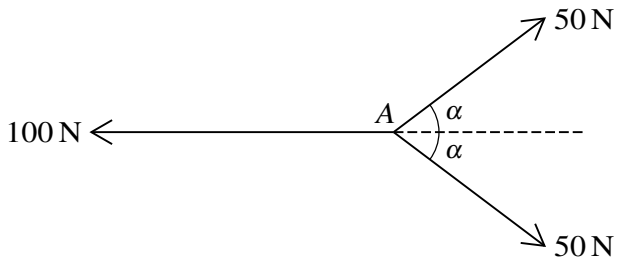
A LEVEL Cambridge Topical Past Papers

PURE MATHEMATICS P4

MECHANICS

2020 — 2025

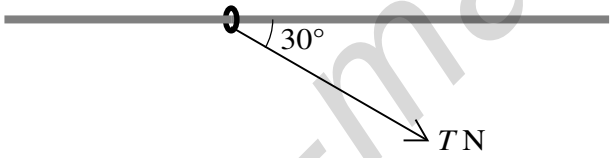
1 - (9709/41_Summer_2020_Q1) ANSWER



Three coplanar forces of magnitudes 100 N, 50 N and 50 N act at a point A, as shown in the diagram. The value of $\cos\alpha$ is $\frac{4}{5}$.

Find the magnitude of the resultant of the three forces and state its direction. [3]

2 - (9709/41_Summer_2020_Q4) ANSWER

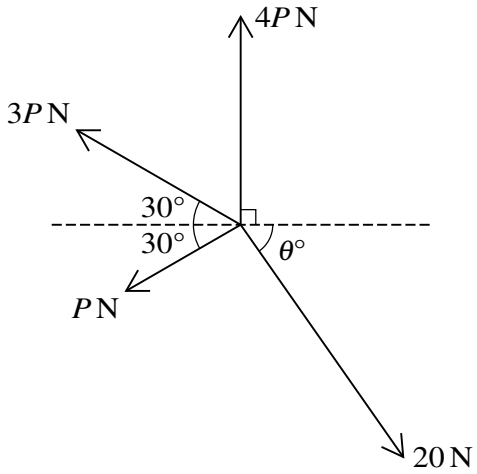


The diagram shows a ring of mass 0.1 kg threaded on a fixed horizontal rod. The rod is rough and the coefficient of friction between the ring and the rod is 0.8. A force of magnitude T N acts on the ring in a direction at 30° to the rod, downwards in the vertical plane containing the rod. Initially the ring is at rest.

(a) Find the greatest value of T for which the ring remains at rest. [4]

(b) Find the acceleration of the ring when $T = 3$. [3]

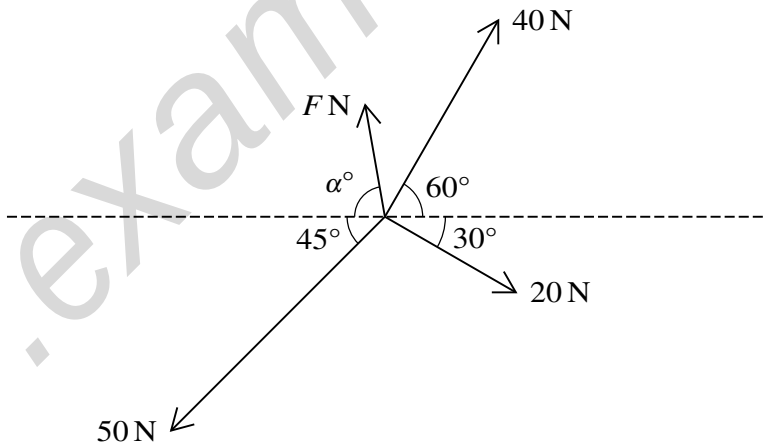
3 - (9709/42_Summer_2020_Q2) ANSWER



Coplanar forces of magnitudes 20 N, P N, $3P$ N and $4P$ N act at a point in the directions shown in the diagram. The system is in equilibrium.

Find P and θ. [6]

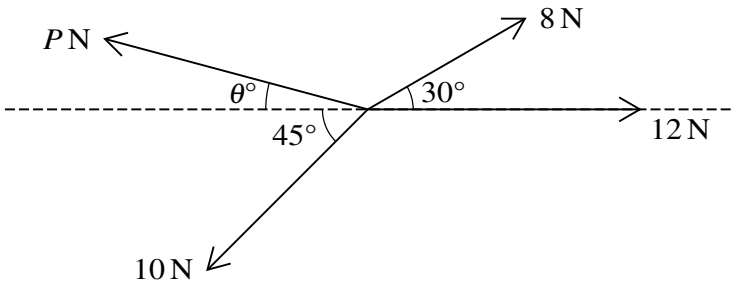
4 - (9709/43_Summer_2020_Q3) ANSWER



Four coplanar forces of magnitudes 40 N, 20 N, 50 N and F N act at a point in the directions shown in the diagram. The four forces are in equilibrium.

Find F and α. [6]

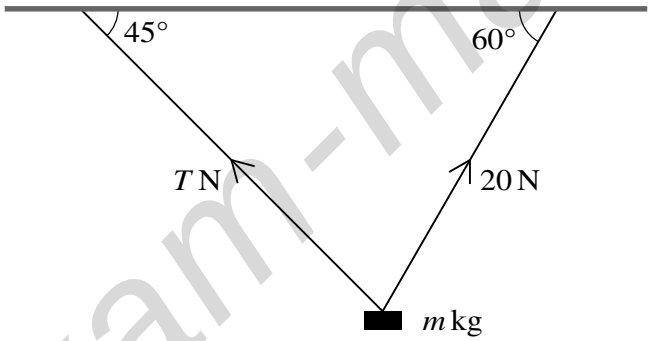
5 - (9709/41_Winter_2020_Q3) ANSWER



Coplanar forces of magnitudes 8 N, 12 N, 10 N and P N act at a point in the directions shown in the diagram. The system is in equilibrium.

Find P and θ. [6]

6 - (9709/42_Winter_2020_Q3) ANSWER



A block of mass m kg is held in equilibrium below a horizontal ceiling by two strings, as shown in the diagram. One of the strings is inclined at 45° to the horizontal and the tension in this string is T N. The other string is inclined at 60° to the horizontal and the tension in this string is 20 N.

Find T and m. [5]

1 - (9709/41_Summer_2020_Q1) QUESTION

	Resultant = $100 - 2 \times 50\cos\alpha$	**M1**
	20 N	**A1**
	Direction is to the left (or equivalent)	**B1**
		3

2 - (9709/41_Summer_2020_Q4) QUESTION

(a)	Resolving forces in either direction	**M1**
	$R = T\sin30 + 0.1g$, $F = T\cos30$	**A1**
	$T\cos30 = 0.8\,(T\sin30 + 0.1g)$	**M1**
	$T = 1.72$ (1.7166...)	**A1**
		4
(b)	$R = 3\sin30 + 0.1g$	**B1**
	$3\cos30 - 0.8(3\sin30 + 0.1g) = 0.1a$	**M1**
	$a = 5.98$ ms^{-2} (5.9807...)	**A1**
		3

3 - (9709/42_Summer_2020_Q2) QUESTION

	Resolving forces in either direction	**M1**
	$20\cos\theta = 4P\cos 30$	**A1**
	$4P + 2P\sin 30 = 20\sin\theta$	**A1**
	$\cos\theta = \frac{\sqrt{3}}{10}P$ $\sin\theta = \frac{P}{4}$ $\frac{3}{100}P^2 + \frac{1}{16}P^2 = 1$	**M1**
	$P = 3.29$	**A1**
	$\theta = 55.3$	**A1**
		6

4 - (9709/43_Summer_2020_Q3) QUESTION

	Attempt to resolve, either direction with correct number of terms	**M1**
	$F\cos\alpha = 40\sin30 + 20\sin60 - 50\sin45$ (= 1.965...)	**A1**
	$F\sin\alpha = 50\cos45 + 20\cos60 - 40\cos30$ (= 10.714...)	**A1**
	Method for either F or α	**M1**
	$F \quad \sqrt{\left((1.965...)^2 + (10.714...)^2\right)} \quad 10.9(10.893)$	**A1**
	$\alpha = \tan^{-1}(10.714... / 1.965...) = 79.6$ (79.606...)	**A1**
		6

5 - (9709/41_Winter_2020_Q3) QUESTION

	Resolve forces either horizontally or vertically	**M1**	Correct number of relevant terms
	$P\cos\theta = 12 + 8\cos30 - 10\cos45$ [= 11.857]	**A1**	
	$P\sin\theta = 10\sin45 - 8\sin30$ [= 3.071]	**A1**	
	$P = \sqrt{\left(11.857^2 + 3.071^2\right)}$	**M1**	OE. Use of correct method for finding P
	$\theta = \tan^{-1}\left(\frac{3.071}{11.857}\right)$	**M1**	OE. Use of correct method for finding θ
	P = 12.2 and θ = 14.5	**A1**	Both correct
		6	