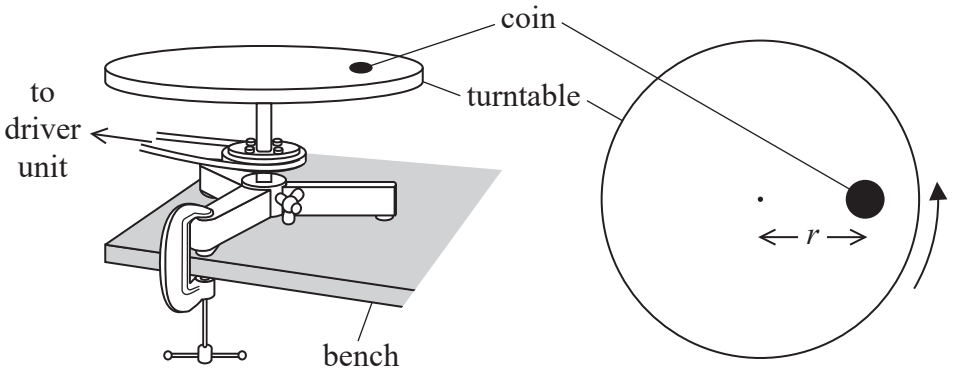
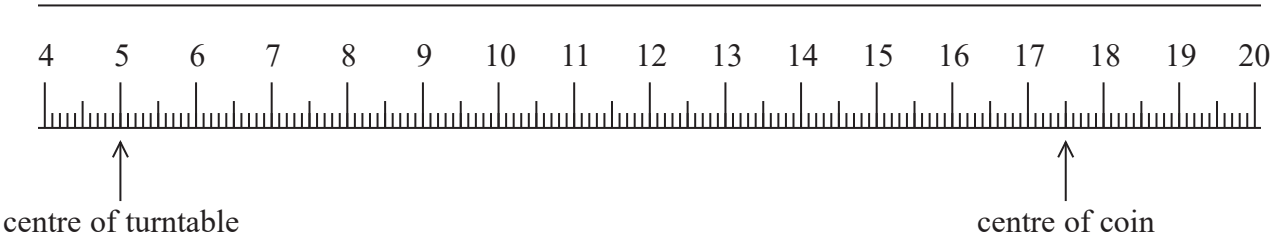
3 A student was investigating the forces involved in circular motion.

He placed a small coin on a horizontal turntable as shown. The turntable was connected to a driver unit so that it could be rotated at a constant rate.



(a) The student measured the distance r between the centre of the turntable and the centre of the coin, with a metre rule as shown.



Explain why the percentage uncertainty in the value of r is about 1%.
Your answer should include a calculation.

(3)

(b) The student switched on the driver unit and increased the rate of rotation until the coin slid off the turntable. He read the angular velocity ω of the turntable from a digital display on the driver unit. He then replaced the coin in the original position on the turntable and repeated the procedure.

His results are shown.

ω / rad s^{-1}				
0.125	0.112	0.118	0.123	0.116

(i) The student used the results to calculate a mean value of ω.

State the purpose of calculating a mean.

(1)

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(ii) Calculate the percentage uncertainty in the mean value of ω.

(3)

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Percentage uncertainty = ...

(iii) The student used ω and r to calculate the centripetal acceleration of the coin at the instant it started to slide.

Calculate the percentage uncertainty in this centripetal acceleration.

(3)

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Percentage uncertainty = ...

(c) The student repeated the procedure with different values of r.

Explain how the value of ω at which the coin started to slide varied as r increased.

(3)

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(Total for Question 3 = 13 marks)

8 In the sport of curling, two teams of 'curlers' take turns sliding polished granite stones across an ice surface towards a circular target marked on the ice.

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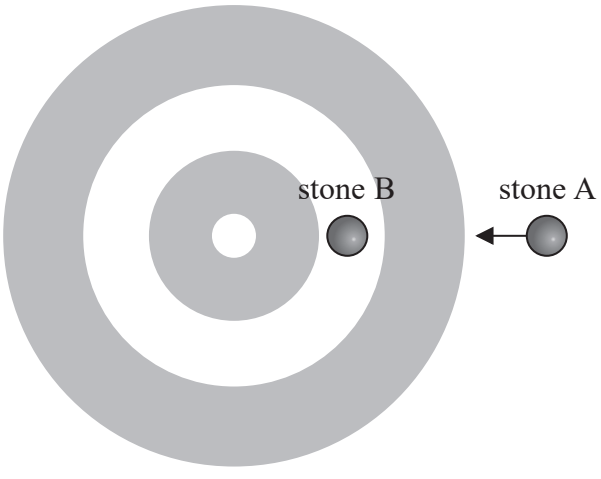
(a) A stone of mass 19.6 kg is accelerated uniformly for 1.25 s before being released by a curler. The stone then decelerates uniformly to rest, travelling 32.5 m in a time of 17.5 s.

Calculate the average useful power developed by the curler in accelerating the stone.

(4)

Average power = ...

*(b) Stone B is stationary. Stone A travels towards the target and makes a direct hit on stone B as shown. Both stones have mass *m*.



The collision is elastic. Just before the collision stone A has a velocity v. After the collision stone B moves off with velocity v.

Discuss how the relevant conservation laws apply to this collision.

(6)

(c) While a stone is moving towards the target, the curlers vigorously sweep the ice directly in front of the stone.

Explain why this may make the stone travel further.

(2)

(Total for Question 8 = 12 marks)