

QUEEN'S COLLEGE

S.3 HALF-YEARLY EXAMINATION 2019-20

PAPER 1

Question-Answer Book

1 hour 30 minutes

This Paper must be answered in English

Date: 6th January 2020 (8:30 a.m. – 10:00 a.m.)

INSTRUCTIONS

- Write your Class and Class Number in the spaces provided on this cover.
- This paper consists of three sections, Section A(1), A(2) and B. Answer ALL questions in this paper.
- Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.
- Graph paper and supplementary answer sheets will be supplied on request. Write your Class and Class Number on each sheet, and staple them together into this book.
- The use of HKEAA approved calculators is permitted.
- Unless otherwise specified, all working must be clearly shown.
- For factorization, you are required to use cross-method and/or identities.
- Unless otherwise specified, numerical answers should be either exact or correct to 3 significant figures.
- The diagrams in this paper are not necessarily drawn to scale.

CLASS	
CLASS NO.	

		Marker's Use Only	
Section	Question No.	Max.	Marks
A(1)	1-10	30	
A(2)	11	6	
	12	7	
	13	7	
	14	9	
	15	10	
	16	11	
A(2) Total		50	
B	17	5	
	18	7	
	19	7	
	20	9	
	21	12	
B Total		40	
Total		120	

Section A(1) (30 marks)

In this section, write the answers in the spaces provided. **NO working step** is required.

1. Factorize each of the following expressions.

(a) $2x^2 - 13x + 21$

(b) $36 - 60a + 25a^2$

(c) $x^4y - 10x^3y^2 + 25x^2y^3$

2. In a Mathematics test, John's score and Peter's score are represented in binary numbers. Use the head (*H*) of a one-dollar coin to represent 1 and the tail (*T*) to represent 0. The full mark of the test is 100.

(a) John's score is represented as follows: *HHTTTTHH*
Find John's score.

(b) Peter's score is represented as follows: *HTHHHTTT*
Find Peter's score.

(c) Who gets a higher score?

3. Simplify the following expressions and express the answers with positive indices.

(All the letters in the expressions represent non-zero numbers.)

(a) $(7k^{-4})^2$

(b) $h^0 \div (5h^{-5})$

(c) $(-b)^{-4} \times (-b^9)$

4. A car depreciates 20% each year. If the value of the car is \$150 000, find its value after 4 years.

5. The rateable value of a flat is \$62 400, find the quarterly rates payable. (Suppose the rates percentage charge is 5%.)

6. The monthly salary of an employee is \$20000. It is increased by 4% this month but it will be decreased by 4% next month.

(a) Find his monthly salary next month.

(b) Find the percentage change in his monthly salary.

Answer

1. (a) _____(1)

(b) _____(1)

(c) _____(1)

2.

(a) _____(1)

(b) _____(1)

(c) _____(1)

3.

(a) _____(1)

(b) _____(1)

(c) _____(1)

4. _____(1)

5. _____(1)

6.

(a) _____(1)

(b) _____(1)

7. Given a set of data 2, 3, 5, 5, 7, 7, 7, 10,
- find the mean, the median and the mode of this set of data.
 - if a new datum "0" is inserted, find the new mean, the new median and the new mode.
 - if the datum "7" is removed, find the new mean, the new median and the new mode.

7. (a) mean _____(1),
 median _____(1),
 mode _____(1).
 (b) mean _____(1),
 median _____(1),
 mode _____(1).
 (c) mean _____(1),
 median _____(1),
 mode _____(1).

8. Solve the following inequalities.

(a) $5(1 - 2x) < -13$

(b) $-\frac{2}{3}x + 5 \geq 2$

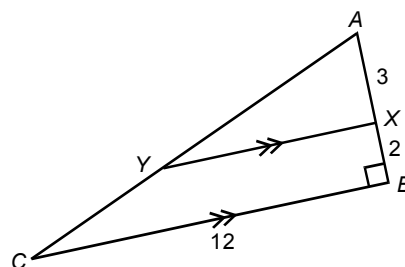
(c) $-\frac{8}{5}x - 12 < -7$

8.
 (a) _____(1)
 (b) _____(1)
 (c) _____(1)

9. (a) It is given that the length of the longest side of a triangle is 4 and the lengths of the other two sides are integers. Under these conditions, how many different triangles can be formed?
 (b) It is given that the lengths of two sides of a triangle are both 5 and the length of the remaining side is an integer. Find the maximum and the minimum values of its perimeter.

9. (a) _____(1)
 (b) Max _____(1)
 Min _____(1)

10. In the figure, $\angle ABC = 90^\circ$, $XY \parallel BC$, $AX = 3\text{cm}$, $XB = 2\text{cm}$ and $BC = 12\text{cm}$.



- Find the length of XY .
- Find the area of trapezium $XBCY$.

10. (a) _____(1)
 (b) _____(1)

Answer

Section A(2) (50 marks)

In this section, working steps must be clearly shown.

11. Brenda deposits \$440 000 in a bank at a simple interest rate of $R\%$ per annum. The amount received after 6 months is \$452 100.

(a) Find the value of R .

(b) Find the number of months required to get simple interest of \$30 250. (6 marks)



Answers written in the margins will not be marked.

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12. (a) If $2^{x+y} = 16$, express x in terms of y .

(b) Hence, if $\begin{cases} 2^{x+y} = 16 \\ 2^{x-y} = 2 \end{cases}$, find the values of x and y . (7

marks)

A large rectangular area with a green border, containing numerous horizontal dotted lines for writing answers.

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14. (a) Simplify $\frac{1}{4}\sqrt[4]{16a^{-2}b^3}$ and express your answer with positive indices. (4 marks)

(b) Express $2^{11} - 2^7 + 22 \times 16^2 + 2^3 + 11$ as a binary number. (5 marks)

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15. In a regular polygon, the sum of interior angles is not less than $1\,000^\circ$.

(a) At least how many sides does the regular polygon have?

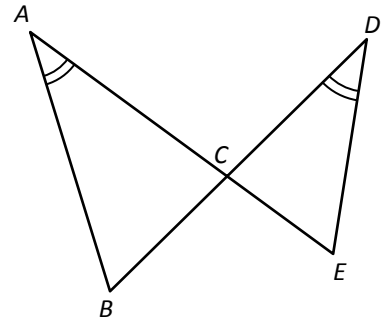
(b) Find the greatest possible size of each exterior angle of the regular polygon. (10 marks)

A large rectangular area with a green border, containing numerous horizontal dotted lines for writing answers.

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16. In the figure, AE and BD intersect at C . It is given that $\angle BAC = \angle EDC$.

(a) Prove that $\triangle ABC \sim \triangle DEC$.

(b) If $AB = 20$, $BC = 12$, $AE = 25$ and $DE = 15$, is AE perpendicular to BD ? Explain your answer.

(11 marks)

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20. A student conducts a survey to investigate the ratings of a restaurant given by the customers. The stem-and-leaf diagram below shows the distribution of the rating (in marks) of the restaurant given by twenty customers interviewed, where x is a non-negative integer less than 10.

Stem (tens)	Leaf (units)
3	5
4	1 4
5	2 2 5 6 7
6	0 0 x 4 5 5 6 7 7
7	0 1 1

- (a) It is given that the mean of the distribution is less than the median by 2 marks. Find x . (4 marks)
- (b) The student interviews four more customers later and the mean of the ratings given by these four customers is the same as the mean of the original distribution. It is given that the ratings given by two of these four customers are 58 marks and 59 marks.
- (i) Find the mean of the rating given by these twenty-four customers. (1 mark)
- (ii) Is it possible for the median of the rating given by these twenty-four customers to be the same as the median of the original distribution? Explain your answer. (4 marks)

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End of Paper 1

SOLUTION

QUEEN'S COLLEGE

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	20	9	
	21	12	
B Total		40	
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Section A(1) (30 marks)

In this section, write the answers in the spaces provided. **NO working step** is required.

Each question carries equal marks.

1. Factorize each of the following expressions.

(a) $2x^2 - 13x + 21$

(b) $36 - 60a + 25a^2$

(c) $x^4y - 10x^3y^2 + 25x^2y^3$

2. In a Mathematics test, John's score and Peter's score are represented in binary numbers. Use the head (*H*) of a one-dollar coin to represent 1 and the tail (*T*) to represent 0. The full mark of the test is 100.

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Find John's score.

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Find Peter's score.

(c) Who gets a higher score?

3. Simplify the following expressions and express the answers with positive indices. (*All the letters in the expressions represent non-zero numbers.*)

a) $(7k^{-4})^2$

b) $h^0 \div (5h^{-5})$

c) $(-b)^{-4} \times (-b^9)$

4. A car depreciates 20% each year. If the value of the car is \$150000, find its value after 4 years.

5. The rateable value of a flat are \$62 400, find the quarterly rates payable. (Suppose the rates percentage charge is 5%.)

6. The monthly salary of an employee is \$20 000. It is increased by 4% this month but it will be decreased by 4% next month.

(a) Find his monthly salary next month.

(b) Find the percentage change in his monthly salary.

Answer

1. (a) $(2x - 7)(x - 3)$

(b) $(5a - 6)^2$

(c) $x^2y(x - 5y)^2$

2.

(a) 99

(b) 88

(c) John

3.

(a) $\frac{49}{k^8}$

(b) $\frac{h^5}{5}$

(c) $-b^5$

4. \$61440

5. \$780

6.

(a) \$19968

(b) -0.16%

7. Given a set of data 2, 3, 5, 5, 7, 7, 7, 10,
- (a) find the mean, the median and the mode of this set of data.
 - (b) if a new datum “0” is inserted, find the new mean, the new median and the new mode.
 - (c) if the datum “7” is removed, find the new mean, the new median and the new mode.

8. Solve the following inequalities.

a) $5(1 - 2x) < -13$

b) $-\frac{2}{3}x + 5 \geq 2$

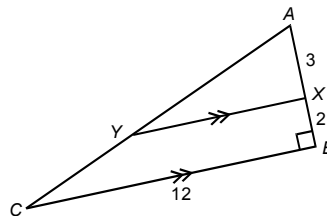
c) $-\frac{8}{5}x - 12 < -7$

9. a) It is given that the length of the longest side of a triangle is 4 and the lengths of the other two sides are integers. Under these conditions, how many different triangles can be formed?

b) It is given that the lengths of two sides of a triangle are both 5 and the length of the remaining side is an integer. Find the maximum and the minimum values of its perimeter.

10. In the figure, $\angle ABC = 90^\circ$, $XY \parallel BC$, $AX = 3\text{cm}$, $XB = 2\text{cm}$ and $BC = 12\text{cm}$.

- a) Find the length of XY .
- b) Find the area of trapezium $XBCY$.



Answer

7. a) The mean is 5.75,
the median is 6,
the mode is 7.
- b) The mean is 5.11,
the median is 5,
the mode is 7.
- a) The mean is 5.57,
the median is 5,
the mode is 5 and 7.

8. a) $x > \frac{9}{5}$
- b) $x \leq \frac{9}{2}$
- c) $x > -\frac{25}{8}$

9. (a) 2
- (b) Max 19
Min 11

10. (a) 7.2 cm
(b) 19.2 cm²

Section A(2) (50 marks)

In this section, working steps must be clearly shown.

11. Brenda deposits \$440 000 in a bank at a simple interest rate of $R\%$ p.a. The amount received after 6 months is \$452 100.

- (a) Find the value of R .
 (b) Find the number of months required to get simple interest of \$30 250.

(6 marks)

Solution:

$$(a) \quad 452\,100 = 440\,000 \times \left(1 + R\% \times \frac{6}{12}\right)$$

$$\frac{452\,100}{440\,000} = 1 + \frac{R}{100} \times \frac{6}{12}$$

$$1.0275 = 1 + \frac{R}{200}$$

$$R = \underline{\underline{5.5}}$$

- (b) Let T years be the time required.

$$440\,000 \times 5.5\% \times T = 30\,250$$

$$24\,200T = 30\,250$$

$$T = 1.25$$

$$\text{Months} = 1.25 * 12 = 15$$

\therefore The months required is 15 months.

12. (a) If $2^{x+y} = 16$, express x in terms of y .

(b) Hence, if $\begin{cases} 2^{x+y} = 16 \\ 2^{x-y} = 2 \end{cases}$, find the values of x and y . (7 marks)

(a) $2^{x+y} = 16$

$$2^{x+y} = 2^4$$

$$\therefore x + y = 4$$

$$\underline{\underline{x = 4 - y}}$$

(b) $2^{x-y} = 2$

$$x - y = 1$$

$$x = y + 1$$

$$4 - y = y + 1 \quad [\text{By the result of (a)}]$$

$$2y = 3$$

$$y = \frac{3}{2}$$

Substitute $y = \frac{3}{2}$ into $x = y + 1$,

$$x = \frac{3}{2} + 1$$

$$= \frac{5}{2}$$

$$\therefore \underline{\underline{x = \frac{5}{2}}}, \underline{\underline{y = \frac{3}{2}}}$$

13. The table below shows the distribution of the daily usage of telephone by the girls in

S.3E.

Daily usage of telephone (min)	Class mark (min)	Number of girls
1 – 30		1
31 – 60		2
61 – 90		3
91 – 120		5
121 – 150		5
151 – 180		6

- (a) Complete the table above by directly filling in the **Class mark (min)** boxes.
- (b) Find the modal class of the daily usage of telephone by these girls.
- (c) Find the mean daily usage of telephone by these girls. (corr. to 3 sig.fig.) (7 marks)

Solution

(a)

Daily usage of telephone (min)	Class mark (min)	Number of girls
1 – 30	15.5	1
31 – 60	45.5	2
61 – 90	75.5	3
91 – 120	105.5	5
121 – 150	135.5	5
151 – 180	165.5	6

(3 marks)

(b) Modal class = 151 min – 180 min

(c) Mean = $\left(\frac{15.5 \times 1 + 45.5 \times 2 + 75.5 \times 3 + 105.5 \times 5 + 135.5 \times 5 + 165.5 \times 6}{22}\right)$ min

= 115 min (corr. to 3 sig. fig.)

14. (a) Simplify $\frac{1}{4}\sqrt[4]{16a^{-2}b^3}$ and express your answer with positive indices. (4 marks)

(b) Express $2^{11} - 2^7 + 22 \times 16^2 + 2^3 + 11$ as a binary number. (5 marks)

$$\begin{aligned} \text{a) } & \frac{1}{4}\sqrt[4]{16a^{-2}b^3} \\ &= \frac{1}{4}(2)a^{-\frac{2}{4}}b^{\frac{3}{4}} \\ &= \frac{b^{\frac{3}{4}}}{2a^{\frac{1}{2}}} \end{aligned}$$

$$\begin{aligned} \text{b) } & 2^{11} - 2^7 + 22 \times 16^2 + 2^3 + 11 \\ &= 2^{11} - 2^7 + (2^4 + 2^2 + 2) \times (2^4)^2 + 2^3 + (2^3 + 2 + 1) \\ &= 2^{11} - 2^7 + 2^{12} + 2^{10} + 2^9 + 2 \cdot 2^3 + 2 + 1 \\ &= 2^{12} + 2^{11} + 2^{10} + 4 \cdot 2^7 - 2^7 + 2^4 + 2 + 1 \\ &= 2^{12} + 2^{11} + 2^{10} + 3 \cdot 2^7 + 2^4 + 2 + 1 \\ &= 2^{12} + 2^{11} + 2^{10} + (2+1) \cdot 2^7 + 2^4 + 2 + 1 \\ &= 2^{12} + 2^{11} + 2^{10} + 2^8 + 2^7 + 2^4 + 2 + 1 \end{aligned}$$

The required binary number is 1 110 110 010 011

15. In a regular polygon, the sum of interior angles is not less than $1\,000^\circ$.

(a) At least how many sides does the regular polygon have?

(b) Find the greatest possible size of each exterior angle of the regular polygon.

(10 marks)

Let n be the number of sides of the polygon.

(a) $(n - 2) \times 180^\circ \geq 1\,000^\circ$

$$n - 2 \geq 5\frac{5}{9}$$

$$n \geq 7\frac{5}{9}$$

$\therefore n$ is an integer.

\therefore The minimum value of n is 8.

\therefore The regular polygon has at least 8 sides.

(b) The sum of exterior angles of a regular polygon is 360° .

\therefore All the exterior angles of a regular polygon are equal.

$$\therefore \text{Size of each exterior angle} = \frac{360^\circ}{n}$$

From (a), $n \geq 8$.

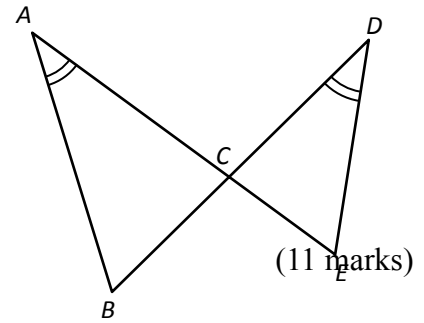
$$\therefore \frac{1}{n} \leq \frac{1}{8}$$

$$\frac{360^\circ}{n} \leq \frac{360^\circ}{8}$$

$$\frac{360^\circ}{n} \leq 45^\circ$$

\therefore The greatest possible size of each exterior angle of the regular polygon is 45° .

16. In the figure, AE and BD intersect at C . It is given that $\angle BAC = \angle EDC$.



- (a) Prove that $\triangle ABC \sim \triangle DEC$.
 (b) If $AB = 20$, $BC = 12$, $AE = 25$ and $DE = 15$, is AE perpendicular to BD ? Explain your answer.

(11 marks)

Solution:

(a) In $\triangle ABC$ and $\triangle DEC$,

$$\angle ACB = \angle DCE$$

$$\angle BAC = \angle EDC$$

$$\angle ABC + \angle ACB + \angle BAC = 180^\circ$$

$$\angle ABC = 180^\circ - \angle ACB - \angle BAC$$

$$\angle DEC + \angle DCE + \angle EDC = 180^\circ$$

$$\angle DEC = 180^\circ - \angle DCE - \angle EDC$$

$$= 180^\circ - \angle ACB - \angle BAC$$

$$\therefore \angle ABC = \angle DEC$$

$$\therefore \underline{\triangle ABC \sim \triangle DEC}$$

vert. opp. \angle s

given

\angle sum of Δ

\angle sum of Δ

AAA

(b) $\therefore \triangle ABC \sim \triangle DEC$

(proved in (a))

$$\therefore \frac{EC}{BC} = \frac{DE}{AB}$$

(corr. sides, $\sim \Delta$ s)

$$\frac{EC}{12} = \frac{15}{20}$$

$$EC = 9$$

$$AC = AE - EC$$

$$= 25 - 9$$

$$= 16$$

In $\triangle ABC$,

$$AC^2 + BC^2 = (16^2 + 12^2) = 400$$

$$AB^2 = 20^2 = 400$$

$$\therefore AC^2 + BC^2 = AB^2$$

$$\therefore \angle ACB = 90^\circ$$

(converse of Pyth. theorem)

i.e. AE is perpendicular to BD .

Section B (40 marks)

In this section, working steps must be clearly shown.

17. It is given that $\sin x + \cos x = \frac{\sqrt{7}}{2}$ and $\sin x \cos x = \frac{3}{8}$, where $\sin x > \cos x > 0$.

Find the exact value of $\cos^2 x - \sin^2 x$.

(5 marks)

$(\cos x - \sin x)^2 = \sin^2 x - 2 \sin x \cos x + \cos^2 x$ $= 1 - 2 \sin x \cos x$ $\therefore \sin x \cos x = \frac{3}{8}$ $(\cos x - \sin x)^2 = 1 - 2 \left(\frac{3}{8} \right) = \frac{1}{4}$ $\therefore \sin x > \cos x > 0, \text{ i.e. } \cos x - \sin x < 0,$ $\therefore \cos x - \sin x = -\frac{1}{2}$ $\cos^2 x - \sin^2 x = (\cos x - \sin x)(\cos x + \sin x)$ $= -\frac{1}{2} \cdot \frac{\sqrt{7}}{2}$ $= -\frac{\sqrt{7}}{4}$	
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18. (a) Factorize


(i) $8x^2 - 24x + 18$.

(ii) $8y^2 - 72y + 162$.

(3 marks)

(b) Using the results in (a), a student claims that $8(8x^2 - 24x + 18)^2 - 576x^2 + 1728x - 1134$ can be rewritten as the product of linear factors. Do you agree? Explain your answer.

(4 marks)

<p>(a)(i) $8x^2 - 24x + 18 = 2(4x^2 - 12x + 9)$</p> $= 2[(2x)^2 - 2(2x)(3) + 3^2]$ $= 2(2x - 3)^2$ <p>(ii) $8y^2 - 72y + 162 = 2(4y^2 - 36y + 81)$</p> $= 2[(2y)^2 - 2(2y)(9) + 9^2]$ $= 2(2y - 9)^2$	
<p>(b) $8(8x^2 - 24x + 18)^2 - 576x^2 + 1728x - 1134$</p> $= 8(8x^2 - 24x + 18)^2 - 72(8x^2 - 24x + 18) + 162$ $= 2[2(8x^2 - 24x + 18) - 9]^2$ $= 2[4(2x - 3)^2 - 9]^2$ $= 2[2^2(2x - 3)^2 - 3^2]^2$ $= 2[2(2x - 3) - 3]^2 [2(2x - 3) + 3]^2$ $= 2(4x - 9)^2 (4x - 3)^2$ <p>Yes, I agree</p> 	

19. (a) By using the fact that for positive x and a if $x^n > a^n$ then $x > a$, solve $x^3 > 1.331$.

(2 marks)

(b) John is going to deposit 120 000 Hong Kong dollars in a bank at the beginning of April 2020. The bank offers two deposit plans for him.

Plan A: Deposit the money in Hong Kong dollars(HKD) with the simple interest rate of 60% per annum.

Plan B: Deposit the money in British pounds (GBP) at the exchange rate of 13.31 HKD/GBP, and the interest on the British pounds compounded quarterly at r % per annum. On the maturity date, the British pounds will be exchanged back into Hong Kong dollars at the rate of 14.5 HKD /GBP.

If John wants to get the money back at the end of December 2020 and he wants to choose plan B as plan B offers better returns. Using the result in (a), find the minimum integral value of r .

(5 marks)

<p>(a) $x^3 > 1.331$ $x^3 > (1.1)^3$ $x > 1.1$</p>	
<p>(b)</p> $\frac{120000 \left(1 + \frac{r\%}{4}\right)^3}{13.31} \cdot (14.5) > 120000 \left(1 + 60\% \times \frac{9}{12}\right)$ $\left(1 + \frac{r}{400}\right)^3 > 1.331$ $1 + \frac{r}{400} > 1.1$ $r > 40$ <p>The minimum integer value of r is 41</p>	

20. A student conducts a survey to investigate the ratings of a restaurant given by the customers. The stem-and-leaf diagram below shows the distribution of the rating (in marks) of the restaurant given by twenty customers interviewed, where x is a non-negative integer less than 10.

Stem (tens)	Leaf (units)
3	5
4	1 4
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- (a) It is given that the mean of the distribution is less than the median by 2 marks. Find x . (4 marks)
- (b) The student interviews four more customers later and the mean of the ratings given by these four customers is the same as the mean of the original distribution. It is given that the ratings given by two of these four customers are 58 marks and 59 marks.
- (i) Find the mean of the rating given by these twenty-four customers. (1 mark)
- (ii) Is it possible for the median of the rating given by these twenty-four customers to be the same as the median of the original distribution? Explain your answer. (4 marks)

<p>(a) $\frac{35 + 41 + 44 + 52 \times 2 + 55 + 56 + 57 + 60 \times 2 + (60 + x) + 64 + 65 \times 2 + 66 + 67 \times 2 + 70 + 71 \times 2}{20} + 2 = \frac{60 + (60 + x)}{2}$</p> $\frac{1178 + x}{20} + 2 = 60 + \frac{x}{2}$ $\frac{x}{2} - \frac{x}{20} = 0.9$ $x = 2$	
<p>(b)(i) mean = $60 + \frac{2}{2} - 2 = 59$ marks</p>	
<p>(b)(ii) Let a and b be the rating of the rest two customers</p> $a + b = 59 \times 4 - 59 - 58 = 119$ <p>If the median remains unchanged, then $a \geq 62$ and $b \geq 62$</p> <p>i.e. $a + b \geq 134$</p> <p>No, it is impossible since $a + b = 119$</p>	

21. Figure 1 shows a right-angled triangle ABC . $AB = 40$ cm, $BC = 9$ cm and D is a point on AC such that it is the circumcentre of $\triangle ABC$.

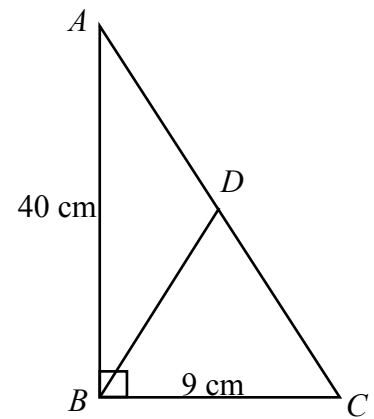


Figure 1

- (a) A student claims that the centroid of $\triangle ABC$ lies on BD .
Do you agree? Explain your answer. (2 marks)
- (b) It is given that E is the centroid of $\triangle ABC$.
- (i) Prove $BE : ED = 2 : 1$. (6 marks)
 - (ii) Find ED . (4 marks)

<p>(a) As D is the circumcenter of $\triangle ABC$, i.e. D is the mid-point of AC</p> <p>BD is a median of $\triangle ABC$</p> <p>Centroid of $\triangle ABC$ is the point of intersection of medians</p> <p>the centroid of $\triangle ABC$ lies on BD</p> <p>Yes, I agree</p>	
<p>(b) Let F be the mid-point of AB</p> <p>In $\triangle ABC$ and $\triangle AFD$</p> <p>F is the mid-point of AB</p> $\frac{AF}{AB} = \frac{1}{2}$ <p>D is the mid-point of AC</p> $\frac{AD}{AC} = \frac{1}{2}$ $\therefore \frac{AF}{AB} = \frac{AD}{AC} = \frac{1}{2}$ <p>$\angle FAD = \angle BAC$ (common angle)</p> <p>$\triangle AFD \sim \triangle ABC$ (ratio of 2 sides, incl. \angles)</p> <p>$FD = \frac{1}{2}BC$ corr. sides, $\sim \Delta$s</p> <p>$\therefore \angle AFD = \angle ABC$ (corr. \angles, $\sim \Delta$s)</p> <p>i.e. $FD \parallel BC$ (corr. \angles, equal)</p> <p>In $\triangle FDE$ and $\triangle CBE$</p> <p>$\angle FDE = \angle CBE$ (alt. \angles, $FD \parallel BC$)</p> <p>$\angle DFE = \angle BCE$ (alt. \angles, $FD \parallel BC$)</p>	

$\angle FED = \angle CEB$ <p>(vert. opp \angles)</p> $\triangle FDE \sim \triangle CBE$ <p>(AAA)</p> $BE : ED = BC : FD$ <p>(corr. sides, $\sim \Delta$s)</p> $= 2:1$	
<p>(c) $AC^2 = 9^2 + 40^2$ (Pyth. Thm.)</p> $AC = 41$ <p>D is the circumcenter of $\triangle ABC$</p> $DA = DB = DC$ $= \frac{41}{2}$ $ED = \frac{1}{3} \left(\frac{41}{2} \right) = \frac{41}{6} \text{ cm}$	

End of Paper 1

QUEEN'S COLLEGE
HALF-YEARLY EXAMINATION 2019 – 2020
MATHEMATICS PAPER 2

Secondary 3

Date: 17th January 2020

Time: 8:30-9:30 (1 hour)

Total: 80 marks

INSTRUCTIONS

1. When told to turn over the question paper, you should check that all questions are there. Look for the words '**END OF PAPER**' after the last question.
2. All questions carry equal marks.
3. Answer all questions. You should use an HB pencil to mark all your answers on the Answer Sheet.
4. You should mark only ONE answer for each question. If you mark more than one answer, you will receive NO MARKS for that question.
5. Total score of this paper 2 is 80 marks.

DO NOT TURN OVER THIS QUESTION PAPER
UNTIL YOU ARE TOLD TO DO SO

There are 40 questions in this paper.

All questions carry equal marks.

Choose the best answer for each question.

1. Factorize $-3x^2 + 5y^2 + 2xy$.
 - A. $(5y+x)(y-3x)$
 - B. $(5y-3x)(y+x)$
 - C. $(3x+5y)(y-x)$
 - D. $(3x+y)(x-5y)$

2. What of the following is /are correct?
 - I. $a^3 - 5^3 = (a-5)^3$
 - II. $a^3 - 1 = (a-1)(a^2 + a + 1)$
 - III. $a^3 - 8 = (a-8)(a^2 + 16a + 64)$
 - A. I only
 - B. II only
 - C. III only
 - D. II and III only

3. Factorize $(3h+5)^2 + 3(3h+5) - 28$.
 - A. $3(3h+1)(h+4)$
 - B. $3(h+3)(3h-2)$
 - C. $9(h+3)(h+4)$
 - D. $(3h+1)(3h-2)$

4. Factorize $25c^2 - 80cd + 64d^2$.
 - A. $(5c+8d)(5c-8d)$
 - B. $(25c+64d)^2$
 - C. $(5c+8d)^2$
 - D. $(5c-8d)^2$

5. Factorize $(x-1)^3 - 27x^3$.
 - A. $-(26x+1)(757x^2 - 27x+1)$
 - B. $-(26x+1)(757x^2 - 29x+1)$
 - C. $-(2x+1)(13x^2 - 5x+1)$
 - D. $-(2x+1)(13x^2 - 3x+1)$

6. Which of the following is the expanded form of $AE013F_{16}$?
 - A. $11 \times 16^6 + 15 \times 16^5 + 0 \times 16^4 + 1 \times 16^3 + 3 \times 16^2 + 16 \times 16^1$

- B. $10 \times 16^6 + 14 \times 16^5 + 0 \times 16^4 + 1 \times 16^3 + 3 \times 16^2 + 15 \times 16^1$
 C. $11 \times 16^5 + 15 \times 16^4 + 0 \times 16^3 + 1 \times 16^2 + 3 \times 16^1 + 16 \times 16^0$
 D. $10 \times 16^5 + 14 \times 16^4 + 0 \times 16^3 + 1 \times 16^2 + 3 \times 16^1 + 15 \times 16^0$

7. Which of the following numbers has the smallest value?

- A. 205_{10}
 B. AE_{16}
 C. 10110100_2
 D. 10111000_2

8. Which of the following is/are correct?

I. $(x^3 + y^{-3})^{\frac{1}{3}} = x + \frac{1}{y}$

II. $(x^3 \cdot y^{-3})^{\frac{1}{3}} = \frac{x}{y}$

III. $(3x^2)^3 = 27x^6$

IV. $(3x^2)^3 = 3x^5$

- A. I and III only
 B. I and IV only
 C. II and III only
 D. II and IV only

9. Simplify $\frac{(3u^4)^2[(s^7t^2)^0]^2}{(u^{-4}s^{14}t^2)^{-1}}$.

- A. $9u^4s^{14}t^2$
 B. $9u^2s^{14}t^2$
 C. $3u^4s^{14}t^2$
 D. $3u^2s^{14}t^2$

10. Simplify $\frac{a^{-3x}}{3b^{-y}} \div \frac{a^{7x}}{(6b^{x+y})^2}$.

A. $\frac{108b^{2xy+2y^2}}{a^{21x^2}}$

B. $\frac{108b^{2x+3y}}{a^{10x}}$

C. $\frac{12b^{2x+3y}}{a^{10x}}$

D. $\frac{12b^{2xy+3y^2}}{a^{21x^2}}$

11. If $5.2 \times 10^1 + 62 \times 10^{-1} = a \times 10^1$, $a =$

A. 5.82.

B. 11.4.

C. 625.2.

D. 6205.2.

12. Sam used \$8000 to buy a new mobile phone. If it depreciates by 30% every 6 months, what is the depreciation after 1.5 years?

A. \$5256

B. \$3315

C. \$3087

D. \$2744

13. The price of the laptop before and after Christmas are \$10500 and \$8500 respectively. What is the percentage change in the price of the laptop?

A. $-23\frac{9}{17}\%$

B. $-19\frac{1}{21}\%$

C. $+19\frac{1}{21}\%$

D. $+23\frac{9}{17}\%$

14. The plane ticket to Japan in May is \$2000, the price of the ticket increases steadily at a rate of 30% each month. What is the price of the ticket in August of the same year?

A. \$2054

B. \$3538.5

- C. \$3800
- D. \$4394

15. Mr. Lee has taken a loan from the bank for his investment, the interest rate offered from the bank is 6% p.a compound monthly with a service charge of \$100 per year. If Mr. Lee has to repay an amount \$110115 to the bank after 2 years. What is the amount that he borrowed? (Correct to the nearest dollar)
- A. \$98138
 - B. \$97824
 - C. \$97692
 - D. \$97515

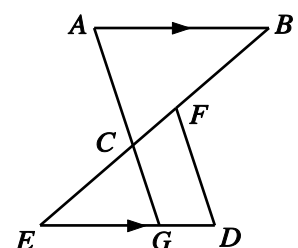
16. The table below shows the progressive tax rate based on the salary income in a certain country.

Net chargeable income	Tax rate
On the first \$30 000	4%
On the next \$30 000	7%
Remainder	13%

If Sandy needs to pay \$4 691 for the salaries tax. What is her net chargeable income?

- A. \$10700
 - B. \$32785
 - C. \$70700
 - D. \$92785
17. Ms. Lee’s courtyard is under maintenance, the length of her squared flower garden is increased by 25%. What is the percentage change in the area of the flower garden?
- A. +93.75%
 - B. +75%
 - C. +56.25%
 - D. +25%

18. In the figure, ACG , EGD and $BFCE$ are straight lines. It is given that $AB \parallel ED$. Which of the following must be true?
- I. $AB = ED$
 - II. $\angle ABC = \angle DEB$



III. $\angle BAC + \angle DGC = 180^\circ$

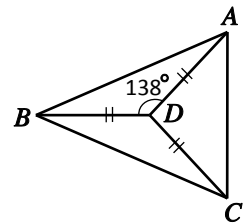
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III only

19. The perimeter of $\triangle PQR$ is 36 units such that $\angle RPQ = \angle RQP$. Coordinates of P and Q are $(2, 1)$ and $(12, 1)$ respectively. Find the coordinates of the vertex R .

- A. $(5, 13)$
- B. $(5, 12)$
- C. $(7, 13)$
- D. $(7, 12)$

20. In the figure, it is given that $\triangle ADB \cong \triangle BDC$ and $AD = BD = CD$. Find the angle of $\angle CAD$.

- A. 30°
- B. 48°
- C. 60°
- D. 96°



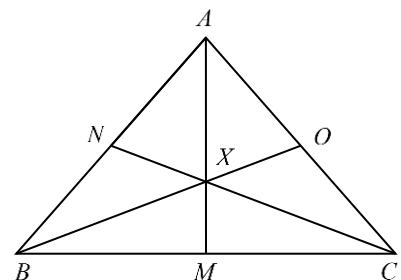
21. In $\triangle ABC$, which of the following is/ are correct?

- I. The perpendicular bisectors must be passed through the vertices of $\triangle ABC$.
- II. The medians must be passed through the vertices of $\triangle ABC$.
- III. The circumcenter of $\triangle ABC$ must be inside the triangle.

- A. II only
- B. III only
- C. II and III only
- D. All of the above

22. In the figure, AM , BO and CN are the medians of $\triangle ABC$, where 3 medians intersect at X , then X is the

- A. centroid of $\triangle ABC$.
- B. circumcentre of $\triangle ABC$.



- C. incentre of $\triangle ABC$.
- D. orthocentre of $\triangle ABC$.

23. Consider $a > b > c > 0$, where k is a non-zero constant.
Which of the following is/ are correct?

- I. $ka > kb > kc$
- II. $(ka)^2 > (kb)^2 > (kc)^2$
- III. $\frac{1}{ka} < \frac{1}{kb} < \frac{1}{kc}$

- A. II only
- B. III only
- C. I and III only
- D. II and III only

24. Solve the inequality $k - \frac{3}{5}k > -2(6 - \frac{2}{5}k)$.

- A. $k < 30$
- B. $k > 30$
- C. $k < 6$
- D. $k > -10$

25. Which of the following inequality satisfy the solutions that must include 4 and exclude -2?

- A. $x > 4$
- B. $x < 0$
- C. $x > -2$
- D. $x < -3$

26. Which of the following inequality represents the range of $5a - 1$, when $a \geq -\frac{1}{5}$?

- A. $5a - 1 \geq -2$
- B. $5a - 1 \leq -2$
- C. $5a - 1 \geq -1$
- D. $5a - 1 \leq -1$

27. If x is a natural number satisfying the inequality $x - 1 > -2 - x$, then the least value of x is

- A. 3.
- B. 2.
- C. 1.
- D. 0.

28. The sides of a triangle are x cm, $3x$ cm and 12 cm, where x is an integer. Which of the following are the possible values of x ?

- A. 4, 5
- B. 5, 6
- C. 5, 6, 7
- D. 6, 7, 8

29. If a set of data is given, which of the following is/ are correct?

- I. Median and mode are always exist in a set of data.
- II. When finding median and mode, the data are not necessary to sort in order.
- III. Median and mode will not be affected by extreme data.

- A. I only
- B. II only
- C. III only
- D. None of above

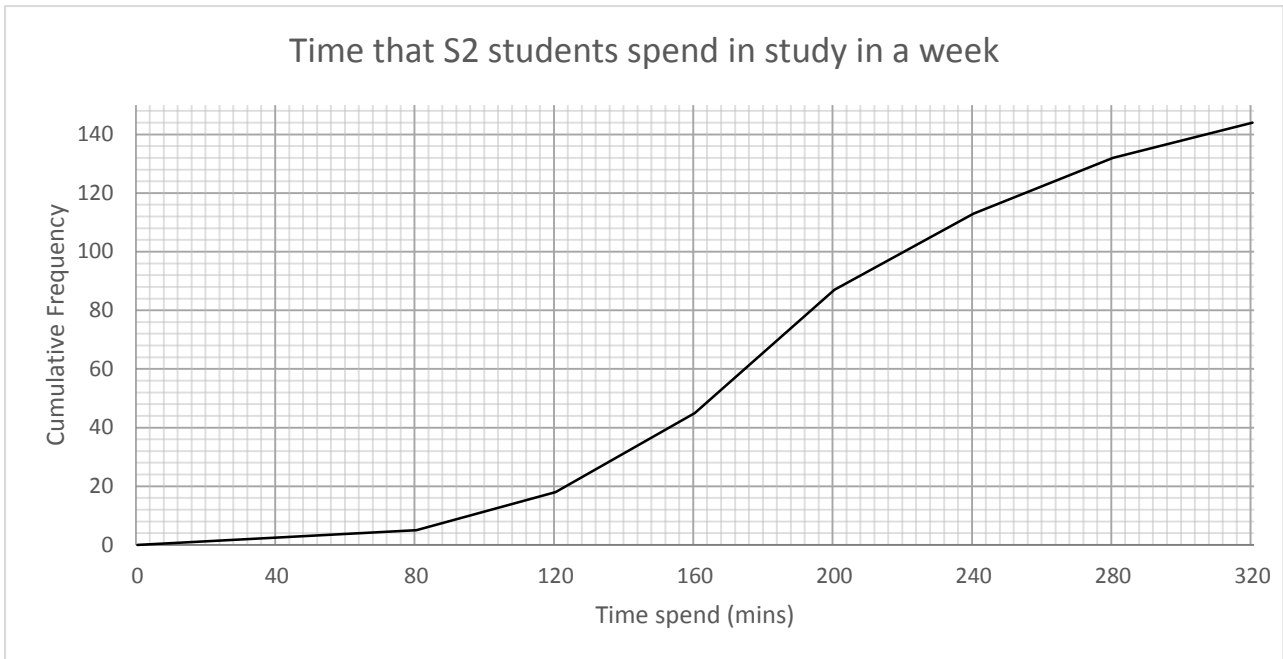
30. The following table shows Samson's marks and the weight of each subject of the examinations.

Subjects	English	Mathematics	Art	Physics
Marks	60	60	90	x
Weight	2	3	1	2

How many marks does he need to get in Physics to reach 70 marks in his total average?

- A. 85
- B. 70
- C. 65
- D. 60

31. The graph below shows the time spend in study of 144 S2 students in a week.



Find the interquartile range of the time spend of the S2 students.

- A. 72
- B. 84
- C. 144
- D. 380

32. Factorize $27m^3n - 15m + 10n - 12mn^3$.

- A. $(3m + 2n)(9m^2n - 6mn^2 - 5)$
- B. $(3m + 2n)(9m^2n + 6mn^2 - 5)$
- C. $(3m - 2n)(9m^2n - 6mn^2 - 5)$
- D. $(3m - 2n)(9m^2n + 6mn^2 - 5)$

33. $1101000011010_2 =$

- A. $13 \times 2^{10} + 44$
- B. $13 \times 2^9 + 44$
- C. $13 \times 2^{10} + 26$
- D. $13 \times 2^9 + 26$

34. If $(8a^3)^{2x} \div b^{-3x-3y} = a^{\frac{3}{2}} \cdot \frac{\sqrt{8}}{b^{-3}}$, then

A. $x = \frac{3}{10}, y = \frac{7}{10}$.

B. $x = \frac{1}{4}, y = \frac{5}{4}$.

C. $x = \frac{1}{4}, y = -\frac{3}{4}$.

D. $x = \frac{1}{4}, y = \frac{3}{4}$.

35. If the height of building A is 5% shorter than that of building B , and the height of building B is 15% shorter than that of building C , then the height of building A is shorter than that of building C by
- A. 10.53%
 - B. 19.25%
 - C. 20.00%
 - D. 23.84%
36. There are 5 boys in the basketball team, one of the boys is 135 cm tall and the mean of the height of the team is x . A new boy joins in afterward, who has the height of 183 cm and the new average height of the team is 173 cm. What is the mean of the height of the original team?
- A. 136.4
 - B. 144
 - C. 171
 - D. 182.5
37. Find the median of $x-1, x+1, x-2, x+3, x-4, x+7, x-8$ and $x+9$.
- A. $x - \frac{1}{2}$
 - B. $x+3$
 - C. $x-1$
 - D. x
38. Consider a data: 7, 8, 10, 10, 11, 11, 13.
Which of the following number should be added to get mean = 8, median = 10 and mode = 10?

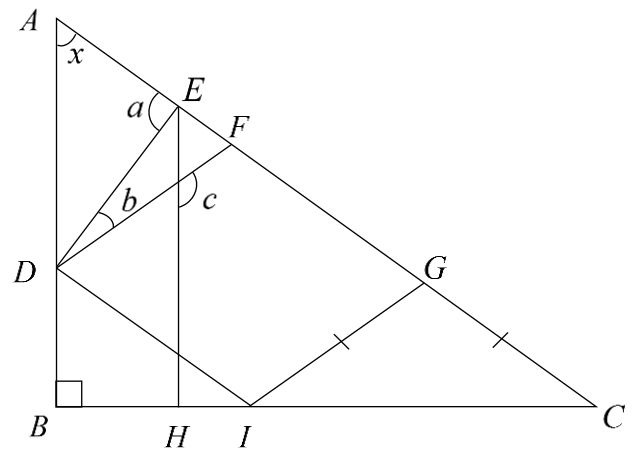
- A. 8
- B. 10
- C. 11
- D. 13

39. Susan is going to replace her rectangular storage box with a new one, where the length is decreased by 15%, the width is increased by 10% and the volume is increased by 10%. What is the percentage change in the depth of the new rectangular storage box?

- A. Increased by 17.6%
- B. Increased by 15%
- C. Decreased by 15%
- D. Decreased by 17.6%

40. In the figure, $AEFGC$, ADB and $BHIC$ are straight lines, where $a:b:c=5:1:6$ and $c=120^\circ$. It is given that $GI=GC$, $DF \parallel IG$ and $FG \parallel DI$. Find x .

- A. 20°
- B. 30°
- C. 50°
- D. 60°



– END OF PAPER –

ROUGH WORK SHEET

QUEEN'S COLLEGE
HALF-YEARLY EXAMINATION 2019 – 2020
MATHEMATICS PAPER 2

Secondary 3

Date: 17th January 2020

Time: 8:30-9:30 (1 hour)

Total: 80 marks

1	B	11	A	21	A	31	B
2	B	12	A	22	A	32	D
3	A	13	B	23	A	33	D
4	D	14	D	24	A	34	D
5	C	15	D	25	C	35	B
6	D	16	C	26	A	36	C
7	B	17	C	27	C	37	D
8	C	18	C	28	A	38	B
9	A	19	C	29	C	39	A
10	C	20	B	30	A	40	C

A	12
B	8
C	12
D	8

1. The answer is B.

$$\begin{aligned} & -3x^2 + 5y^2 + 2xy \\ & = 5y^2 + 2xy - 3x^2 \\ & = \underline{\underline{(5y - 3x)(y + x)}} \end{aligned}$$

2. The answer is B.

I. $a^3 - 5^3 = (a - 5)(a^2 + 5a + 25)$

III. $a^3 - 8 = (a - 2)(a^2 + 2a + 4)$

\therefore Only II is correct.

3. The answer is A.

$$\begin{aligned} & (3h + 5)^2 + 3(3h + 5) - 28 \\ & = [(3h + 5) - 4][(3h + 5) + 7] \\ & = \underline{\underline{3(3h + 1)(h + 4)}} \end{aligned}$$

4. The answer is D.

$$\begin{aligned} & 25c^2 - 80cd + 64d^2 \\ & = \underline{\underline{(5c - 8d)^2}} \end{aligned}$$

5. The answer is C.

$$\begin{aligned} & (x - 1)^3 - 27x^3 \\ & = (x - 1)^3 - (3x)^3 \\ & = [(x - 1) - 3x][(x - 1)^2 + 3x(x - 1) + 9x^2] \\ & = (-2x - 1)[(x^2 - 2x + 1) + 3x^2 - 3x + 9x^2] \\ & = (-2x - 1)(13x^2 - 5x + 1) \\ & = \underline{\underline{-(2x + 1)(13x^2 - 5x + 1)}} \end{aligned}$$

6. The answer is D.

$$\begin{aligned} & AE013F_{16} \\ & = \underline{\underline{10 \times 16^5 + 14 \times 16^4 + 0 \times 16^3 + 1 \times 16^2}} \\ & \quad \underline{\underline{+ 3 \times 16^1 + 15 \times 16^0}} \end{aligned}$$

7. The answer is B.

$$205_{10} = 205$$

$$AE_{16} = 174$$

$$10110100_2 = 180$$

$$10111000_2 = 184$$

\therefore $AE_{16} = 174$ has the smallest value.

8. The answer is C.

I. $(x^3 + y^{-3})^{\frac{1}{3}} = \sqrt{x^3 + y^{-3}}$

IV. $(3x^2)^3 = 27x^6$

\therefore Only II and III are correct.

9. The answer is A.

$$\begin{aligned} & \frac{(3u^4)^2 [(s^7 t^2)^0]^2}{(u^{-4} s^{14} t^2)^{-1}} \\ & = \frac{9u^8}{u^4 s^{-14} t^{-2}} \\ & = 9u^{8-4} s^{0-(-14)} t^{0-(-2)} \\ & = \underline{\underline{9u^4 s^{14} t^2}} \end{aligned}$$

10. The answer is C.

$$\begin{aligned} & \frac{a^{-3x}}{3b^{-y}} \div \frac{a^{7x}}{(6b^{x+y})^2} \\ & = \frac{b^y}{3a^{3x}} \times \frac{36b^{2x+2y}}{a^{7x}} \\ & = \frac{36b^{2x+3y}}{3a^{10x}} \\ & = \frac{12b^{2x+3y}}{a^{10x}} \end{aligned}$$

11. The answer is A.

$$\begin{aligned}
 5.2 \times 10^1 + 62 \times 10^{-1} &= a \times 10^1 \\
 5.2 \times 10^1 + 62 \times 10^{-1} \\
 &= 5.2 \times 10^1 + 0.62 \times 10^1 \\
 &= (5.2 + 0.62) \times 10^1 \\
 &= \underline{\underline{5.82 \times 10^1}}
 \end{aligned}$$

12. The answer is A.

The depreciation

$$\begin{aligned}
 &= \$8000 - \$8000(1 - 30\%)^3 \\
 &= \$8000 - \$2744 \\
 &= \underline{\underline{\$5256}}
 \end{aligned}$$

13. The answer is B.

The percentage change

$$\begin{aligned}
 &= \frac{8500 - 10500}{10500} \times 100\% \\
 &= \frac{-2000}{10500} \times 100\% \\
 &= \underline{\underline{-19\frac{1}{21}\%}}
 \end{aligned}$$

14. The answer is D.

The price

$$\begin{aligned}
 &= \$2000(1 + 30\%)^3 \\
 &= \$2000(1.3)^3 \\
 &= \underline{\underline{\$4394}}
 \end{aligned}$$

15. The answer is D.

Let $\$P$ be the amount that Mr. Lee borrow

$$\begin{aligned}
 P\left(1 + \frac{6\%}{12}\right)^{24} + \$200 &= \$110115 \\
 P\left(1 + \frac{6\%}{12}\right)^{24} &= \$110115 - \$200 \\
 P(1.005)^{24} &= \$109915 \\
 P &= \$97515
 \end{aligned}$$

\therefore The amount is \$97515.

16. The answer is C.

Let $\$C$ be Sandy's net chargeable income.

$$\begin{aligned}
 \$30000(4\%) + \$30000(7\%) + (C - 2 \times \$30000)(13\%) \\
 &= \$4691 \\
 \$1200 + \$2100 + 13\%(C - \$60000) &= \$4691 \\
 C - \$60000 &= \$10700 \\
 C &= \$70700
 \end{aligned}$$

\therefore Sandy's net chargeable income is \$70700.

17. The answer is C.

Let l be the length of the squared flower garden.

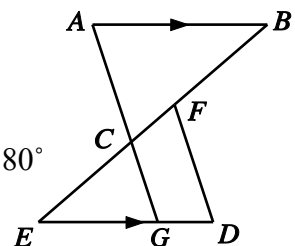
The percentage change

$$\begin{aligned}
 &= \frac{l^2(1 + 25\%)^2 - l^2}{l^2} \times 100\% \\
 &= \frac{l^2(1.5625 - 1)}{l^2} \times 100\% \\
 &= \underline{\underline{+56.25\%}}
 \end{aligned}$$

\therefore The area of the squared flower garden is increased by 56.25%.

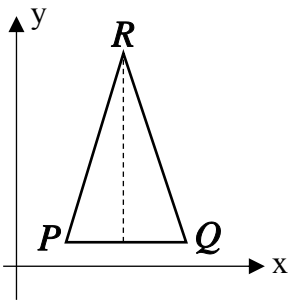
18. The answer is C.

- I. $AB = ED$
- II. $\angle ABC = \angle DEB$
- III. $\angle BAC + \angle DGC = 180^\circ$



∴ Only II and III are correct.

19. The answer is C.



$P(2, 1)$ and $Q(12, 1)$.

$$\therefore \angle RPQ = \angle RQP$$

$$\therefore RP = RQ$$

The length of PQ

$$= 12 - 2$$

$$= 10$$

The length of RP

$$= \frac{(36-10)}{2}$$

$$= 13$$

The length between point R and PQ

$$= \sqrt{13^2 - 5^2}$$

$$= 12$$

The coordinate of R is $(2 + \frac{10}{2}, 1 + 12)$

∴ The coordinate of R is $(7, 13)$.

20. The answer is B.

$$\therefore \triangle ADB \cong \triangle BDC,$$

$$\therefore \angle ADB = \angle BDC = 138^\circ$$

$$\angle ADB + \angle BDC + \angle CDA = 360^\circ$$

$$2 \times 138^\circ + \angle CDA = 360^\circ$$

$$\angle CDA = 84^\circ$$

$$\angle CAD = \angle ACD$$

$$\angle CAD + \angle ACD + \angle CDA = 180^\circ$$

$$2\angle CAD + 84^\circ = 180^\circ$$

$$\underline{\underline{\angle CAD = 48^\circ}}$$

21. The answer is A.

∴ Only II is correct.

22. The answer is A.

23. The answer is A.

∴ Only II are correct.

24. The answer is A.

$$k - \frac{3}{5}k > -2(6 - \frac{2}{5}k)$$

$$k - \frac{3}{5}k > -12 + \frac{4}{5}k$$

$$k - \frac{7}{5}k > -12$$

$$5k - 7k > -60$$

$$-2k > -60$$

$$\underline{\underline{k < 30}}$$

25. The answer is C.

∴ Include 4 and exclude -2

∴ $x > -2$

26. The answer is A.

$$5a - 1$$

$$\text{when } a \geq -\frac{1}{5}$$

$$5\left(-\frac{1}{5}\right) - 1$$

$$= -1 - 1$$

$$= -2$$

$$\therefore \underline{\underline{5a - 1 \geq -2}}$$

27. The answer is C.

$$x - 1 > -2 - x$$

$$2x > -1$$

$$x > -\frac{1}{2}$$

∴ x is a natural number.

∴ The require value is 1.

28. The answer is A.

Considering

$$x + 3x > 12 \text{ --- (1)}$$

$$x + 12 > 3x \text{ --- (2)}$$

$$3x + 12 > x \text{ --- (3)}$$

From (1), $x + 3x > 12$

$$4x > 12$$

$$x > 3$$

From (2), $x + 12 > 3x$

$$-2x > -12$$

$$x < 6$$

From (3), $3x + 12 > x$

$$2x > -12$$

$$x > -6$$

\therefore Possible value of x is 4, 5.

\therefore There are 2 different triangles.

29. The answer is C.

\therefore Only III is correct.

30. The answer is A.

Mean

$$\frac{60 \times 2 + 60 \times 3 + 90 \times 1 + 2x}{2 + 3 + 1 + 2} = 70$$

$$\frac{390 + 2x}{8} = 70$$

$$390 + 2x = 560$$

$$x = \underline{\underline{85}}$$

31. The answer is B.

The upper quartile

$$= 144 \times 75\%$$

$$= 108$$

\therefore The reading of 108 is 232 minutes.

The lower quartile

$$= 144 \times 25\%$$

$$= 36$$

\therefore The reading of 36 is 148 minutes.

The interquartile range

$$= 232 - 148$$

$$= 84$$

32. The answer is D.

$$27m^3n - 15m + 10n - 12mn^3$$

$$= (27m^3n - 12mn^3) - 15m + 10n$$

$$= 3mn(9m^2 - 4n^2) - 5(3m - 2n)$$

$$= 3mn(3m - 2n)(3m + 2n) - 5(3m - 2n)$$

$$= (3m - 2n)[3mn(3m + 2n) - 5]$$

$$= \underline{\underline{(3m - 2n)(9m^2n + 6mn^2 - 5)}}$$

33. The answer is D.

$$1101000011010_2$$

$$= 2^{12} + 2^{11} + 2^9 + 2^4 + 2^3 + 2$$

$$= (2^3 + 2^2 + 1)2^9 + (2^4 + 2^3 + 2)$$

$$= \underline{\underline{13 \times 2^9 + 26}}$$

34. This answer is D.

$$\therefore (8a^3)^{2x} \div b^{-3x-3y} = a^{\frac{3}{2}} \cdot \frac{\sqrt{8}}{b^{-3}}$$

i.e. $(2a)^{6x} b^{3(x+y)} = (2a)^{\frac{3}{2}} b^3$

$$\therefore \begin{cases} 6x = \frac{3}{2} \dots\dots\dots(i) \\ 3(x+y) = 3 \dots\dots\dots(ii) \end{cases}$$

From (i), $x = \frac{1}{4}$

Substituting $x = \frac{1}{4}$ into (ii), we have

$$3\left(\frac{1}{4} + y\right) = 3$$

$$\frac{1}{4} + y = 1$$

$$y = \frac{3}{4}$$

35. The answer is B.

Let h be the height of building C .

$$\begin{aligned} \text{Height of building } A &= h(1-5\%)(1-15\%) \\ &= 0.8075h \end{aligned}$$

\therefore Building A is shorter than building C

by $\frac{h-0.8075h}{h} \times 100\%$, i.e. 19.25%

36. The answer is C.

Mean height of the original team

$$\frac{a+b+c+d+135}{5} = x$$

$$a+b+c+d = 5x-135$$

Mean height of the new team

$$\frac{a+b+c+d+135+183}{6} = 173$$

$$(5x-135)+135+183 = 1038$$

$$5x = 855$$

$$x = \underline{\underline{171}}$$

37. The answer is D.

$$x-1, x+1, x-2, x+3, x-4, x+7, x-8 \text{ and } x+9$$

Rearrange

$$x-8, x-4, x-2, x-1, x+1, x+3, x+7, x+9$$

$$= \frac{x-1+x+1}{2}$$

$$= \frac{2x}{2}$$

$$= x$$

38. The answer is B.

39. The answer is A.

Let l, w, v be the length, width and volume of the storage box

$$\begin{aligned} \text{The new depth} &= \frac{(1+10\%)v}{(1+10\%)w(1-15\%)l} \\ &= \frac{1.1v}{(1.1w)(0.85l)} \\ &= \frac{v}{0.85wl} \end{aligned}$$

Percentage change

$$= \frac{\frac{v}{0.85wl} - \frac{v}{wl}}{\frac{v}{wl}} \times 100\%$$

$$= \frac{\left(\frac{1}{0.85} - 1\right) \frac{v}{wl}}{\frac{v}{wl}} \times 100\%$$

$$= 17.6\%$$

40. The answer is C.

$$x = 50^\circ$$