Forces - 2018

1. 9702/11/M/J/18/No.10
A horizontal metal bar PQ of length 50.0 cm is hinged at end P. The diagram shows the metal bar viewed from above.

Two forces of 16.0 N and 5.0 N are in the horizontal plane and act on end Q as shown in the diagram.

What is the total moment about P due to the two forces?

A 1.5 Nm  B 4.4 Nm  C 6.5 Nm  D 9.4 Nm

2. 9702/11/M/J/18/No.12
Two parallel forces, each of magnitude $F$, act on a rod of length $5d$.

Which diagram shows the positions of the two forces that will produce the largest torque on the rod?

A  

B  

C  

D  

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3. 9702/12/M/J/18/No.11
An astronaut throws a stone horizontally near to the surface of the Moon, where there is no atmosphere.

Which row describes the horizontal and vertical forces acting on the stone after release?

<table>
<thead>
<tr>
<th></th>
<th>horizontal force</th>
<th>vertical force</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>non-zero and constant</td>
<td>constant</td>
</tr>
<tr>
<td>B</td>
<td>non-zero and constant</td>
<td>decreasing</td>
</tr>
<tr>
<td>C</td>
<td>zero</td>
<td>constant</td>
</tr>
<tr>
<td>D</td>
<td>zero</td>
<td>decreasing</td>
</tr>
</tbody>
</table>

4. 9702/12/M/J/18/No.13
A uniform diving-board is held by two fixed rods at points P and Q. A person stands at end R of the diving-board, as shown.

![Diagram of a diving-board with forces on P and Q]

The forces exerted by the rods on the board are vertical. The board remains in equilibrium as the person slowly moves towards point Q from end R.

Which row describes the changes to the forces exerted by the rods on the board?

<table>
<thead>
<tr>
<th></th>
<th>force at P</th>
<th>force at Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>decreases</td>
<td>decreases</td>
</tr>
<tr>
<td>B</td>
<td>decreases</td>
<td>increases</td>
</tr>
<tr>
<td>C</td>
<td>increases</td>
<td>decreases</td>
</tr>
<tr>
<td>D</td>
<td>increases</td>
<td>increases</td>
</tr>
</tbody>
</table>
5. Two forces, each of magnitude $F$, act in opposite directions on a rod.

Each force acts on the rod at a distance $d$ from the pivot $P$.

What is the torque of this couple about $P$?

A 0  
B $F \times d$  
C $2F \times d$  
D $2F \times 2d$

6. The vector diagram shows three coplanar forces acting on an object at $P$.

The magnitude of the resultant of these three forces is 1 N.

What is the direction of this resultant force?

A  
B  
C  
D
7. 9702/12/M/J/18/No.17

The diagram shows a ball of weight \( W \) hanging in equilibrium from a string.

![Diagram of a ball hanging from a string](image)

The string is at an angle \( \theta \) to the vertical. The tension in the string is \( T \). The ball is held away from the wall by a horizontal force \( P \) from a metal rod.

What is the relationship between the magnitudes of \( T \), \( P \) and \( W \)?

A. \( P = T \cos \theta \) and \( W = T \sin \theta \)
B. \( T = P + W \)
C. \( T^2 = P^2 + W^2 \)
D. \( W = P \tan \theta \) and \( W = T \cos \theta \)

8. 9702/13/M/J/18/No.12

Which diagram shows a couple formed by two forces, each of magnitude \( F \), acting on a rod?

A. ![Diagram A](image)
B. ![Diagram B](image)
C. ![Diagram C](image)
D. ![Diagram D](image)
9. 9702/12/F/M/18/No.11  
The diagram shows four forces applied to a circular object.

Which row describes the resultant force and resultant torque on the object?

<table>
<thead>
<tr>
<th></th>
<th>resultant force</th>
<th>resultant torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>non-zero</td>
<td>non-zero</td>
</tr>
<tr>
<td>B</td>
<td>non-zero</td>
<td>zero</td>
</tr>
<tr>
<td>C</td>
<td>zero</td>
<td>non-zero</td>
</tr>
<tr>
<td>D</td>
<td>zero</td>
<td>zero</td>
</tr>
</tbody>
</table>

10. 9702/12/F/M/18/No.13  
In which example is it **not** possible for the underlined body to be in equilibrium?

A. An **aeroplane** climbs at a steady rate.
B. An aeroplane tows a **glider** at a constant altitude.
C. A **speedboat** changes direction at a constant speed.
D. Two boats tow a **ship** into harbour.