2020 SA2

中正中学 义顺

CHUNG CHENG HIGH SCHOOL (YISHUN)

E

2020 End-Of-Year Examination
Secondary Two Express

CANDIDATE NAME	
CLASS	
INDEX NUMBER	

MATHEMATICS

6 October 2020

SECTION A

2 hour 30 minutes

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer all the questions.
If working is needed for any question it must be shown below that question.
Essential working must be shown for full marks to be awarded.
All answers should be given in their simplest form.

The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question. The total marks for this section is 52.

For Examiner's Use	
Section A	/ 52
Section B	/ 48
Total	/ 100

Setter: Mrs Chan Wei Ling and Ms Mellissa Chia

1. The floor plan of a house is drawn using a scale of 2 cm to represent 0.001 km.

(a) Express this scale in the form of $1 : n$.

Answer 1 : _____ [1]

(b) Find the actual length, in metres, represented by 20 cm on the plan.

Answer _____ m [1]

(c) The area of the study room is 18 m^2. Calculate the area, in square centimetres, of the study room on the plan.

Answer _____ cm^2 [2]

2. Simplify $\frac{2}{7y} \times \frac{(3xy)^2}{8x^2z}$.

Answer _____ [2]

3. **(a)** Factorise fully $2x^2y-2xy+x-1$.

Answer _____ [2]

(b) It is given that $a+b=3$ and $a^2-b^2=45$. Without solving for a and b, find the value of $8a-8b$.

Answer _____ [3]

4. Express each of the following as a single fraction in its simplest form.

(a) $\dfrac{3}{x-7}-\dfrac{2}{7-x}$

Answer _____ [2]

(b) $\dfrac{2x}{9y^2-x^2}+\dfrac{5}{x+3y}$

Answer _____ [3]

5. One solution of the equation $2x^2-kx+12=0$ is $x=4$. Find

(a) the value of k.

Answer $k=$ _____ [2]

(b) the other root of the equation.

Answer $x=$ _____ [2]

6. The volume of a hemisphere is given by the formula $V = \frac{2}{3}\pi r^3$.

(a) Express r as the subject of the formula.

Answer _____ [2]

(b) Hence, find the value of r when $V = 80$.

Answer $r =$ _____ [2]

(c) Give a reason to justify why V is directly proportional to r^3.

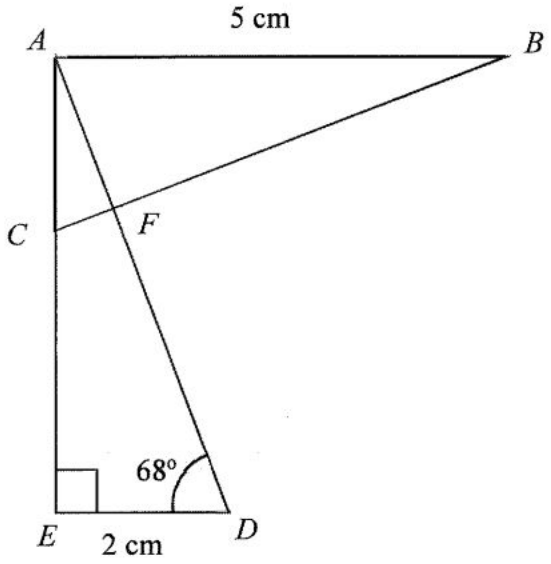
Answer: _____

_____

_____

_____ [1]

7. ΔABC is congruent to ΔEAD. Given that $AB = 5$ cm, $ED = 2$ cm, $EA = 5$ cm, angle $ADE = 68°$, angle $AED = 90°$ and AD meets BC at F.



(a) Find the length of CE.

Answer $CE =$ _____ cm [1]

(b) Find $\angle ABC$.

Answer $\angle ABC =$ _____ ° [2]

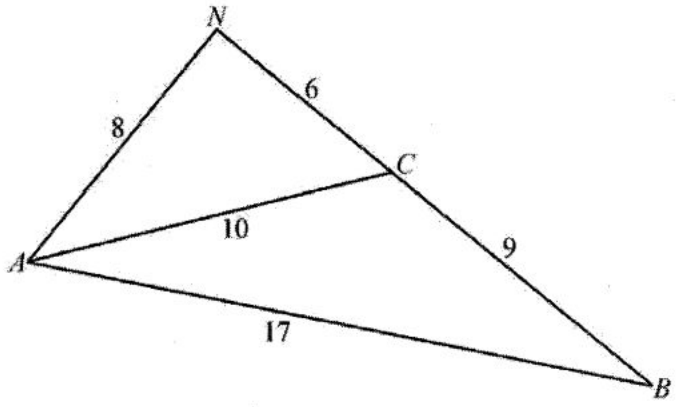
(c) Find $\angle AFC$.

Answer $\angle AFC =$ _____ ° [2]

(d) Name a triangle that is similar to ΔACF.

Answer _____ [1]

8. In the diagram, ABC is a triangle in which $AC = 10$ cm, $BC = 9$ cm and $AB = 17$ cm. N is a point on BC produced, where $CN = 6$ cm and $AN = 8$ cm.



(a) With clear working steps, explain why $\angle ANB$ is a right angle.

Answer:

[2]

(b) Find the value of $\tan \angle ABN$.

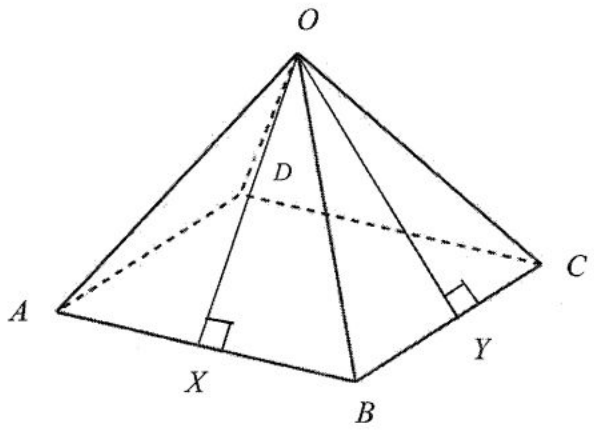
Answer _____ [1]

(c) Calculate the value of $\angle ACB$.

Answer $\angle ACB =$ _____ ° [2]

9. James is trying to solve the equation $(5x+6)(x-3)=x-3$. He divides both sides of the equation by $x-3$ to obtain $5x+6=1$. Thus, James says that $x=-1$ is the only solution. Do you agree with James? Support your conclusion and justify your solution(s) for x using clear working steps. [3]

10. The diagram shows a right rectangular pyramid with base $ABCD$. It is given that $AB = 42$ cm, $BC = 30$ cm, $OX = 25$ cm and $OY = 29$ cm.



(a) Find the height of the pyramid.

Answer _____ cm [2]

(b) Find the volume of the pyramid.

Answer _____ cm^3 [2]

(c) Find the total surface area of the pyramid.

Answer _____ cm^2 [3]

11. The masses, in grams, of 25 apples and 20 oranges were recorded.
The results are shown in the stem-and-leaf diagram.

Leaves for mass of apples						Stem	Leaves for mass of oranges					
					8	9	2					
			2	1	0	10	3	3	5			
		6	5	0	0	11	0	2	4	4	7	8
	9	7	4	3	2	12	1	1	5	5	6	8
8	6	2	2	2	0	13	2	3	4			
9	8	8	6	5	4	14	0					

Key (Apples)
8 | 9 means 98 grams

Key (Oranges)
10 | 3 means 103 grams

(a) Write down the modal mass of the apples.

Answer _____ grams [1]

(b) Write down the median mass of the oranges.

Answer _____ grams [1]

(c) Calculate the mean mass of the oranges.

Answer _____ grams [2]

(d) Make two comments comparing the masses of the apples and the oranges. [2]

1.

2.

End of Paper

中正中学 义顺

CHUNG CHENG HIGH SCHOOL (YISHUN)

E

2020 End-Of-Year Examination
Secondary Two Express

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS

6 October 2020

SECTION B

2 hour 30 minutes

Additional Materials: 1 sheet of graph paper

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
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Answer all the questions.
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Essential working must be shown for full marks to be awarded.
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The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question. The total marks for this section is 48.

For Examiner's Use	
Section A	/ 52
Section B	/ 48
Total	/ 100

Setter: Mrs Chan Wei Ling and Ms Mellissa Chia

1. Alex and Ben are in a coffee shop. Alex buys three cups of coffee and two cups of tea for \$6.75. Ben buys four cups of coffee and three cups of tea. He pays with a \$10 note and receives change of 60 cents.

(a) Use c to represent the cost, in dollars, of a cup of coffee and t to represent the cost, in dollars, of a cup of tea. Write down two simultaneous equations to represent this information.

Answer Eqn (1) _____ [1]

Eqn (2) _____ [1]

(b) Solve the simultaneous equations in (a) to find the value of c and of t.

Answer $c =$ _____ $t =$ _____ [3]

(c) Hence, calculate the total cost of two cups of coffee and five cups of tea.

Answer \$_____ [1]

2. It is given that p is inversely proportional to $(q-3)^2$. It is known that $q = 5$ when $p = 2$.

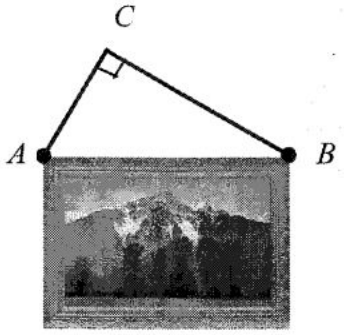
(a) Find an equation connecting p and q.

Answer _____ [3]

(b) Find the values of q when $p = 50$.

Answer $q =$ _____ or $q =$ _____ [4]

3. In the diagram below, a wire of length 42 cm, is used to hang a photo on a nail at the point C.



(a) Given that the length of AC is y cm, write down an expression, in terms of y, for the length of BC.

Answer _____ cm [1]

(b) Given that the length of the photo is 30 cm, form an equation in terms of y, and show that it reduces to $y^2 - 42y + 432 = 0$.

Answer: [3]

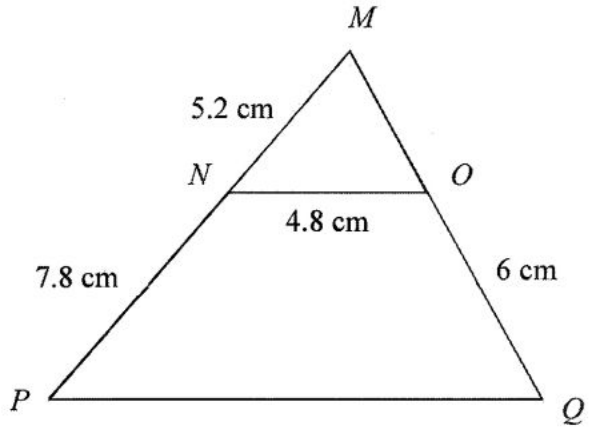
(c) Solve the equation $y^2 - 42y + 432 = 0$.

Answer $y =$ _____ or $y =$ _____ [2]

(d) Find the length of BC.

Answer _____ cm [1]

4. ΔMNO is similar to ΔMPQ. $MN = 5.2$ cm, $NP = 7.8$ cm, $NO = 4.8$ cm and $OQ = 6$ cm.



(a) Find the scale factor of enlargement from ΔMNO to ΔMPQ.

Answer _____ [1]

(b) Find the length MO.

Answer _____ cm [2]

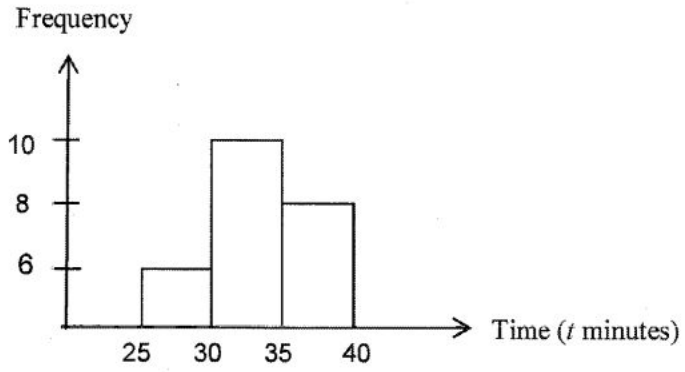
(c) Find the length PQ.

Answer _____ cm [2]

5. The length of times, t minutes, taken by 24 students to complete a test is given by the following frequency table.

Time (t minutes)	$25 < t \leq 30$	$30 < t \leq 35$	$35 < t \leq 40$
Frequency	6	10	8

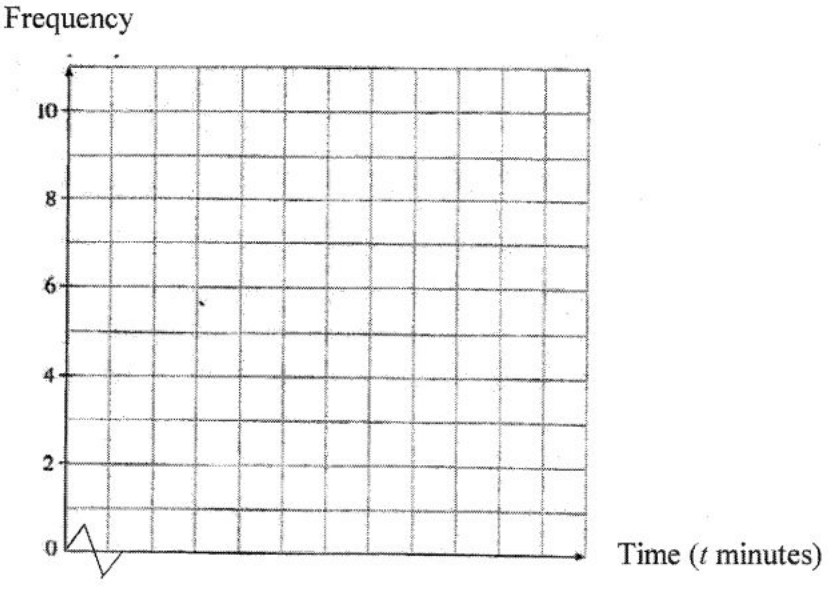
(a) Nancy drew a histogram as follows to represent the above information. Explain what is misleading about her histogram.



Answer:

[2]

(b) In the answer space below, draw a histogram that will accurately represent the same information given in the above frequency table. Include appropriate labelling where necessary.



[2]

(c) Calculate the mean time taken by the students to complete the test.

Answer _____ minutes [2]

6. Fireworks were launched vertically upwards during National Day Parade 2020. The height, h metres, of the fireworks above the ground after time, t seconds, is given by $h = -5t^2 + 40t$.

t	0	1	2	3	4	5	6	7	8
h	0	35	60	75	80	75	k	35	0

(a) Calculate the value of k.

Answer $k =$ _____ [1]

(b) On your graph paper, draw the graph of $h = -5t^2 + 40t$ for $0 \le t \le 8$. You are to use a scale of 2 cm to represent 1 unit on the t-axis and 2 cm to represent 10 units on the h-axis. [3]

Using your graph,

(c) state the coordinates of the maximum point and explain its meaning.

Answer Maximum point: (,) [1]

_____

[1]

_____

(d) find the time duration of the firework display.

Answer _____ [1]

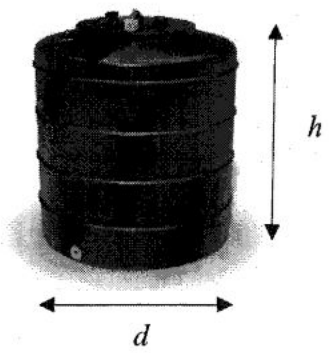
(e) state the line of symmetry and draw the line of symmetry on the graph.

Answer _____ [2]

7. Here is some information about a heating oil tank.

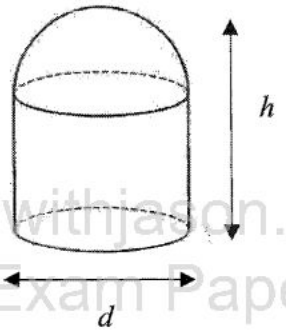
Top Outlet Tank

Height (h):	2.55 m
Diameter (d):	2.1 m
Mass of empty tank:	650 kg



Safety information: the tank can be filled to a maximum of 90% of its total volume.

In this question, the oil tank can be modelled as a cylinder with a hemisphere on top.



(a) Calculate the area, in square metres, of the base of the oil tank.

Answer _____ m^2 [1]

(b) Calculate the volume, in cubic metres, of the tank.

Answer _____ m^3 [2]

(c)

Useful information
• Density of heating oil: 820 kg/m^3
• $Density = \frac{Mass}{Volume}$

The tank is never filled to more than its safe volume. It will need a special foundation if its total mass per square metre, on the ground beneath, is greater than 1530 kg/m^2. Given that the model is an underestimation of the actual volume of the tank, does the tank need a special foundation?

Justify your decision with calculations. [5]

End of paper

ANS

中正中学 义顺

CHUNG CHENG HIGH SCHOOL (YISHUN)

E

2020 End-Of-Year Examination

Secondary Two Express

CANDIDATE NAME			
CLASS		INDEX NUMBER	

MATHEMATICS

6 October 2020

SECTION A

2 hour 30 minutes

Additional Materials: NIL

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For Examiner's Use	
Section A	**/ 52**
Section B	**/ 48**
Total	**/ 100**

Setter: Mrs Chan Wei Ling and Ms Mellissa Chia

1. The floor plan of a house is drawn using a scale of 2 cm to represent 0.001 km.

(a) Express this scale in the form of $1 : n$.

Section A:
Q1-4 (16M) – PQ
Q5-6 (9M) - Fyn
Q7-9 (14M) – WL
Q10-11 (13M) - Mellissa

$2\,cm : 0.001\,km$
$= 2\,cm : 1\,m$
$= 1\,cm : 0.5\,m$
$= 1\,cm : 50\,cm$

Answer 1 : 50 [A1] [1]

(b) Find the actual length, in metres, represented by 20 cm on the plan.

1 cm: 0.5 m

= 20 cm: 10 m [A1]

Answer 10 m [1]

(c) The area of the study room is 18 m^2. Calculate the area, in square centimetres, of the study room on the plan.

$1\,cm : 0.5\,m$
$= 1\,cm^2 : 0.25\,m^2$ [M1]
$18\,m^2 : \frac{18}{0.25}\,cm^2$
$= 18\,m^2 : 72\,cm^2$ [A1]

Answer 72 cm^2 [2]

2. Simplify $\frac{2}{7y} \times \frac{(3xy)^2}{8x^2z}$.

$\frac{2}{7y} \times \frac{9x^2y^2}{8x^2z}$ [M1 – evaluate $(3xy)^2$]
$= \frac{18x^2y^2}{56x^2yz}$
$= \frac{9y}{28z}$ [A1]

Answer $\frac{9y}{28z}$ [2]

3. **(a)** Factorise fully $2x^2y-2xy+x-1$.

$2x^2y-2xy+x-1$
$=2xy(x-1)+(x-1)$ [M1]
$=(2xy+1)(x-1)$ [A1]

Answer $(2xy+1)(x-1)$ [2]

(b) It is given that $a+b=3$ and $a^2-b^2=45$. Without solving for a and b, find the value of $8a-8b$.

$a^2-b^2=45$
$(a+b)(a-b)=45$ [M1]
$3(a-b)=45$
$a-b=15$ [A1]

$8a-8b=8(a-b)$
$=8(15)$
$=120$ [A1]

Answer 120 [3]

4. Express each of the following as a single fraction in its simplest form.

(a) $\dfrac{3}{x-7}-\dfrac{2}{7-x}$

$=\dfrac{3}{x-7}-\dfrac{2}{-(x-7)}$ [M1]

$=\dfrac{5}{x-7}$ [A1]

Accept: $\dfrac{3}{x-7}+\dfrac{2}{x-7}$

Answer $\dfrac{5}{x-7}$ [2]

(b) $\dfrac{2x}{9y^2-x^2}+\dfrac{5}{x+3y}$

$=\dfrac{2x}{(3y+x)(3y-x)}+\dfrac{5}{x+3y}$ [M1 – for factorizing $9y^2-x^2$]

$=\dfrac{2x+5(3y-x)}{(3y+x)(3y-x)}$ [M1]

$=\dfrac{15y-3x}{(3y+x)(3y-x)}$ [A1]

Answer $\dfrac{15y-3x}{(3y+x)(3y-x)}$ [3]

5. One solution of the equation $2x^2-kx+12=0$ is $x=4$. Find

(a) the value of k.

$2(4)^2-k(4)+12=0$ [M1]

$32-4k+12=0$

$-4k=-44$

$k=11$ [A1]

Answer $k=11$ [2]

(b) the other root of the equation.

$2x^2-11x+12=0$

$(x-4)(2x-3)=0$ [M1]

$x-4=0$ *or* $2x-3=0$

$x=4$ *or* $2x=3$

$x=1\dfrac{1}{2}$ [A1]

Answer $x=1\dfrac{1}{2}$ [2]

6. The volume of a hemisphere is given by the formula $V = \frac{2}{3}\pi r^3$.

(a) Express r as the subject of the formula.

$V = \frac{2}{3}\pi r^3$

$r^3 = V \div \frac{2}{3}\pi$ [M1]

$r^3 = \frac{3V}{2\pi}$

$r = \sqrt[3]{\frac{3V}{2\pi}}$ [A1]

Answer $r = \sqrt[3]{\frac{3V}{2\pi}}$ [2]

(b) Hence, find the value of r when $V = 80$.

$r = \sqrt[3]{\frac{3(80)}{2\pi}}$ [M1]

$= 3.36778$

$= 3.37$ (to 3 sf) [A1]

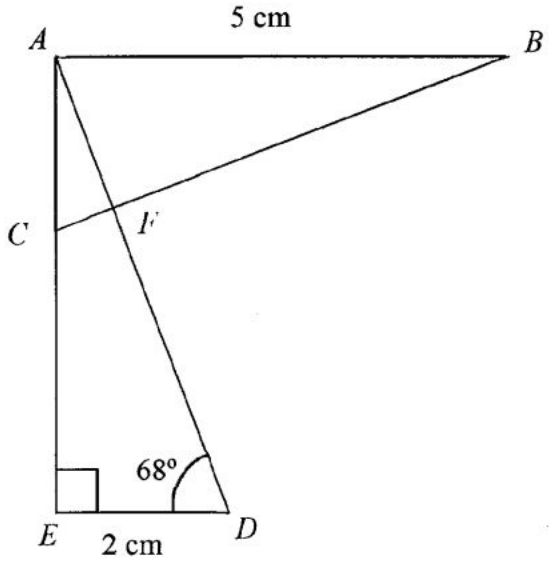
Answer $r = 3.37$ [2]

(c) Give a reason to justify why V is directly proportional to r^3.

Answer: V is directly proportional to r^3 as V can be expressed as $V = kr^3$, where $k = \frac{2}{3}\pi$, which is a constant. [R1]

(Accept other logical reason with the right concept of direct proportion.) [1]

7. ΔABC is congruent to ΔEAD. Given that $AB = 5$ cm, $ED = 2$ cm, $EA = 5$ cm, angle $ADE = 68°$, angle $AED = 90°$ and AD meets BC at F.



(a) Find the length of CE.

$CE = 5 - 2 = 3$ cm [A1]

Answer $CE = 3$ cm [1]

(b) Find $\angle ABC$.

$\angle EAD = 180° - 90° - 68°$ (angle sum of triangle) [M1 – to penalise if students did not state reason]
$= 22°$
$\angle ABC = \angle EAD$
$= 22°$ [A1]

Answer $\angle ABC = 22$ ° [2]

(c) Find $\angle AFC$.

$\angle AFC = 180° - 22° - 68°$ [M1]
$= 90°$ [A1]

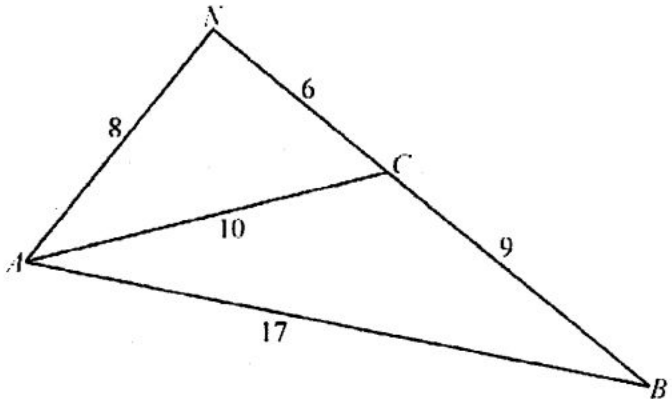
Answer $\angle AFC = 90$ ° [2]

(d) Name a triangle that is similar to ΔACF.

ΔBAF *or* ΔADE *or* ΔBCA [A1]

Answer _____ [1]

8. In the diagram, ABC is a triangle in which $AC = 10$ cm, $BC = 9$ cm and $AB = 17$ cm. N is a point on BC produced, where $CN = 6$ cm and $AN = 8$ cm.



(a) With clear working steps, explain why $\angle ANB$ is a right angle.

Answer:

[2]

$CN^2 + AN^2 = 6^2 + 8^2 = 100$

$AC^2 = 10^2 = 100$

[M1]

$CN^2 + AN^2 = AC^2$

By the converse of Pythagoras' Theorem, $\angle ANB = 90°$.

Or: $BN^2 + NA^2 = 15^2 + 8^2 = 289$

$AB^2 = 17^2 = 289$

$BN^2 + NA^2 = AB^2$

(b) Find the value of $\tan \angle ABN$.

$\tan \angle ABN = \frac{8}{15}$ [A1]

Answer $\frac{8}{15}$ [1]

(c) Calculate the value of $\angle ACB$.

$\tan \angle ACN = \frac{8}{6}$

$\angle ACN = 53.1301°$ [M1]

$\angle ACB = 180° - 53.1301°$

$\angle ACB = 126.9°$ (to 1 d.p.) [A1]

Answer $\angle ACB =$ 126.9 ° [2]

9. James is trying to solve the equation $(5x+6)(x-3)=x-3$. He divides both sides of the equation by $x-3$ to obtain $5x+6=1$. Thus, James says that $x=-1$ is the only solution. Do you agree with James? Support your conclusion and justify your solution(s) for x using clear working steps. [3]

No, I do not agree with James. Dividing both sides by the factor (x-3) will eliminate one possible solution of x. [R1]

$(5x+6)(x-3)=x-3$

$5x^2-9x-18=x-3$

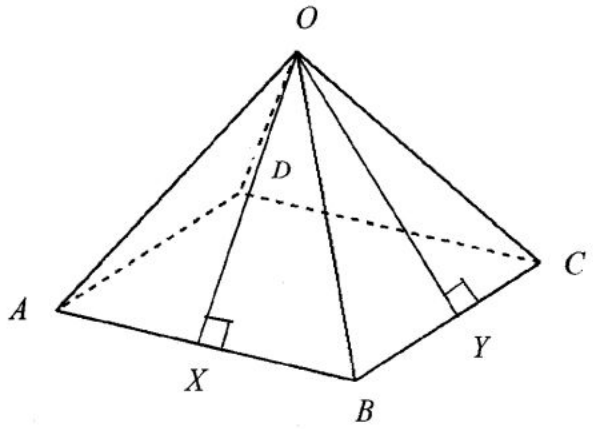
$5x^2-10x-15=0$ [M1]

$x^2-2x-3=0$

$(x-3)(x+1)=0$

$x=3$ *or* $x=-1$ [A1]

10. The diagram shows a right rectangular pyramid with base $ABCD$. It is given that $AB = 42$ cm, $BC = 30$ cm, $OX = 25$ cm and $OY = 29$ cm.



(a) Find the height of the pyramid.

Let the height of the pyramid be h cm.

$h^2 = 29^2 - 21^2$ [M1] or $h^2 = 25^2 - 15^2$

$h = 20$ [A1]

Answer 20 cm [2]

(b) Find the volume of the pyramid.

$$\text{Volume} = \frac{1}{3} \times (42 \times 30) \times 20$$
$$= 8400 \text{ cm}^3$$

Answer 8400 cm^3 [2]

(c) Find the total surface area of the pyramid.

Total surface area

$(42 \times 30) + 2 \times \left(\frac{1}{2} \times 42 \times 25\right) + 2 \times \left(\frac{1}{2} \times 30 \times 29\right)$ cm^2 [M2 – deduct 1 mark for each error]

$= 1260 + 1050 + 870$ cm^2

$= 3180 \text{ cm}^2$ [A1]

Answer _____ cm^2 [3]

11. The masses, in grams, of 25 apples and 20 oranges were recorded.
The results are shown in the stem-and-leaf diagram.

Leaves for mass of apples						Stem	Leaves for mass of oranges					
					8	9	2					
			2	1	0	10	3	3	5			
		6	5	0	0	11	0	2	4	4	7	8
	9	7	4	3	2	12	1	1	5	5	6	8
8	6	2	2	2	0	13	2	3	4			
9	8	8	6	5	4	14	0					

Key (Apples)
8 | 9 means 98 grams

Key (Oranges)
10 | 3 means 103 grams

(a) Write down the modal mass of the apples.

Answer 132 [A1] grams [1]

(b) Write down the median mass of the oranges.

$$\text{Median} = \frac{118+121}{2}$$
$$= 119.5 \quad [A1]$$

Answer 119.5 grams [1]

(c) Calculate the mean mass of the oranges.

$$\text{Mean mass} = (92+103\times2+105+110+112+114\times2+117+118$$
$$+121\times2+125\times2+126+128+132+133+134+140) \div 20 \quad [M1]$$

$$= 2373 \div 20$$
$$= 118\frac{13}{20} \text{ (accept 118.65)} \quad [A1]$$

Answer _____ grams [2]

(d) Make two comments comparing the masses of the apples and the oranges. [2]

1. The masses of apples cluster around 130g to 149g while the masses of oranges cluster around 110g to 128g.

2. The masses of apples are heavier than the masses of oranges by a bigger percentage or proportion.

(accept other logical comments relevant to the context/distribution/statistics)

End of Paper

中正中学 义顺

CHUNG CHENG HIGH SCHOOL (YISHUN)

E

2020 End-Of-Year Examination
Secondary Two Express

CANDIDATE NAME

CLASS | INDEX NUMBER

MATHEMATICS

6 October 2020

SECTION B

2 hour 30 minutes

Additional Materials: 1 sheet of graph paper

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer all the questions.
If working is needed for any question it must be shown below that question.
Essential working must be shown for full marks to be awarded.
All answers should be given in their simplest form.

The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question. The total marks for this section is 48.

For Examiner's Use	
Section A	/ 52
Section B	/ 48
Total	/ 100

Setter: Mrs Chan Wei Ling and Ms Mellissa Chia

1. Alex and Ben are in a coffee shop. Alex buys three cups of coffee and two cups of tea for \$6.75. Ben buys four cups of coffee and three cups of tea. He pays with a \$10 note and receives change of 60 cents.

(a) Use c to represent the cost, in dollars, of a cup of coffee and t to represent the cost, in dollars, of a cup of tea. Write down two simultaneous equations to represent this information.

$3c+2t=6.75$ [A1]

$4c+3t=9.4$ [A1]

Answer Eqn (1) $3c+2t=6.75$ [1]

Eqn (2) $4c+3t=9.4$ [1]

(b) Solve the simultaneous equations in (a) to find the value of c and of t.

$3c+2t=6.75 \quad ---(1)$

$4c+3t=9.4 \quad ---(2)$

$(1)\times 3: \quad 9c+6t=20.25 \quad ---(3)$ [M1 – elimination or substitution method]

$(2)\times 2: \quad 8c+6t=18.8 \quad ---(4)$

$(3)-(4): \quad c=1.45$ [A1]

$$t=\frac{6.75-3(1.45)}{2}$$
$$=1.2 \quad \text{[A1]}$$

Answer $c=$ 1.45 $t=$ 1.2 [3]

(c) Hence, calculate the total cost of two cups of coffee and five cups of tea.

Total cost $= 2(1.45)+5(1.2)=8.9$

Answer \$8.90 [A1] [1]

2. It is given that p is inversely proportional to $(q-3)^2$. It is known that $q = 5$ when $p = 2$.

(a) Find an equation connecting p and q.

$$p = \frac{k}{(q-3)^2}$$

$$2 = \frac{k}{(5-3)^2} \quad \text{[M1]}$$

$$2 = \frac{k}{4}$$

$$k = 8 \quad \text{[M1]}$$

$$p = \frac{8}{(q-3)^2} \quad \text{[A1]} \quad \text{(Accept } p(q-3)^2 = 8\text{)}$$

Answer: $p = \frac{8}{(q-3)^2}$ [3]

(b) Find the values of q when $p = 50$.

$$50 = \frac{8}{(q-3)^2}$$

$$(q-3)^2 = \frac{8}{50} \quad \text{[B1]}$$

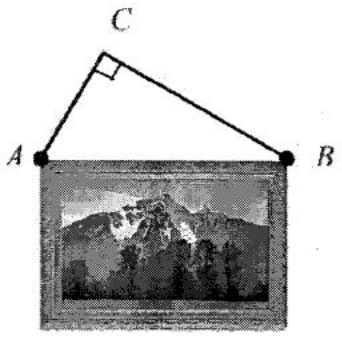
$$(q-3)^2 = \frac{4}{25}$$

$$q - 3 = \pm\frac{2}{5} \quad \text{[M1]}$$

$$q = 3\frac{2}{5} \quad \textit{or} \quad 2\frac{3}{5} \quad \text{[A2]}$$

Answer $q = 3\frac{2}{5}$ or $q = 2\frac{3}{5}$ [4]

3. In the diagram below, a wire of length 42 cm, is used to hang a photo on a nail at the point C.



(a) Given that the length of AC is y cm, write down an expression, in terms of y, for the length of BC.

$BC = 42 - y$ [A1]

Answer $42 - y$ cm [1]

(b) Given that the length of the photo is 30 cm, form an equation in terms of y, and show that it reduces to $y^2 - 42y + 432 = 0$.

Answer: [3]

$y^2 + (42 - y)^2 = 30^2$ [M1]

$y^2 + 1764 - 84y + y^2 = 900$ [M1]

$2y^2 - 84y + 864 = 0$

$y^2 - 42y + 432 = 0$ (shown) [B1]

(c) Solve the equation $y^2 - 42y + 432 = 0$.

$(y - 24)(y - 18) = 0$ [M1]

$y = 24$ *or* 18 [A1]

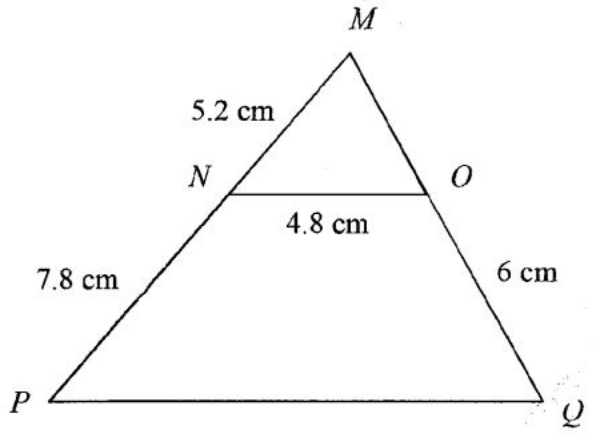
Answer $y = 24$ or $y = 18$ [2]

(d) Find the length of BC.

$BC = 42 - 18 = 24$ [A1]

Answer $BC = 24$ cm [1]

4. ΔMNO is similar to ΔMPQ. $MN = 5.2$ cm, $NP = 7.8$ cm, $NO = 4.8$ cm and $OQ = 6$ cm.



(a) Find the scale factor of enlargement from ΔMNO to ΔMPQ.

Scale factor of enlargement $= \frac{5.2+7.8}{5.2} = \frac{5}{2} = 2\frac{1}{2}$ [A1]

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

(b) Find the length MO.

$\frac{MN}{MP} = \frac{5.2}{13}$

$\frac{x}{x+6} = \frac{2}{5}$ [M1]

$5x = 2x + 12$

$x = 4$ [A1]

Answer $x = 4$ cm [2]

(c) Find the length PQ.

$\frac{4.8}{PQ} = \frac{2}{5}$ [M1] (Accept $PQ = 2.5 \times 4.8$)

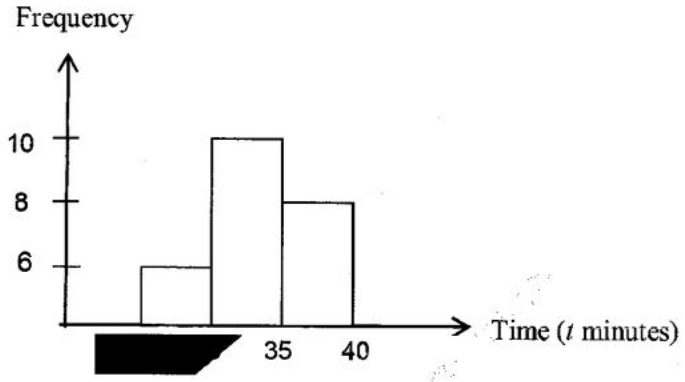
$PQ = 12$ [A1]

Answer $PQ = 12$ cm [2]

5. The length of times, t minutes, taken by 24 students to complete a test is given by the following frequency table.

Time (t minutes)	$25 < t \leq 30$	$30 < t \leq 35$	$35 < t \leq 40$
Frequency	6	10	8

(a) Nancy drew a histogram as follows to represent the above information. Explain what is misleading about her histogram.



Answer

The vertical axis does not start from zero (or vertical axis has inconsistent intervals). [R1]

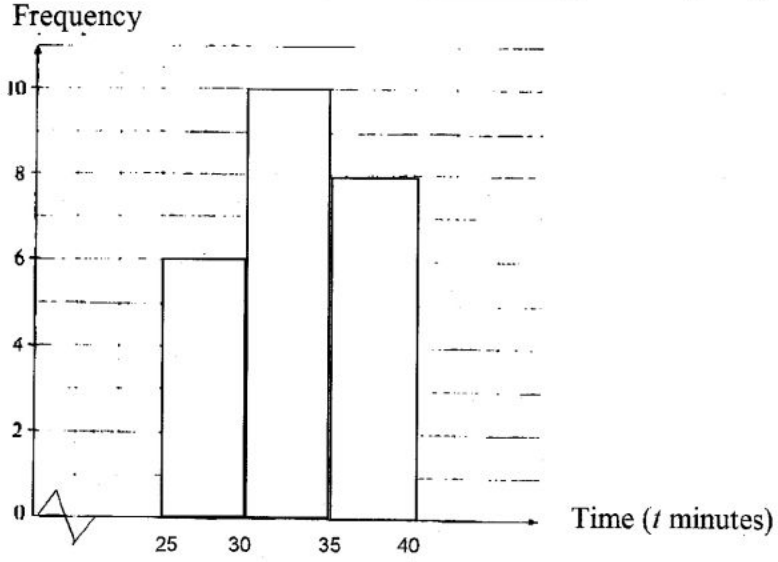
It appeared as if the time (in minutes) taken in the interval $30 < t \leq 35$ is 3 times of time taken in $25 < t \leq 30$.

But actually the time taken is only $1\frac{2}{3}$ times.

[2]

(b) In the answer space below, draw a histogram that will accurately represent the same information given in the above frequency table. Include appropriate labelling where necessary.

A2 – deduct 1 mark for any wrongly drawn bar or non-labelling of x-axis



(c) Calculate the mean time taken by the students to complete the test.

$$\text{Mean} = \frac{27.5\times6+32.5\times10+37.5\times8}{6+10+8} \quad \text{[B1 - mid-value of each class interval]}$$
$$= \frac{790}{24}$$
$$= 32.91667$$
$$= 32.9 \text{ (to 3 s.f.)}$$

Answer 32.9 minutes [2]

6. Fireworks were launched vertically upwards during National Day Parade 2020. The height, h metres, of the fireworks above the ground after time, t seconds, is given by $h = -5t^2 + 40t$.

t	0	1	2	3	4	5	6	7	8
h	0	35	60	75	80	75	k	35	0

(a) Calculate the value of k.
$h = -5(6)^2 + 40(6) = 60$

Answer $k = 60$ [1]

(b) On your graph paper, draw the graph of $h = -5t^2 + 40t$ for $0 \le t \le 8$. You are to use a scale of 2 cm to represent 1 unit on the t-axis and 2 cm to represent 10 units on the h-axis. [3]

Using your graph,

(c) state the coordinates of the maximum point and explain its meaning.

Answer Maximum point: (4 , 80) [1]

This means that the fireworks reached a maximum height of 80 m when time is 4 seconds. [R1] [1]

(d) find the time duration of the firework display.

Answer 8 seconds [1]

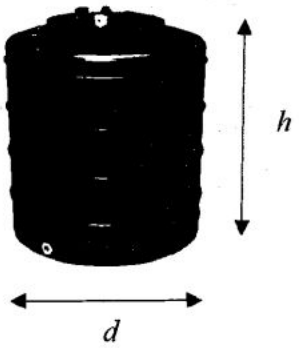
(e) state the line of symmetry and draw the line of symmetry on the graph.

Answer $t = 4$ [2]

7. Here is some information about a heating oil tank.

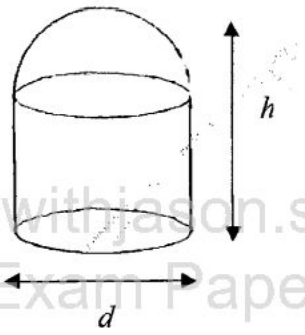
Top Outlet Tank

Height (h):	2.55 m
Diameter (d):	2.1 m
Mass of empty tank:	650 kg



Safety information: the tank can be filled to a maximum of 90% of its total volume.

In this question, the oil tank can be modelled as a cylinder with a hemisphere on top.



(a) Calculate the area, in square metres, of the base of the oil tank.

$$\begin{aligned} \textit{Base area} &= \pi(1.05)^2 \\ &= 3.463606 \\ &= 3.46 \quad (\textit{to } 3\ s.f.) \quad \text{[A1]} \end{aligned}$$

Answer _____ m^2 [1]

(b) Calculate the volume, in cubic metres, of the tank.

$$\text{Volume} = \pi(1.05)^2 \times 1.5 + \frac{2}{3}\pi(1.05)^3 \quad \text{[M1]}$$

$$\begin{aligned} &= 7.61993 \\ &= 7.62 \quad \text{(to 3 s.f.)} \quad \text{[A1]} \end{aligned}$$

Answer _____ m^3 [2]

(c)

Useful information
• Density of heating oil: 820 kg/m^3
• $Density = \frac{Mass}{Volume}$

The tank is never filled to more than its safe volume. It will need a special foundation if its total mass per square metre, on the ground beneath, is greater than 1530 kg/m^2. Given that the model is an underestimation of the actual volume of the tank, does the tank need a special foundation?

Justify your decision with calculations. [5]

Volume of tank $= 0.9 \times 7.61993 \text{ m}^3$ [M1]
$= 6.85793 \text{ m}^3$

Mass of oil $= 820 \times 6.85793 \text{ kg}$ [M1]
$= 5623.5026 \text{ kg}$

Total mass of oil and tank $= 5623.5026 + 650 \text{ kg}$ [M1]
$= 6273.5026 \text{ kg}$

Mass per m^2 $= \frac{6273.5026}{3.463606}$ [M1]
$= 1811.26$

Since mass per m^2 of oil and tank is greater than 1530 kg/m^2, a special foundation is needed. [A1]

End of paper