2014 Free Exam

Engage Education Foundation

Units 3 and 4 Maths Methods (CAS): Exam 2

Technology-enabled Practice Exam Solutions

Stop!

Don't look at these solutions until you have attempted the exam.

Any Questions?

Check that you're using the most recent version of these solutions, then email practiceexams@ee.org.au.

Section A – Multiple-choice questions

Question 1
The correct answer is D.

Question 2
The correct answer is D.

Question 3
The correct answer is A.

Question 4
The correct answer is D.

Question 5
The correct answer is B.

Question 6
The correct answer is B.

Question 7
The correct answer is B.

Question 8
The correct answer is C.

Question 9
The correct answer is A.

Question 10
The correct answer is E.

Question 11
The correct answer is A.

Question 12
The correct answer is A.

Question 13
The correct answer is B.

Question 14
The correct answer is A.

Question 15
The correct answer is C.

Question 16
The correct answer is A.

Question 17
The correct answer is E.

Question 18
The correct answer is E.

Question 19
The correct answer is B.

Question 20
The correct answer is A.

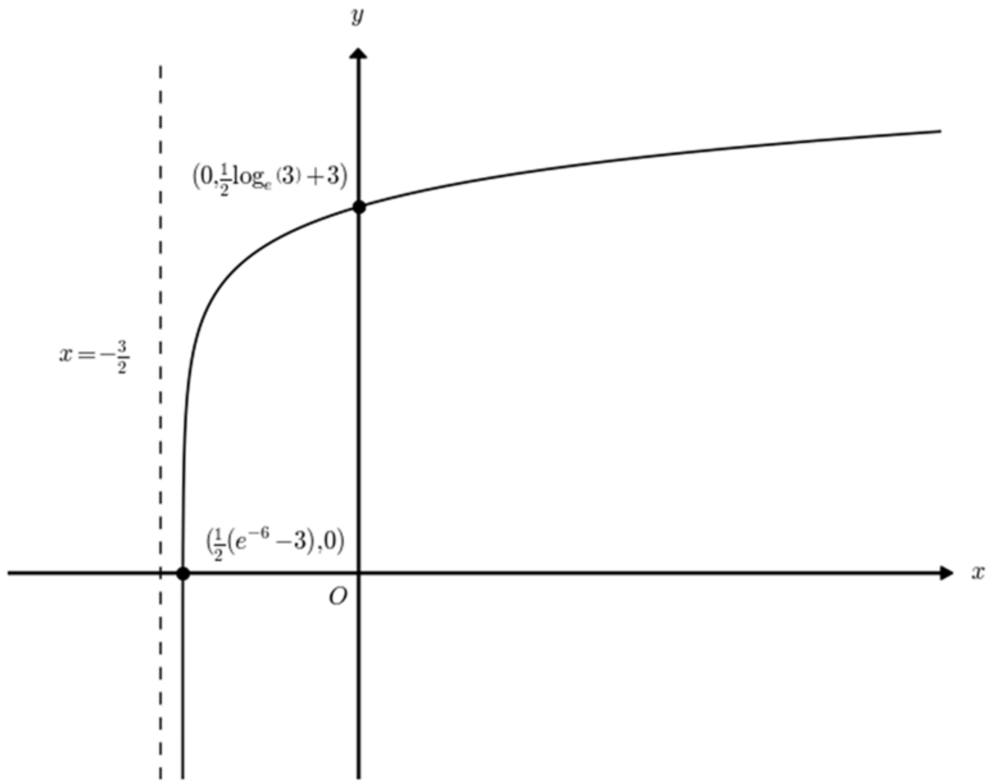
Question 21
The correct answer is E.

Question 22
The correct answer is D.

Section B – Short-answer questions

Marks allocated are indicated by a number in square brackets, for example, [1] indicates that the line is worth one mark.

Question 1a



Requires a sketched graph with:

- x-intercept at $(\frac{1}{2}\left(e^{(-6)}-3\right), 0)$ [1]
- y-intercept at $(0, \frac{1}{2}\ln(3)+3)$ [1]
- Vertical asymptote at $x=-\frac{3}{2}$ [1]

Question 1b i

Domain: $(\frac{-3}{2}, \infty)$, Range: $(-\infty, \infty)$ [1]

Question 1b ii

$f'(x)=\frac{1}{2x+3}$ [1]

Question 1b iii

f(x) has inverse by interchanging x and y such that we have

$$x = \frac{1}{2}\ln(2y + 3) + 3$$

$$2(x - 3) = \ln(2y + 3)$$

$$2y + 3 = e^{2(x-3)}$$

$$y = \frac{e^{2(x-3)} - 3}{2}$$

$$f^{-1}(x) = \frac{e^{2(x-3)} - 3}{2}$$

Question 1c

$a = 4.2184$ [1]

$b = 4.2184$ [1]

Question 1d i

$q = \frac{1}{2}\ln(2p + 3) + 3$ [1]

Question 1d ii

Gradient = $\frac{p-q}{q-p}$ [1]

Sub (p, q) into $y = \frac{p-q}{q-p}x + c$

$$q = \frac{p - q}{q - p}p + c$$

So, $c = q - \frac{p-q}{q-p}p$

So, $y = \frac{p-q}{q-p}(x - p) + q$, as required [1]

Question 1d iii

$$\begin{aligned}\text{length} &= \sqrt{(p-q)^2 + (q-p)^2}\\ &= \sqrt{2(p-q)^2}\\ &= \sqrt{2\left(p - \left(\frac{1}{2}\ln(2p+3) + 3\right)\right)^2}\end{aligned}$$

(as $q = \frac{1}{2}\ln(2p + 3) + 3$ from 1di) [2]

$$= \sqrt{2}\left(p - \left(\frac{1}{2}\ln(2p + 3) + 3\right)\right)$$

Question 1e

Given that length = $\sqrt{2}(p - \frac{1}{2}\ln(2p + 3) - 3)$, let $\frac{d\ length}{dp} = \sqrt{2}\left(1 - \frac{1}{2p+3}\right) = 0$

Solving for p, $p = -1$ [2]

Question 2a i
$r = \frac{h}{2}$ [1]

Question 2a ii
$V = \frac{\pi h^3}{12}$ [1]

Question 2b
$\frac{dh}{dt} = \frac{1}{\frac{dV}{dh}} \times \frac{dV}{dt}$ [1]

$\frac{dh}{dt} = -\frac{2}{5\pi h^2} m/min$ [1]

Question 2c
$\frac{dh}{dt} = -\frac{1}{40\pi}$ [1]

Depth is decreasing at $\frac{1}{40\pi}$ m/min

Question 2d
Full volume = $\frac{2000\pi}{3}$

Since $\frac{dV}{dt} = -0.1, V = \frac{2000\pi}{3} - 0.1t$ [1]

t = 20934.00 minutes [1]

Question 2e i
$t = 13.108$ hours [1]

Question 2e ii
$\frac{dv}{dt} = 3t^2 - 2t + 1$ [1]

$\frac{d^2v}{dt^2} = 6t - 2 = 0, \therefore t = \frac{1}{3}$ [1]

$t = \frac{1}{3}$ is a minimum by the second derivative test. Just before $t = \frac{1}{3}, \frac{d^2v}{dt^2} < 0$, so the gradient is decreasing, and just after $t = \frac{1}{3}, \frac{d^2v}{dt^2} > 0$, so the gradient is increasing. [1]

Substituting into $\frac{dv}{dt}$: $3(\frac{1}{3})^2 - 2\left(\frac{1}{3}\right) + 1 = 0.667$ metres/hour [1]

Question 2f
The amount of uptime is 20934.00 minutes (from part 2d)

The amount of downtime is 13.108 * 60 minutes

$$\frac{13.108 * 60}{13.108 * 60 + 20934} \times 100 = 3.62\%$$

[1]

Question 3a i
$\Pr(S \geq 1.10) = 0.023$ [1]

Question 3a ii

$\frac{1.00-a}{b} = \frac{1.10-1}{0.05}$ [1]

$\frac{1.10-a}{b} = \frac{1.30-1}{0.05}$ [1]

$1 - a = 2b$

$1.1 - a = 6b$

$a = 0.95$ [1]

$b = 0.025$ [1]

Question 3b i

0.0001 [1]

Question 3b ii

Where X is binomially distributed with p=0.4, n=10,

$\Pr(X \geq 2) = 1 - \Pr(X = 0) - \Pr(X = 1)$ [1]

$=0.9536$ [1]

Question 3b iii

Mean $= n \times p = 4$ [1]

Variance $= n \times p \times (1 - p) = 2.4$ [1]

Question 3c i

$\Pr(pay\ \$20\ or\ over, one\ week\ from\ now) = 0.7$ [1]

$\Pr(pay\ \$20\ or\ over, two\ weeks\ from\ now) = 0.7 \times 0.3 + 0.3 \times 0.4 = 0.33$ [1]

Question 3c ii

$\frac{2}{3}$ [1]

Question 4a i

Gradient $= \frac{-5}{k}$ [1]

Question 4a ii

$y' = \frac{-5}{x^2}$ [1]

$x = \sqrt{k}$ [1]

Question 4b i

10 [1]

Question 4b ii

$\int_a^1 f(x) = -5\ln(c)$ [1]

$c = e^{-2}$ [1]

Question 4c i

$A = \frac{1}{2} \times (a+b) \times h, where\ a = 5, b = \frac{5}{k}, h = k-1$ [1]

$$A = \frac{1}{2} \times \left(5 + \frac{5}{k}\right) \times (k-1)$$

$$A = \frac{1}{2}\left(\frac{5k+5}{k}\right)(k-1)$$

$A = \frac{5}{2}\left(\frac{k^2-1}{k}\right)$ [1]

Question 4c ii

$\frac{5(k+1)(k-1)}{2k} = 10$ [1]

$k = 2 \pm \sqrt{5}$, but $k > 0$ so $k = 2 + \sqrt{5}$ [1]

Question 4c iii

At all points between 1 and k, the curve $\frac{5}{x}$ is lower than the line AK, therefore the integral (i.e. the area under the curve) of $\frac{5}{x}$ will be less than the area of the parallelogram formed by the line AK.

Since $\int_1^k f(x) < 10, k < e^2$ because $\int_1^{e^2} f(x) = 10.$ [1]

Question 4d

$$\int_1^{pq} f(x) = 5\ln(pq) = 6$$

$$\int_1^{\frac{p}{q}} f(x) = 5\ln(\frac{p}{q}) = 4$$

$pq = e^{\frac{6}{5}}$

$\frac{p}{q} = e^{\frac{4}{5}}$ [1]

$p = qe^{\frac{4}{5}}$

$q^2 \times e^{\frac{4}{5}} = e^{\frac{6}{5}}$

$q = e^{\frac{1}{5}}$

$p = e$ [1]

Question 4e i

The point of intersection is $(\frac{5}{n}, n)$ [1]

$$f'\left(\frac{5}{n}\right) = -\frac{n^2}{5}$$

Tangent: $y = -\frac{n^2}{5}x + 2n$ [1]

Question 4e ii

$x - int = \frac{10}{n}$

$y - int = 2n$

$n = \sqrt{5}$ [1]