S4E/5N EM Prelim 2024 Paper 1 Marking Scheme

Answer all the questions.

1. Evaluate $\dfrac{4.5^3}{\sqrt{23.4}\times 8.17}$, leaving your answer correct to 4 significant figures.

Answer **2.306** ----- B1 [1]

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2. Express the ratio $1\frac{2}{3}$ kg : 450 g : 300 g in its simplest form.

$\frac{5000}{3}$ g : 450 g : 300 g ----- M1 (convert first number to g)

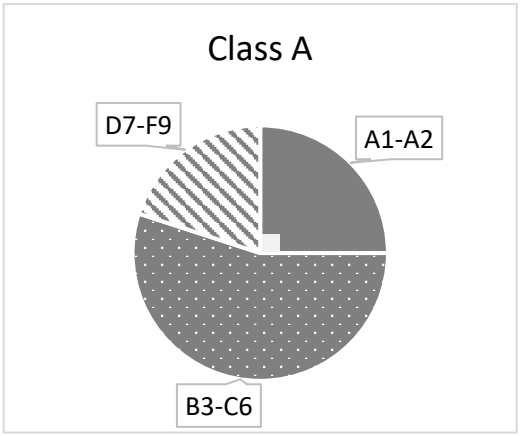
5000 : 1350 : 900

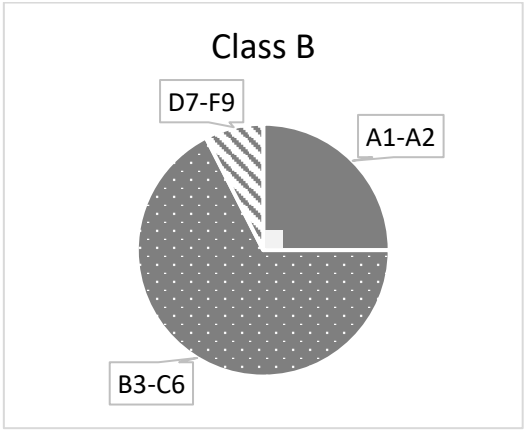
100 : 27 : 18 -------- **A1 (**

Answer ..... : ..... : ..... [2]

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3. The Mathematics grades of students in Class A and Class B are summarised on accurate pie charts shown below.





For each statement, state whether you agree or disagree and explain your reason.

Statement	Agree / Disagree	Reason
(a) More students in Class A failed Mathematics compared to Class B.	**Disagree**	**We do not know the total number of students in each class.** ----- **B1**
(b) The percentage of students who achieved A1-A2 are the same for both classes.	**Agree**	**The proportion/percentage is** $\frac{90}{360}=\frac{1}{4}$ **for A1-A2 for both classes.** ----- **B1**

[2]

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4. A regular polygon has n sides. The size of each interior angle is 5 times the size of each exterior angle.

(a) Calculate the value of each exterior angle.

$5x + x = 180$
$\boldsymbol{x = 30}$ ------- B1

Answer ……..° [1]

(b) State the value of n.

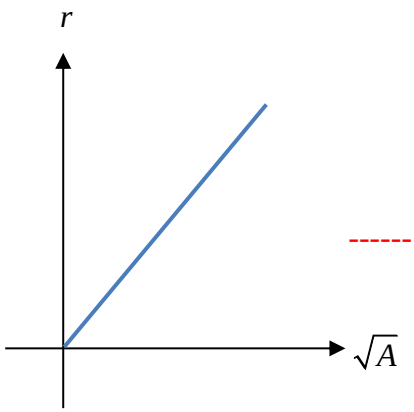
$n = \frac{360}{30} = \mathbf{12}$ ------- B1

Answer n = ……. [1]

---

5. The radius, r, of an object is directly proportional to the square root of its surface area, A.

(i) Sketch the relationship between r and A on the space below.



------ B1

[1]

(ii) The surface area of the object is 1.21 cm^2 when the radius is 0.44 cm.

Find the surface area of the object when the radius is 1.2 cm.

$r = k\sqrt{A}$
$0.44 = k\sqrt{1.21}$ ------- M1
$k = 0.4$

$r = 0.4\sqrt{A}$
$1.2 = 0.4\sqrt{A}$
$3 = \sqrt{A}$
$A = 9\,cm^2$ ------- **A1**

Answer …….. cm^2 [2]

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6. **(a)** Expand and simplify $(4x-1)^2+2$.

$(4x-1)^2+2 = 16x^2-8x+1+2$

$= 16x^2-8x+3$ --- B1

Answer …….. [1]

(b) Hence, or otherwise, explain if $(4x-1)^2+2$ is always odd, given that x is an integer.

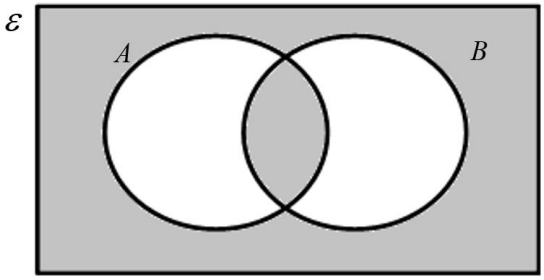
Answer : **16 and 18 are even numbers**. Hence, $16x^2-8x$ will be an even number. ------ B1

Adding an **odd number to an even number gives an odd number**.

Therefore adding 3 to $16x^2-8x$ will always be odd. ------ B1 [2]

---

7. **(a)** Write down the set represented by the shaded region.



Answer $(A\cap B)\cup(A\cup B)'$ --- B1 [1]

(b) It is given that $\xi = \{ x : x \text{ is an integer}\}$, $A = \{x : x \le 9\}$ and B {2, 4, 6, 8}.

State and explain whether the following mathematical statements are **true** or **false**.

(i) $B \subset A$.

This is **True** because **all the elements in B are in A** and B ≠ A --- B1

…….. [1]

(ii) $B \in A$.

This is **False** because B is a set, not an element --- B1

…….. [1]

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8. Express $\frac{2}{d+3e}-\frac{d-15e}{d^2-9e^2}$ as a single fraction in its simplest form

$\frac{2}{d+3e}-\frac{d-15e}{d^2-9e^2}$

$= \frac{2}{d+3e}-\frac{d-15e}{(d+3e)(d-3e)}$ ---- M1 (factorise denominator)

$= \frac{2(d-3e)-(d-15e)}{(d+3e)(d-3e)}$ ---- M1 (single fraction or better)

$= \frac{2d-6e-d+15e}{(d+3e)(d-3e)}$

$= \frac{d+9e}{(d+3e)(d-3e)}$ ----- A1 (accept $\frac{d+9e}{d^2-9e^2}$)

Answer …….…….. [3]

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9. A plan of a garden is drawn to a scale 1 : 20.

(a) Calculate the length of the line on the plan which represents 13 m long.

1 cm : 20 cm
1 cm : 0.2 m
? : 13 m

$\frac{13}{0.2}$ = **65 cm** ------ B1

Answer …….…….. cm [1]

(b) The actual area of a pond in the garden is p m^2.

Show, with clear working, that the area of the pond represented on the map is $25p$ cm^2.

1 cm : 20 cm
1 cm : 0.2 m
1 cm^2 : 0.04 m^2 ------- M1
? : p m^2

$\frac{p}{0.04} = p \div \frac{4}{100}$
$= p \times \frac{100}{4}$
$= 25p$ } A1 (show all steps)

[2]

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10. x is 35% of y.
$2x + 45 = y$.

Find the value of x and of y.

$x = 0.35y$ – – – – – [1]
$2x + 45 = y$ ---------- [2]

Sub [1] into [2] :

$2(0.35y) + 45 = y$ ------ M1
$0.7\,y + 45 = y$
$0.3\,y = 45$
$\boldsymbol{y = 150}$ ------ A1

And $\boldsymbol{x = 52.5}$ ------ A1

Answer x = …… , y = …… [3]

---

11. The difference between simple interest and compound interest for a period of 3 years at 5% per annum is $366.

Find the principal amount.

Interest (compound int) – Simple interest = 366

$$\left[P\left(1+\frac{5}{100}\right)^3 - P\right] - \frac{P\times 5\times 3}{100} = 366$$ ------ M1 (compound interest application correct)

------ M1 (difference is compound interest – simple interest)

$[1.57625P - P] - 0.15 = 366$
$0.007625P = 366$
$P = \mathbf{48000}$ ------ A1

Answer $……. [3]

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12. The following data shows the masses of 11 parcels in kg.

1.8	2.1	2.4	2.5	2.6	3.2	3.3	3.5	3.8	4.0	4.9

(a) Calculate the mean mass.

$$\frac{2.6+3.2+2.4+3.3+1.8+4.0+4.9+3.5+3.8+2.5+2.1}{11} = \mathbf{3.1}$$ ----- B1

Answer …… kg [1]

(b) Find the median mass.

Rearrange

1.8 2.1 2.4 2.5 2.6 **3.2** 3.3 3.5 3.8 4.0 4.9 ----- B1

Answer …… kg [1]

(c) Two parcels (the 2.4 kg and the 4.9kg) were removed from the delivery van.

Explain why the median mass remains unchanged.

Answer ……

The 2 weights falls on the left and right of the median value, keeping the median weight unchanged in the middle. ----- B1 [1]

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13. (a) By **completing the square**, find the coordinates of the turning point of the curve $y = x^2 + 4x + 7$.

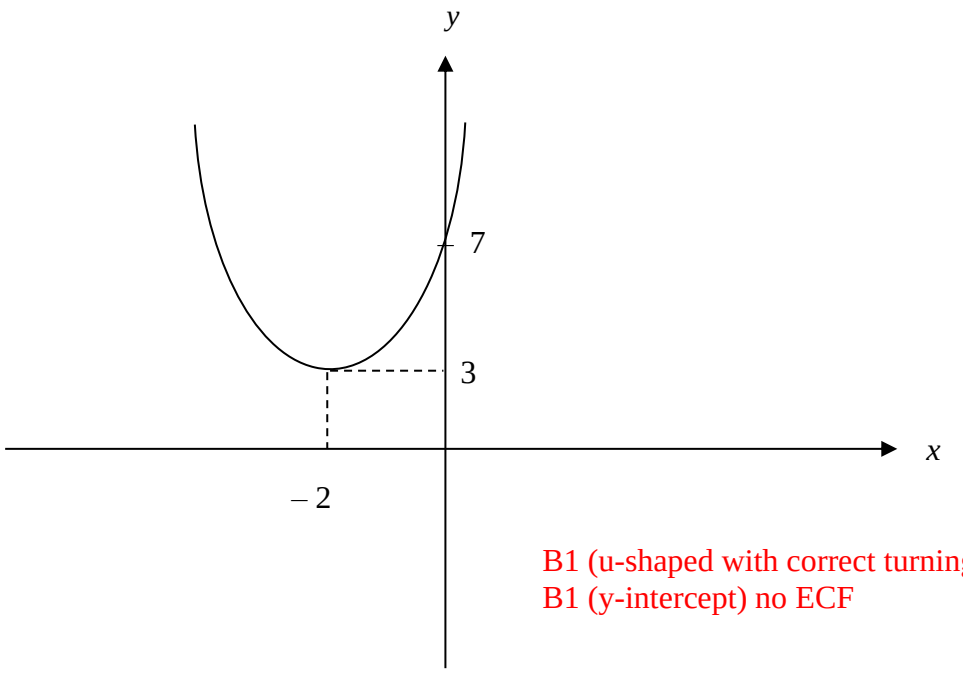
$x^2 + 4x + 7 = (x+2)^2 - 4 + 7$

$= (x+2)^2 + 3$ ----- M1 (this must be evident)

Turning point is **(– 2, 3)** ----- A1

Answer (…… , ……..) [2]

(b) Hence, sketch the graph of $y = x^2 + 4x + 7$ in the space below, showing your y-intercept and turning point clearly.



B1 (u-shaped with correct turning point)
B1 (y-intercept) no ECF

[2]

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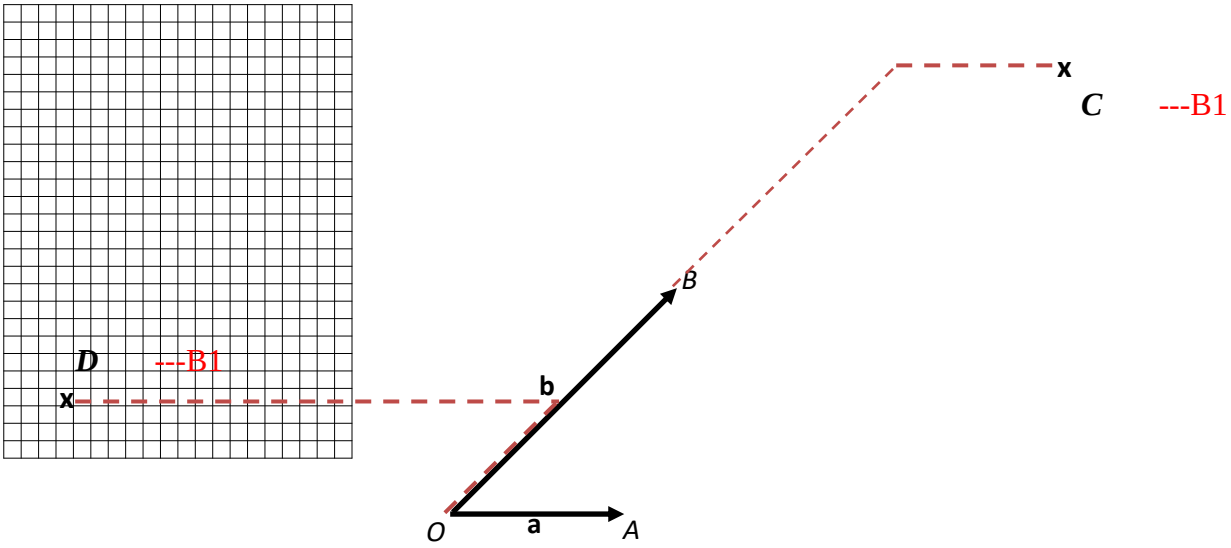
14. On the grid, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

(a) Mark clearly on the grid in the answer space,

(i) the point ***C*** such that $\overrightarrow{OC} = 2\mathbf{b} + \mathbf{a}$

(ii) the point ***D*** such that $\overrightarrow{OD} = \frac{1}{2}\mathbf{b} - 3\mathbf{a}$.

Answer



[2]

(b) Find $\overrightarrow{CD}$ in terms of **a** and **b**.

$\overrightarrow{CD} = \overrightarrow{CO} + \overrightarrow{OD}$

$= -2\mathbf{b} - \mathbf{a} + \frac{1}{2}\mathbf{b} - 3\mathbf{a}$ ----- M1

$= -4\mathbf{a} - \frac{3}{2}\mathbf{b}$ ----- A1

Answer $\overrightarrow{CD}$ = …….. [2]

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15. Simplify $\left(\frac{9p^3q^{-2}}{p^{-1}}\right)^{-\frac{3}{2}}$, leaving your answer in positive index.

$\left(\frac{9p^3q^{-2}}{p^{-1}}\right)^{-\frac{3}{2}} = \left(\frac{9p^4}{q^2}\right)^{-\frac{3}{2}}$ ---- M1

$= \left(\frac{q^2}{9p^4}\right)^{\frac{3}{2}}$ ---- M1

$= \frac{q^3}{27p^6}$ ---- A1

(or B1 for each term)

$\left(\frac{9p^3q^{-2}}{p^{-1}}\right)^{-\frac{3}{2}} = \frac{9^{-\frac{3}{2}}p^{-\frac{9}{2}}q^3}{p^{\frac{3}{2}}}$ ---- M1

$= \frac{1}{27}p^{-6}q^3$ ---- M1

$= \frac{q^3}{27p^6}$ ---- A1

Answer …….…….. [3]

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16. Danny wants to purchase ingredients from Malaysia.

He needs to pay the Malaysia supplier MYR 2000 for the ingredients.
The transportation fees for the ingredients is MYR 60.
For importing goods into Singapore, a 9% Goods and Services Tax (GST) is payable on the cost of goods and transportation.

The exchange rate between Singapore dollars ($) and Malaysian Ringgit (MYR) is $1 = MYR 3.46.

Calculate the amount of money, in Singapore dollars, that Danny has to pay to import the ingredients.

MYR : $
3.46 : 1
2060 : $\frac{2060}{3.46}$ ---- M1
= 595.3757

With GST = $\frac{109}{100} \times 595.3757$ ---- M1 (*their* value)
= $648.959

= **$648.96** ---- A1

Answer $…….. [3]

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17. When written as a product of its prime factors,

$$X = 2^n \times a^b .$$

The cube root of X is 14.

(a) Find the values of n, a, and b.

$\sqrt[3]{X} = 14$

$X = 14^3$

$= 2^3 \times 7^3$ $\quad n = \mathbf{3}$ --- B1 , $\quad a = \mathbf{7}$, $b = \mathbf{3}$ ---- B1

Answer $n =$ …… , $a =$ …… , $b =$ …….. [2]

(b) Using the answer in **(a)**, find the largest possible number that will divide X and 756 exactly.

$X = 2^3 \times 7^3$

$756 = 2^2 \times 3^3 \times 7$ ---- M1

HCF $= 2^2 \times 7 = \mathbf{28}$ ------- **A1 / B2**

Answer …….. [2]

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18. On a certain day, Barry took the bus to school.
The bus travels at an average speed of 12.5 m/s

(a) Convert 12.5m/s to km/h.

$$\frac{12.5m}{1s} = \frac{0.0125km}{\frac{1}{3600}h} = \mathbf{45} \text{ km/h}$$ ------ B1

Answer ……..…….. km/h [1]

(b) Jeff and Barry travel the **same distance** to school.
Jeff walked at an average speed of 5 km/h and took 20 minutes longer than Barry.
Find the distance each of them travelled to school.

Let d be distance each travel to school.

$\frac{d}{5} = \frac{d}{45} + \frac{20}{60}$ ------ M1 (or equivalent)

$\frac{9d}{45} - \frac{d}{45} = \frac{1}{3}$

$\frac{8d}{45} = \frac{1}{3}$

$24d = 45$

d = **1.875** km ------ A1

Answer ……..…….. km [2]

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19. A straight line meets the curve $y = x^2 - 2x - 3$ at two points A (–3, k) and B (4, 5).

By finding the value of k,

(i) Show that $k = 12$.

Answer :

Sub A (–3, k) into equation
$k = (-3)^2 - 2(-3) - 3$ ---- B1 (substituting)
$= 12$

(ii) Find the equation of the straight line.

Gradient = $\dfrac{12-5}{-3-4}$ ---- M1
$= -1$

$y = -x + c$
$5 = -4 + c$
$c = 9$

$y = -x + 9$ ------ A1

Answer …….. [2]

(iii) Find the length of the line segment AB.

Length of AB = $\sqrt{(12-5)^2 + (-3-4)^2}$
$= \sqrt{98}$
$= 9.89949$

$=$ **9.90 units** (3 s.f) ------ B1 (or more accurate approximation)

Answer …….. units [1]

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20. In a sequence, the same number is subtracted each time to obtain the next term.
The first four terms of the sequence are as follows:

54 x y 33

(a) Find the value of x and y.

$\frac{54-33}{3}=7$
x = **47** , y = **40** ---- B1 (both correct)

Answer x = ……, y =…….. [1]

(b) Write down an expression for the nth term of this sequence.

61 – 7*n* ---- B1

Answer …….. [1]

(c) Which term in the sequence will give the first negative number?

$61-7n<0$
$7n>61$
$n>8\frac{5}{7}$

9th term ---- B1 (accept 9 or ninth)

Answer ……..… term [1]

(d) Explain why -260 is **not** a term of this sequence.

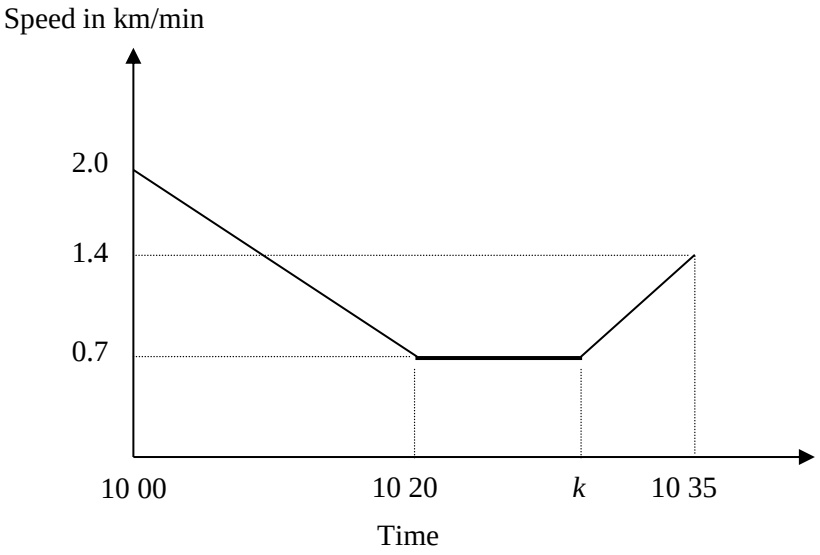
Answer ……

$61-7n=-260$
$7n=321$
$n=45\frac{6}{7}$
Since n is not a positive integer/ whole number,
– 260 is no a term in this sequence. ----- B1 (with working)

…… [1]

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21. The diagram shows the speed-time graph of a van. The van decelerates uniformly until it reaches 0.7 km/min. It then continues at this constant speed for k minutes before accelerating its speed uniformly at 0.1 km/min^2.



(a) Find the speed of the van at 10 05.

$acceleration = \frac{2-0.7}{20} = 0.065$ km/m^2 ----- M1

Speed at 1005 = 2 – (5× 0.065)

= **1.675** km/min ----- A1 (accept $1\frac{27}{40}$)

Answer …… km/min [2]

(b) Find the value of k.

$\frac{1.4-0.7}{T} = 0.1$ ----- M1

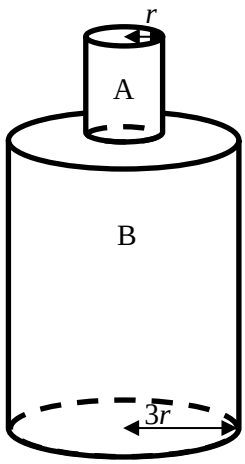
T = 7 min

k = 1035 h – 7 min = 1028 h ----- A1

Answer k = ……..…… [2]

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22.



The shape of a closed container can be modelled by stacking a smaller cylinder, *A*, on top of a larger cylinder, *B*. Cylinder *A* and Cylinder *B* are geometrically similar.
The radii of Cylinder *A* and Cylinder *B* are *r* cm and 3*r* cm respectively.

(a) It takes 98 seconds to fill the container to the brim.
Calculate the time taken to fill Cylinder *B*.

$\frac{r_A}{r_B} = \frac{1}{3}$

$\frac{V_A}{V_B} = \left(\frac{1}{3}\right)^3 = \frac{1}{27}$ ----- M1

Time taken to fill Cylinder $B = \frac{98}{28} \times 27$

= 94.5 sec ----- A1

Answer ……..…….. s [2]

(b) Given that the height of cylinder *A* is *h* cm, find an expression for the total surface area of the container in terms of *r*, *h* and π.

2 circles + curved surface A + curved surface B

$= 2\pi(3r)^2 + 2\pi rh + 2\pi(3r)(3h)$ ------ M2 (M1 for any 2 correct)

$= 18\pi r^2 + 2\pi rh + 18\pi rh$

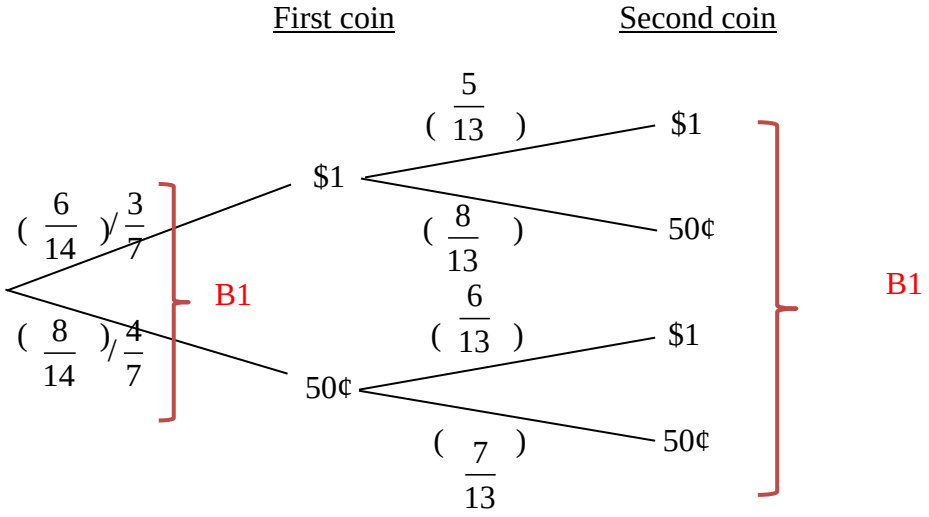
$= 18\pi r^2 + 20\pi rh$ ------ A1

Answer ……..…… cm^2 [3]

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23. Mdm Chng has six $1 coins and eight 50 cents coins in her purse.
She takes the coins out of her purse, at random, one after the other, without replacement.

The probability tree diagram below shows the possible outcomes and their probabilities.



(i) Complete the probability tree diagram.

[2]

(ii) Find the probability that the total value of the two coins taken out is $1.50

P ($1and 50 cents or 50 cents and $1)

$= \left(\frac{6}{14}\times\frac{8}{13}\right)+\left(\frac{8}{14}\times\frac{6}{13}\right)$ ------ M1

$= \frac{48}{91}$ ------ A1

Answer …… [2]

(iii) Mdm Chng took a third coin out.

Find the probability that the total sum of the three coins taken out is $2.

P ($1and 50 cents and 50 cents or 50 cents and $1 and 50 cents or 50 cents and 5- cents and $1)

$= \left(\frac{6}{14}\times\frac{8}{13}\times\frac{7}{12}\right)\times 3$ ------ M1

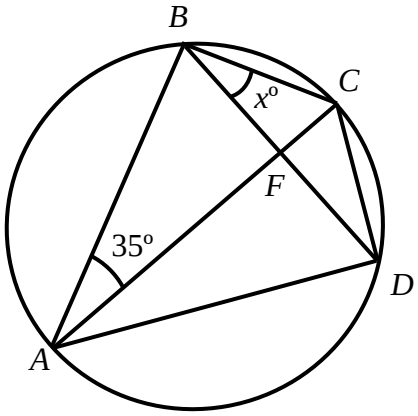
$= \frac{6}{13}$ ------ A1

Answer …… [2]

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24. In the diagram, *A, B, C, D,* are points on a circle.

AC and *BD* intersect at *F*. Angle $CBF = x°$ and angle $BAC = 35°$.



(a) Find, in terms of *x*, angle *BCD*. Give reason(s) clearly.

Angle *CAD* = *x* (angles in same segment) ------- M1 (with reason)

Angle *BCD* = 180 – (35 + *x*) (angles in opp segment)

= **145 – *x*** ------ A1 (with reason above)

Answer ……..……° [2]

(b) Given that angle *ADB* = 55°, show that *AC* is a diameter of the circle.

Answer :

Angle *BCA* = Angle *ADB* (angles in same segment)
= 55°
Angle *ACD* = 145 – *x* – 55
= 90° – *x*

Angle *ADC* = 180 – *x* – (90 – *x*) --- M1 (accept without reason)
= 90°

Since Angle *ADC* = 90°, *AC* is a diameter of the circle (**rt angle in a semicircle**) --- A1

[2]

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25. In **Shop *P***, a tub of ice cream cost \$18.70, a carton of milk cost \$8.60 and a box of chocolates cost \$10.
In **Shop *G***, a tub of ice cream cost \$17.50, a carton of milk cost \$7.40 and a box of chocolates cost \$13.

The items are exactly the same in both shops.

The information above can be represented by the Matrix $\mathbf{A} = \begin{pmatrix} 18.7 & 17.5 \\ 8.6 & 7.4 \\ 10 & 13 \end{pmatrix}$.

(a) Tina buys 5 tubs of ice cream, 3 cartons of milk and 1 box of chocolates.
Mike buys 3 tubs of ice cream, 4 cartons of milk and x boxes of chocolates.

Represent this information in a 2×3 matrix **B**.

Answer $\mathbf{B} = \begin{pmatrix} 5 & 3 & 1 \\ 3 & 4 & x \end{pmatrix}$ ---- B1[1]

(b) Find, in terms of x, the matrix $\mathbf{C} = \mathbf{BA}$.

$$\begin{pmatrix} 5 & 3 & 1 \\ 3 & 4 & x \end{pmatrix}\begin{pmatrix} 18.7 & 17.5 \\ 8.6 & 7.4 \\ 10 & 13 \end{pmatrix} = \begin{pmatrix} 129.3 & 122.7 \\ 90.5+10x & 82.1+13x \end{pmatrix}$$ ----- B2/1/0

Answer $\mathbf{C} = \begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(c) State what the elements in matrix **C** represents.

Answer The total amount Tina and Mike has to pay for items from Shop P and Shop G respectively. **---- B1**

(d) Determine if it is possible for Mike to spend the same amount regardless of which shop he buys the items from. Justify your answer with calculations.

$90.5+10x = 82.1+13x$ ------ M1 (their expressions from (b)

$8.4 = 3x$

$x = \mathbf{2.8}$

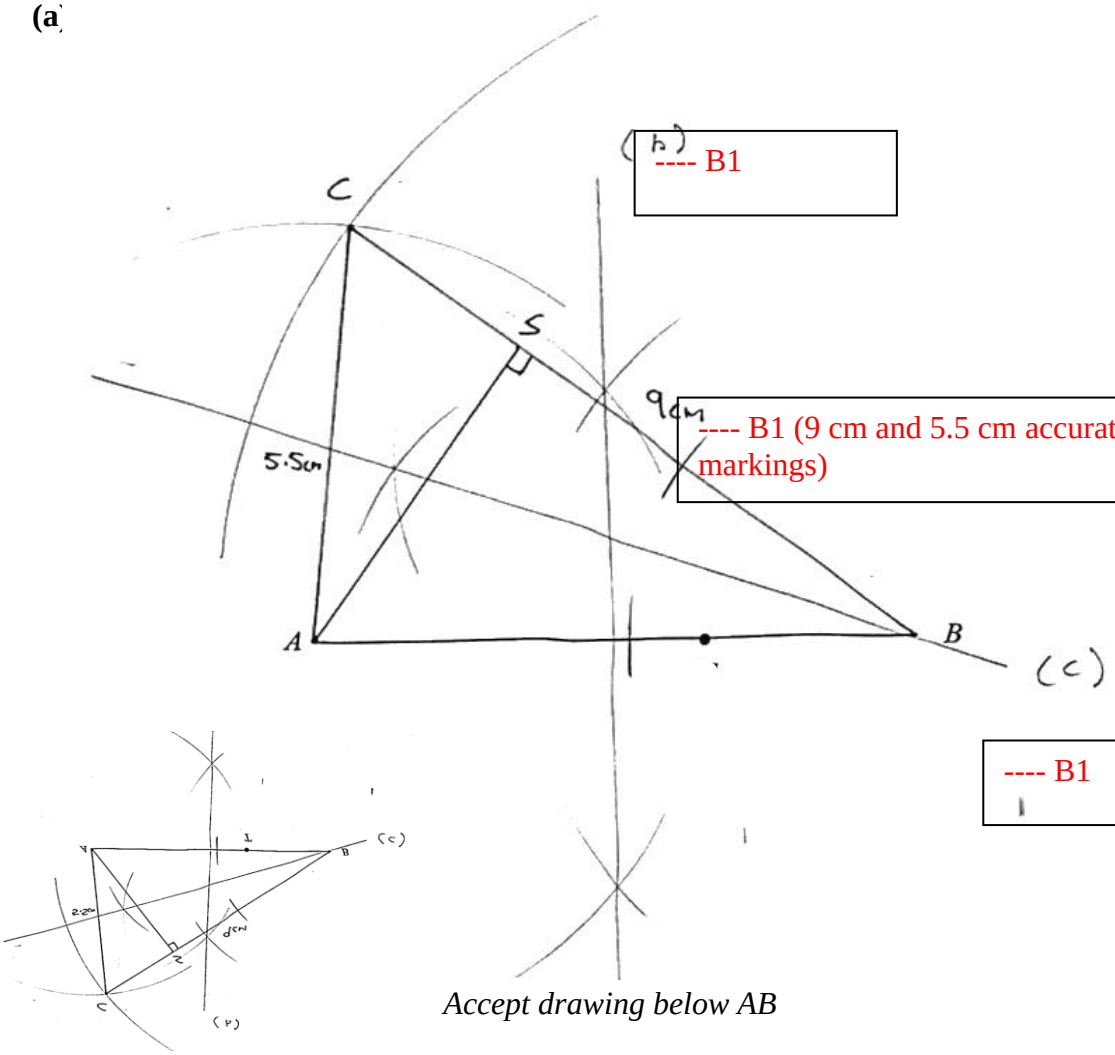
Since x is not a whole number, it is not possible. ------ A1

Answer $x =$ ..... [2]

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26. In the diagram below, the line *AB* has been drawn. T is a point on the line *AB*.

(a)]



---- B1

---- B1 (9 cm and 5.5 cm accurate with markings)

---- B1

Accept drawing below AB

(b) Measure $\angle CAB$.

Answer ..... **83** ---- B1 (+/- 1)° [1]

(c) Construct the perpendicular bisector of *AB*. [1]

(d) Construct the angle bisector of $\angle ABC$. [1]

(e) *S* is a point on *BC* such that *AS* is the shortest distance from *A* to *BC*.
Measure the line segment *AS*.

Answer **4.7 cm** ---- B1 (+/- 0.1) ..... cm [1]

End of Paper

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