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**SEMESTER TWO**

**MATHEMATICS**

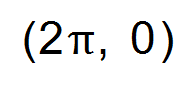
**METHODS**

**UNITS 3 & 4**

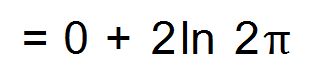
**2021**

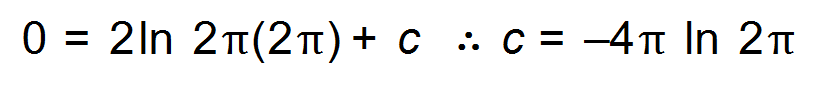
**SOLUTIONS**

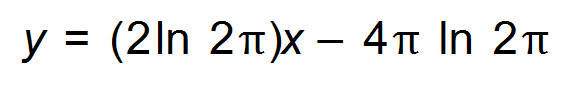
**Calculator−free Solutions**

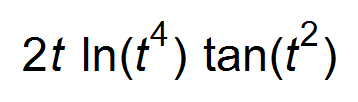
1. (a) 

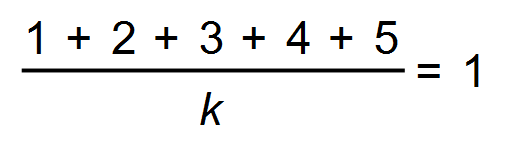
 ✓

When x = 2π, *m* ✓

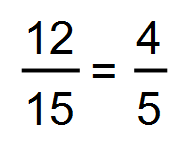


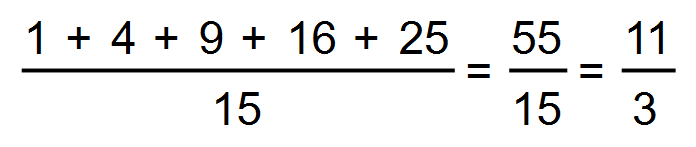
 ✓

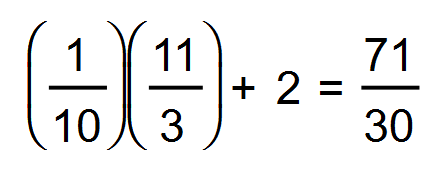
(b)  ✓✓ [5]

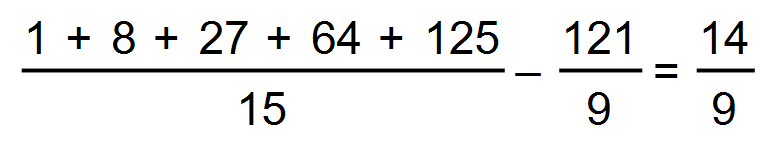
2. (a) 

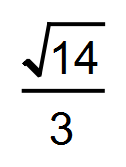
*k* = 15 ✓

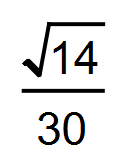
(b)  ✓

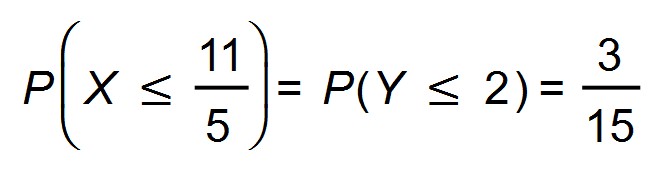
(c)  ✓

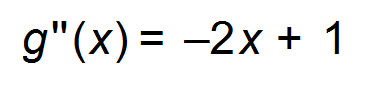
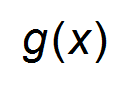
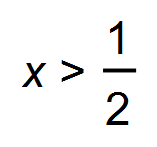
(d) (i) Expected value  ✓

Variance of *Y*: 

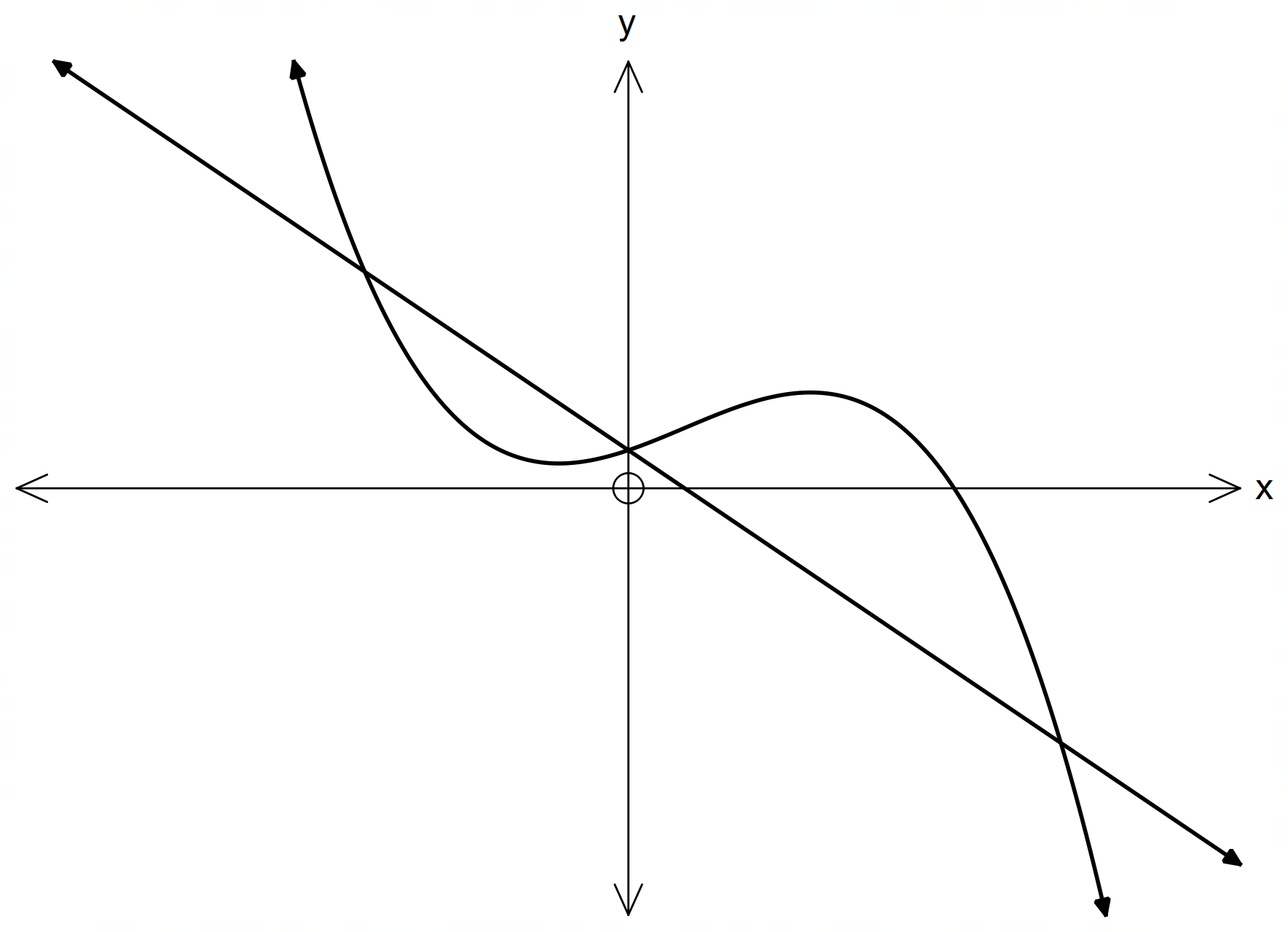
Standard deviation of *Y* =  ✓

Standard deviation of *X* =  ✓

(ii)  ✓✓ [8]

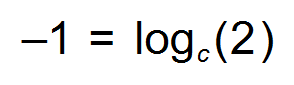
3. (a)  whenis concave down ✓✓

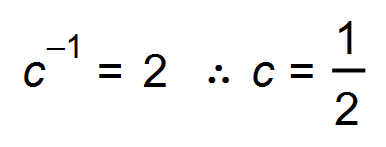
(b) Maximum ✓

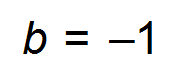
 (c)

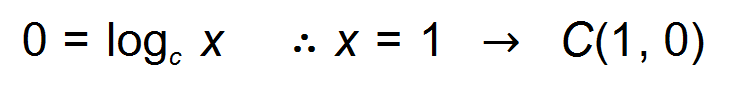
Correct point of inflection ✓

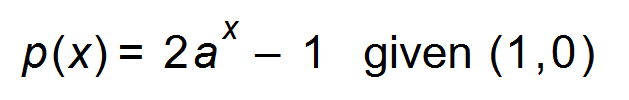
Shape showing local minimum and maximum ✓ [5]

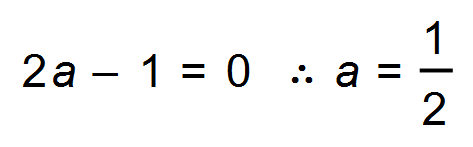
4. (a) 

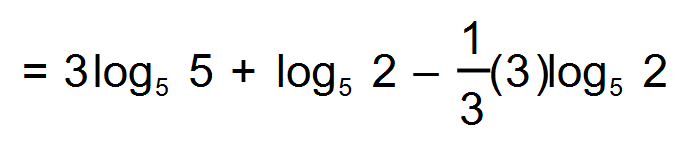
 ✓

 ✓

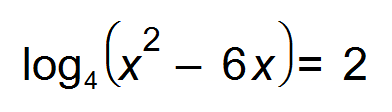




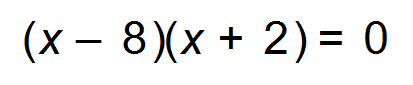
 ✓

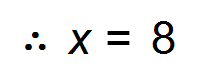
(b)  ✓

= 3 ✓

(c)  ✓

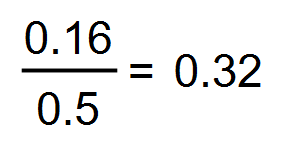


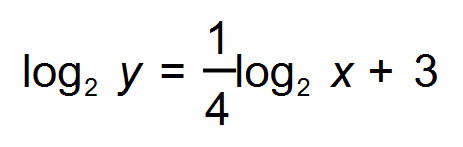


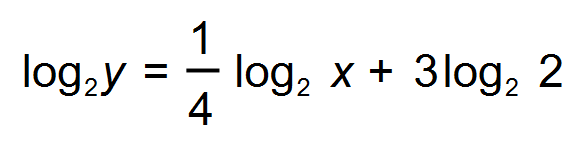
 ✓ [7]

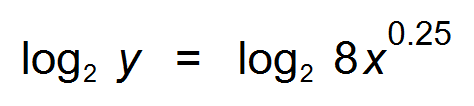
5. (a) 0.16 ✓

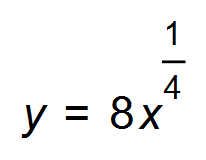
(b) 0.34 ✓

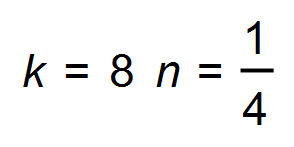
(c)  ✓✓ [4]

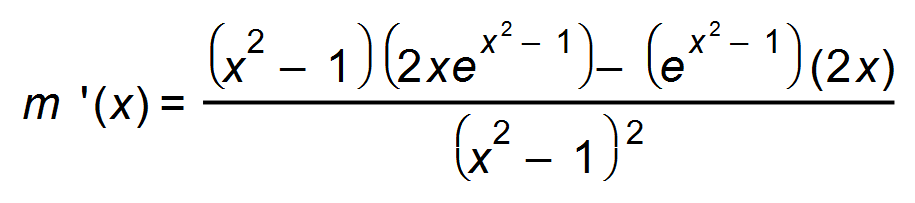
6. 

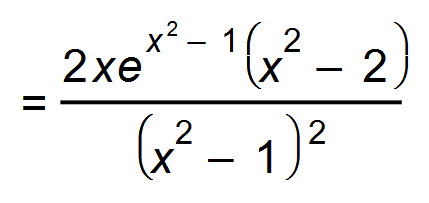
 ✓

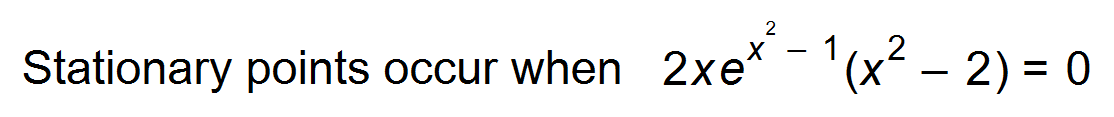


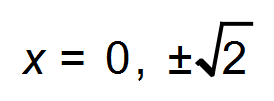
 ✓

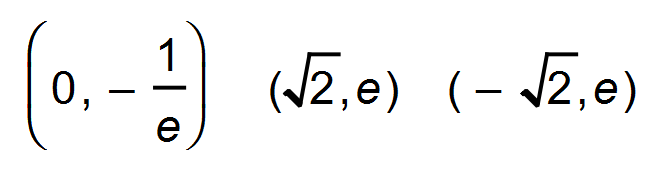
 ✓ [3]

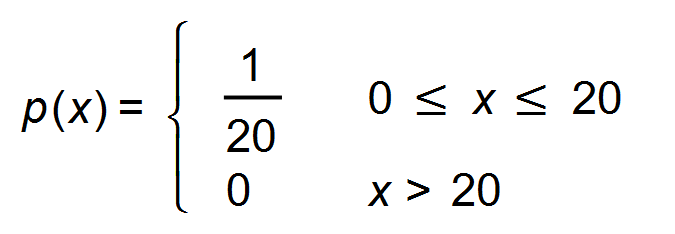
7.  ✓

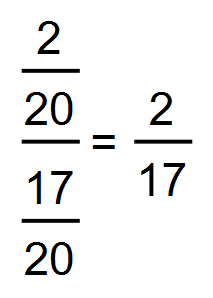


 ✓

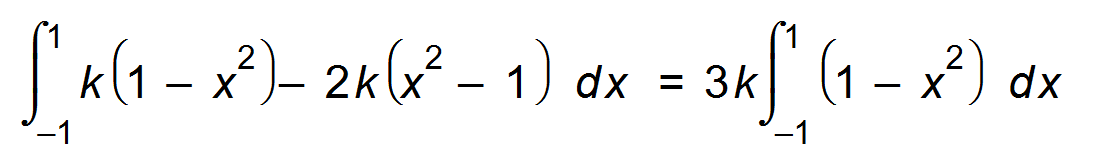
∴  ✓

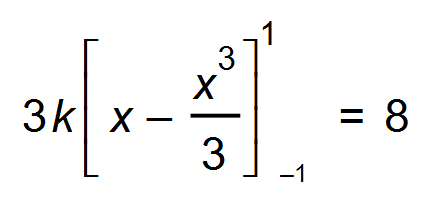
∴  ✓ [4]

8. (a)  ✓

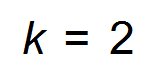
(b)  ✓✓

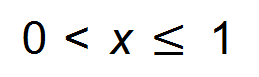
(c) 10 minutes ✓ [4]

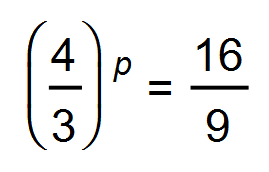
9.  ✓

 ✓

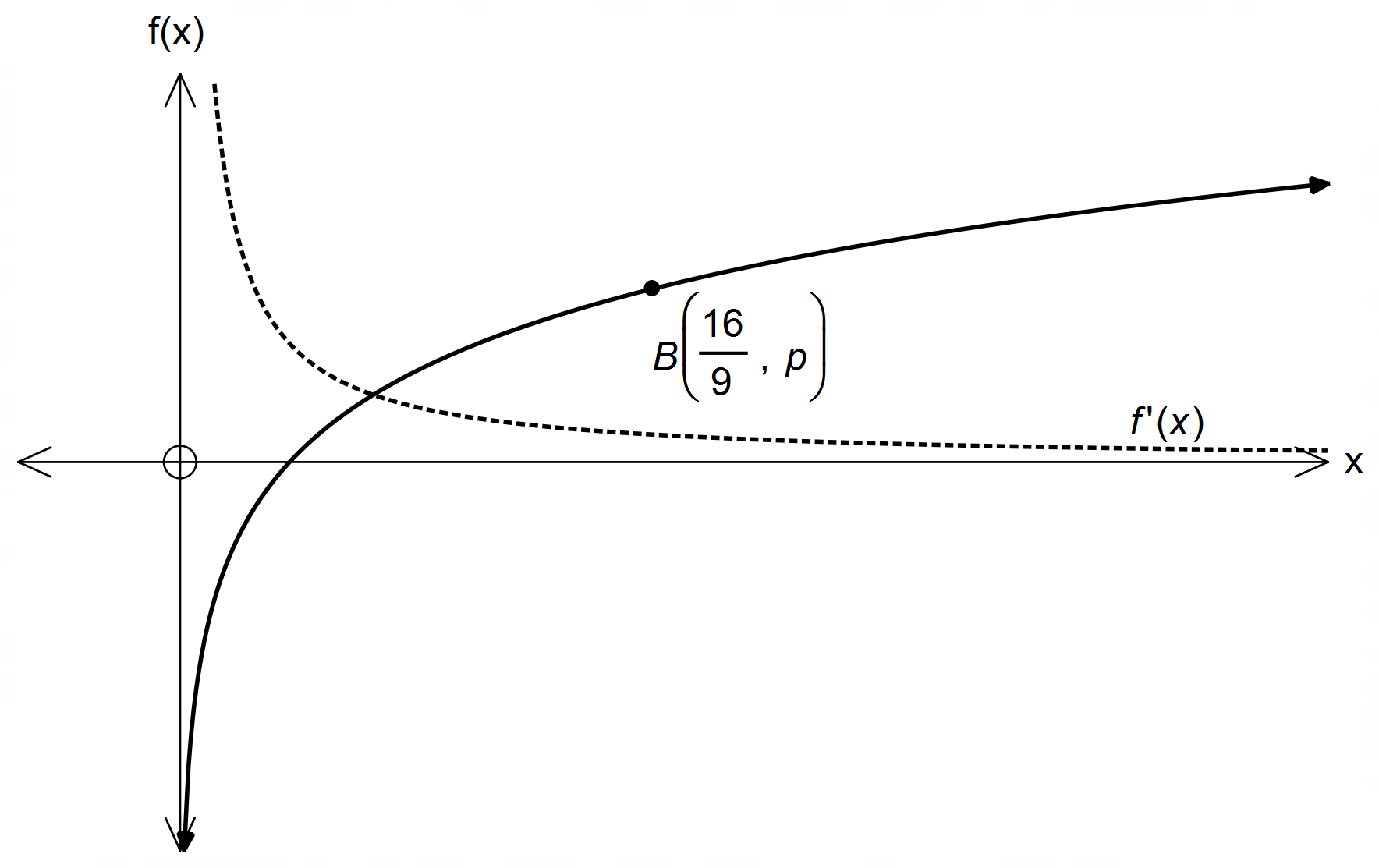


 ✓ [3]

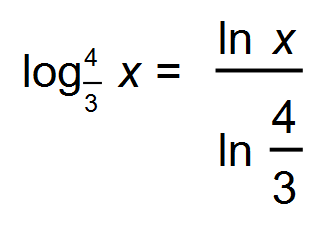
10. (a)  ✓✓

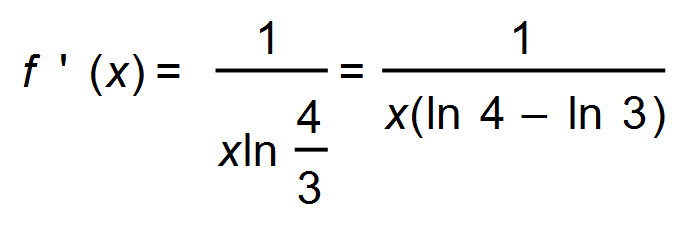
(b)  ✓

*p* = 2 ✓

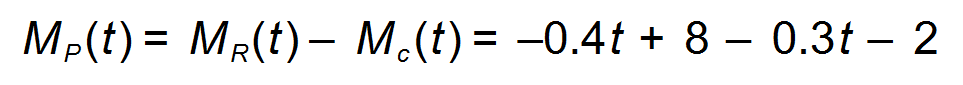
(c) (i)

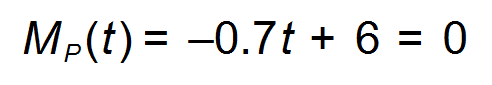
✓

10. (c) (ii) 

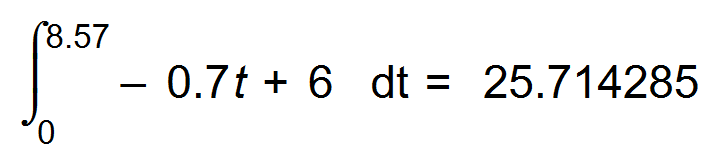
 ✓✓ [7]

**Calculator−Assumed Solutions**

11. (a)  ✓

Maximum profit occurs when 

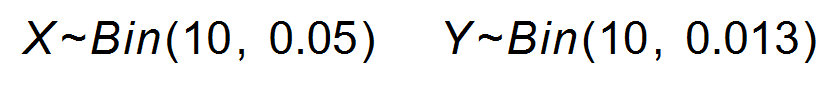
therefore *t* = 8.57 years ✓

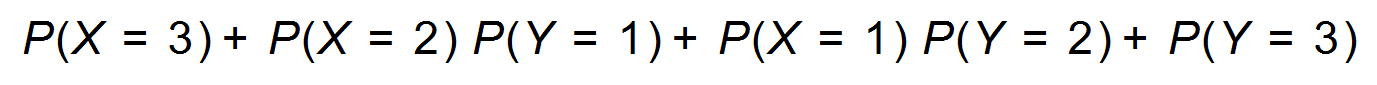
(b)  ✓

Maximum profit = $25714285-$12000000 = $13 714 285 ✓ [4]

12. (a) Discrete data; Independent events ✓

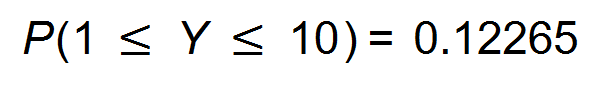
Only two outcomes: under the limit or over the limit. ✓

(b) (i) **** ✓

 ✓

(0.01048)+(0.07463)(0.11556)+(0.31512)(0.00685)+(0.00024)

= 0.02150 ✓

(ii)  ✓

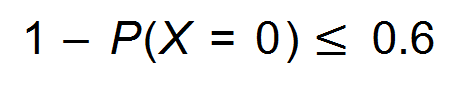
(iii) X~Bin(275, 0.05) E (X) = 13.75

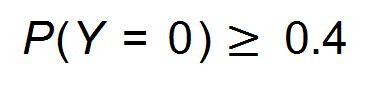
∴ 13 drivers. ✓

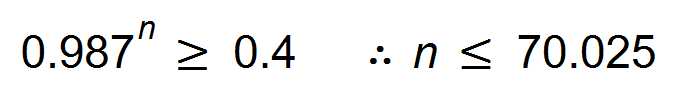
Variance = 275 x 0.05 x 0.95 = 13.0625

Standard deviation = 3.6142 ✓

(iv) 

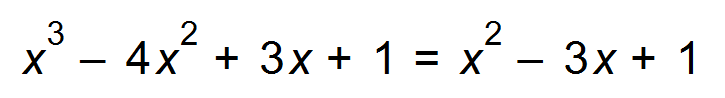
 ✓

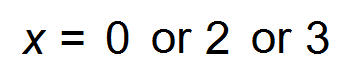


 ✓

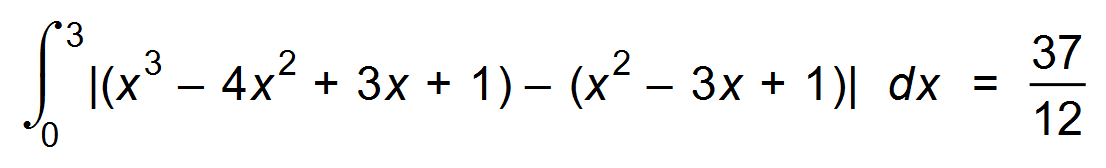
Therefore the maximum value of *n* = 70 ✓ [11]

13. Point of intersection:

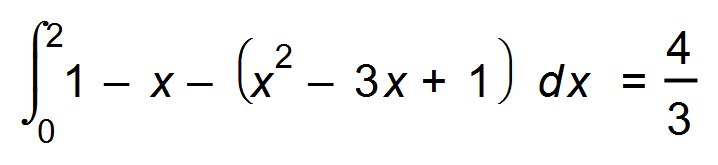


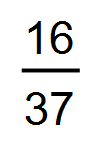


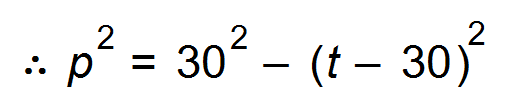
Area of shaded part:

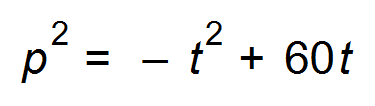
 units2 ✓✓ Alternate

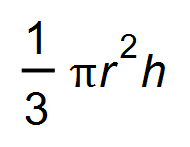
Shaded area under line:

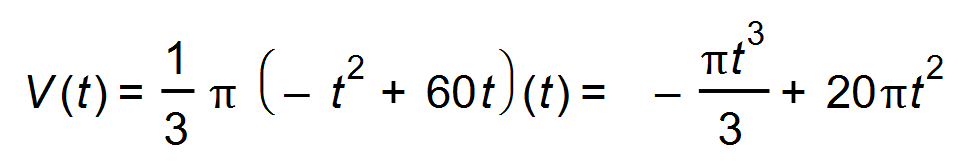
 units2  ✓

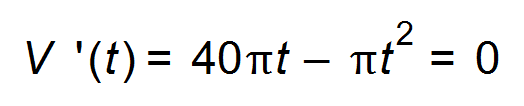
Fraction:  ✓ [4]

14. (a) AC = *t* – 30  ✓

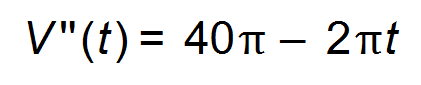
 ✓

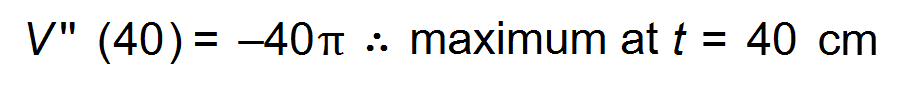
Volume of cone = 

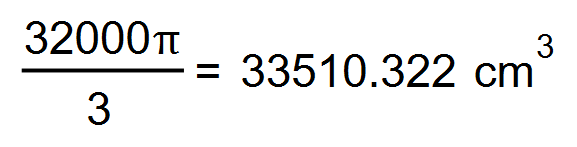
 ✓

(b)  ✓

*t* = 0 or 40 ✓

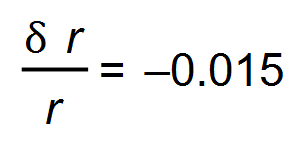
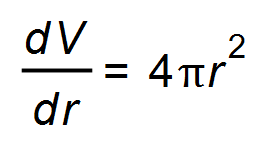
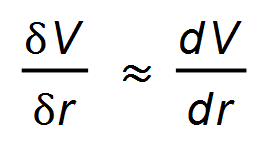


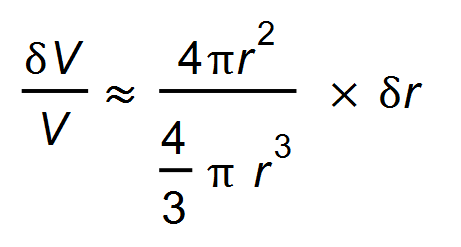
 ✓

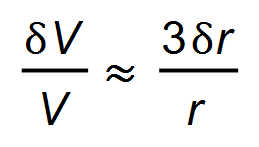
(c) Volume of cone at *t* = 40 cm is  ✓

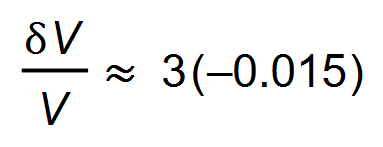
Volume of sphere = 113 097.336 cm3

Percentage = 29.63% ✓

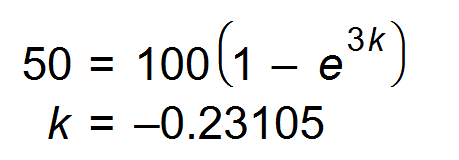
(d)   

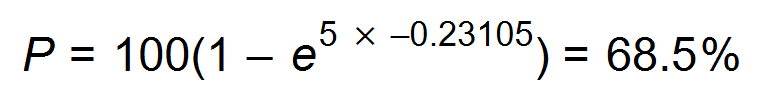
 ✓



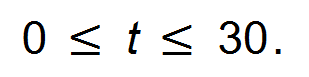
 ✓

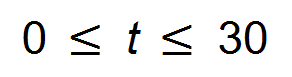
Approximately 4.5% decrease in volume. ✓ [11]

15. (a)  ✓

(b) Less than 5 minutes:  ✓

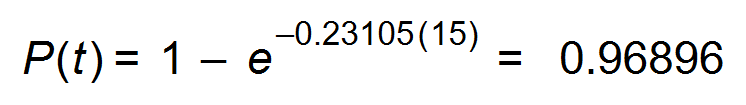
Percentage 5 minutes or longer = 31.5% ✓

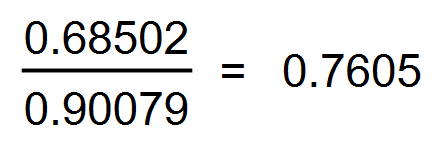
(c) (i) *t* is a continuous random variable where

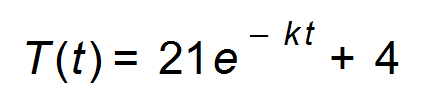
The function in the domain is positive.

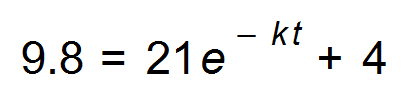
The probability at *t* = 0 is 0 and *t* = 30 is 1,

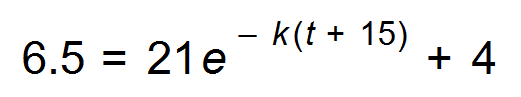
therefore is cumulative. ✓✓

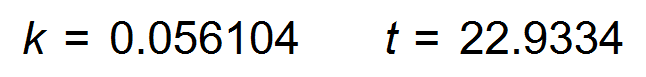
(ii)  ✓

(iii)  ✓✓ [8]

16. 

 ✓

 ✓

 ✓

The liquid was placed in the fridge at 11:37 am ✓ [4]

17. (a) 6 year old tree is growing at a rate of 17.69 cm/year

50 year old tree is growing at a rate of 2.277 cm/year ✓

7.8 times faster ✓

(b) (i) Convenience sample: this sample may not be

representative of all the six year old trees in the plantation.

The sample is not large enough. ✓✓

(ii) Stratified sample where a number of trees from each

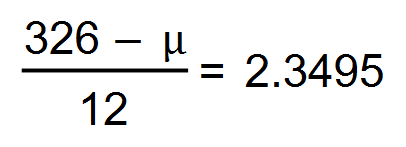
area according to the size of the area are chosen at random.

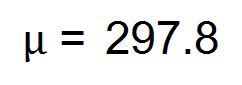
Or

Systematic and Array sample: Every *n*th tree starting

at a randomly assigned tree as one walks down each row.✓✓

(c) (i)  ✓

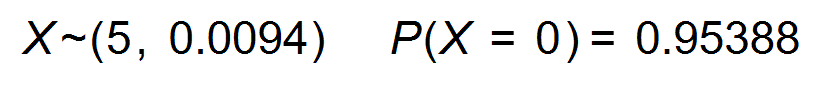
 ✓

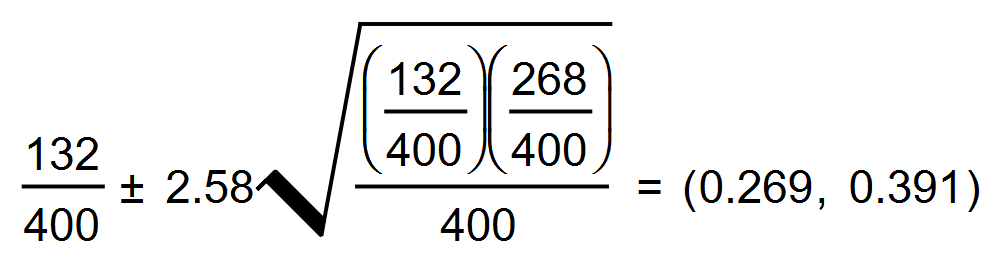
cm ✓

(ii) According to the model, the height of a six year old tree

is 297.8 cm and the mean of the sample is the same,

therefore the model is suitable. ✓

(iii)  ✓

(d)  ✓✓

With a 99% confidence level, between 26.9% and 39.1% of the

mature trees can be used for luxury furniture. ✓ [14]

18. Over - estimate = 0.2(0.127+0.172+0.184+0.184+0.181) = 0.1696 ✓

Under - estimate = 0.2(0+0.127+0.172+0.181+0.173) = 0.1306 ✓

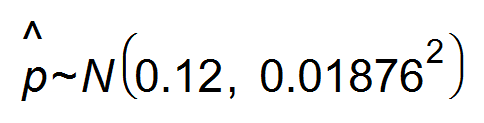
Average = 0.1501 units2 ✓ [3]

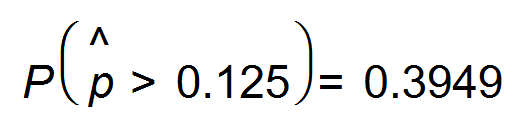
19. (a) (i) *n* > 30

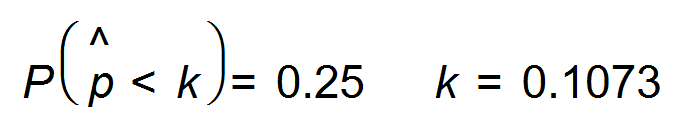
*np* = 300 x 0.12 = 36 *npq* = 300 x 0.12 x 0.88 = 31.68

*np* > 10 *npq* > 10 therefore

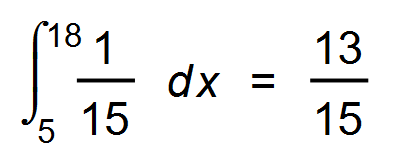
a normal distribution can apply. ✓✓

(ii)  ✓✓

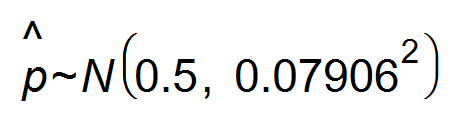
(iii)  ✓

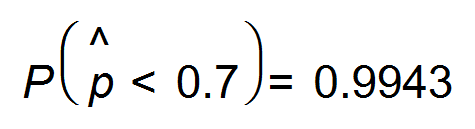
(iv)  ✓

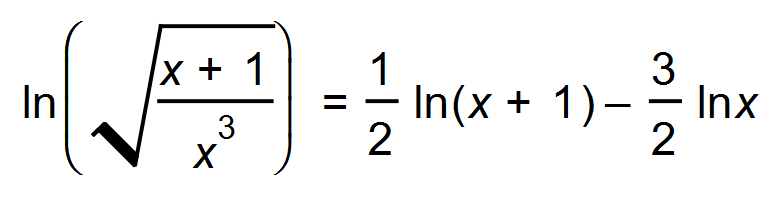
10.7% ✓

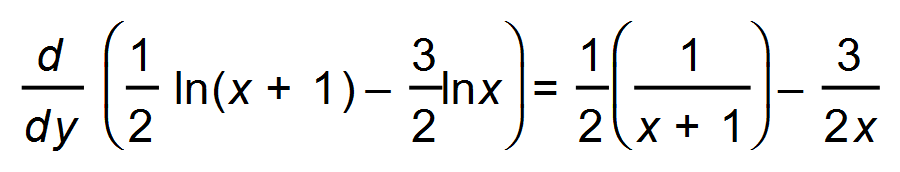
(b) (i)  ✓

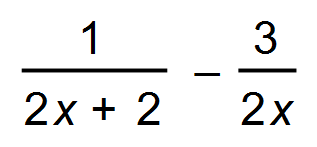
(ii) Expected waiting time= 12.5 days ✓

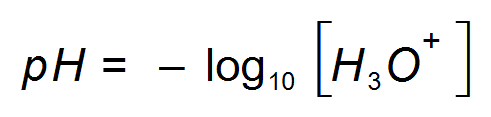
Normal distribution  ✓✓

(iii)  ✓ [12]

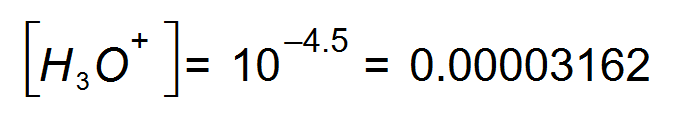
20. (a)  ✓

 ✓✓

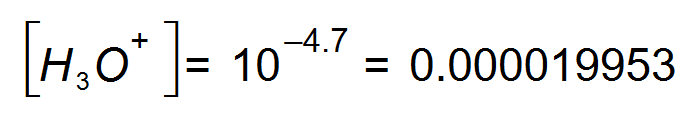
= 

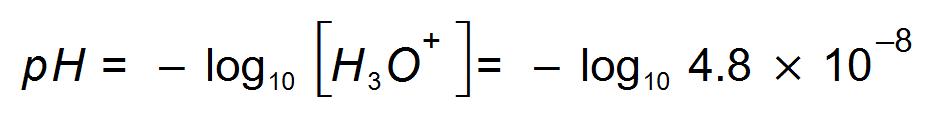
(b) (i) 

Hydronium ions range from

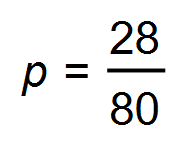
 moles per litre ✓

to

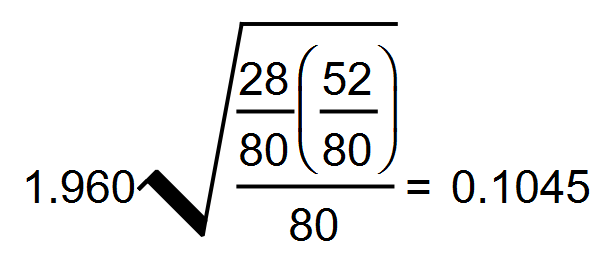
moles per litre ✓

(ii)  ✓

*pH* = 7.32 therefore it is not acidic. ✓ [7]

21. (a)  ✓

(b) (i) (0.2455, 0.4545) ✓✓

(ii) ME= ✓

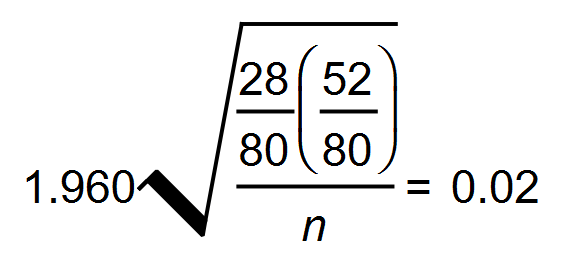
(iii) 95% the width is 0.209

99% the width is 0.2747 ✓

0.209*x* = 0.2747

*x* = 1.3144 ✓

Therefore an increase of 31.45%

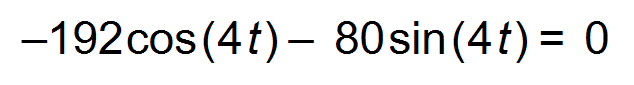
(c)  ✓

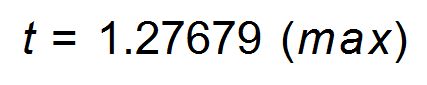
*n* = 2184.9 ✓

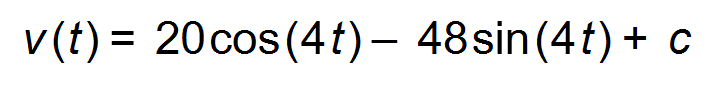
Therefore sample size of 2185 ✓

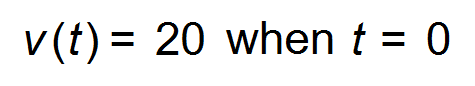
(d) 0.95 x 40 = 38

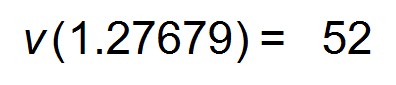
∴ Approximately 38 would contain the true proportion ✓ [10]

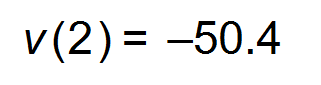
22. (a) 

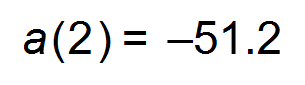
 ✓



 therefore c = 0 ✓

units/sec ✓

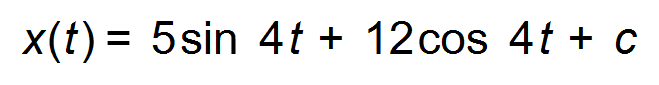
(b) units/sec ✓

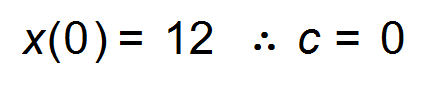
 units/sec2 ✓

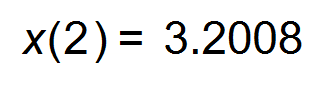
The velocity and the acceleration are both negative,

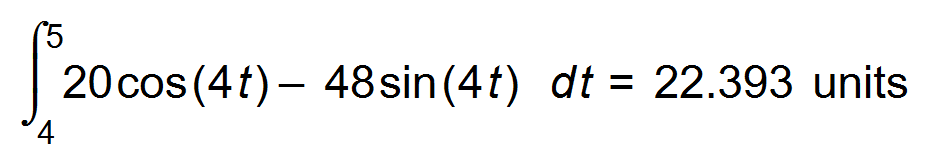
therefore the particle is moving faster to the left.

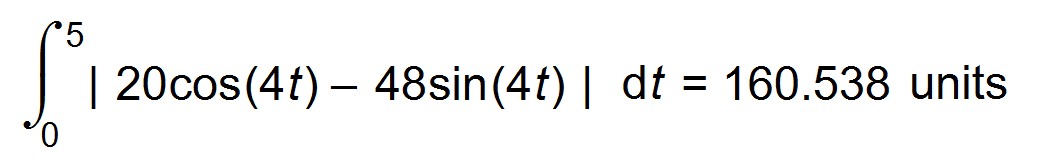
∴ Increasing speed ✓

(c) 

 ✓

units ✓

(d)  ✓✓

(e)  ✓✓ [12]

End of Questions