03/09/2019



THE KING'S SCHOOL

2019 Higher School Certificate Year 11 Examination

Earth & Environmental Science

General Instructions

- Reading time 5 minutes
- Working time 2 hours
- Write using **black** pen NO red pen
- Draw diagrams using pencil
- Write your student number where marked
- Show all relevant working in questions involving calculations
- NESA-approved calculators may be used
- Use the Multiple Choice Response Sheet provided for your answers to Section I

Total marks - 75

Section I

Total marks (20)
Attempt all questions
Allow about 30 minutes for this section

Section II

Total marks (55)
Attempt all questions
Allow about 1 hour 30 minutes for this section

This paper MUST NOT be removed from the examination room

1. Observe the image of the Earth's internal structure shown below.



What is the main piece of evidence that tells us about the Earth's internal layers?

- A Direct observation of the internal Earth via deep boreholes many hundreds of kilometres deep.
- B Observation of the behaviour of earthquake waves that change speed and direction as they move through the Earth.
- C Investigation of the magma that emerges from volcanoes from deep within the Earth.
- D Large meteorite impact craters that reach deep down into the Earth.
- 2. Travis finds a rock with large mineral crystals, evenly spread out around the sample. After testing he finds that the rock is very hard and difficult to break. What rock type is Travis likely to have?
 - A igneous
 - B metamorphic
 - C sedimentary
 - D ironic

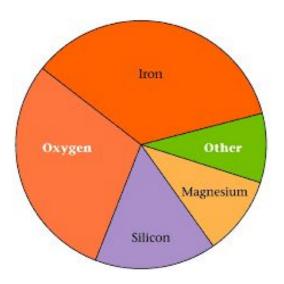
3. The pie-chart opposite shows the elemental composition of the solid portion of the Earth (geosphere) by weight.

> What is the approximate percentage of the element that is in the second-largest amount inside the solid Earth?



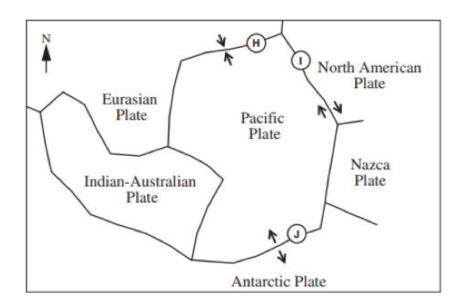
C 30%

40% D



- 4. The pie-chart shown above represents the solid portion of the Earth (geosphere). How would you expect the amount of iron to compare with another pie-chart representing the crust (lithosphere) of the Earth?
 - Α it would be greater
 - it would be lower В
 - С it would be the same
 - there would be no iron present at all D
- 5. Quartz is the most common mineral found on the surface of the Earth. It belongs to the most common group of minerals, made of the elements oxygen and silicon, known as:
 - Α carbonates.
 - В silicates.
 - С sulfates.
 - oxides. D
- 6. Scientists Vine and Matthews studied the patterns of palaeomagnetism around mid-ocean ridges. What did their research indicate?
 - Α The Earth's magnetic field has reversed polarity many times as new ocean crust has been formed.
 - The Earth's magnetic field has been weak and then strong as new В ocean crust has been formed.
 - The Earth's magnetic field has completely stopped working at C different times in the past.
 - D The Earth's magnetic field runs along the mid-ocean ridges.

7. The diagram below shows the direction of movement at three boundaries of the Pacific Plate.



What are the types of plate tectonic boundaries at locations H, I and J?

	Н	I	J
Α	convergent	divergent	conservative
В	conservative	convergent	divergent
С	divergent	conservative	convergent
D	convergent	conservative	divergent

8. This photo shows a Year 11 student using Mars Bars to model the internal Earth and plate tectonic processes.

Which layer of the Earth is best represented by the slow-flowing, semi-solid caramel of the Mars Bar?

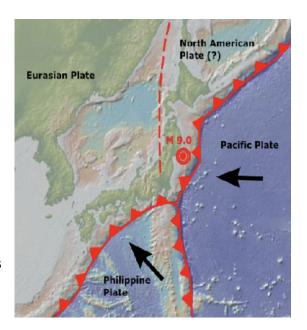
- A crust
- B outer core
- C mantle
- D inner core



9. The islands of Japan sit above a ocean-ocean convergent plate boundary - see the diagram opposite.

What features are most likely to occur in this sort of tectonic environment?

- A trenches, island arc volcanoes, reverse faults
- B rift valleys, synclines, earthquakes up to 700km in depth
- C steep-sided volcanoes, earthquakes up to 700km in depth, rift valleys
- D normal faults, continental volcanoes, powerful earthquakes

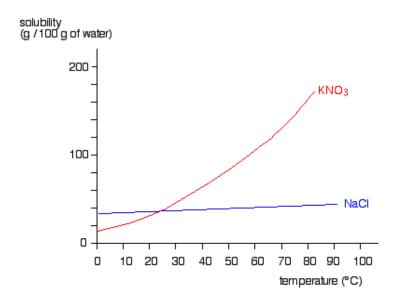


- 10. According to 'Plate Tectonic Theory', in what tectonic setting would some of the oldest oceanic crust be found?
 - A at a mid-ocean ridge
 - B near a large hotspot volcano
 - C on the ocean floor in-between two major continental landmasses
 - D some distance away from a mid-ocean ridge, near an oceanic trench
- 11. A research team from the UNSW Coastal and Regional Oceanography group has been investigating the floor of the Indian Ocean, between the Australian and Indian landmasses. The main aim of the research is to determine what kind of tectonic boundary, if any, exists between the two continents.

The team has found a shallow linear valley between the landmasses that runs in a northerly direction for over 4,500 km. There does not appear to be any active volcanoes along the valley, but powerful shallow earthquakes have been detected in the area. Based on this evidence, what kind of plate tectonic boundary might be present?

- A a divergent boundary
- B a convergent boundary
- C a transform boundary
- D no known kind of boundary

- 12. Heated fluids, like water, rise when they absorb heat energy. This is because:
 - A the fluid is pushed away from the source of the heat energy.
 - B the fluid becomes less dense, and gravity pulls on it with less force.
 - C the fluid re-emits the heat energy, pushing it in the opposite direction.
 - D the fluid expands in all directions, including upwards.
- 13. In the Earth's water cycle, the transformation of liquid water into water vapour as it absorbs the heat from the Sun is known as:
 - A convection.
 - B evaporation.
 - C advection.
 - D condensation.
- 14. The graph below shows how the amount of two salts that can be dissolved in water, sodium chloride (NaCl) and potassium nitrate (KNO3), changes with temperature.



Which of the following can be concluded from the graph?

- A sodium chloride is less soluble in water than potassium nitrate
- B the solubility of potassium nitrate only changes a little bit as the temperature of the water increases
- C potassium nitrate is not as soluble as sodium chloride in water of 20°C
- D salts become less soluble as the temperature of water increases

15. Sean goes for a swim at the beach in the late Autumn. He notices that, although the day-time temperatures have dropped to 18°C, the ocean water is still around 20°C.

Which property of water best accounts for this observation?

- A boiling point
- B ability to act as solvent
- C thermal capacity
- D surface tension



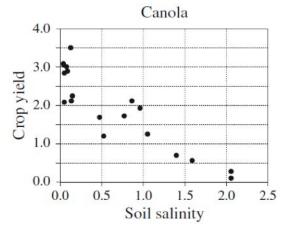
- 16. In terms of distribution of the Earth's water, which of the following places the amount of water found in each component from largest to smallest?
 - A Ocean water, glaciers and icecaps, groundwater, surface water, atmosphere.
 - B Ocean water, groundwater, glaciers and icecaps, surface water, atmosphere.
 - C Ocean water, surface water, glaciers and icecaps, groundwater, atmosphere.
 - D Ocean water, glaciers and icecaps, surface water, atmosphere, groundwater.
- 17. A study was conducted over five years in the Hawkesbury River. It measured the effect of nutrients on the dissolved oxygen content of the water.

What is the *dependent variable* in this investigation?

- A the Hawkesbury river
- B the amount of nutrients
- C the duration of the study
- D

the dissolved oxygen content of the water

- 18. *Groundwater* can sometimes rise to the surface, leading to *salinisation* of the topsoil. What is the human impact that leads to this rise?
 - A an increase in the amount of annual rainfall in the groundwater catchment area
 - B unusually large amounts of stormwater released to soak into the ground in urban areas
 - C excessive evaporation of surface water, drawing water up from the water table
 - D land clearing operations that remove deep rooted plants
- 19. The graph below shows data on canola crop yields at different levels of soil salinity.



How would you describe the *correlation* between these two variables?

- A strong positive correlation
- B strong negative correlation
- C no correlation at low levels of salinity, then negative as salinity levels continue to increase
- D no correlation at all
- 20. Some of the typical effects of *introduced species* are:
 - A Increased diversity and flourishing of the native fauna.
 - B Damage to the environment and competition with native species.
 - C Restoration of the health of the environment and increased food supply for native species.
 - D Enrichment of the soil and increasing native plant growth.

End of Section I

Student number	

Section II Total marks (55) Attempt ALL questions Allow about 1 hour and 30 minutes for this section

Allow about 1 hour and 30 minutes for this section		
Answer the questions in the spaces provided.		
Show all relevant working in questions involving calculations.		
Question 21 (4 marks)	Marks	
In the Year 11 Earth and Environmental Science Course, you conducted a practical investigation to compare the differences in the density of representative rock samples found in the crust, mantle and core.	⁄e	
Write a method (using numbered steps) of the investigation that you conducted Be sure to identify any equipment used.	l. 4	

Bobby is investigating the *physical properties* of a mineral, pyrite, shown here.

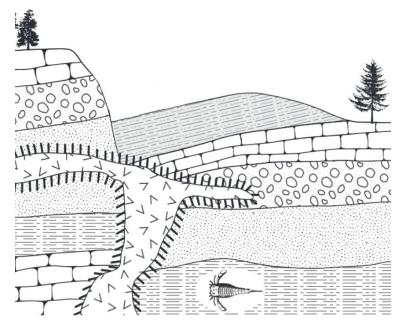


Shown below are some physical properties that he could investigate. Define each of these.

(a)	Lustre:		
(b)	Streak:		

2

Examine the diagram below showing a series of rock layers, and a fossil in one of the layers.



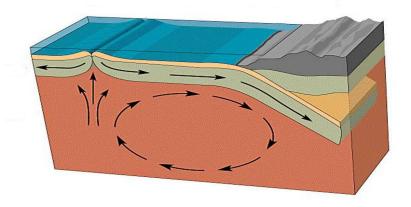
(a) Demonstrate how a palaeontologist could use the 'Law of Superposition' and the 'Law of Cross-Cutting Relationships' to find the relative order of these layers.

(b) Using the processes outlined in Part (a), clearly label the OLDEST and the YOUNGEST rock layers on the diagram above.

Question 24 (3 marks)	Marks
Describe TWO remote sampling AND/OR geophysical techniques used in the search for non-renewable resources.	_
	3

5

Examine the diagram below showing plate tectonic processes.



Analyse how energy flow and gravity influence crustal movement at plate boundaries.		

Question 26 (3 marks)

Marks

Evaluate the contribution of ONE of the following to our understanding of tectonic plates:

3

- Wegener continental drift
- Benioff and Wadati earthquake depths
- Hess sea floor spreading
- Vine and Matthews magnetic reversals
- Glomar Challenger age of oceanic floors

Different plate boundaries lead to the production of different types of magmas, which result in very different kinds of volcanic eruptions.

(a) Complete the table below by writing appropriate terms in the blank boxes.

4

2

Magma composition	Silica content (low or high)	Melting point (low or high)	Viscosity of magma	Eruption type
felsic			high	
				effusive

(b)	Explain ONE way that magma (lava) interacting with overlying ice can lead to the production of ash clouds in volcanic eruptions.

Simon is conducting an experiment to model how the release of elastic

potential energy in rock leads to

earthquakes.

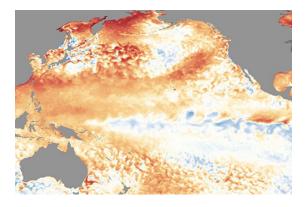
He stretches a rubber band attached to a wooden block sitting on a piece of rough sandpaper. When the block suddenly jerks forward, he records how far the rubber band was stretched, as well as how far the block moves (see photo opposite).



Propose a hypothesis that Simon could test using his experiment.	
Outline ONE method that Simon could use to make his experiment accurate.	
Outline ONE method that Simon could use to make his experiment <i>reliab</i>	le.

Question 29 (4 marks)	Marks
The movement of water in the oceans of the Earth is sometimes referred to as the 'Thermohaline Circulation'.	
Using your knowledge from the 'Energy Transformations' module of the Earth and Environmental Science course, account for the movement of cold, salty water towards the bottom of the ocean, forming deepwater currents.	
Include a location on Earth where this movement would occur in your answer.	4

ENSO (El Niño Southern Oscillation) events are caused by changes to a combination of ocean currents and atmospheric movement in the Pacific Ocean known as the 'Walker Circulation'. The 'neutral phase' of the Walker Circulation is shown in the image below (not in colour).



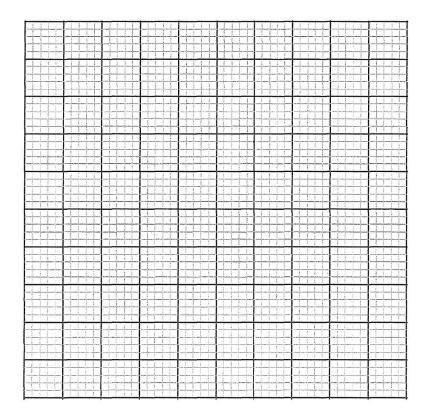
Describe the changes that occur in the Walker Circulation during an *El Niño* climatic event. Give ONE consequence of this event for the weather of Australia.

3

The data below represents the relationship between soil salinity and crop yield on farms in western NSW.

Soil salinity (mS/m)	Crop yield (tonnes per hectare)
10	30
15	26
20	21
25	15
30	14
35	13
40	12

(a) Draw a graph of these results on the grid below.



Question 31 continues on the next page

Que	estion 31 (continued)	Marks
(b)	Outline the trend shown in the graph that you have drawn.	1
	estion 32 (4 marks)	
thes	rironmental scientists keep a close eye on our freshwater ecosystems - se systems are critical to human survival, particularly in a dry continent such Australia.	
(a)	Describe a human activity that can lead to a change in water quality in a freshwater ecosystem.	2
(b)	Describe the effect of this activity on aquatic environments.	2

Question 33 (6 marks)	Marks
In the Year 11 Earth & Environmental Science Course, you conducted an investigation into a local introduced species.	
Identify the local introduced species that you investigated:	_
(a) Outline a biotic and an abiotic effect of the named species.	2
	_
(b) Describe a human activity that favours the named species.	2
(c) Describe a control or mitigation method for the named species (do not	_
just say "killing the plant/animal").	2
	_

End of paper

Section I

1. B	11. C
2. A	12. B
3. C	13. B
4. B	14. C
5. B	15. C
6. A	16. A
7. D	17. D
8. C	18. D
9. A	19. C
10. D	20. B

Section II

Question 21

Criteria	Marks
Outlines a method for measuring mass	
AND	
Outlines a method for measuring volume	
AND	
• Includes the calculation for density (i.e. mass divided by volume – units not required)	4
AND	
• Identifies ALL relevant equipment required i.e. measuring cylinder,	
water displacement pan, mass balance (or similar)	
• Does THREE of the above	3
• Does TWO of the above	2
• Does ONE of the above	1

- e.g. 1. Measure the mass of the rock sample(s) by placing them on an electronic mass balance.
 - 2. Fill up a water displacement pan with water until it is full. Then place the rock sample in the pan, and collect the water that pours out with a measuring cylinder.
 - 3. The amount of water that fills the measuring cylinder is the volume of the rock (in cm³).
 - 4. Divide the mass of the rock by its volume to get the density (in g/cm³).

Question 22

Criteria	Marks
• Defines lustre as the shine / reflective qualities of a mineral	
AND	2
Defines streak as the colour the mineral makes when dragged along	2
the ground or across a white tile	
• Does ONE of the above	1

e.g. [as above]

Question 23(a)

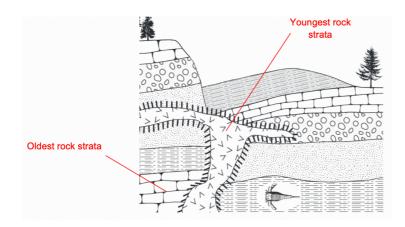
Criteria	Marks
 Answer demonstrates how a property of the 'Law of Superposition' ('cause') can be applied to dating the rock strata ('effect') AND Answer demonstrates how a property of the 'Law of Cross-Cutting Relationships' ('cause') can be applied to dating the rock strata ('effect') 	4
Does THREE of the above	3
• Does TWO of the above	2
• Does ONE of the above	1

e.g. The Law of Superposition states the oldest layers will be found at the bottom, so we will need to look for the bottom layer in the strata. The Law of Cross-Cutting Relationships states that a layer will be younger than any other layer it cuts across, like the layer that climbs vertically through the strata in the diagram.

Question 23(b)

Criteria	Marks
Correctly identifies the youngest rock strata	
AND	2
Correctly identifies the oldest rock strata	
Does ONE of the above	1

e.g.



Question 24

Criteria	Marks
• Gives TWO features of TWO a remote sampling AND/OR	2
geophysical technique	3
• Gives TWO features of ONE remote sampling AND/OR geophysical	
technique	
OR	2
• Gives ONE feature of TWO a remote sampling AND/OR	
geophysical technique	
• Gives ONE feature of ONE remote sampling OR geophysical	1
technique	1

e.g. [answer varies] One form of remote sampling that can be used to search for non-renewable resources is satellite imagery. Satellites can be used to scan hundreds of square kilometres in a range of wavelengths, looking for particular surface landforms or reflectances that might indicate a deposit. For deposits suspected to be below the Earth's surface, geophysical techniques such as 'density mapping' can use a gravimeter to detect subtle changes in the gravitational field, and therefore the density, that could be associated with deposits.

Question 25

Criteria	Marks
• Shows how (heat) energy flow (cause) relates to the movement of tectonic plates (effect) AND	
• Shows how gravity (cause) relates to the movement of tectonic plates (effect) AND	5
• Provides at least ONE link between the action or effect of (heat)	
energy flow and gravity	
• Does FOUR of the above	4
Does THREE of the above	3
Does TWO of the above	2
Does ONE of the above	1

e.g. As the magma in the mantle is heated by the hot inner core of the Earth, it rises towards the crust. When this heat energy reaches the bottom of the crust, it melts through and begins dragging the sections of crust, or plates, apart. Where two plates converge, the denser oceanic plate is usually subducted underneath. Its leading edge tilts and is pulled down into the mantle by gravity under its own weight. In the same way, the cooler magma around the subduction zone is also denser compared with the hotter areas, and also sinks down under the influence of gravity into the mantle.

Question 26

Criteria	Marks
• Gives TWO benefits AND/OR limitations regarding the contribution	
to our understanding of tectonic plates of ONE of the	
scientists/research teams	3
AND	3
• Provides a value judgement summarising the value of their	
contribution	
• Does TWO of the above	2
• Does ONE of the above	1

e.g. [answer varies] Wegener was one of the first scientists to seriously propose that the Earth's continents were not fixed in place: that they moved around over geological time. Whilst he was able to provide some evidence in the form of the same fossils and rock types on vastly separated continents, he was not able to provide a plausible way for the continents to move. However, his contribution was a significant one as he got the scientific community thinking.

Question 27(a)

Criteria	Marks
• Correctly labels 7 boxes	4
• Correctly labels 5-6 boxes	3
• Correctly labels 3-4 boxes	2
Correctly labels 1-2 boxes	1

e.g.

Magma composition	Silica content (low or high)	Melting point (low or high)	Viscosity of magma	Eruption type
felsic	high	low	high	explosive
mafic	low	high	low	effusive

Question 27(b)

Criteria	Marks
• Relates the 'cause' of the overlying ice to the 'effect' of the magma producing ash clouds in volcanic eruptions	2
• Gives some relevant information relating to magma's interactions with ice	1

e.g. When the edges of magma erupting form a volcano come into contact with ice, it can be forced to cool very quickly, which can form volcanic glass. This glass is very brittle and is easily shattered into small pieces which are carried up into the air to form ash clouds.

Question 28(a)

Criteria	Mark
• Proposes a hypothesis that is testable by the experiment	1

e.g. [answer varies] The further the rubber band is allowed to stretch, the further the wooden block will move.

Question 28(b)

Criteria	Mark
Outlines a method that Simon could use to make his experiment	1
more accurate	1

e.g. [answer varies] Simon could use marks on the bench to set up the wooden block and ruler in exactly the same locations each time to take his measurements.

Question 28(c)

Criteria	Mark
Outlines a method that Simon could use to make his experiment	1
more reliable	1

e.g. [answer varies] Simon could do multiple trials of his experiment and then calculate the average from these trials to help eliminate the effects of uncontrolled variables.

Question 29

Criteria	Marks
 Identifies cold water as being relatively denser that other (surface) water AND Identifies salty water as being relatively denser that other (fresh) water AND Recalls that denser water will tend to sink (under the influence of gravity) AND Identifies a suitable location for this downward motion to occur 	4
	2
Does THREE of the above	3
Does TWO of the above	2
• Does ONE of the above	1

e.g. At the poles of the Earth, the oceanic water is cooled, becoming denser. This cooler water then sinks down towards the ocean floor due to gravity. If the water at the surface is so cool that it actually freezes into ice, then it releases any salt that it contains into the water below. As this salt dissolves back into the water, it also makes the water denser than the surrounding water, adding to the sinking effect.

Question 30

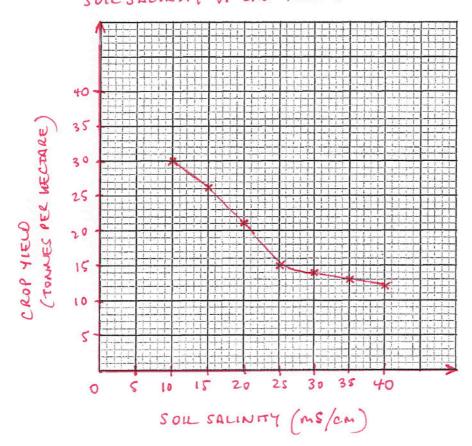
Criteria	Marks
• Describes a change to ocean currents related to an El Niño climatic	
event	
AND	
• Describes an atmospheric change related to an El Niño climatic	3
event	
AND	
• Outlines the weather in Australia related to an El Niño climatic event	
Does TWO of the above	2
Does ONE of the above	1

e.g. During an El Niño climatic event, the weather of Australia becomes dry, usually resulting in drought conditions for an extended period. This is because atmospheric winds push away from Australia eastward across the Pacific Ocean. Normally warm water would be allowed to gather near the east coast of Australia, but during an El Niño, this warm water is pushed away from the coast, taking any moisture-producing air masses with it.

Question 31(a)

Criteria	Marks
S.A.L.T.T.	
• Scales: both graph scales go up in regular increments	
AND	
• Axes: the dependent variable in on the side (y-axis) of the graph	
AND	5
• Labels: both axes labelled with units	3
AND	
• Title: title includes both the independent and dependent variables	
AND	
• Type: graph is a line graph (continuous data)	
• Does FOUR of the above	4
Does THREE of the above	3
Does TWO of the above	2
Does ONE of the above	1

e.g.



Question 31(b)

Criteria	Mark
Outlines the general trend in the graph	1

e.g. The graph shows the crop yield becomes lower as soil salinity increases.

Question 32(a)

Criteria	Marks
• Gives TWO features of a human activity that leads to water pollution	2
Gives ONE feature	1

e.g. A human activity that can lead to water pollution is soil disturbance, whether by deliberately pulling up plants that have been binding the soil, or repeatedly walking in sensitive areas, trampling groundcover and killing it.

Question 32(b)

Criteria	Marks
Gives TWO features of the effect of aquatic environments	2
Gives ONE feature	1

e.g. Soil that is washed into water bodies as part of stormwater can make the water cloudy. This can reduce its temperature and oxygen levels, and make it difficult for some aquatic predators to see their prey.

Question 33(a)

Criteria	Marks
• Gives ONE biotic effect AND ONE abiotic effect of the named species	2
Gives ONE biotic OR abiotic effect	1

e.g. [answer varies] Among many other items, the scats of foxes contain the remnants of fruit and berries from native and introduced species, which can be distributed over wide distances. Foxes are also a known predator of most animals up to 5.5kg, and are thought to have played a major part in many extinctions in Australia.

Question 33(b)

Criteria	Marks
• Gives TWO features of a human impact that favours the named species	2
Gives ONE feature	1

e.g. Humans provide a ready source of food for foxes by keeping domesticated animals such as chickens in unsecured enclosures. Foxes are also known to eat from pet food bowls and rubbish bins.