Harder Rearranging a Formula Exam Practice

Q1. Make a the subject of the formula, $a(b+1) = d$

$$a = \frac{d}{b+1}$$

Answer: $a = \frac{d}{b+1}$

(1 mark)

Q2. Make b the subject of the formula, $\frac{a}{b-1} = d$

$$a = (b-1)d$$
$$a = bd - d$$
$$a + d = bd$$
$$\frac{a+d}{d} = b$$

Answer: $b = \frac{a+d}{d}$

(2 marks)

Q3. Make q the subject of the formula, $p + \sqrt{q+2} = r$

$$\sqrt{q+2} = r - p$$
$$q + 2 = (r-p)^2$$
$$q = (r-p)^2 - 2$$

Answer: $q = (r-p)^2 - 2$

(2 marks)

Q4. Make u the subject of the formula, $\frac{1}{\sqrt[3]{u-2}} = 8v + 3$

$$\frac{1}{8v+3} = \sqrt[3]{u-2}$$

$$\left(\frac{1}{8v+3}\right)^3 = u-2$$

$$\left(\frac{1}{8v+3}\right)^3 + 2 = u$$

Answer: $u = \left(\frac{1}{8v+3}\right)^3 + 2$

(3 marks)

Q5. Make a the subject of the formula, $s = vt - \frac{1}{2}at^2$

$$\frac{1}{2}at^2 = vt - s$$

$$at^2 = 2(vt - s)$$

$$a = \frac{2(vt-s)}{t^2}$$

Answer: $a = \frac{2(vt-s)}{t^2}$

(2 marks)

Q6. Make d the subject of the formula, $\frac{1}{c} + \frac{1}{d} = \frac{1}{e}$

$$\frac{1}{d} = \frac{1}{e} - \frac{1}{c}$$

$$\frac{1}{d} = \frac{c-e}{ec}$$

$$\frac{d}{1} = \frac{ec}{c-e}$$

Answer: $d = \frac{ec}{c-e}$

(4 marks)

Multiple copies of the subject letter

Q7. Make x the subject of the formula, $3(x + a) = x + b$

$3x + 3a = x + b$

$3x - x = b - 3a$

$2x = b - 3a$

$x = \frac{b-3a}{2}$

Answer: $x = \frac{b-3a}{2}$

(2 marks)

Q8. Make p the subject of the formula, $a(2p - q) = p + 1$

$2ap - aq = p + 1$

$2ap - p = 1 + aq$

$p(2a - 1) = 1 + aq$

$p = \frac{1+aq}{2a-1}$

Answer: $p = \frac{1+aq}{2a-1}$

(3 marks)

Q9. Make r the subject of the formula, $\frac{2r+s}{3r} = 4$

$2r + s = 12r$

$s = 10r$

$\frac{s}{10} = r$

Answer: $r = \frac{s}{10}$

(3 marks)

Q10. Make c the subject of the formula, $\frac{2c+d}{3c-5} = 4$

$2c+d = 4(3c-5)$

$2c+d = 12c-20$

$d+20 = 10c$

$\frac{d+20}{10} = c$

Answer: $c = \frac{d+20}{10}$

(3 marks)

Q11. Make m the subject of the formula, $\frac{2(3m-3n)}{3m-5n} = 4$

$2(3m-3n) = 4(3m-5n)$

$6m-6n = 12m-20n$

$14n = 6m$

$\frac{14n}{6} = m$

$\frac{7n}{3} = m$

Answer: $m = \frac{7n}{3}$

(4 marks)

Q12. Make m the subject of the formula, $e = mgh + \frac{1}{2}mv^2$

$e = m(gh + \frac{1}{2}v^2)$

$\frac{e}{gh+\frac{1}{2}v^2} = m$

$\frac{2e}{2gh+v^2} = m$

Answer: $m = \frac{2e}{2gh+v^2}$

(3 marks)

Q13. Here is a formula: $\frac{3x-2}{5} - \frac{3y-2}{5y} = 0$

(a) make x the subject

$$\frac{3x-2}{5} = \frac{3y-2}{5y}$$

$$(3x-2)5y = 5(3y-2)$$

$$15xy - 10y = 15y - 10$$

$$15xy = 25y - 10$$

$$x = \frac{25y-10}{15y}$$

Answer: $x = \frac{25y-10}{15y}$

(2 marks)

(b) make y the subject

The formula is $15xy = 25y - 10$ from part (a)

$$15xy - 25y = -10$$

$$y(15x - 25) = -10$$

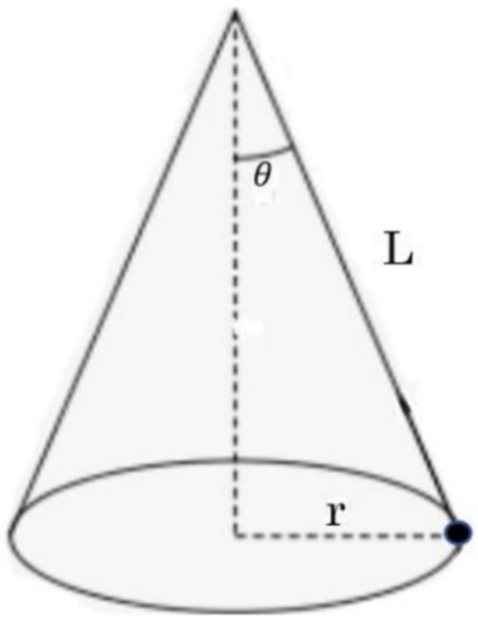
$$y = \frac{-10}{15x - 25}$$

Answer: $y = \frac{-10}{15x-25}$

(3 marks)

Applied Mixed Practice Problems

Q14. A marble is attached to the end of a string of length L cm which is held at angle θ to the vertical. On being given a horizontal force, the marble follows the path of a circle as shown below.



The number of seconds t to complete a circle, is given by:

$$t = 2\pi\sqrt{\frac{Lcos(\theta)}{g}}$$

If the marble takes 4 seconds to complete a circuit, the length of the string is 30 cm, g = 9.8, work out the angle between the string and the vertical. Give your answer to 1 decimal place.

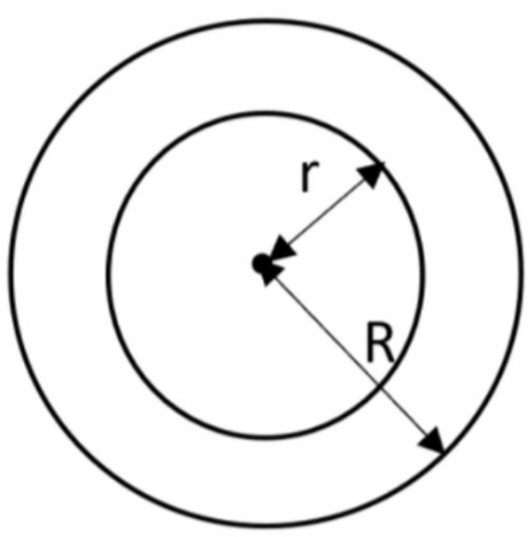
$4 = 2\pi\sqrt{\frac{30\cos(\theta)}{9.8}} \Rightarrow \left(\frac{4}{2\pi}\right)^2 = \frac{30\cos(\theta)}{9.8}$

$\Rightarrow \frac{9.8}{30}\left(\frac{4}{2\pi}\right)^2 = \cos(\theta) \Rightarrow \cos^{-1}\left(\frac{9.8\times16}{30\times4\pi^2}\right) = \theta$

Answer: 82.4°

(3 marks)

Q17. Below is an annulus.



a) Find a formula for the area A of the annulus in terms of r and R.

$A = \pi R^2 - \pi r^2$

b) Find a formula for r in terms of A and R

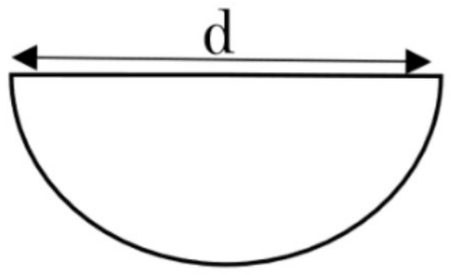
$A = \pi R^2 - \pi r^2$

$\pi r^2 = \pi R^2 - A$

$r = \sqrt{\frac{\pi R^2 - A}{\pi}}$

(Total: 6 marks)

Q15. Here is a semi-circle, with diameter d:



a) Find a formula for the circumference c of the shape in terms of r where is the radius of the semi-circle.

- Curved part of shape is $\frac{1}{2}$ of circumference of circle

i.e, $\frac{1}{2} \times 2\pi r = \frac{2\pi r}{2}$

$\Rightarrow C = \frac{2\pi r}{2} + 2r$

$C = \pi r + 2r$

Answer: $C = \pi r + 2r$

(2 marks)

b) Hence or otherwise, find a formula for r in terms of the circumference c

$C = \pi r + 2r$

$C = r(\pi + 2)$

$\frac{C}{\pi + 2} = r$

Answer: $r = \frac{C}{\pi + 2}$

(2 marks)

Q16. Amit works in a bank. He uses the formula $F = P\alpha(1 + r)^n$ where F is the future value of an investment, P is its present value, r is the annual interest rate, n is the number of years the money is to be invested. α is a number between 0.9 and 1 which reflects the current confidence the bank has in its forecasts.

a) Find a formula for the interest rate.

$F = (1+r)^n$

$P\alpha$

$\left(\frac{F}{P\alpha}\right)^{\frac{1}{n}} = 1 + r$

$\Rightarrow \left(\frac{F}{P\alpha}\right)^{\frac{1}{n}} - 1 = r$

Answer: $r = \left(\frac{F}{P\alpha}\right)^{\frac{1}{n}} - 1$

(3 marks)

b)

(i) Amit has set the confidence coefficient to 0.95.
If a customer's investment is worth £24,000 now and is to be worth £25,300 after 2 years, find the interest rate the bank will have to apply.

$\left(\frac{25300}{24000 \times 0.95}\right)^{\frac{1}{2}} - 1 = r$

$r = 0.0533$

Answer: 5.3%

(2 marks)

(ii) Suppose that Amit sets the confidence coefficient to 0.98. State whether r will have to increase or decrease compared to the previous value of α.

r will decrease compared to before.

Answer: decrease

(1 mark)