1.9 Tropical Storms: Formation, Structure and Distribution: 30-minute Pack

AQA 8035 · Calculators not allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State the typical latitude band (in degrees north and south) where tropical storms most commonly form globally.

(Total for Question 1 is 1 mark)

2 Give TWO reasons why tropical storms tend not to form within about 5 degrees of the equator.

(Total for Question 2 is 2 marks)

3 Explain how tropical storms form, starting from a warm ocean surface and including the roles of sea surface temperature, low pressure, rising air, the Coriolis effect and wind shear. Use named processes and sequence your explanation clearly for the tropical storm formation context.

(Total for Question 3 is 6 marks)

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4 Suggest two practical actions coastal communities can take to reduce the risk from tropical storm impacts, and give a brief reason for each action in the tropical storm preparedness context.

(Total for Question 4 is 4 marks)

5 Explain why low vertical wind shear helps a tropical storm to intensify, in the oceanic formation context.

(Total for Question 5 is 3 marks)

6 Figure 1 shows a simplified global map of tropical storm tracks over a recent 10 year period. The data are: Atlantic basin: 120 storms between 10 and 30 degrees north, mostly curving north-eastward after westward motion; North Pacific: 160 storms between 5 and 25 degrees north, tracking west then recurving poleward; South Pacific/Indian Ocean: 90 storms between 5 and 25 degrees south, moving westwards. Describe the global distribution of tropical storms shown in Figure 1.

(Total for Question 6 is 4 marks)

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7 A vertical cross section through the centre of a mature tropical storm shows three main features: a calm central area, a ring of very tall cloud surrounding it, and outer spiralling bands of cloud and rain. Name each of the three features and explain the role of the ring of very tall cloud.

(Total for Question 7 is 4 marks)

8 Explain how climate warming might change the intensity and distribution of tropical storms in future, using physical processes taught in the tropical storms topic.

(Total for Question 8 is 4 marks)

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Mark scheme · 1.9 Tropical Storms: Formation, Structure and Distribution: 30-minute Pack

Question 1

about 5 to 30 degrees north and south of the equator, oe **B1**

Answer: About 5 to 30 degrees north and south of the equator.

Question 2

the Coriolis effect is too weak near the equator to cause sufficient spin, oe **B1**

rising air near the equator tends to move vertically without producing the rotation needed, or other phrasing about lack of Coriolis force, oe **B1**

Answer: Because the Coriolis effect is too weak near the equator to provide the spin needed for cyclone rotation, and rising air there does not acquire sufficient rotation to form organised cyclonic circulation.

Question 3

Level 3 A clear, well-sequenced explanation that links warm sea surface temperatures and deep warm water to strong evaporation and rising moist air, describes development of a central low pressure and organised convection, explains how the Coriolis effect induces rotation, and shows why low wind shear is necessary for vertical alignment. The answer shows cause and effect throughout and reaches a coherent description of cyclone formation. **5-6**

Level 2 A reasonable explanation that covers most key processes, such as warm water causing evaporation and rising air, and mentions rotation by the Coriolis effect and low wind shear, but with less sequencing or weaker links between processes. **3-4**

Level 1 Limited factual points, for example naming one or two relevant factors (warm water, Coriolis) with little or no explanation of how they interact to form a tropical storm. **1-2**

Level 0 No relevant content. **0**

Indicative content:

- Warm sea surface temperatures of about 27°C or warmer, to a depth of around 60 to 70 metres, provide heat energy and moisture by evaporation.
- Warm, moist air rises from the ocean surface, creating an area of low surface pressure beneath.
- Rising air cools and condenses to form deep convection and thunderstorm clouds, releasing latent heat which warms the column of air and lowers pressure further, intensifying upward motion.
- The Coriolis effect causes the rising air to turn, producing organised rotation around the low pressure centre and preventing air flowing directly into the centre; this rotation is essential for cyclone development but is too weak very close to the equator.
- Low vertical wind shear allows the developing system to remain vertically aligned so the heat engine is maintained; strong shear would disrupt the structure and prevent intensification.
- Over time, the organised convection and rotation produce a warm-core, tightly organised system with spiral rainbands, an eyewall of strongest winds, and a relatively calm eye at the centre.

Question 4

action 1 named, e.g. building sea walls or flood defences, oe **B1**

reason for action 1, e.g. reduces damage from storm surge and coastal flooding, oe **B1**

action 2 named, e.g. early warning systems and evacuation planning, oe **B1**

reason for action 2, e.g. allows people to move to safety and reduces casualties, oe **B1**

Answer: Build sea walls or flood defences to reduce damage from storm surge and coastal flooding; implement robust early warning systems and evacuation plans so people can move to safety and casualties are minimised.

Question 5

low wind shear allows the storm to remain vertically aligned, oe **B1**

linked detail, e.g. vertical alignment keeps the rising warm, moist air above the surface heat source, allowing strong convection, oe **B1**

linked consequence, e.g. this strengthens the central low pressure and increases wind speeds, so the storm intensifies, oe **B1**

Answer: Low wind shear allows the storm to stay vertically aligned so rising warm moist air remains above the ocean heat source, sustaining strong convection; this strengthens the central low pressure and increases wind speeds, causing intensification.

Question 6

storms are concentrated between about 5 and 30 degrees north and south of the equator, oe **B1**

most tracks begin moving westward then often curve poleward or northeast/east as they move, oe **B1**

higher numbers in the North Pacific and Atlantic north of the equator compared with the southern hemisphere data given, oe **B1**

some basins show recurving tracks when storms move away from the equator, oe **B1**

Answer: Tropical storms are concentrated in bands roughly 5 to 30 degrees north and south of the equator. In the Atlantic and North Pacific they commonly move westward then curve poleward or northeast as they recurve; the North Pacific shows the highest total in the data given, while the South Pacific and Indian Ocean tracks are mainly in the southern band and move westward.

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Question 7

names the calm central area as the eye, oe	**B1**
names the ring of very tall cloud as the eyewall, oe	**B1**
names the outer bands as spiral rainbands or outer rainbands, oe	**B1**
explains the role of the eyewall, e.g. location of the strongest winds and heaviest convection/rainfall that drives the storm, oe	**B1**

Answer: Features: the eye (the calm centre), the eyewall (the ring of very tall cloud around it) and spiral rainbands (the outer bands of cloud and rain). The eyewall is the ring of strongest winds and most intense convection and heavy rain surrounding the eye; it is the main engine of the storm and produces the highest wind speeds and most destructive conditions.

Question 8

warmer sea surface temperatures can provide more heat energy and moisture, allowing storms to become more intense, oe	**B1**
linked detail, e.g. higher ocean heat content can increase the potential for higher wind speeds and heavier rainfall in storms, oe	**B1**
distribution change, e.g. storms may form or move into higher latitudes as warmer waters extend poleward, oe	**B1**
linked consequence, e.g. regions not previously exposed to frequent intense storms may face increased risk, oe	**B1**

Answer: Climate warming raises sea surface temperatures and ocean heat content, giving storms more heat energy and moisture so they can become more intense with stronger winds and heavier rainfall. Warmer waters may extend poleward, allowing storms to form or track into higher latitudes and exposing new regions to risk.

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