S3 First Term Examination (2014 - 2015)
Mathematics
Time allowed: 2 hours

Rough work sheet: 1

Date: 16-1-2015
Time: 08:30 am-10:30 am

Name: _____
Class: _____ No. _____

Instructions to students:

1. This paper consists of three parts, Conventional Questions, Multiple-choice Questions and Bonus Questions. There are Section A and Section B in Conventional Questions.
2. The maximum score of this paper is 100.
3. Attempt ALL questions. Write your answers in the spaces provided in this Question / Answer Book.
4. Unless otherwise specified, s.
5. Unless otherwise specified, numerical answers should be exact or correct to **3 significant figures**.
6. The diagrams in this paper are not necessarily drawn to scale.

Section A (49 marks)

1. Simplify $\dfrac{(x^2y)^{-2}}{x^{-2}}$ and express your answer with positive indices.

(3 marks)

2. (a) Factorize $x^2+2xy-15y^2$.
   (b) Hence factorize $x^2+2xy-15y^2-(x-3y)^2$.

(3 marks)

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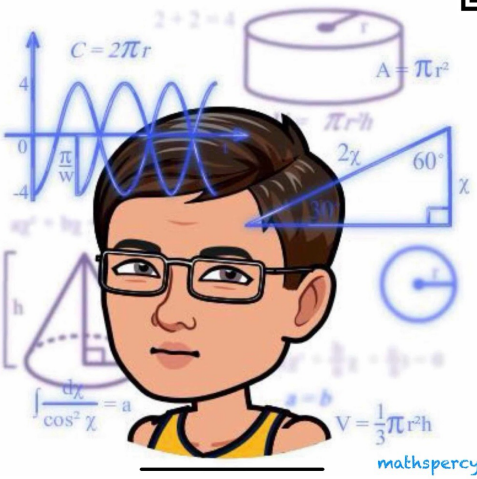


3. Figure 1 shows a pyramid *VABCD* of height 11 cm. Its base is a rectangle of length 9 cm and width 5 cm. Find the area of the lateral surfaces of the pyramid.

(3 marks)

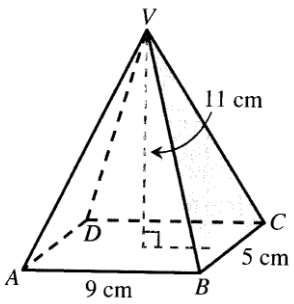


Figure 1

4. Figure 2 shows two similar figures. Find x.

(3 marks)

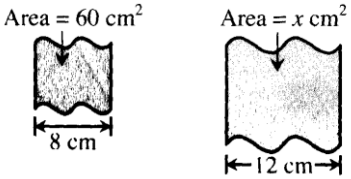


Figure 2

5. Use tree diagram to list all the possible outcomes for tossing three coins.

(3 marks)

First coin Second coin Third coin Possible Outcomes

6. Marcus has four \$20 banknotes, three \$50 banknotes and two \$100 banknotes in his wallet. If a banknote is chosen randomly, find the expected value of the amount.

(3 marks)

7. In Figure 3, H is the in-center of ΔABC and BH is the angle bisector of $\angle ABC$. Find $\angle BCA$.

(4 marks)

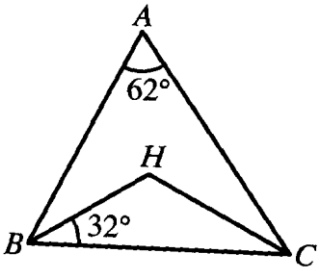


Figure 3

8. (a) Convert 116 into a binary number.
   (b) Convert 116_{16} into a denary number.
   (Steps must be clearly shown. No mark will be given for an answer only.)

(4 marks)

9. There are 3 white socks, 2 yellow socks and 2 red socks in a drawer.
   (a) Frankie randomly takes out 1 sock from the drawer, find the probability that the sock taken out is white.

(2 marks)

   (b) Frankie randomly takes out 2 socks from the drawer.
      (i) List the sample space by tabulation in Table 1.
      (ii) Find the probability that the socks taken out of the same colour.

(3 marks)

Table 1

10. Figure 4 shows a solid which consists of a right cylinder and a hemisphere. The diameters of the cylinder and the hemisphere are 12 cm and 18 cm respectively. The height of the solid is 15 cm. Find
    (a) the volume of the solid.
    (b) the total surface area of the solid.

(6 marks)

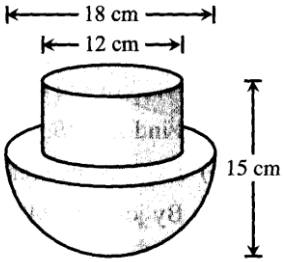


Figure 4

11. Figure 5 shows that AB and AC are the equal sides of the isosceles triangle ABC, and $AB = 10$ cm. The perpendicular bisector of AB meets AC at D, and the perimeter of ΔBCD is 17 cm.
    (a) Prove that $\Delta ADE \cong \Delta BDE$.
    (b) Find BC.

(6 marks)

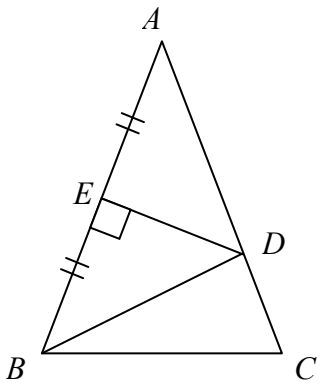


Figure 5

12. In Figure 6, H and I are two points of AC and BC respectively. $AH=AB$ and $\angle AHI=123^o$. $\angle BAH=48^o$, $\angle ABC=99^o$ and $\angle HCI=33^o$.
    (a) Find $\angle BIH$.
    (b) Join HB. Prove that HI is the perpendicular bisector of BC.

(6 marks)

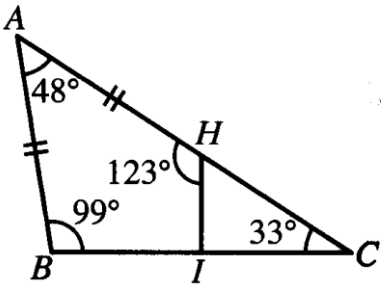


Figure 6

Section B (31 marks)

13. (a) Factorize $16x^3+250$.
    (b) Factorize $6x^2-x-40$.
    (c) Hence, factorize $16x^3-6x^2+x+290$.

(6 marks)

14. Simplify $\dfrac{3^n}{4\left(3^{n+1}\right)+5\left(3^{n-1}\right)}$.

(5 marks)

15. A fair dice is thrown twice. Find the probabilities of the following events happening.
    (a) The sum of the two numbers is less than 5.
    (b) The product of the two numbers is greater than 16.
    (c) The first number obtained is '3' and the second number obtained is greater than '3'.

(8 marks)

16. The height and the base radius of an inverted right circular conical container are 18 cm and 16 cm respectively.
    (a) Find the capacity of the circular conical container in terms of π.
    (b) Figure 7(a) shows a frustum which is made by cutting off the lower part of the inverted right circular conical container. The height of the frustum is 6 cm. Find the volume of the frustum.

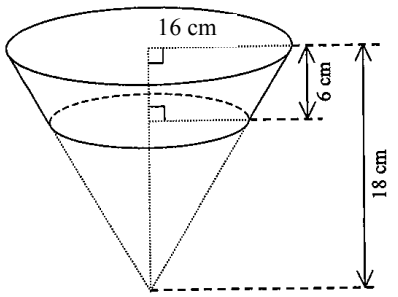


Figure 7(a)

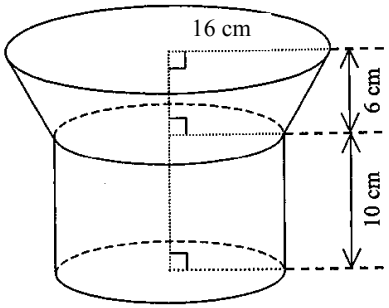


Figure 7(b)

    (c) Figure 7(b) shows a vessel which is held vertically. The vessel consists of two parts with a common base : the upper part is the frustum shown in Figure 7(a) and lower part is a right circular cylinder of height 10 cm. Some water is poured into the vessel. The vessel now contains 1000π cm^3 of water.
        (i) Find the depth of water in the vessel.
        (ii) If a piece of metal of volume 600π cm^3 is then put into the vessel and the metal is totally immersed in the water, will the water overflow? Explain your answer.

(12 marks)

Bonus Questions (10 marks)

17. In Figure 8, F is the mid-point of AB. E is a point on AC such that $AE:EC = 2:1$. Find $\dfrac{\text{Area of } \Delta BFE}{\text{Area of } \Delta BCE}$.

(3 marks)

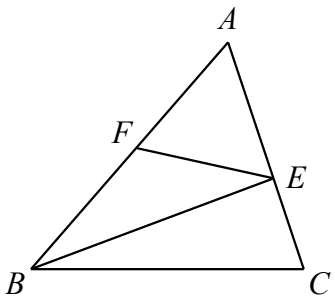


Figure 8

18. (a) If the denary number of $10110\,W111_2$ is $y5x$. Find the value of x, y and W.

(4 marks)

(b) If the denary number of $P702_{16}$ is $58R0$ and the sum of P and R is 10. Find the values of P and R.

(3 marks)

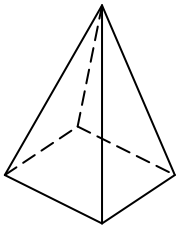
Multiple Choice (20 marks)

1	2	3	4	5	6	7	8	9	10
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**

1. The moon was formed approximately 4 600 000 000 years ago. Use scientific notation to represent this number.
   A. 4.6×10^{8}
   B. 4.6×10^{9}
   C. 46×10^{8}
   D. 46×10^{9}

2. If $2\cdot8^{x}\cdot\left(\frac{1}{16}\right)^{x}=2^{-4}$, then $x=$
   A. 2
   B. 3
   C. 4
   D. 5

3. The number of faces (F), the number of vertices (V) and the number of edges (E) for the given figure are

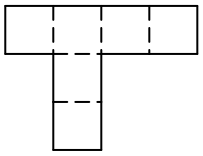


   A. $F=4$, $V=5$, $E=8$ respectively.
   B. $F=4$, $V=6$, $E=8$ respectively.
   C. $F=5$, $V=5$, $E=8$ respectively.
   D. $F=5$, $V=6$, $E=8$ respectively.

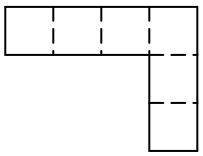
4. How many axes of rotational symmetry of a regular tetrahedron are there passing through the vertices of the regular tetrahedron?
   A. 1
   B. 2
   C. 3
   D. 4

5. In a triangular pyramid, if the angles between each of the 3 slant edges and the base are equal, then what is the projection of the vertex on the base triangle?
   A. in-centre
   B. circumcentre
   C. orthocentre
   D. centroid

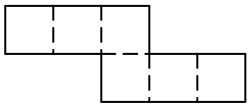
6. Which of the following nets can be folded up to form a cube?
   A.



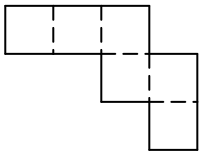
   B.



   C.



   D.

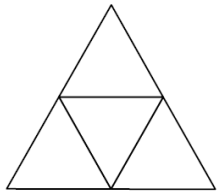


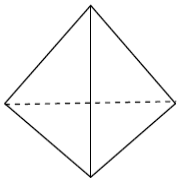
7. $a^{2}+a^{2}=$
   A. $2a^{2}$
   B. a^{4}
   C. $2a^{4}$
   D. $(2a)^{2}$

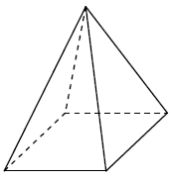
8. A number is drawn at random from the integers 1 to 100. What is the probability that the number drawn is divisible by 3?
   A. $\frac{1}{3}$
   B. $\frac{33}{100}$
   C. $\frac{17}{50}$
   D. $\frac{33}{50}$

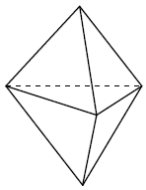
9. Which of the following sets of numbers represents the sides of a right angled triangle?
   A. 4 cm, 6 cm, 10 cm
   B. 5 cm, 13 cm, 12 cm
   C. 4 cm, 5 cm, 6 cm
   D. 6 cm, 3 cm, 2 cm

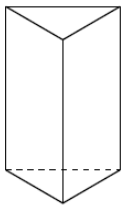
10. Which of the following 3-D figures can be made by the net on the right?



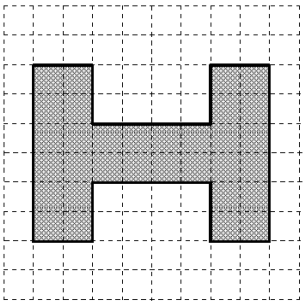
A. 

B. 

C. 

D. 

11. How many axes of symmetry of the following figure?

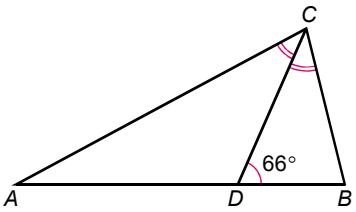


A. 0
B. 2
C. 4
D. 6

12. A number is drawn at random from the digits 1, 2, 3...9. What is the probability that the number drawn is odd?

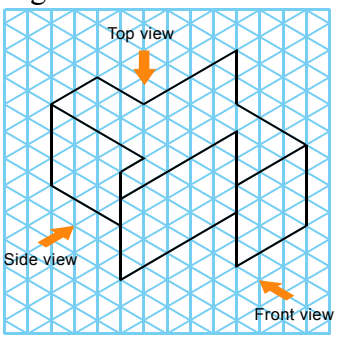
A. $\frac{5}{9}$
B. $\frac{4}{9}$
C. 0
D. 1

13. In the figure, ADB is a straight line. CD is the angle bisector of $\angle ACB$, $AB = AC$ and $\angle CDB = 66°$. Find $\angle CAB$.

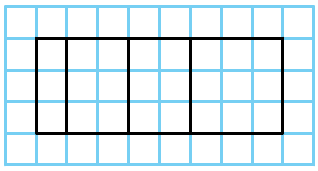


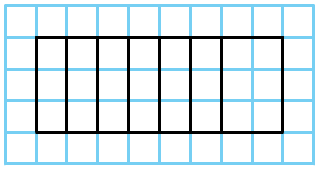
A. 28^o
B. 33^o
C. 38^o
D. 48^o

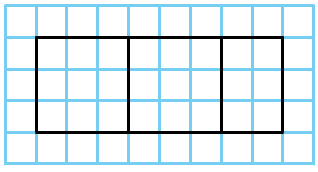
14. The following shows the drawing of a solid on isometric grid.

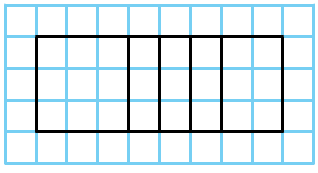


Which of the following is the front view of the solid?

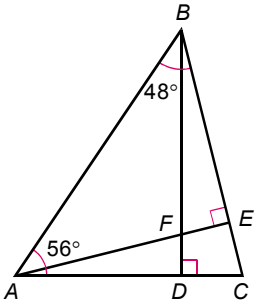
A. 

B. 

C. 

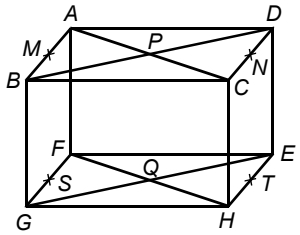
D. 

15. In the figure, ADC and BEC are straight lines. AE and BD are the altitudes of ΔABC on BC and AC respectively, and AE and BD intersect at F. $\angle ABC = 48°$ and $\angle BAC = 56°$. Find $\angle DFE$.



A. 76°
B. 82°
C. 98°
D. 104°

16. The figure shows cuboid $ABCDEFGH$. AC and BD intersect at P, HF and EG intersect at Q. M, N, S and T are the mid-points of AB, CD, FG and HE respectively. Which of the following is not correct?

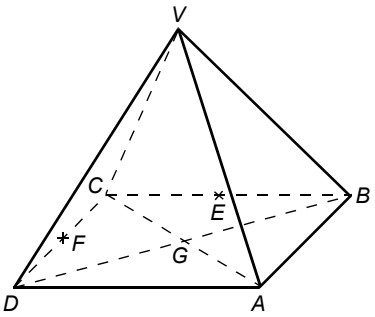


	Point / line segment	Projection on plane $EFGH$
A.	P	Q
B.	MN	ST
C.	AQ	AF
D.	PD	QE

17. $hl - kl + hm - km - hn + kn =$
A. $(h-k)(l+m-n)$.
B. $(h-k)(l-m+n)$.
C. $(h+k)(l+m-n)$.
D. $(h+k)(l-m+n)$.

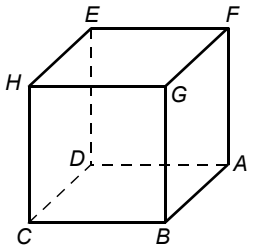
18. If $-4x^2 + axy + 30y^2 \equiv b(x+5y)(cx-3y)$, then
A. $a = 26,\ b = 2,\ c = -2$.
B. $a = -26,\ b = 2,\ c = -2$.
C. $a = 14,\ b = -2,\ c = 2$.
D. $a = -14,\ b = -2,\ c = 2$.

19. In the figure, $VABCD$ is a right pyramid with a square base. E and F are the mid-points of BC and CD respectively, and G is the point of intersection of AC and BD. Which of the following is the angle between line segment VC and base $ABCD$?



A. $\angle BCD$
B. $\angle VCE$
C. $\angle VCF$
D. $\angle VCG$

20. The figure shows cube $ABCDEFGH$.



Which of the following is **NOT** correct?
A. $\angle ABC = 90°$
B. The projection of line segment HF on plane $ABCD$ is line segment CA.
C. The projection of E on plane $ABGF$ is D.
D. $AE^2 = AD^2 + DE^2$

End of Paper