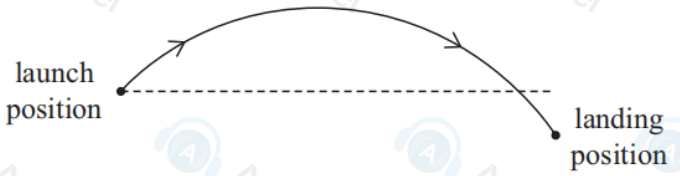
6 The path of a projectile is shown.



The projectile landed at a height lower than the height from which it was launched.

Assuming there is no air resistance acting on the projectile, which of the following is a correct statement?

A At the maximum height, the horizontal velocity is a minimum.

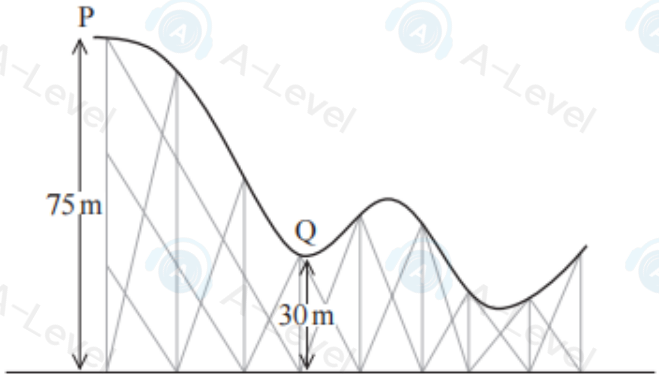
B At the maximum height, the vertical velocity is a maximum.

C The initial horizontal velocity is equal to the final horizontal velocity.

D The initial vertical velocity is equal to the final vertical velocity.

(Total for Question 6 = 1 mark)

3 The diagram shows a roller coaster. A roller coaster car stops momentarily at P before descending towards Q.



Which of the following expressions could be used to determine the velocity of the roller coaster car at Q?

☐ **A** $\sqrt{75g} - \sqrt{30g}$

☐ **B** $\sqrt{150g} - \sqrt{60g}$

☐ **C** $\sqrt{45g}$

☐ **D** $\sqrt{90g}$

(Total for Question 3 = 1 mark)

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3 A ball of mass 0.040 kg is dropped from a height of 1.5 m.

What is the kinetic energy of the ball just before it hits the ground?

☒ **A** 0.045 J

☒ **B** 0.060 J

☒ **C** 0.39 J

☒ **D** 0.59 J

(Total for Question 3 = 1 mark)

1 Which of the following units is equivalent to the watt?

☒ **A** N m

☒ **B** $N m^{-1}$

☒ **C** J s

☒ **D** $J s^{-1}$

(Total for Question 1 = 1 mark)

6 A person stands on a moving staircase.

The moving staircase increases the gravitational potential energy of the person by 5000 J in a time of 42 s.

The efficiency of the moving staircase is 0.63

Which of the following expressions gives the power input to the moving staircase in watts?

☒ **A** $\frac{42}{5000 \times 0.63}$

☒ **B** $\frac{42 \times 0.63}{5000}$

☒ **C** $\frac{5000}{42 \times 0.63}$

☒ **D** $\frac{5000 \times 0.63}{42}$

(Total for Question 6 = 1 mark)

1 An engine is used to remove water from a mine. The engine transfers energy to the water at a rate of 180 kW and wastes energy at a rate of 60 kW.

Which of the following expressions gives the efficiency of the engine?

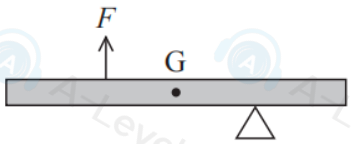
- ☒ **A** $\frac{180}{240}$
- ☒ **B** $\frac{60}{240}$
- ☒ **C** $\frac{60}{180}$
- ☒ **D** $\frac{180}{300}$

(Total for Question 1 = 1 mark)

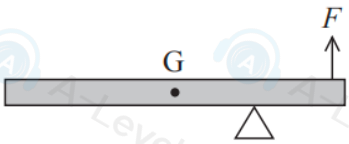
5 A beam is supported by a pivot as shown in the diagrams. The centre of gravity of the beam is at G. The beam is acted on by a force *F*.

Which diagram shows an arrangement where the beam could **not** be in equilibrium?

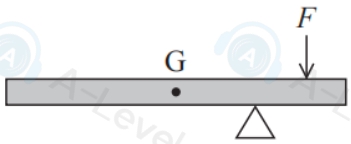
A



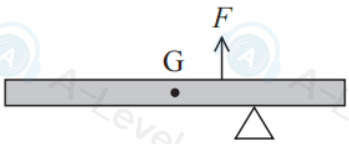
B



C



D



- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 5 = 1 mark)

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2 A lamp has a constant power input and a constant efficiency.

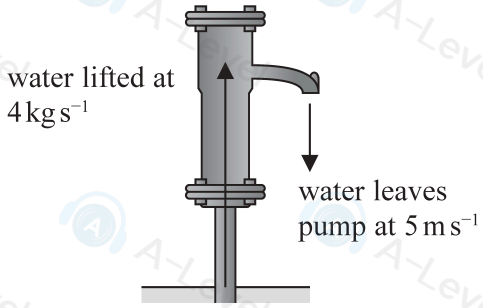
Which row of the table describes how the useful power output and total energy output vary with time?

	Useful power output	Total energy output
☒ **A**	constant	constant
☒ **B**	constant	increases
☒ **C**	increases	constant
☒ **D**	increases	increases

(Total for Question 2 = 1 mark)

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8 An electric pump lifts water from a well through a height of 10 m at a rate of $4\,kg\,s^{-1}$. The water leaves the pump with a velocity of $5\,m\,s^{-1}$ as shown.



Which of the following expressions could be used to determine the minimum power output of the pump in watts?

☒ **A** $\frac{1}{2}(4 \times 5^2)$

☒ **B** $(4 \times 9.81 \times 10)$

☒ **C** $(4 \times 9.81 \times 10) + \frac{1}{2}(4 \times 5^2)$

☒ **D** $(4 \times 9.81 \times 10) - \frac{1}{2}(4 \times 5^2)$

(Total for Question 8 = 1 mark)

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2 An object of mass 8.2 kg, initially at rest, falls a vertical distance of 25 m through the air and has a final velocity of 20 m s^{-1}.

Which of the following gives the energy in joules dissipated by air resistance?

☒ **A** $8.2 \times 9.81 \times 25$

☒ **B** $0.5 \times 8.2 \times 20^2 + 8.2 \times 9.81 \times 25$

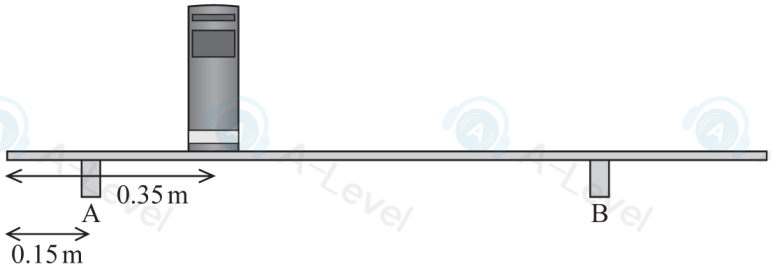
☒ **C** $8.2 \times 9.81 \times 25 - 0.5 \times 8.2 \times 20^2$

☒ **D** $0.5 \times 8.2 \times 20^2 - 8.2 \times 9.81 \times 25$

(Total for Question 2 = 1 mark)

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13 Two brackets, A and B, support a shelf of length 1.2 m. Bracket A is positioned 0.15 m from the left-hand end of the shelf. A book is placed 0.35 m from the left-hand end of the shelf as shown.



(a) The normal contact forces of each bracket on the shelf are equal.

Determine the distance of bracket B from the left-hand end of the shelf.

weight of book = 8.5 N
weight of shelf = 14 N

(5)

Distance = ...

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12 Treadmills may be used in a gym. To increase the difficulty of the training, the gradient of the treadmill can be increased.



(a) A person on a treadmill warms up by running at a constant speed of $2.5\,m\,s^{-1}$ with the treadmill horizontal. He then sets the treadmill to an angle of 3.0° to the horizontal and continues to run at the same speed.

Calculate the additional power that his legs would have to supply when running for 10 minutes with the treadmill at this angle.

(4)

mass of athlete = 80.0 kg

Additional power = ...

(b) Suggest why running on a treadmill is easier than running on a running track.

(1)

(Total for Question 12 = 5 marks)

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