

# 'O' Level 2009 EM 4016 paper 1

$$1(a) \quad 20xy - 5y \\ = \underline{5y(4x-1)} \#$$

$$(b) \quad 4x - 4(x+3) \\ = 4x - 4x - 12 \\ = \underline{-12} \#$$

$$2. \quad 100\% - \$48 \\ 1\% - \frac{\$48}{100} \\ 235\% - \$112.80$$

$$\therefore \text{Selling price} = \underline{\$112.80} \#$$

$$3. (a) \text{ Modal colour} = \underline{\text{Blue}} \#$$

$$(b) \text{ Angle representing the colour green} = \frac{5}{9+5+6+3} \times 360^\circ \\ = \underline{75^\circ} \#$$

$$4 (a) \quad \frac{17}{24} \times 100\% = \underline{70\frac{5}{6}\%} \#$$

$$(b) \text{ Fraction of candidates who were not awarded} \\ \text{an A or B grade} = 1 - \frac{1}{3} - \frac{1}{4} \\ = \underline{\frac{5}{12}} \#$$

$$5 (a) \quad 2^p \times 5 = 40$$

$$2^p = \frac{40}{5}$$

$$2^p = 8$$

$$2^p = 2^3$$

$$p = \underline{\underline{3}} \#$$

$$(b) \quad 1 \div x^{-4} = 1 \div \frac{1}{x^4}$$

$$= 1 \times \frac{x^4}{1}$$

$$= \underline{\underline{x^4}} \#$$

$$6. (a) \quad x^\circ + \hat{EDC} = 180^\circ \text{ (int. } \angle\text{s, } AE \parallel DC)$$

$$\therefore x = 180 - 130$$

$$(b) \quad \hat{EAB} = 180^\circ - x^\circ = 130^\circ \text{ (int. } \angle\text{s)}$$

$$\text{Sum of interior } \angle\text{s} = (5-2) \times 180^\circ$$

$$x^\circ + \hat{EAB} + y^\circ + 80^\circ + 130^\circ = 3 \times 180^\circ$$

$$50^\circ + 130^\circ + y^\circ + 80^\circ + 130^\circ = 540^\circ$$

$$y = \underline{\underline{150}} \#$$

$$7. \quad -2 < 2x - 5 < 7$$

$$-2 + 5 < 2x < 7 + 5$$

$$\therefore \underline{\underline{\frac{3}{2} < x < 6}} \#$$

$$8. \text{ Total amount} = 5000 \left( 1 + \frac{4.8}{100} \right)^6$$

$$= \$6624.265$$

$$\therefore \text{Interest} = \$6624.265 - \$5000$$

$$= \$1624.265$$

$$\approx \underline{\underline{\$1624.27}} \text{ (2 d.p.)} \#$$

$$9. (a) \text{ Area of } \triangle ABC = \frac{1}{2} ab \sin C$$

$$= \frac{1}{2} (7.43) (7.43) \sin 38^\circ$$

$$= 16.993$$

$$\approx \underline{\underline{17.0 \text{ cm}^2}} \text{ (3 s.f.)} \#$$

$$(b) \text{ Volume of the prism} = \text{Base area} \times \text{ht}$$

$$= \text{Area of } \triangle ABC \times 20$$

$$= 16.993 \times 20$$

$$= 339.87$$

$$\approx \underline{\underline{340 \text{ cm}^3}} \text{ (3 s.f.)}$$

$$10. (a) \text{ First term} = 38$$

$$\text{2nd term} = 38 - 7$$

$$= \underline{\underline{31}} \#$$

$$\text{3rd term} = 31 - 7$$

$$= \underline{\underline{24}} \#$$

$$(b) \text{ nth term} = \underline{\underline{45 - 7n}} \#$$

11. Small tin : 415 g — \$1.04  
                   1 g —  $\frac{\$1.04}{415}$   
                                   = \$0.002506  
                                    $\approx$  \$0.00251 (3 s.f.)

Large tin : 815 g — \$1.98  
                   1 g —  $\frac{\$1.98}{815}$   
                                   = \$0.002429  
                                    $\approx$  \$0.00243 (3 s.f.)

∴ The large tin gives better value because it costs less per gram. #

12. (a) Acceleration during the 1st 40 seconds  
       =  $\frac{24}{40}$   
       = 0.6 m/s<sup>2</sup> #

(b) Total distance travelled = Total area under the graph  
       =  $\frac{1}{2} (60)(24)$   
       = 720 m #

13. (a) Let  $w$  be the width of prism.

let  $V_1$  = volume of water when  $d = 12$  cm

and  $V_2$  = volume of water when  $d = 24$  cm.

$$\frac{V_1}{V_2} = \frac{\text{Base area when } d=12 \times w}{\text{Base area when } d=24 \times w}$$

$$\frac{V_1}{V_2} = \left(\frac{12}{24}\right)^2 \times \frac{w}{w}$$

$$V_1 = \frac{1}{4} V_2$$

Since  $V_2$  takes 8 seconds,

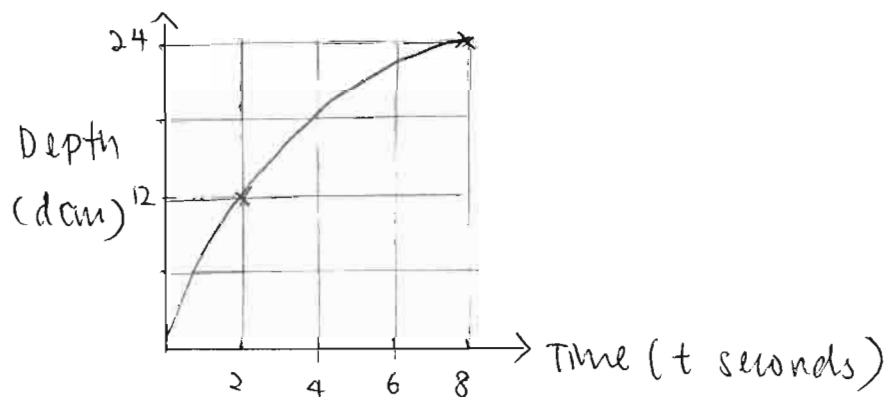
$\therefore V_1$  takes 2 seconds.

$\therefore t = \underline{2}$  when  $d = 12$  #

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(b)



14. Surface area of the toy

$$= 2\pi r^2 + \pi r l$$

$$= 2\pi (2.8)^2 + \pi (2.8)(7.2)$$

$$= 112.59$$

$$\approx \underline{113 \text{ cm}^2} \text{ (3 s.f.)} \#$$

$$15. (a) (i) \quad \frac{V_s}{V_L} = \left(\frac{R_s}{R_L}\right)^3$$
$$\frac{640}{1250} = \left(\frac{R_s}{R_L}\right)^3$$
$$\therefore \frac{R_s}{R_L} = \sqrt[3]{\frac{640}{1250}}$$
$$= \frac{4}{5}$$

Ratio of the smaller radius to the larger radius = 4:5 #

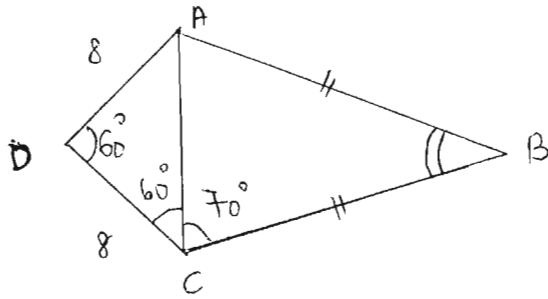
$$(ii) \quad \frac{A_s}{A_L} = \left(\frac{4}{5}\right)^2$$
$$= \frac{16}{25}$$

$\therefore$  Ratio of the surface area to the larger surface area  
= 16:25 #

$$(b) \quad \frac{M_s}{M_L} = \left(\frac{R_s}{R_L}\right)^3$$
$$\frac{M_s}{25} = \left(\frac{4}{5}\right)^3$$
$$M_s = \frac{64}{125} \times 25$$
$$= 12.8 \text{ kg}$$

$\therefore$  Mass of the smaller sphere = 12.8 kg #

16. (a) (i)



$$\hat{DAC} = \hat{ACD} = 60^\circ$$

$\therefore \triangle DAC$  is an equilateral  $\triangle$ ,  $\therefore$  length of  $AC = \underline{\underline{8 \text{ cm}}}$  #

(ii) Since  $\hat{ACD} = 60^\circ$ ,  $\therefore \hat{ACB} = 130^\circ - 60^\circ$   
 $= 70^\circ$

$$\begin{aligned} \therefore \hat{ABC} &= 180^\circ - 2(70^\circ) \\ &= \underline{\underline{40^\circ}} \quad (\text{sum of } \angle\text{s in } \triangle) \# \end{aligned}$$

(b) (i)  $\hat{POT} = 2\hat{PQO}$  ( $\angle$  at centre =  $2\angle$ s at  $O^{\text{ce}}$ )  
 $= 2(32^\circ)$   
 $= \underline{\underline{64^\circ}}$  #

(ii)  $\hat{OPT} = 90^\circ$  (tan  $\perp$  radius)

$$\begin{aligned} \therefore \hat{OTP} &= 180^\circ - 90^\circ - 64^\circ \\ &= \underline{\underline{26^\circ}} \quad (\text{sum of } \angle\text{s in } \triangle) \# \end{aligned}$$

17 (a)(i)  $2x^2 + kx - 15 = 0$  — (1)

Sub  $x = 3$ ,

$$2(3)^2 + 3k - 15 = 0$$

$$18 + 3k - 15 = 0$$

$$3k = -3$$

$$k = \underline{-1} \#$$

(ii) Sub  $k = -1$  into (1),

$$2x^2 - x - 15 = 0$$

$$(2x + 5)(x - 3) = 0$$

$$2x + 5 = 0$$

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

$$= -2.5$$

or  $x - 3 = 0$

$$x = 3 \text{ (given)}$$

∴ The other solution is  $x = -2.5$  #.

(b)  $6p^2 - 3pq - 10ap + 5aq$

$$= 3p(2p - q) - 5a(2p - q)$$

$$= \underline{(2p - q)(3p - 5a)} \#$$

18 (a)  $150 = \underline{2 \times 3 \times 5^2} \#$

(b)  $150 = 2 \times 3 \times 5^2$

$$48 = 2^4 \times 3$$

$$\text{HCF} = 2 \times 3 = \underline{6} \#$$

(c) LCM of 48 and 150 =  $2^4 \times 3 \times 5^2$   
= 1200

Least number of chocolate bars he could have bought  
=  $\frac{1200}{150}$   
= 8 #

$$19(a) (i) \frac{494.6}{56.33 \times 98.12} = \frac{494.6}{5527.0996}$$

$$= \underline{\underline{0.0894863556}} \#$$

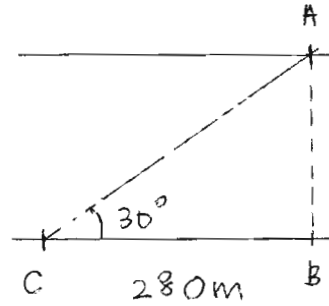
$$(ii) 0.089486355 \approx \underline{\underline{0.1}} \text{ (1 d.p.)} \#$$

$$(b) \tan 30^\circ = \frac{AB}{280}$$

$$AB = 280 \tan 30^\circ$$

$$= 161.65$$

$$\approx \underline{\underline{162 \text{ m}}} \text{ (3 s.f.)}$$



$$20. (a) \text{ Median mark} = 50 \text{ percentile}$$

$$= \underline{\underline{54}} \#$$

$$(b) \text{ Interquartile range} = \text{Upper quartile} - \text{Lower quartile}$$

$$= 65 - 44$$

$$= \underline{\underline{21}} \#$$

$$(c) \text{ Number of students who are awarded a Grade A}$$

$$= 800 - 720$$

$$= \underline{\underline{80}} \#$$

$$21 (a) 1.32 \times 10^9 - 832 \times 10^6 = 10^6 [1.32 \times 10^3 - 832]$$

$$= 10^6 [1320 - 832]$$

$$= 488 \times 10^6$$

$$= \underline{\underline{4.88 \times 10^8}} \#$$

$$(b) \text{ Average number of people per square kilometre living in Africa}$$

$$= \frac{832 \times 10^6}{26.6 \times 10^6} = \underline{\underline{31.3 \text{ people per sq. km}}} \#$$

21 (c)  $\frac{\text{Number of people living in Singapore}}{\text{Number of people living in China}}$

$$= \frac{4.48 \times 10^6}{1.32 \times 10^9}$$

$$= \frac{4.48}{1.32 \times 10^3}$$

$$= \frac{4.48}{1320}$$

$$= \frac{14}{4125}$$

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Ratio of no. of people living in Singapore : no. of people living in China

$$= 14 : 4125$$

$$= \underline{\underline{1 : 294\frac{9}{14}}} \#$$

22. (a) Length of the major arc AB =  $r\theta$

$$= 10(2\pi - 2.3)$$

$$= 39.83$$

$$\approx \underline{\underline{39.8 \text{ cm (3 s.f.)}}} \#$$

(b)  $\sin x = \frac{1}{2}$

$$\therefore \sin \frac{\pi}{6} = \frac{1}{2} \quad \text{and} \quad \sin \left( \pi - \frac{\pi}{6} \right) = \sin \frac{\pi}{6} = \frac{1}{2}$$

$$\therefore x = \frac{\pi}{6}$$

$$\text{or} \quad \frac{5\pi}{6}$$

$$= 0.5235$$

$$\text{or} \quad 2.617$$

$$\approx \underline{\underline{0.524}}$$

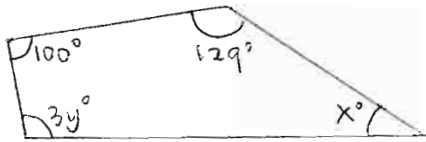
$$\text{or} \quad \underline{\underline{2.62 \text{ (3 s.f.)}}} \#$$

23 (a)



$$2y^\circ + 80^\circ + x^\circ = 180^\circ$$

$$\underline{x = 100 - 2y} \quad \text{--- (1) \#}$$



$$100^\circ + 129^\circ + 3y^\circ + x^\circ = (4-2)180^\circ$$

$$\underline{3y + x = 131} \quad \text{--- (2) \#}$$

(b)

Sub (1) into (2),

$$3y + 100 - 2y = 131$$

$$y = 31$$

$$\text{Sub } y = 31 \text{ into (1), } x = 100 - 2(31)$$

$$= 38$$

$$\therefore \underline{x = 38 \text{ and } y = 31} \quad \#$$

24. (a) In  $\triangle ABX$  and  $\triangle DCX$ ,  $AX = DX$  (given)

$BX = CX$  (given)

$\hat{A}XB = \hat{C}XD$  (vertical opp.  $\angle$ s)

$\therefore$  By SAS property,  $\triangle ABX$  &  $\triangle DCX$  are congruent  $\#$

(b)  $\triangle ABC$  and  $\triangle DCB$  OR  $\triangle ABD$  and  $\triangle DCA$   $\#$

(c)  $\triangle ADX$  and  $\triangle BXC$  are not congruent.  $\#$

25. (a) gradient of AB =  $\frac{2}{6}$   
=  $\frac{1}{3}$  #

(b) Equation of AB:  $y = \frac{1}{3}x + c$   
Sub (0, 1),  
 $\therefore y = \frac{1}{3}x + 1$  #

(c) Area of  $\Delta ABC = \frac{1}{2} \times 3 \times 6$   
=  $9 \text{ units}^2$  #

(d) Two possible points of D are  $(-6, -4)$ ,  $(6, 0)$

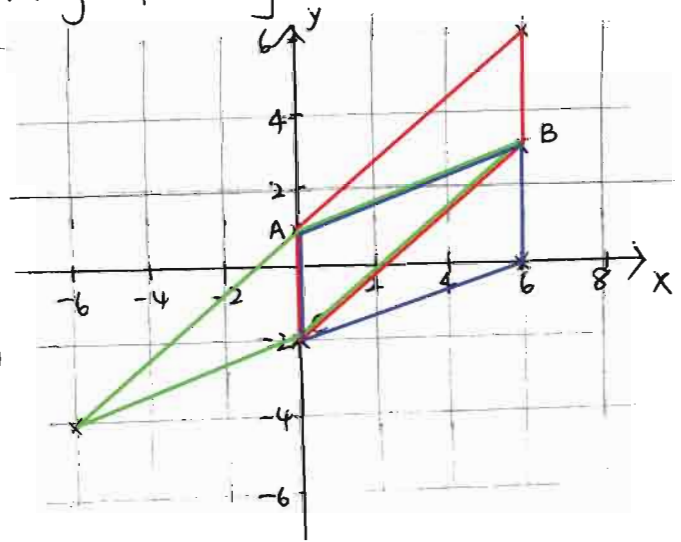
or  $(b, b)$  [ Any two ]

26. (a)  $\vec{BA} = \vec{BO} + \vec{OA}$   
=  $-6\vec{b} + 6\vec{a}$

(i)  $\vec{BM} = \frac{1}{3} \vec{BA}$   
=  $\frac{1}{3} [-6\vec{b} + 6\vec{a}]$   
=  $-2\vec{b} + 2\vec{a}$   
=  $2\vec{a} - 2\vec{b}$  #

(ii)  $\vec{OM} = \vec{OB} + \vec{BM}$   
=  $6\vec{b} + 2\vec{a} - 2\vec{b}$   
=  $2\vec{a} + 4\vec{b}$  #

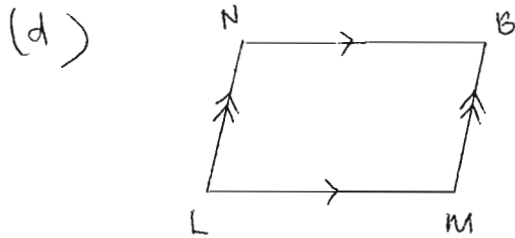
(iii)  $\vec{ML} = \vec{MO} + \vec{OL}$   
=  $-2\vec{a} - 4\vec{b} + 3\vec{a}$   
=  $\vec{a} - 4\vec{b}$  #



$$\begin{aligned}
 (b) \quad \vec{LP} &= 3\vec{LM} \\
 \vec{OP} - \vec{OL} &= 3(4\vec{b} - \vec{a}) \\
 \vec{OP} &= 12\vec{b} - 3\vec{a} + 3\vec{a} \\
 &= \underline{\underline{12\vec{b}}} \quad *
 \end{aligned}$$

$$\begin{aligned}
 (c) \quad \vec{OP} &= 12\vec{b} \\
 &= 2(6\vec{b}) \\
 &= 2\vec{OB}
 \end{aligned}$$

$\therefore O, B$  and  $P$  are collinear and  $OP$  is twice of  $OB$ . \*



Since  $LMBN$  is a parallelogram,

$$\vec{NB} = \vec{LM}$$

$$\vec{OB} - \vec{ON} = 4\vec{b} - \vec{a}$$

$$\vec{ON} = \vec{OB} - 4\vec{b} + \vec{a}$$

$$= 6\vec{b} - 4\vec{b} + \vec{a}$$

$$= 2\vec{b} + \vec{a}$$

$$= \underline{\underline{\vec{a} + 2\vec{b}}} \quad *$$