EDUCATION SOUTH WEST

KING EDWARD VI
COMMUNITY COLLEGE

Year 12
Induction Task

# ANSWERS

# Induction Task

The aim of this task is to 'bridge the gap' between GCSE and A-level Mathematics.

There are two levels of questions, GCSE and AS level.

- Complete all of the GCSE questions. Use the mark scheme to mark these in **purple pen**, when you have finished. You should spend approximately 3 hours on this
- Complete as many as you can of the AS level questions. Some of these are tricky, but some of them are no more difficult than the GCSE questions. Those doing Further Maths should attempt all of these.
- Students should use purple pen to comment on what went well and what they need to improve on and complete the grid at the front of the booklet
- During the third week, you will be given an **induction test** based on these types of questions

Deadline: Friday 11th September 2026

# Learning = a change in long-term memory

'if nothing has changed nothing has been learned'

Meaningful learning is about producing organised, coherent and integrated mental models that allow people to make inferences and apply their knowledge. (Karpicke, J. 2012)

## THE BENEFITS:

1. Retrieval practice aids later retention
   'every time you retrieve a memory it becomes deeper, stronger and easier to access in the future'
2. Testing identifies gaps in knowledge
3. Testing causes students to learn more from the next learning episode
4. Testing produces better organisation of knowledge
5. Testing improves transfer of knowledge to new contexts
6. Facilitates retrieval of material that wasn't tested
7. Improves metacognition
8. Prevents interference from previous material when learning new content
9. Provides valuable feedback to teachers
10. Regular testing encourages students to study more

# Exemplar marking

## PURE: Surds and indices

**Q1.**(a) Circle the value of $3^{-2}$

$-6$ $\frac{1}{6}$ $\frac{1}{9}$ $-9$

1 ✓ **(1)**

(b) Work out the value of $(-8)^0 + 8^{-\frac{2}{3}}$

$8^{-2/3} = (8^{1/3})^{-2}$

$= 2^{-2}$

$= \frac{1}{4}$ ✓ 1

$(-8)^0 + 8^{-2/3} = 0^+ + \frac{1}{4}$

$= \frac{1}{4}$

Answer $\frac{1}{4}$ ×

**(3)**
**(Total 4 marks)**

## GCSE: Surds and indices

| Question number | Topic | Estimated number of marks | | Comment |
|---|---|---|---|---|
| 1 | Negative and fractional indices | 2 | Total 4 | Correct negative & fractional indices but forgot $(-8)^0 = 1$. |

# GCSE: Surds and indices

**Q1.**

**(a)** $\frac{1}{9}$

**B1**

$\frac{1}{8^{\frac{2}{3}}}$ or $2^{-2}$ or $(\sqrt[3]{8})^{-2}$ or $(\sqrt[3]{8}) = 2$

or $64^{\frac{1}{3}}$ or $(\sqrt[3]{64})^{-1}$ or $(8^2) = 64$

**(b)**

or $(-8)^0 = 1$ seen or implied

**M1**

$\frac{1}{\sqrt[3]{8^2}}$ or $\frac{1}{\sqrt[3]{64}}$ or $\frac{1}{(\sqrt[3]{8})^2}$ or $\left(\frac{1}{\sqrt[3]{8}}\right)^2$

or $\sqrt[3]{\left(\frac{1}{8}\right)^2}$ or $\sqrt[3]{\frac{1}{64}}$ or $\frac{1}{64^{\frac{1}{3}}}$

or $\sqrt[3]{\frac{1}{8}} = \frac{1}{2}$ or $\left(8^{\frac{2}{3}}\right) = 4$

or $\frac{1}{4}$ or $\frac{1}{2^2}$ or $\left(\frac{1}{2}\right)^2$ or $4^{-1}$

*oe*

**M1**

$1\frac{1}{4}$

*oe*

**A1**

**Additional Guidance**

$8^{\frac{2}{3}} = \frac{1}{64}$ with answer $1\frac{1}{64}$

**M1M0A0**

**[4]**

**Q2.**

$x^{-\frac{2}{3}}$ or $a = -\frac{2}{3}$

*B2* $(x^{\frac{1}{3}})^2$ *or* $(x^2)^{\frac{-1}{3}}$ *or* $(x^{\frac{2}{3}})^{-1}$ *or* $(x^{-2})^{\frac{1}{3}}$ *or* $(x^{\frac{1}{3}})^{-2}$ *or* $\frac{1}{x^{\frac{2}{3}}}$ *or* $-\frac{2}{3}$

*B1* $(\sqrt[3]{x3})^{-2}$ *or* $(\sqrt[3]{x^2})^{-1}$ *or* $(\frac{1}{x^2})^{\frac{1}{3}}$ *or* $\frac{1}{(x^2)^{\frac{1}{3}}}$ *or* $(\frac{1}{\sqrt[3]{x}})^2$ *or base* $x$ *with any negative index.*

**B3**

**[3]**

**Q3.**

(a) $w^5$

*Any letter is OK, eg* $x^5$

**B1**

(b) $8x^3y^5$

*B1 If all parts correct but × or one + included*
*B1 for 2 correct (× may be included but + may not)*
*B1 if wrong further work after correct answer seen*

**B2**

**Additional Guidance**

$8x^3y^6$ **B1**

$6x^3y^5$ **B1**

$8x^2y^5$ **B1**

$8 \times x^3 \times y^5$ **B1**

$8 \times x^3 + y^5$ **B1**

$8x^3y^5 = 8xy^8$ **B1**

$8 \times x^3 \times y^6$ **B1**

$8 + x^3 + y^5$ **B0**

(c) $6a^2b^4$ **B2**

One part correct **B1**

**Q4.**

(a) $m^2$

*Do not accept $m \times m \times m$*

**B1**

(b) $3 \times 5 + 5 \times \sqrt{2} - 3 \times \sqrt{2} - \sqrt{2} \times \sqrt{2}$

or $3 \times 5 + 2\sqrt{2} - \sqrt{2}\ \sqrt{2}$

or $13 + 5\sqrt{2} - 3\sqrt{2}$

*oe 4 terms or correct combination of 3 terms needed. If 4 terms given, 3 must be correct for M1*

*Allow in 'box method' or FOIL but watch out for correct signs (still allow one error).*

**M1**

$13 + 2\sqrt{2}$

**A1**

**Additional Guidance**

If answer correct allow 2 marks.

$15 + 5\sqrt{2} - 3\sqrt{2} + 4$

**M1**

$19 + 2\sqrt{2}$

**A0**

| × | 3 | $\sqrt{2}$ |
|---|---|---|
| 5 | 15 | $5\sqrt{2}$ |
| $\sqrt{2}$ | $3\sqrt{2}$ | 2 |

$17 + 8\sqrt{2}$

**M0**
**(Only two terms correct)**

| × | 3 | $\sqrt{2}$ |
|---|---|---|
| 5 | 15 | $5\sqrt{2}$ |
| $-\sqrt{2}$ | $3\sqrt{2}$ | 2 |

$13 + 2\sqrt{2}$

**M1**
**A1**
**(Terms incorrect in table but 'recovered')**

$5 \times 3 = 15$, $3 \times \sqrt{2} = 3\sqrt{2}$, $5 \times \sqrt{2} = 5\sqrt{2}$, $-\sqrt{2} \times \sqrt{2} = -2$

**M1**

$13 + 8\sqrt{2}$

**A0**

(c) $\frac{27}{5}$ or $5\frac{2}{5}$ or 5.4

*B2 for 27 and* $\frac{1}{5}$

*B2 for* $\frac{1}{5} \times 3^3$

*B1 for 27 or* $\frac{1}{5}$

*B1 for 5* ***and*** *3 seen*

**Additional Guidance**

$\frac{1}{5} \times 3^3 = \frac{1}{5} \times 9 = 1.8$

**B2**

$\frac{1}{5} \times 9 = 1.8$

**B1**

$\sqrt{25} = \pm 5$ and $\sqrt[4]{81} = \pm 3$ (allow a mixture or + and – for 3 and 5 but negative elsewhere not allowed)

**B1**

**[6]**

**Q5.**

(a) $6\sqrt{2}$

**B1**

(b) $\sqrt{\frac{24}{6}}$ or $\sqrt{\frac{8}{2}}$ or $\sqrt{4}$

or $\frac{\sqrt{8}}{\sqrt{2}}$ or $\frac{2\sqrt{2}}{\sqrt{2}}$

or $\frac{\sqrt{8}\times\sqrt{2}}{\sqrt{2}\times\sqrt{2}}$ or $\frac{\sqrt{16}}{2}$ or $\frac{4}{2}$

or $\frac{\sqrt{3}\times 2\sqrt{2}}{\sqrt{6}}$ or $\frac{2\sqrt{6}}{\sqrt{6}}$

or $\frac{\sqrt{3}\times 2\sqrt{2}\times\sqrt{2}}{\sqrt{6}\times\sqrt{2}}$ or $\frac{2\sqrt{12}}{\sqrt{12}}$

or $\frac{\sqrt{3}\times\sqrt{8}\times\sqrt{6}}{\sqrt{6}\times\sqrt{6}}$ or $\frac{\sqrt{24}\times\sqrt{6}}{\sqrt{6}\times\sqrt{6}}$

or $\frac{\sqrt{144}}{6}$ or $\frac{12}{6}$

**M1**

2

**A1**

**Additional Guidance**

$\frac{\sqrt{24}}{\sqrt{6}}$ does not score alone without further working

**M0**

**[3]**

**Q6.**

$\frac{10}{3\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$ or $\frac{10\sqrt{5}}{15}$

$\frac{10}{3\sqrt{5}} \times \frac{3\sqrt{5}}{3\sqrt{5}}$ or $\frac{30\sqrt{5}}{45}$

or $\frac{\sqrt{20}}{3}$

*oe*

*Must multiply numerator and denominator*

*eg* $\frac{10}{\sqrt{45}}$ *is M0*

$\frac{10}{\sqrt{45}} \times \frac{\sqrt{45}}{\sqrt{45}}$ *is M1*

**M1**

$\frac{2\sqrt{5}}{3}$

**A1**

**[2]**

**Q7.**

$\cos 30° = \frac{\sqrt{3}}{2}$ or $\tan 60° = \sqrt{3}$

**M1**

$4\sqrt{3}$

**A1**

$\sqrt{48}$ or $k = 48$

*ft value seen in the form* $a\sqrt{b}$ *where* $a$ *and* $b$ *are integers > 1*

**B1ft**

**[3]**

# GCSE: Factorising, expanding and solving equations

**Q8.**

$2x(3x - 7)$

*B1 $2(3x^2 - 7x)$ or $x(6x - 14)$*

*SC1 $2x(3x + 7)$*

**B2**

**Additional Guidance**

Allow multiplication signs for B2 or B1
eg $2x \times (3x - 7)$

**B2**

Condone missing final bracket
eg $2x(3x - 7$

**B2**

Accept $(2x + 0)(3x - 7)$

**B2**
**[2]**

**Q9.**

**Alternative method 1**

$4x - 6y = 48$
and
$18x + 6y = -15$

$6x - 9y = 72$

(and
$6x + 2y = -5$)

*oe*

*Equating coefficients*

**M1**

$22x = 33$

or $x = 1.5$

$-11y = 77$

or $y = -7$

*oe*

*Elimination of one variable*

**M1 dep**

$x = 1.5$ and $y = -7$

*oe*

*SC1 for $x = 1.5$ and $y = -7$ without working or using trial and improvement*

**A1**

**Alternative method 2**

$x = \frac{24 + 3y}{2}$ or $y = \frac{2x - 24}{3}$

or $x = \frac{-5-2y}{6}$ or $y = \frac{-5-6x}{2}$

*oe*

*Rearranging*

**M1**

$22x = 33$

or $x = 1.5$

$-11y = 77$

or $y = -7$

*oe*

*Elimination of one variable*

**M1 dep**

$x = 1.5$ and $y = -7$

*oe*

*SC1 for $x = 1.5$ and $y = -7$ without working or using trial and improvement*

**A1**

**[3]**

**Q10.** $(t + 4)(t^2 + 4t + 4t + 16)$

*oe Must be correct*

**M1**

$t^3 + 4t^2 + 4t^2 + 16t + 4t^2 + 16t + 16t + 64$

*ft From their $(t + 4)(t^2 + 4t + 4t + 16)$*

*oe Must have at least 4 terms correct*

*M2 $t^3 + 3t^2(4) + 3t\,(4)^2 + 4^3$ oe*

**M1**

$t^3 + 12t^2 + 48t + 64$

**A1**

**[3]**

**Q11.**

$(3x + a)(x + b)$
where $ab = 8$ or $a + 3b = 14$
or
$3x(x + 4) + 2(x + 4)$
or
$x(3x + 2) + 4(3x + 2)$

**M1**

$(3x + 2)(x + 4)$

*oe*

**A1**

**[2]**

**Q12.**

$(2x + 1)(2x – 1)$

**M1**

$(2x + 5)(2x + 1)$

**M1**

$\frac{2x-1}{2x+5}$

*Do not allow further work*

**A1**

**[3]**

**Q13.**

$6(x + 3)$ or $(–)2(x – 2)$
or $6x + 18$ or $2x – 4$ or $–2x + 4$
or $(x – 2)(x + 3)$

**M1**

$6x + 18 – 2x + 4$
or $4x + 22$
or $x^2 – 2x + 3x – 6$
or $x^2 + x – 6$

*allow three correct terms after expansion ignore RHS and denominator*

*allow three correct terms after expansion as denominator or RHS*

**M1**

$x^2 – 3x – 28 = 0$

**A1**

$(x - 7)(x + 4)$ (= 0)

*correct method to solve their quadratic equation by*
*correct substitution into the quadratic formula*
*or correct completion of the square*
*or correct factorisation*

**M1**

($x$ =) 7 and ($x$ =) – 4

*SC2 ($x$ =) 7 or ($x$ =) – 4*

**A1**

**Additional Guidance**

Correct substitution into quadratic formula

$$x = \frac{--3 \pm \sqrt{(-3)^2 - 4 \times 1 \times -28}}{2 \times 1}$$

**[5]**

**Q14.**

**Alternative method 1**

$y = -3 - 4x$

**B1**

$x^2 + 2x + 5$ = their $-3 - 4x$

**M1**

$x^2 + 6x + 8 = 0$

*ft their $-3 - 4x$*

**A1ft**

$(x + 4)(x + 2)$ (= 0)

*Correct method to solve their quadratic equation*

$x = -4, -2$

*ft their quadratic equation*

**A1ft**

$y$ = 13, 5

*SC2 Both pairs of correct values without valid working*

**A1**

**Alternative method 2**

$x = (\text{their } \frac{-3-y}{4})^2 + 2(\frac{-3-y}{4})$

**B1**

$y = (\text{their } \frac{-3-y}{4})^2 + 2(\frac{-3-y}{4}) + 5$

**M1**

$y^2 - 18y + 65 = 0$

*ft their* $\frac{-3-y}{4}$

*oe may have common denominator 16*

**A1ft**

$(y - 5)(y - 13)\ (= 0)$

*Correct method to solve their quadratic equation*

**M1**

$y = 13, 5$

*ft their quadratic equation*

**A1ft**

$x = -4, -2$

*SC2 Both pairs of correct values without valid working*

**A1**

**Alternative method 3**

$4x + x^2 + 2x + 5 = -3$

*oe*

**B1**

$x^2 + 6x + 5 = -3$

**M1**

$x^2 + 6x + 8 = 0$

**A1**

$(x + 4)(x + 2)\ (= 0)$

*Correct method to solve their quadratic equation*

**M1**

$x = -4, -2$

*ft their quadratic equation*

**A1 ft**

$y$ = 13, 5

*SC2 Both pairs of correct values with no valid working*

**A1**

**Alternative method 4**

$4x + y = -3$ and

$y - x^2 - 2x = 5$

or

$4x + y = -3$ and

$-2x + y = x^2 + 5$

*oe*

*the equations must be used as simultaneous equations*

**B1**

$4x + x^2 + 2x = -8$ or $x^2 + 6x = -8$
or
$6x = -3 - x^2 - 5$

*oe*

**M1**

$x^2 + 6x + 8 = 0$

**A1**

$(x + 4)(x + 2)$ (= 0)

*Correct method to solve their quadratic equation*

**M1**

$x = -4, -2$

*ft their quadratic equation*

**A1ft**

$y$ = 13, 5

*SC2 Both pairs of correct values with no valid working*

**A1**
**[6]**

**Q15.**

(a) **Alternative method 1**

$x^2 - 3x - 3x$
or $x^2 - 6x$
or $b = 9 - a$
or $\frac{a}{2} = -3$

*oe*

**M1**

**Alternative method 2**

Substitutes a value for $x$ into the identity and obtains a correct equation in $a$ and $b$

**M1**

$a = -6$

**A1**

$b = 15$

**A1**

**Additional Guidance**

$x = 0$ gives $b = 9 - a$

$x = 1$ gives $1 + a + b = 4 - a$

$x = 2$ gives $4 + 2a + b = 1 - a$

$x = 3$ gives $9 + 3a + b = -a$

(b) 2

**B1**

**Q16.**

(a) **Alternative method 1**

$a = 2$ or $2(x^2 - 3x + 2.5)$ or
$2(x^2 - 3x) + 5$

**M1**

$x^2 - 3x = (x - 1.5)^2 - 1.5^2$

*oe*

*ft their* $x^2 - 3x$

**M1dep**

$a$ = 2 and $b$ = 1.5 and $c$ = 0.5

*oe eg* $2(x - 1.5)^2 + 0.5$

**A1**

**Alternative method 2**

$a$ = 2

**B1**

$x^2 - bx - bx + b^2$ or
$x^2 - 2bx + b^2$ or
$-2ab = -6$ or
$-ab = -3$ or
$b$ = 1.5

*oe*

**M1**

$a$ = 2 and $b$ = 1.5 and $c$ = 0.5

*oe eg* $2(x - 1.5)^2 + 0.5$ **A1**

(b) **Alternative method 1**

their $2(x - 1.5)^2$ = 8.5 – their 0.5

**M1**

their $(x - 1.5) = \pm \sqrt{\frac{8.5 - \text{their } 0.5}{2}}$

*oe*

**M1dep**

3.5 and –0.5

*oe*

**A1**

**Alternative method 2**

$2x^2 - 6x - 3.5$ (= 0) or
$4x^2 - 12x - 7$ (=0)

*oe 3-term quadratic equation or expression*

**M1**

Correct use of quadratic formula

eg $\frac{--12 \pm \sqrt{(-12)^2 - 4 \times 4 \times -7}}{2 \times 4}$

or correct factorisation

eg $(2x - 7)(2x + 1) = 0$

*oe* **M1dep**

3.5 and –0.5

*oe* **A1**

**Q17.**

$y\,(4x + 9)$ or $4xy + 9y$

*oe* **M1**

$4xy + 9y = 8 - 3x$

*oe* **M1dep**

$4xy + 3x = 8 - 9y$

or $x(4y + 3) = 8 - 9y$

*oe* **M1dep**

$x = \frac{8 - 9y}{4y + 3}$ **A1**

# GCSE : Linear graphs

**Q18.**

$m = 5$

**B1**

$3 = 5 \times 4 + c$ **or** $3 = 20 + c$

*$y - 3 = 5(x - 4)$ or $y - 3 = 5x - 20$ oe*

**M1**

$c = -17$

*SC1 for $y = -0.2x + 3.8$ (using the perpendicular gradient)*

**A1** **[3]**

**Q19.**

(Gradient of $PQ$ =) $\frac{-4}{7}$

*Allow 0.57 or better for $\frac{4}{7}$*

**B1**

$0 = \frac{-4}{7} \times 14 + K$

*(K =) 14 × their $\frac{4}{7}$ or $-14 \times$ their $\frac{-4}{7}$ (= 8)*

*8 marked at the $y$-intercept*

*ft non-integer gradient*

**M1**

$y = \frac{-4}{7}x + 8$

*ft non-integer gradient*

**A1ft**

$4x + 7y = 56$

*oe*

*ft their equation with a non-integer coefficient of $x$ and M1 awarded*

**A1ft**

**[4]**

**Q20.**

**Alternative method 1**

*P* (1, 3) or $y$ = 3 or grad *OP* = 3

**B1**

grad $PQ = -\dfrac{1}{\text{their } 3}$ or $-\dfrac{1}{3}$

**M1**

$y = \left(\text{their } -\dfrac{1}{3}\right)x + c$

and substitutes (1, their 3)

or

$y - \text{their } 3 = \left(\text{their } -\dfrac{1}{3}\right)(x-1)$

*oe*

$\dfrac{\textit{their } 3}{x-1}$ *or* $-\dfrac{\textit{their } 3}{x-1}$

**M1dep**

Substitutes $y$ = 0 in their equation

$$-\frac{\textit{their } 3}{x-1} = \textit{their } -\frac{1}{3}$$

**M1dep**

(10, 0)

**A1**

**Alternative method 2**

*P* (1, 3) or $y$ = 3 or grad *OP* = 3

**B1**

$\dfrac{\text{their } 3}{1} = \dfrac{QN}{\text{their } 3}$

**M1dep**

their 3 × their 3 or 9

**M1dep**

$\tan PON = \frac{\text{their } 3}{1}$

*N is on the $x$-axis*

*PN is perpendicular to the $x$-axis*

**M1**

(10, 0)

**A1**

**[5]**

# GCSE: Sequences and functions

**Q21.**

(a) 1536

**B1**

(b) $2^{n+2} + 2^n + 1$

**B1**

**[2]**

**Q22.**

$\frac{x}{3}$

**B1**

**[1]**

**Q23.**

$2(cx + 5) + c$ or $2cx + 10 + c$

**M1**

their $2cx = 6x$ or their $2c = 6$
or $c = 3$

*Must have attempted fg(x)*

**M1**

13

*SC2 for 11*

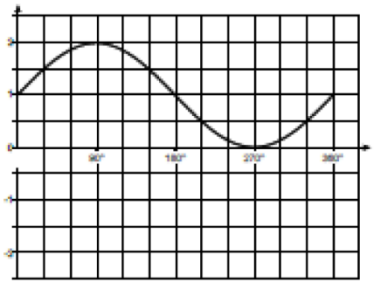
**A1**

**[3]**

# GCSE: Trigonometry and proof

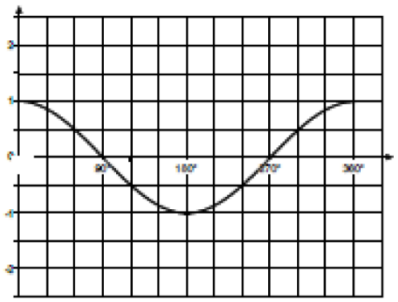
**Q24.**

(a) Fully correct graph



**B1**

(b) Fully correct graph



**B1**

**[2]**

**Q25.**

$n$ and $n + 1$ seen

*Two consecutive integers expressed algebraically, eg $n - 1$ and $n$*

**M1**

$(n + 1)^2 - n^2$

*Subtraction of their consecutive integers squared*

**M1dep**

$n^2 + 2n + 1 - n^2$

*Correct expansion*

**A1**

$2n + 1$ and explanation why this expression must be odd

*Strand (i). Explanation why their expression must be odd*

**Q1**

**[4]**

**Q26.**

6.5 – 2.3 or 4.2 and 5 or 85 seen

**M1**

$\sin 5 = \frac{6.5-2.3}{AD}$ or

$\cos 85 = \frac{6.5-2.3}{AD}$ or

$\left(\frac{6.5 - 2.3}{\tan 5}\right)^2 + (6.5 - 4.2)^2$

*oe*

**M1**

$\frac{6.5 - 2.3}{\sin 5}$ or $\frac{6.5 - 2.3}{\cos 85}$ or

$\sqrt{\left(\frac{6.5-2.3}{\tan 5}\right)^2 + (6.5-4.2)^2}$

*oe*

**M1dep**

[48, 48.2]

**A1**

**[4]**

# GCSE: Sectors

**Q27.**

$\frac{60}{360} \times 2 \times \pi \times 12$

*oe Mark complete method*

**M1**

$4\pi$ or [12.56, 12.6] or $\pi 4$

*NB $4\pi + 24$ is M1, A0*

*NB $4\pi \div 2$ implies M0*

*12.4 implies M1*

**A1**

**[2]**

**Q28.**

(a) $\pi \times 9.2 \times 9.2$ or 265.(...)

*oe*

**M1**

$\frac{125}{360} \times \pi \times 9.2 \times 9.2$

*oe*

**M1dep**

[92, 92.5]

**A1**

(b) ½ × 9.2 × 9.2 × sin 125

*oe*

**M1**

[34.6, 34.7]

**A1**

[57, 58]

*ft their (a) − [34.6, 34.7]*

*Allow rounding of final answer*

**A1ft**

**[6]**

# GCSE: Statistical diagrams and probability

**Q29.**

(a) Four correct cumulative frequencies

*23, 48, 87 and 100*

**B1**

Five correct heights plotted

*(…, 12), (…, 23), (…, 48), (…, 87) and (…, 100)*

**B1**

Five points plotted at correct upper boundaries

*(15, …), (20, …), (40, …), (55, …) and (70, …)*

*Must be an increasing function*

**B1**

Straight lines or smooth curve going through the five points

*ft **their** 5 plotted points.*

*Must be an increasing function*

**B1ft**

**Additional Guidance**

Ignore anything to the left of *their* (15, 12)

Ignore anything to the right of *their* (70, 100), must be an increasing function

tolerance $\pm\frac{1}{2}$ square

Accept histograms / bars for heights plotted but upper boundary points must be identified either by plots or curve / polygon

(b) *their* LQ plotted
and *their* median plotted
and *their* UQ plotted

*ft **their** cf graph provided increasing function*

*tolerance $\pm\frac{1}{2}$ square (± 1 )*

*B1ft for 2 correctly plotted*

**B2ft**

Box plot with 8 and 69 correct

*Correct diagrammatic representation*

**B1**

**Additional Guidance**

Allow values plotted as points for B2ft

**[7]**

**Q30.**

(a) Bar between 2 and 3 to a height of 13

Bar between 4 and 5 to a height of 19

Bar between 7 and 10 to a height of 5

*B1 for bar between 7 and 10 correct*

**B2**

**Additional Guidance.** Two of the values, 13 and 19 come straight from the table, so students who draw a 'bar chart' rather than a histogram will get two of the heights correct. This is why they have to get all three bars correct for 2 marks, and the only way they can score 1 mark is to get the bar between 7 and 10 at a height of 5. This mark is independent, so if they mess up the bars for 2 to 3 and/or 4 to 5, for example by misreading scales, then as long as the 7 to 10 bar is at a height of 5 award B1.
Note: Any 'gaps' between bars, eg 2 to 3 being draw from 2.1 to 3 counts as an error.

(b) 17 and 28

*B1 for 28 correct*

**B2**

**Additional Guidance.** One of the values, 17 comes straight from the histogram, so students who read it as a 'bar chart' rather than a histogram will get one of the entries correct. This is why they have to get both entries correct for 2 marks, and the only way they can score 1 mark is to get the entry for $5 < c \leq 7$ as 28. This mark is independent, so if they mess up the entry for $3 < c \leq 4$ for example 8.5 or 34, as long as the other entry is 28 this scores B1

**[4]**

**Q31.**

(a) $\frac{29}{50}$

*oe 0.58*

**B1**

(b) $\frac{23}{50}$

*oe 0.46*

*SC1 incorrect but consistent denominator, greater than 29, in (a) and (b) with correct numerators.*

**B1**

(c) L'

**B1**

(d) $\frac{40}{50}$ or 40 seen

*6, 23 and 11 identified*

**M1**

L ∪ T

*T ∪ L*

*SC1 A ∪ B or B ∪ A*

**A1**

**[5]**

**Q32.**

**Alternative method 1**

$\frac{4}{10}$ (black)

*oe*

*May be on diagram*

**M1**

$\frac{4}{10} \times \frac{3}{9}$

*oe*

*0.4 × 0.33...*

*May be on diagram*

**M1dep**

$\frac{12}{90} = \frac{1}{9}$

*oe*

*0.13... or 13.(...)%*

**A1**

**Alternative method 2**

4 × 3 or 12
or 10 × 9 or 90

**M1**

4 × 3 or 12
and 10 × 9 or 90

**M1dep**

$\frac{12}{90} = \frac{1}{9}$

*oe*

*0.13... or 13.(...)%*

**A1**

**Q33.**

$\frac{9}{27}$ or $\frac{18}{27}$ or fraction with denominator 22

*oe*

**M1**

$\frac{9}{27} \times \frac{8}{22}$ or $\frac{72}{594}$ or

$\frac{18}{27} \times \frac{7}{22}$ or $\frac{126}{594}$

*oe*

**M1**

their $\frac{72}{594}$ + their $\frac{126}{594}$ or $\frac{198}{594}$

*oe*

*dep on 2nd M1*

**M1dep**

Clear indication that $\frac{198}{594}$ and $\frac{9}{27}$ are equivalent fractions

**A1**

**[4]**

# GCSE: Speed-time graphs

**Q34.**

(a) 0.5 × 20 × 5 or 50
or
5 × 50 or 250
or
0.5 × 40 × 5 or 100
or
0.5 × 5 × (110 + 50)
*oe*
*Working may be on the diagram*
*e.g.1 Trapezium rule*
*e.g.2 Attempt to count squares and convert to a distance*
*For example*
*0.5 × 2 × 5 = 5 and their 5 × 10*

**M1**

0.5 × 20 × 5 + 5 × 50 + 0.5 × 40 × 5 = 400
or
50 + 250 + 100 = 400
or
0.5 × 5 × (110 + 50) = 400
*oe*

**A1**

(b) **Alternative method 1**

0.5 × 60 × 6 or 180
*oe*
*Distance for first 60 seconds*

**M1**

0.5 × 60 × 6 + 50 × 6 or 480
*oe*
*Distance for first 110 seconds*
*This mark implies the first M1*
*0.5 × (110 + 50) × 6 is M2*

**M1**

480 and Yes

**A1**

**Alternative method 2**

0.5 × 60 × 6 or 180

*oe*

*Distance for first 60 seconds*

**M1**

(400 − their 180) ÷ 6 or [36, 37]
or
(400 − their 180) ÷ 50 or 4.4
or
Correctly builds up to a distance ≥ 400

*Remaining distance ÷ speed → time*

*or*

*Remaining distance ÷ time → speed*

**M1**

[96, 97] and Yes
or
4.4 and Yes
or
Correct time for their build up and Yes

**A1**

**[5]**

**Q35.**

(a) Attempts to calculate an area

eg $\frac{1}{2}$ × 90 × 9.4

*Attempts to calculate average speeds over* ***equal*** *time intervals* ***and*** *divides by number of intervals (****and*** *multiplies by 120)*

**M1**

[545, 565]

*A1 [530, 580]*

**A2**

m(etres)

*Allow correct conversion to other units if supported by an area*
*eg 0.564 km after 564 calculated for area*

**B1**

(b) Tangent drawn at 70 seconds

**B1**

Attempt at $\frac{y_2 - y_1}{x_2 - x_1}$ for their tangent

*At least one of numerator or denominator correct*

**M1**

[0.06, 0.14]

**A1**

**[7]**

# AS level: Trigonometry

**Q36.**

**(a)**

| | | |
|---|---|---|
| $AC^2 = 12.8^2 + 7.5^2$ oe | **M1** | allow correct application of cosine rule or from finding relevant angle and using trig |
| $AC = 14.83543056..$ | **A1** | rot to 3 or more sf , or 15 |
| $\tan C = {}^{12.8}/_{7.5}$<br>or $C = 90 - \tan^{-1}({}^{7.5}/_{12.8})$ oe | **M1** | or $\sin C = {}^{12.8}/_{\text{their}14.8}$<br>or $\cos C = {}^{7.5}/_{\text{their}14.8}$ |
| 59.6 to 59.64 | **A1** | |
| $\frac{AD}{\sin(155 - \textit{their}59.6)} = \frac{\textit{their}14.8}{\sin 35}$ oe | **M1** | |
| 25.69 to 25.8 | **A1** | allow **B2** for $25.69 \leq AD < 25.8$ unsupported…..but **B0** for 25.8 unsupported |
| | **[6]** | |

**(b)**

| | | |
|---|---|---|
| area of $ABC = 48$ soi | **B1** | may be implied by correct final answer in range or by sight of ½ × 12.8 × 7.5 oe |
| ½×their 14.8…×their 25.7…×sin(their 59.6 – 10) | **M1** | may be implied by 144.8 to 146 |
| 192.8 to 194[$m^2$] | **A1** | |
| | **[3]** | |

**Q37.**

| | | |
|---|---|---|
| $\cos A = \frac{105^2 + 92^2 - 75^2}{2 \times 105 \times 92}$ oe | M1 | or $\cos B = \frac{75^2 + 92^2 - 105^2}{2 \times 75 \times 92}$ oe |
| 0.717598…soi | A1 | 0.2220289…soi |
| A = 44.14345…° soi<br>[0.770448553…] | A1 | B = 77.1717719……° soi<br>[1.346901422] |
| ½ × 92 × 105 × sin (*their* A) | M1 | or ½ × 75 × 92 × sin (*their* B) |
| 3360 or 3361 to 3365 | A1 | |
| | **[5]** | |

# AS level: Algebra and graphs

**Q38.**

| | | |
|---|---|---|
| $[r=]\sqrt{\frac{A}{\pi(x+y)}}$ or $[r=]\sqrt{\frac{A}{\pi x+\pi y}}$ as final answer | 2 | square root symbol must extend below fraction line; accept to power ½ with appropriate brackets<br><br>**M1** for a triple decker fraction or for $r^2=\frac{A}{\pi(x+y)}$ or for $[r=]\pm\sqrt{\frac{A}{\pi(x+y)}}$ or for their final answer for $r$ ft their $r^2$ |
| | **[2]** | |

**Q39.**

| | | |
|---|---|---|
| $y(x-2)=(x+3)$ | M1 | for multiplying by $x-2$; condone missing brackets |
| $xy-2y=x+3$ or ft [ft from earlier errors if of comparable difficulty – no ft if there are no $xy$ terms] | M1 | for expanding bracket and being at stage ready to collect $x$ terms |
| $xy-x=2y+3$ or ft | M1 | for collecting $x$ and 'other' terms on opposite sides of eqn |
| $[x=]\frac{2y+3}{y-1}$ o.e. or ft | M1 | for factorising and division |

**Q40.**

| | | |
|---|---|---|
| $y = 4x + 10$ | B3 | **M1** for $y = 4x + b$ oe<br><br>and **M1** for $y - 6 =$ their $a\,(x + 1)$ oe<br>or for $(-1, 6)$ subst in $y =$ (their $a)x + b$ oe<br><br>or **M1** for $y = ax + 10$ |
| $(0, 10)$ or ft | B1 | condone $y = 10$ isw |
| $(-10/4, 0)$ oe or ft | B1 | condone $x = -10/4$ isw |
| | [5] | |

**Q41.**

**(a)**

| | | |
|---|---|---|
| graph of shape with vertices at $(-2, -3)$, $(0, 0)$ and $(2, -4)$ | 2<br><br>[2] | M1 for 2 vertices correct |

**(b)**

| | | |
|---|---|---|
| graph of shape with vertices at $(1, -1)$, $(3, 2)$ and $(5, -2)$ | 2<br><br>[2] | M1 for 2 vertices correct or for shape with vertices at $(-5, -1)$, $(-3, 2)$ and $(-1, -2)$ |

**Q42.**

**(a)**

| | | |
|---|---|---|
| $(6, -1.5)$ oe | B2<br><br>[2] | B1 for each value; allow $x = 6$, $y = -1.5$ |

**(b)**

| | | |
|---|---|---|
| $(2, -3)$ | B2<br><br>[2] | B1 for each value; allow $x = 2$, $y = -3$ |

**Q43.**

| | | |
|---|---|---|
| $x + 3(5x - 2) = 8$ or $y = 5(8 - 3y) - 2$ | M1 | for subst to eliminate one variable; condone one error; |
| $16x = 14$ or $16y = 38$ | M1 | for collecting terms and simplifying; condoning one error ft |
| (7/8, 19/8) oe | A2<br>**[4]** | or $x = 14/16$, $y = 38/16$ oe isw<br>allow **A1** for each coordinate |

# AS level: Surds and indices

**Q44.**

**(a)**

| | | |
|---|---|---|
| 1 | 1<br>[1] | |

**(b)**

| | | |
|---|---|---|
| $\frac{3}{5}$ or 0.6 | 3<br><br><br><br><br>[3] | allow **B3** for ±0.6 oe;<br><br>**M1** for $\left(\frac{25}{9}\right)^{-\frac{1}{2}}=\left(\frac{9}{25}\right)^{\frac{1}{2}}$ soi or $\frac{1}{\left(\frac{25}{9}\right)^{\frac{1}{2}}}$<br><br>and **M1** for at least one of 3 and 5 found |

**Q45.**

(a)

| | | |
|---|---|---|
| $\frac{1}{9}$ | 2<br><br><br>[2] | isw conversion to decimal<br>M1 for 9 or for $3^{-2}$ or for $\frac{1}{3}$<br>Except M0 for 9 from 27/3 or $\sqrt[3]{27}$ |

(b)

| | | |
|---|---|---|
| $2a^2c^{-4}$ or $\frac{2a^2}{c^4}$ as final answer | 3<br><br><br><br>[3] | B1 for each element; must be multiplied<br><br>if B0, allow SC1 for $64a^6c^3$ obtained from numerator or for all elements correct but added |

**Q46.**

(a)

| | | |
|---|---|---|
| $-31+6\sqrt{5}$ | 3<br><br><br>[3] | **B2** for −31 or **B1** for 9 − 40 or **SC1** for 49<br>and **B1** for $6\sqrt{5}$<br><br>if 0, allow **M1** for three terms correct in $9-6\sqrt{5}+12\sqrt{5}-40$ |

(b)

| | | |
|---|---|---|
| $22\sqrt{2}$ | 2<br><br><br>[2] | **M1** for $\sqrt{72}=6\sqrt{2}$ soi or for $\frac{32}{\sqrt{2}}=16\sqrt{2}$<br>soi or for $\frac{12+32}{\sqrt{2}}$ oe |

**(3)**

# AS level: Inequalities

**Q47.**

| | | |
|---|---|---|
| $4x - 5 > 14x + 7$ | M1 | for correctly multiplying by 7 to eliminate the fraction, including expanding bracket if this step done first |
| $-12 > 10x$ or $-10x > 12$ or ft | M1 | for correctly collecting $x$ terms on one side and number terms on the other and simplifying |
| $x < -\frac{12}{10}$ or $-\frac{12}{10} > x$ oe isw or ft | M1 | ft their $ax$ [inequality] $b$, where $b \neq 0$ and $a \neq 0$ or $\pm 1$ |
| | [3] | |

**Q48**

| | | |
|---|---|---|
| $(3x + 1)(x + 3)$ | M1 | or $3(x + 1/3)(x + 3)$<br>or for $-1/3$ and $-3$ found as endpoints eg by use of formula |
| $x < -3$<br>[or]<br>$x > -1/3$ oe | A1<br>A1 | mark final answers;<br>allow only A1 for $-3 > x > -1/3$ oe as final answer or for $x \leq -3$ and $x \geq -1/3$<br>if M0, allow SC1 for sketch of parabola the right way up with their solns ft their endpoints |
| | [3] | |

# AS level: Quadratics and their graphs

**Q49.**

**(a)**

| | | |
|---|---|---|
| $(3x)^2 = h^2 + (2x+1)^2$ oe | B1 | for a correct Pythagoras statement for this triangle, in terms of $x$, with correct brackets |
| $9x^2 = h^2 + 4x^2 + 4x + 1$ and completion to given answer , $h^2 = 5x^2 - 4x - 1$ | B1 | for correct expansion, with brackets or correct signs; must complete to the given answer with no errors in any interim working<br><br>may follow $3x^2 = h^2 + (2x+1)^2$ oe for **B0 B1** |
| | [2] | |

**(b)**

| | | |
|---|---|---|
| $[0 =]\ 5x^2 - 4x - 8$ | B1 | for subst and correctly rearranging to zero |
| $\frac{4 \pm \sqrt{(-4)^2 - 4\times5\times-8}}{2\times5}$ or ft | M1 | for use of formula in their eqn rearranged to zero, condoning one error; ft only if their rearranged eqn is a 3-term quadratic; no ft from $5x^2 - 4x - 1$ [=0] |
| $\frac{4+\sqrt{176}}{10}$ or $\frac{2}{5} + \frac{\sqrt{44}}{5}$ oe | A1 | isw wrong simplification;<br><br>A0 if negative root also included |
| | [3] | |

**Q50.**

(a)

| | | |
|---|---|---|
| $\left(x - \frac{5}{2}\right)^2 - \frac{1}{4}$ oe | B3 | B1 for $a = 5/2$ oe<br>and M1 for $6 - $ *their* $a^2$ soi; |
| $\left(\frac{5}{2}, -\frac{1}{4}\right)$ oe or ft | B1 | accept $x = 2.5, y = -0.25$ oe |
| | [4] | |

(b)

| | | |
|---|---|---|
| (2, 0) and (3, 0) | B2 | B1 each<br>or B1 for both correct plus an extra<br>or M1 for $(x-2)(x-3)$ or correct use of formula or for $their\ a \pm \sqrt{their\ b}$ ft from (i) |
| (0, 6) | B1 | |
| graph of quadratic the correct way up and crossing both axes | B1 | ignore label of their tp;<br>condone stopping at $y$-axis |

**(4)**

**Q51.**

| | | |
|---|---|---|
| $3(x-2)^2 - 7$ isw or $a = 3, b = 2\ c = 7$ www | 4 | B1 each for $a = 3, b = 2$ oe<br>and B2 for $c = 7$ oe<br>or M1 for $[-]\frac{7}{3}$ or for $5 - their\ a(their\ b)^2$<br>or for $\frac{5}{3} - (their\ b)^2$ soi |
| $-7$ or ft | B1 | B0 for $(2, -7)$ |
| | [5] | |

**Q52.**

| | | |
|---|---|---|
| **(i)** $x = 4$<br>$(4, -3)$ | B1<br>B1<br>[2] | or $x = 4, y = -3$ |

**(ii)**

| | | |
|---|---|---|
| (0, 13) isw | 1 | or [when $x = 0$], $y = 13$ isw<br>0 for just (13, 0) or ($k$, 13) where $k \neq 0$ |
| [when $y = 0$, ] $(x-4)^2 = 3$ | M1 | or $x^2 - 8x + 13$ [= 0] |
| $[x =]4 \pm \sqrt{3}$ or $\frac{8 \pm \sqrt{12}}{2}$ isw | A2 | need not go on to give coordinate form<br>A1 for one root correct |
| | [4] | |

**(iii)**

| | | |
|---|---|---|
| replacement of $x$ in their eqn by $(x-2)$ | M1 | may be simplified; eg $[y =] (x-6)^2 - 3$<br>or allow M1 for $(x - 6 - \sqrt{3})(x - 6 + \sqrt{3})$ [=0 or $y$] |
| completion to given answer $y = x^2 - 12x + 33$, showing at least one correct interim step | A1 | cao; condone using f($x-2$) in place of $y$ |
| | [2] | |

**Q53.**

**(i)**

| | | |
|---|---|---|
| graph of cubic correct way up | B1 | B0 if stops at $x$-axis |
| crossing $x$-axis at −3, 2 and 5 | B1 | on graph or nearby; may be in coordinate form<br>mark intent for intersections with both axes |
| crossing $y$-axis at 30 | B1 | or $x = 0$, $y = 30$ seen if consistent with graph drawn |
| | [3] | |

**(ii)**

| | | |
|---|---|---|
| correct expansion of two of the linear factors | M1 | may be 3 or 4 terms |
| correct expansion and completion to given answer, $x^3 - 4x^2 - 11x + 30$ | A1 | must be working for this step before given answer |
| | [2] | |

**(iii)**

| | | |
|---|---|---|
| translation | B1 | 0 for shift or move etc without stating translation |
| $\begin{pmatrix} 0 \\ -36 \end{pmatrix}$ | B1 | or 36 down, or $-36$ in $y$ direction oe |
| | [2] | |

# AS level: Proof

**Q54.**

| | | |
|---|---|---|
| $n(n+1)(n+2)$ | **M1** | condone division by $n$ and then $(n+1)(n+2)$ seen, or separate factors shown after factor theorem used; |
| argument from general consecutive numbers leading to: | | |
| at least one must be even | **A1** | or divisible by 2; |
| [exactly] one must be multiple of 3 | **A1** | if M0:<br>allow **SC1** for showing given expression always even |

**Q55.**

**(i)**

| | | |
|---|---|---|
| $3n$ isw | | 1<br>**[1]** |

**(ii)**

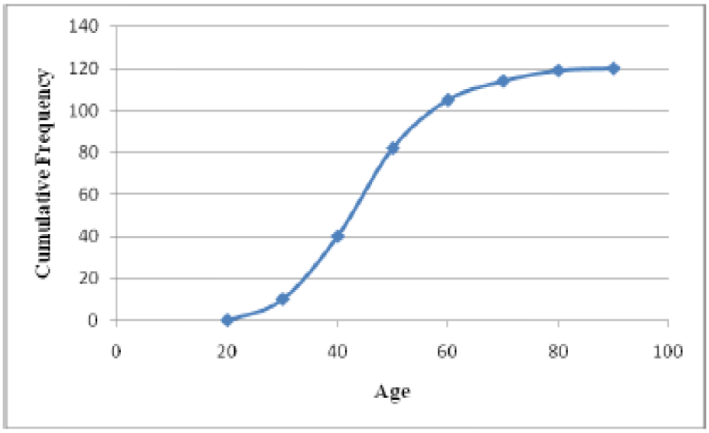
| | | |
|---|---|---|
| at least one of $(n-1)^2$ and $(n+1)^2$ correctly expanded | M1 | must be seen |
| $3n^2+2$ | B1 | |
| comment eg $3n^2$ is always a multiple of 3 so remainder after dividing by 3 is always 2 | B1 | dep on previous B1<br>B0 for just saying that 2 is not divisible by 3 – must comment on $3n^2$ term as well<br>allow B1 for $\frac{3n^2+2}{3} = n^2 + \frac{2}{3}$ |
| | **[3]** | |

# AS level: Statistics and probability

**Q56.**

**(i)**

| Upper Bound | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
|---|---|---|---|---|---|---|---|---|
| Cumulative Freq | 0 | 10 | 40 | 82 | 105 | 114 | 119 | 120 |




| | |
|---|---|
| B1 | Cumulative frequencies All correct |
| G1 | For plotted points (Provided plotted at correct UCB positions) |
| G1 | For joining points (within ½ a square) |
| G1 | For scales |
| G1 | For labels |
| | All marks dep on good attempt at cumulative frequency, but not cumulative fx's or other spurious values. |
| [5] | |

**(ii)**

Median = 45

| | |
|---|---|
| B1 | Allow answers between 44 and 46 without checking curve. Otherwise check curve. No marks if not using diagram. |

Q1 = 37 Q3 = 53

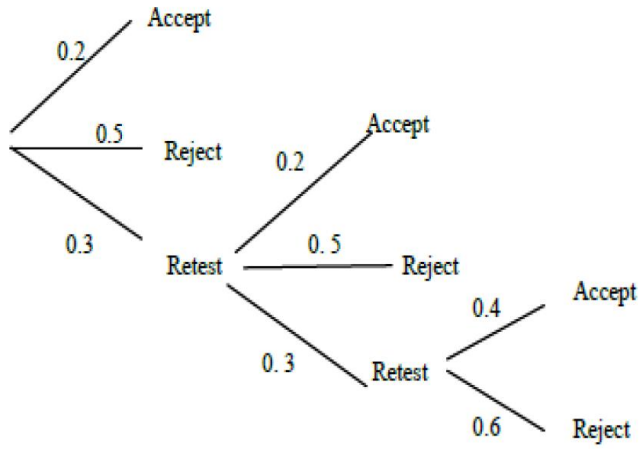
| | |
|---|---|
| B1 | For Q3 or Q1 Allow Q1 between 37 and 38 without checking Allow Q3 between 52 and 54 without checking |

Inter-quartile range = 53 – 37 = 16

| | |
|---|---|
| B1 | For IQR providing both Q1 and Q3 are correct |

**Q57.**

(i)




| | |
|---|---|
| | Do a vertical scan and give: |
| G1 | First column |
| G1 | Second column |
| | Final column |
| G1 | Do not award if first two branches missing<br>Branches two and three should come out of 'retest' |

(ii)

$$P(\text{Accepted}) = 0.2 + (0.3 \times 0.2) + (0.3 \times 0.3 \times 0.4)$$

$$= 0.2 + 0.06 + 0.036 = 0.296$$

| | |
|---|---|
| M1 | For second or third product |
| A1 | CAO |
| [2] | |

(iii)

$$P(\text{At least one retest given accepted}) = \frac{P(\text{At least one retest and accepted})}{P(\text{Accepted})}$$

$$= \frac{0.3 \times 0.2 + 0.3 \times 0.3 \times 0.4}{0.296} = \frac{0.096}{0.296}$$

$$= 0.324$$

| | |
|---|---|
| M1 | For numerator |
| M1 | For denominator |
| A1 | FT their 0.296 and 0.096<br>Allow 0.32 with working |
| [3] | |

**Q58.**

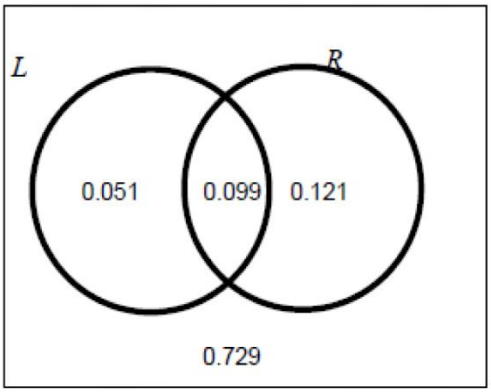
(i)

| | | |
|---|---|---|
| Because $P(L \mid R) \neq P(L)$ | E1<br><br>[1] | If two or more methods given and only one correct, do not award the mark<br><br>Allow $0.45 \neq 0.15$ |

(ii)

| | | |
|---|---|---|
| $P(L \cap R) = P(L \mid R) \times P(R) = 0.45 \times 0.22$<br>$= 0.099$ | M1<br>A1<br>[2] | For product<br>CAO |

(iii)




| | |
|---|---|
| G1 | For two labelled intersecting circles, provided no incorrect labelling. |
| G1 | For at least 2 correct probabilities.<br>FT their $P(L \cap R)$ from part (ii) provided $\leq 0.15$ |
| G1 | For remaining probabilities.<br>FT their $P(L \cap R)$ providing probabilities between 0 and 1. |
| [3] | |

**Q59.**

(i)

| | | | |
|---|---|---|---|
| (A) | P(Watched cyc but not fb) $= \frac{15}{250} = \frac{3}{50} = 0.06$ | B1<br>[1] | CAO (aef) |
| (B) | P(Watched one or two) $= \frac{33+12+21+14+3+65}{250}$ | M1 | OR: $\frac{250-(64+38)}{250} =$ |
| | $= \frac{148}{250} = \frac{74}{125} = 0.592$ | A1<br>[2] | CAO (aef) |

(ii)

| | | |
|---|---|---|
| P(Not watched fb\|watched cyc) $= \frac{15}{67} = 0.224$ $(0.223880597\ldots)$ | M1<br><br>A1<br>[2] | <br><br>CAO (aef) |

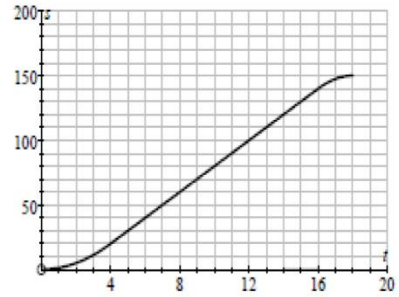
# AS level: Kinematic graphs

**Q60.**

**(i)**

| | | |
|---|---|---|
| When $t=4$, $s=\frac{1}{2}\times 4\times 10$ | | Finding the area of the triangle or equivalent. |
| $s=20$ | B1 | |
| When $t=18$, $s=\frac{1}{2}\times(18+12)\times 10$ | M1 | A complete method of finding the area of the trapezium or equivalent. |
| $s=150$ | A1 | CAO |
| | [3] | |

**(ii)**




| | | |
|---|---|---|
| Graph joining (0,0), (4,20) and (18, 150) | B1 | Allow FT for their (4,20) and (18, 150)<br>Condone extension to (20, 150) with a horizontal line. |
| The graph goes through (16, 140) | B1 | |
| | | Allow SC1 for the first two marks if there is a consistent displacement from a correct scale, eg plotting (18,150) at (19, 150) |
| Curves at both ends | B1 | The sections from $t=0$ to $t=4$ and from $t=16$ to $t=18$ are both curves |
| | [3] | |