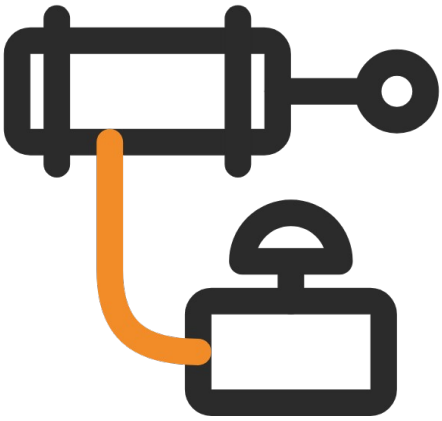
Lesson Pn7 Review Questions

Force, Pressure and Area



Answer every question in your jotter. Show your working. Tap a question below to go to it. Tap **Show answer** under a question to mark it.

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Questions

2014 Section 2 Question 12 (c)

1. The piston in cylinder (1) has a diameter of 20 mm and is supplied with air at a pressure of $2\,N\,mm^{-2}$.

Calculate the outstroking force of the cylinder.

Show all working and final unit. **3**

Show answer ›

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2. Cylinder (B) requires an outstroking force of 18 N.

Calculate the air pressure required if the diameter of the piston is 12 mm.

Show answer ›

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3. Air at a pressure of 0.32 N mm^{-2} is supplied to cylinder Ⓑ. This results in an outstroking force of 620 N.

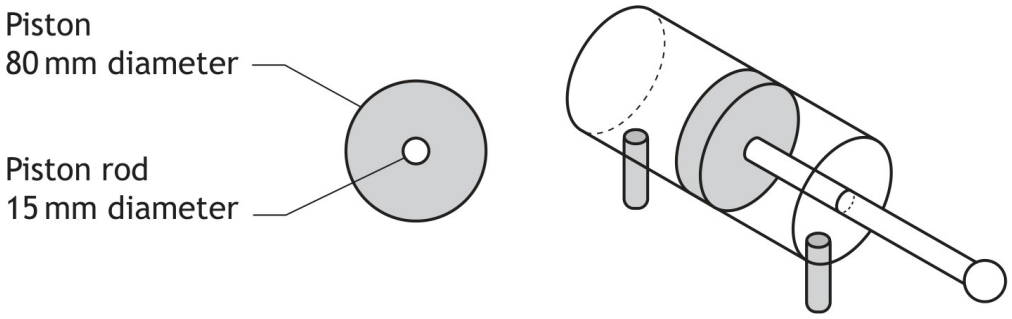
(i) Calculate the area of the piston.

(ii) Calculate the **diameter** of the piston.

Show answer ›

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4. The pneumatic cylinder used is shown in the diagram below.



Calculate the air pressure required to produce an **instroking** force of 1460 N. **4**

Show all working and final unit.

Show answer ›

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5. Cylinder (A) is supplied with an air pressure of 1.4 N mm^{-2} and the piston has an outstroking force of 490 N.

(a) Calculate the area of the piston in cylinder (A). **3**

An engineer compared the size of the outstroke force and the instroke force of a double-acting cylinder when supplied with the **same** air pressure.

The result of the test showed that there was a difference in the size of the two forces.

(b) Explain the difference in the size of these two forces. **2**

Show answer ›

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Answers

Check your understanding (booklet)

1 F = P × A. F in N, P in N mm^{-2}, A in mm^2.

2 r = 10 mm. $A = \pi r^2 = \pi \times 10^2 = 314\ mm^2$

3 F = P × A = 0.4 × 500 = 200 N

4 Piston area minus rod area.

5 The rod takes up part of the piston, so the area is smaller (cause). With the same pressure, the force is smaller (effect).

Answer to question 1

2014 Section 2 Question 12 (c)

Marking instructions

Question			Expected Answer(s)	Max Mark	Additional Guidance
	(c)		$A = \Pi r^2$ $= 3{\cdot}14 \times 10 \times 10$ $= 314 mm^2$ $P = \frac{F}{A}$ $F = PA$ $= 2 \times 314$ $= 628 N$	3	Calculation of area (no units) - 1 Substitution with area value **calculated** above (FTE) - 1 Answer from given working with unit - 1

‹ Back to question 1

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Answer to question 2

2024 Section 2 Question 15 (b)

Marking instructions

Question			Expected response	Max mark	Additional guidance
15.	(b)		$A = \frac{\pi d^2}{4}$ $A = \frac{\pi 12^2}{4}$ A = 113.0973355 (mm^2) (36π) $P = \frac{F}{A}$ $P = \frac{18\ N}{113.0973355}$ P = 0.1591549431 **P = 0.16 Nmm^{-2} (2 sf)**	3	1 mark for area (unit not required) Accept 36π. 1 mark for substitution (apply FTE from area). Accept use of diameter (12 mm) for substitution if area not calculated. 1 mark for correct answer from given working with unit.

‹ Back to question 2

Answer to question 3

2023 Section 2 Question 9 (b)(i), (b)(ii)

Marking instructions

Question			Expected response	Max mark	Additional guidance
	(b)	(i)	$P = \frac{F}{A}$ $0.32 = \frac{620}{A}$ $A = \frac{620}{0.32}$ A = 1937.5 A = **1900 mm^2 (2 sf)**	3	1 mark for substitution. 1 mark for transposition. 1 mark for correct answer from given working with unit.

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Question			Expected response	Max mark	Additional guidance
9.	(b)	(ii)	$A = \frac{\pi d^2}{4}$ $1900 = \frac{\pi d^2}{4}$ $d = \sqrt{\frac{1900 \times 4}{\pi}}$ d = 49.1849 d = **49 mm (2 sf)**	**3**	1 mark for substitution. Allow FTE from (b)(i). 1 mark for transposition. 1 mark for correct answer from given working with unit. If radius is given as the final answer then max 2 marks.

‹ Back to question 3

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Answer to question 4

2015 Section 2 Question 14 (b)

Marking instructions

Question			Expected Answer(s)	Max Mark	Additional Guidance
	(b)		$A_{rod} = \frac{\pi d^2}{4}$ $= \frac{3{\cdot}14 \times 15^2}{4} = 176.6\ (mm^2)$ A_{piston} $= \frac{3 \cdot 14 \times 80^2}{4} = 5024\ (mm^2)$ (1 mark for correct calculation of either area - ignore units) $A_{effective} = A_{piston} - A_{rod}$ = 5024 - 176·6 = **4847·4** mm^2 (1 mark for correct answer from given working - ignore units) P = F/A = 1460/4847·4 (1 mark for substitution) = 0·3Nmm^{-2} (0.3 MPa) (1 mark for correct answer from given working with unit)	4	

‹ Back to question 4

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Answer to question 5

2022 Section 2 Question 15 (c), (d)

Marking instructions

Question			Expected response	Max mark	Additional guidance
	(c)		$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$ $1.4 = \frac{490}{\text{Area}}$ $A = \frac{490}{1.4}$ A = **350 mm^2 (2 sf)**	**3**	1 mark for substitution. 1 mark for transposition. 1 mark for correct answer from given working with unit.

Question			Expected response	Max mark	Additional guidance
15.	(d)		The area on the instroke is smaller (due to the piston rod), …resulting in the instroking force being smaller The area on the outstroke is larger (due to no piston rod), …resulting in the outstroking force being larger The two areas are different … therefore the outstroke force is larger	**2**	1 mark for cause (difference in area – stated or inferred). 1 mark for effect (specific effect on difference in force in/outstroke). Do not accept size in place of area. Do not accept forces will be different. Allow FTE.

‹ Back to question 5

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