OUNDLE
School

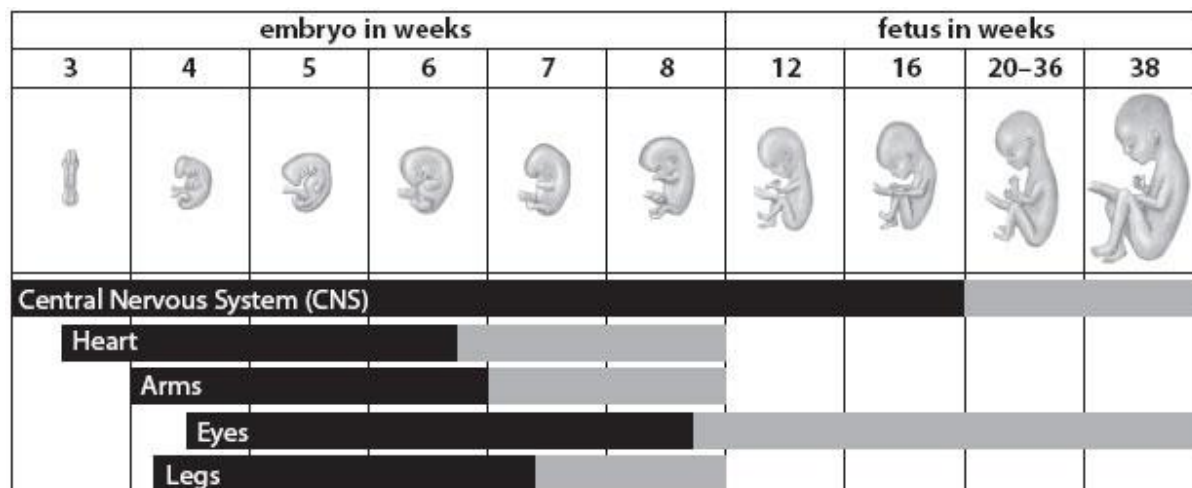2020 Academic Scholarship
Preliminary Examination

Science

Time Allowed : 60 minutes

- Write your name on the question paper
- Write all your answers on the question paper
- Calculators are allowed

Biology Section

1. Foetal alcohol syndrome occurs when a pregnant woman drinks large quantities of alcohol.
   The diagram shows the development of the embryo and foetus during its time in the uterus.
   The bars show the time period during which foetal alcohol syndrome can cause an abnormality in a specific body part.
   The darker the bar, the more likely an abnormality will occur in that body part.

embryo in weeks						fetus in weeks			
3	4	5	6	7	8	12	16	20–36	38

Central Nervous System (CNS)

Heart

Arms

Eyes

Legs

a.

i. Complete the sentence by putting a cross (X) in the box next to your answer.
   The body part most likely to be affected by foetal alcohol syndrome throughout pregnancy is the…

   A   central nervous system   ☐

   B   heart   ☐

   C   arms   ☐

   D   eyes   ☐

   (1)

ii. State the period of time when a defect in the development of the legs is most likely to occur.

   ....

   (1)

b. Alcohol is a drug.
i. Define the term drug.

   ....

   ....

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   (2)

ii.   Explain why alcohol is classed as a depressant.

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(2)

c.
i.   Describe a long-term effect of alcohol abuse.

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(2)

ii.   Discuss the ethics of allowing alcoholics to have an organ transplant.

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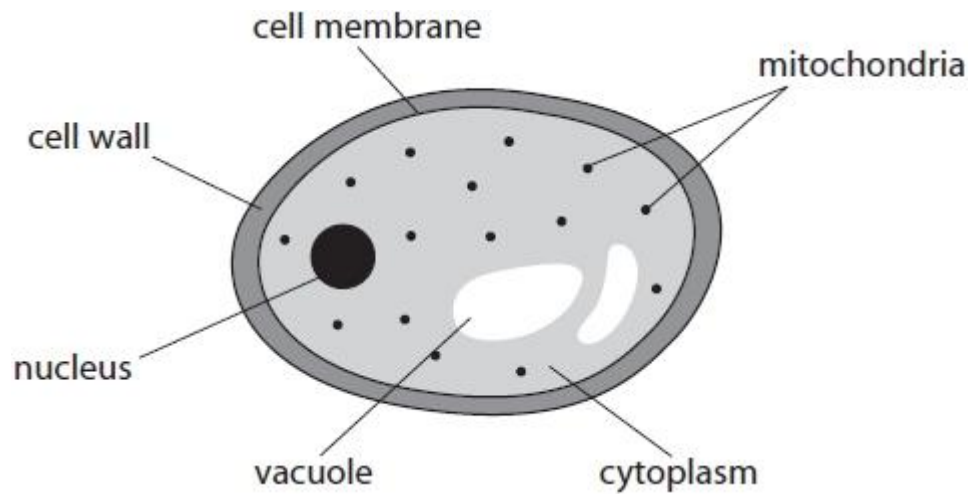
(2)

(Total 10 marks)

2. The diagram shows a yeast cell.

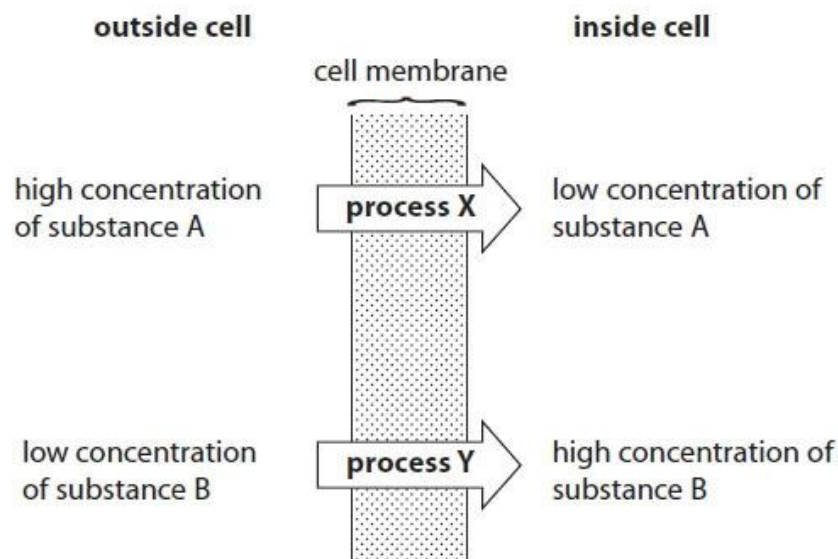Describe how the structure of a bacterial cell differs from this yeast cell.

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(Total 2 marks)

3. Substances in the soil are taken up by plant root hair cells.
a. The diagram shows the direction of movement of two substances A and B across the cell membrane of a root hair cell.

outside cell   inside cell
                    cell membrane

high concentration   process X   low concentration of
of substance A   substance A

low concentration   process Y   high concentration of
of substance B   substance B

i. Name process X.

....

(1)

ii. Name process Y.

....

(1)

iii. Mineral ions are taken up by the root hair cells of plants.
Name the type of vessel that transports these mineral ions through the plant.

....

(1)

b. A student investigated osmosis in a courgette.
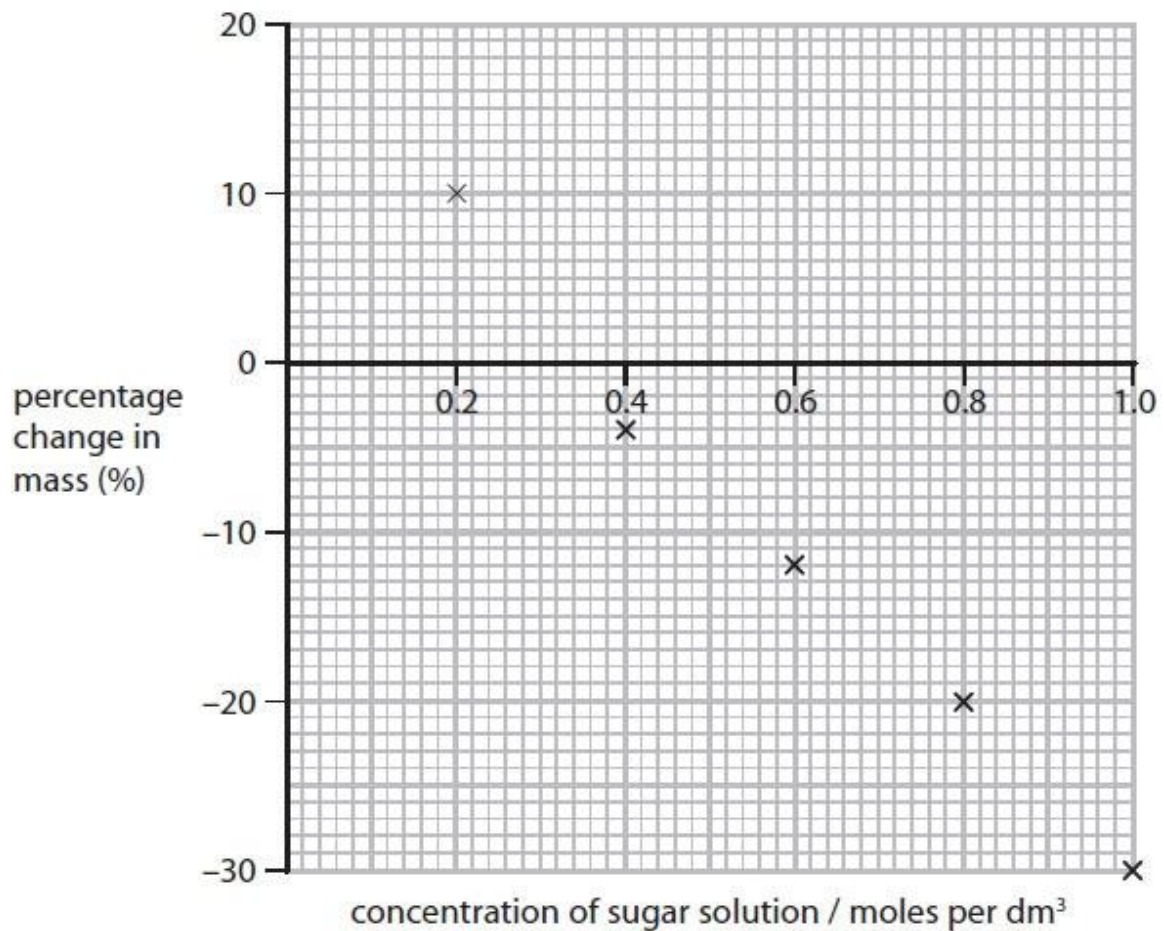The photograph shows a courgette.

The student weighed pieces of courgette and placed them in five different concentrations of sugar solution.
After one hour she dried and reweighed the pieces of courgette.
She calculated the percentage change in mass.
The graph shows the results of this investigation.

i. Draw a line of best fit on the graph.

(1)

ii. Use your line of best fit to estimate the concentration of sugar solution that would result in no change in mass.

Estimate = ... moles per dm^3

(1)

iii. Explain why there was an increase in the mass of the courgette in the sugar solution at 0.2 moles per dm^3.
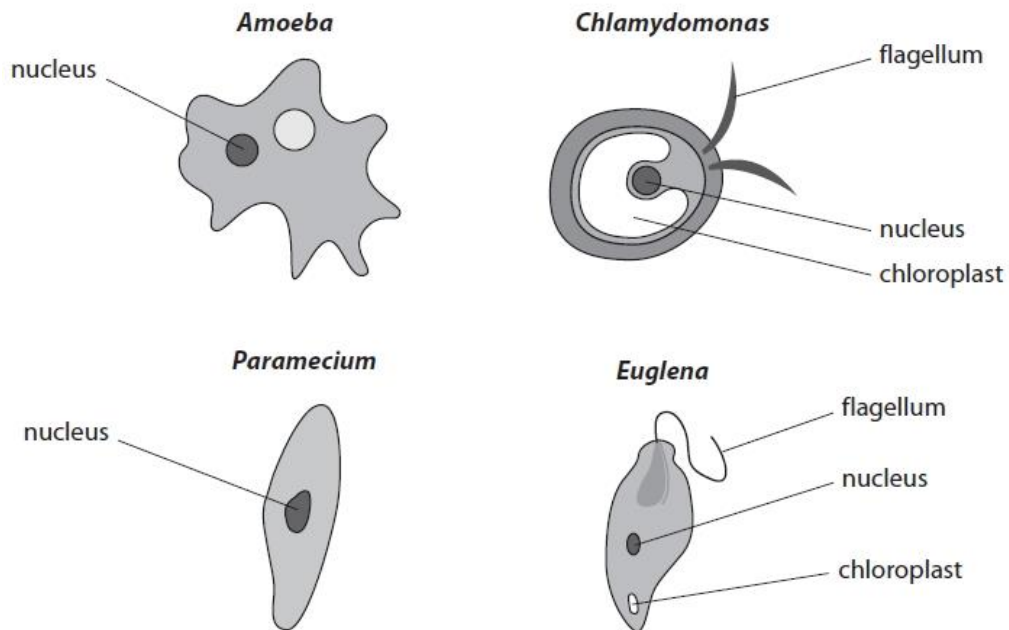
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(3)

(Total 8 marks)

4.

a. All the organisms in the diagram belong to one Kingdom.

Amoeba

nucleus

Chlamydomonas

flagellum

nucleus

chloroplast

Paramecium

nucleus

Euglena

flagellum

nucleus

chloroplast

i. Which Kingdom do these organisms belong to?
Put a cross (X) in the box next to your answer.

A	Animalia	
B	Fungi	
C	Protoctista	
D	Prokaryotes	

(1)

ii. In which structure are the chromosomes of these organisms found?
Put a cross (X) in the box next to your answer.

A	cilia	
B	chloroplast	
C	flagellum	
D	nucleus	

(1)

iii. Suggest one reason why both Euglena and Chlamydomonas could be placed into the Kingdom Plantae.

....

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(1)

b. *Euglena* is unusual because it is both heterotrophic and autotrophic.
i. Explain how this helps *Euglena* to survive.

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(3)

ii. A scientist discovered a new species of Euglena in boiling acidic mud in Costa Rica.
Explain how this discovery could be validated by the scientific community.

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(2)

(Total 8 marks)

Total for Biology Section = 28 marks

Chemistry Section

5. Greenhouse gases affect the temperature of the Earth.
a. Which gas is a greenhouse gas?
    Place a cross (X in the box next to your answer.

A	Argon	
B	Methane	
C	Nitrogen	
D	Oxygen	

    (1)

b. An increase in global temperature will cause climate change.
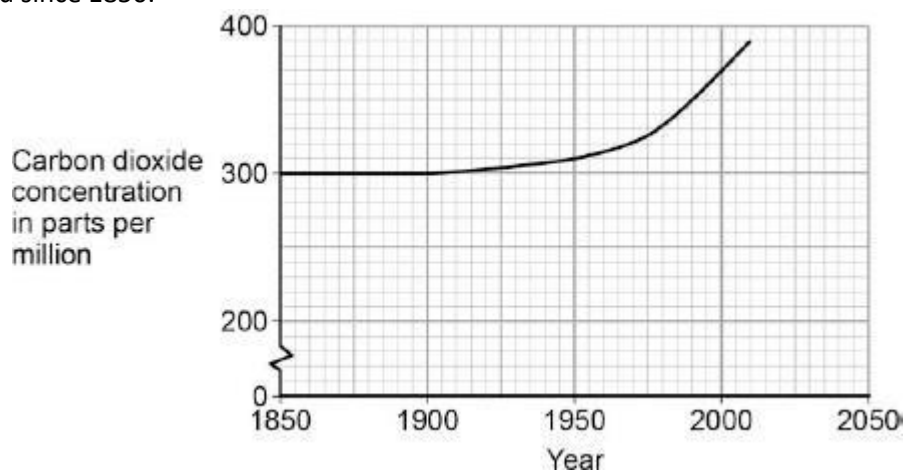   What is one possible effect of climate change?
    Place a cross (X) in the box next to your answer.

A	Deforestation	
B	Global dimming	
C	Sea levels rising	
D	Volcanic activity	

    (1)

c. Carbon dioxide is also a greenhouse gas.
    The figure below shows how the concentration of carbon dioxide in the atmosphere has
    changed since 1850.

Which process is the reason for the change in carbon dioxide concentration shown on the figure above?

Place a cross (*X*) in the box next to your answer.

A	Burning of fossil fuels	
B	Carbon capture	
C	Formation of sedimentary rocks	
D	Photosynthesis	

(1)

d.   Give three conclusions that can be made from the graph above.

1. ....

....

2. ....

....

3. ....

....

(3)

(Total 6 marks)

6. A student investigated the reactivity of three different metals.

This is the method used.
1. Place 1 g of metal powder in a test tube.
2. Add 10 cm^3 of metal sulfate.
3. Wait 1 minute and observe.
4. Repeat using the other metals and metal sulfates.

The student placed a tick in the table below if there was a reaction and a cross if there was no reaction.

Sulfate	Zinc	Copper	Magnesium
Copper sulfate	✓	X	✓
Magnesium sulfate	X	X	X
Zinc sulfate	X	X	✓

a. What is the dependent variable in the investigation?
   Place a cross (X) in the box next to your answer.

   A   Time taken   ☐

   B   Type of metal   ☐

   C   Volume of metal sulfate   ☐

   D   Whether there was a reaction or not   ☐

   (1)

b. Give one observation the student could make that shows there is a reaction between zinc and copper sulfate.

....

....
   (1)

c. The student used measuring instruments to measure some of the variables.
   Draw one line from each variable to the measuring instrument used to measure the variable.

   Variable   **Measuring instrument**

                                             | Balance |
   | Mass of metal powder | | Measuring cylinder |
                                             | Ruler |
                                             | Burette |
   | Volume of metal sulfate | | Thermometer |
                                             | Test tube |

   (2)

d. Use the results shown in table above to place zinc, copper and magnesium in order of reactivity.

Most reactive   ....

⇩   ....

Least reactive   ....

(1)

e. Suggest one reason why the student should not use sodium in this investigation.

....

....

(1)

f. Which metal is found in the Earth as the metal itself?
    Place a cross (*X*) in the box next to your answer.

A	Calcium	
B	Gold	
C	Lithium	
D	Potassium	

(1)

(Total 7 marks)

7.   The figure below shows magnesium burning in air.

a.   Look at the figure above.
     How can you tell that a chemical reaction is taking place?

....

....
                                                                                                                              (1)

b.   Name the product from the reaction of magnesium in the figure.

....
                                                                                                                              (1)

c.   The magnesium needed heating before it would react. What conclusion can you draw from
     this?
     Place a cross (X) in the box next to your answer.

        A   The reaction is reversible   ☐

        B   The reaction has a high activation energy   ☐

        C   The reaction is exothermic   ☐

        D   Magnesium has a high melting point   ☐

                                                                                                                              (1)

d. A sample of the product from the reaction in the figure above was added to water and shaken.
    Universal indicator was added.
    The universal indicator turned blue.
    What is the pH value of the solution?
    Place a cross (X) in the box next to your answer.

    A   1   ☐

    B   4   ☐

    C   7   ☐

    D   6   ☐

    (1)

    (Total 4 marks)

8. Rock salt is a mixture of sand and salt.
    Salt dissolves in water. Sand does not dissolve in water. Some students separated rock salt.
    This is the method used.
    1. Place the rock salt in a beaker.
    2. Add 100 cm^3 of cold water.
    3. Allow the sand to settle to the bottom of the beaker.
    4. Carefully pour the salty water into an evaporating dish.
    5. Heat the contents of the evaporating dish with a Bunsen burner until salt crystals start to form.

a. Suggest one improvement to step 2 to make sure all the salt is dissolved in the water.

    ....

    ....
    (1)

b. The salty water in step 4 still contained very small grains of sand. Suggest one improvement to step 4 to remove all the sand.

    ....

    ....
    (1)

c. Suggest one safety precaution the students should take in step 5.

    ....

    ....
    (1)

d. Another student removed water from salty water using the apparatus in the figure below.
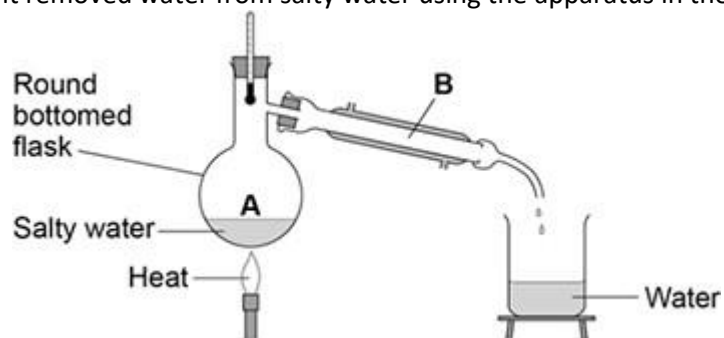
Describe how this technique works by referring to the processes at A and B.

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(2)

e. What is the reading on the thermometer during this process?

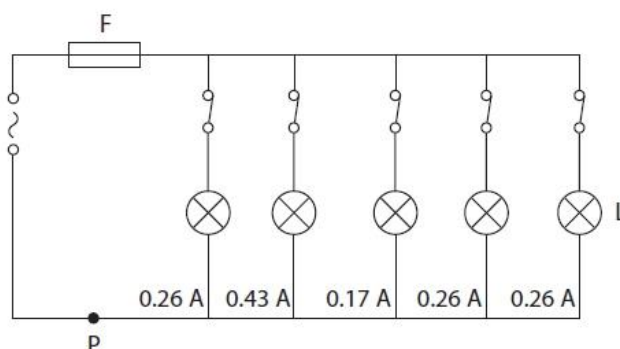... °C

(1)

(Total 6 marks)

Total for Chemistry Section = 23 marks

Physics Section

9. The diagram shows part of a lighting circuit in a house.
   The circuit is protected by fuse F.

a. Which word best describes the arrangement of the bulbs in the above circuit.
   Place a cross (X) in the box next to your answer.

   A   together   ☐

   B   series   ☐

   C   parallel   ☐

   D   separated   ☐

   (1)

b. Give two reasons why the lamps are wired in this way.

1. ....

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2. ....

....

....

   (2)

c. What is the current at P?
   Place a cross (X) in the box next to your answer.

   A   0.17 A   ☐

   B   0.26 A   ☐

   C   0.43 A   ☐

   D   1.38 A   ☐

   (1)

d. Explain how the fuse protects the circuit.

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(2)

e. This diagram shows another lighting circuit.
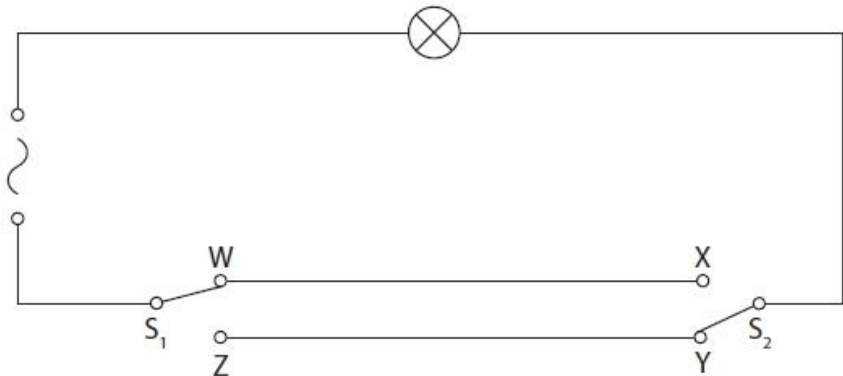
i. Complete the table by putting a tick (✓) in the box if the lamp is lit and a cross (X) in the box if the lamp is not lit.

S₁ position	S₂ position	lamp lit (✓ or ✗)
W	X	
W	Y	
Z	X	
Z	Y	

(2)

ii. Suggest where this circuit would be useful in a house.

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(1)

(Total 9 marks)

10. The simplified diagram shows a crane being used to lift a large rock.
The diagram is not to scale.
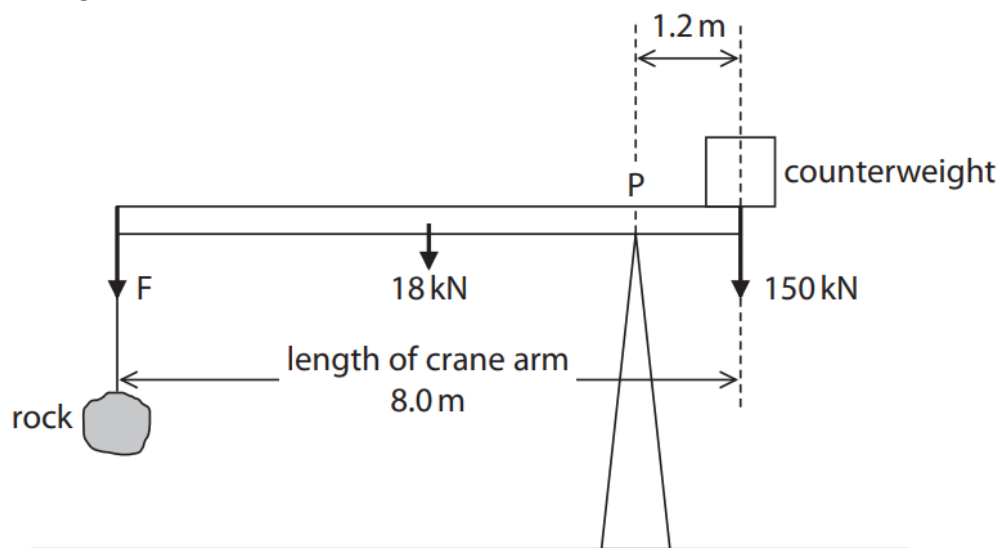
a. The table gives information about the forces acting on the uniform crane arm. Complete the table by giving the missing information.

Force	Name of force
F	weight of rock
150 kN	weight of counterweight
18 kN	

(1)

b.

i. State the equation linking moment, force and perpendicular distance from the pivot.

(1)

ii. Calculate the clockwise moment of the weight of the counterweight about the pivot, P.

moment = ... N m

(1)

c.
i. State the principle of moments.

....

....

....

....

(1)

ii. Calculate the weight of the rock.

weight = ... N

(3)

(Total 7 marks)

11. A springboard or diving board is used for diving and is a board that is itself a spring
The 3 metre springboard has been an Olympic event since 1908. The image below shows an athlete competing in the Barcelona Olympics in 1992.
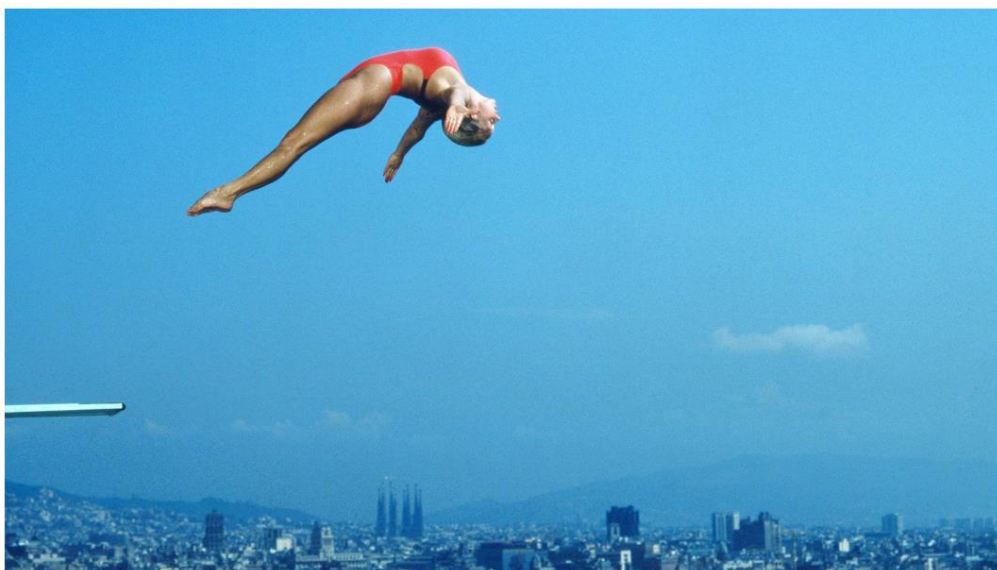
a. Discuss the energy changes that take place during an athlete's dive. From beginning to end.

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(6)

b.   Using the terms force and acceleration explain why a diver jumping from a 5 metre board hits the water moving slower than a diver jumping from the 10 metre board.

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(2)

(Total 8 marks)

Total for Physics Section = 24 marks