $\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx}$

Euler's method: If $\frac{dy}{dx} = f(x),\ x_0 = a$ and $y_0 = b$,
then $x_{n+1} = x_n + h$ and $y_{n+1} = y_n + hf(x_n)$

acceleration: $a = \frac{d^2x}{dt^2} = \frac{dv}{dt} = v\frac{dv}{dx} = \frac{d}{dx}\left(\frac{1}{2}v^2\right)$

constant (uniform) acceleration: $v = u + at$ $\quad s = ut + \frac{1}{2}at^2$ $\quad v^2 = u^2 + 2as$ $\quad s = \frac{1}{2}(u+v)t$

Vectors in two and three dimensions

$\underset{\sim}{r} = x\underset{\sim}{i} + y\underset{\sim}{j} + z\underset{\sim}{k}$

$|\underset{\sim}{r}| = \sqrt{x^2 + y^2 + z^2} = r$ $\qquad$ $\underset{\sim}{r}_1 . \underset{\sim}{r}_2 = r_1 r_2 \cos\theta = x_1 x_2 + y_1 y_2 + z_1 z_2$

$\dot{\underset{\sim}{r}} = \dfrac{d\underset{\sim}{r}}{dt} = \dfrac{dx}{dt}\underset{\sim}{i} + \dfrac{dy}{dt}\underset{\sim}{j} + \dfrac{dz}{dt}\underset{\sim}{k}$

Mechanics

momentum:	$\underset{\sim}{p} = m\underset{\sim}{v}$
equation of motion:	$\underset{\sim}{R} = m\underset{\sim}{a}$
friction:	$F \le \mu N$

SPECIALIST MATHEMATICS

TRIAL EXAMINATION 2

MULTIPLE- CHOICE ANSWER SHEET

STUDENT NAME:..

INSTRUCTIONS

Fill in the letter that corresponds to your choice. Example: A ▬ C D E

The answer selected is B. Only one answer should be selected.

1.	A	B	C	D	E	12.	A	B	C	D	E
2.	A	B	C	D	E	13.	A	B	C	D	E
3.	A	B	C	D	E	14.	A	B	C	D	E
4.	A	B	C	D	E	15.	A	B	C	D	E
5.	A	B	C	D	E	16.	A	B	C	D	E
6.	A	B	C	D	E	17.	A	B	C	D	E
7.	A	B	C	D	E	18.	A	B	C	D	E
8.	A	B	C	D	E	19.	A	B	C	D	E
9.	A	B	C	D	E	20.	A	B	C	D	E
10.	A	B	C	D	E	21.	A	B	C	D	E
11.	A	B	C	D	E	22.	A	B	C	D	E