Class:	Register No:	Name: MS

CRESCENT GIRLS' SCHOOL
SECONDARY FOUR
PRELIM EXAMINATION

PHYSICS **5058/02**
Paper 2

28 Aug 2013
1 hr 45 min

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided at the top of this page and on all separate answer sheets used.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluids.

Section A (50 marks)
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B (30 marks)
Answer **all** questions.
Question 11 has a choice of parts, answer **either one**.
Write your answers in the writing paper provided.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Unless specified in the question, you may assume the following constants:

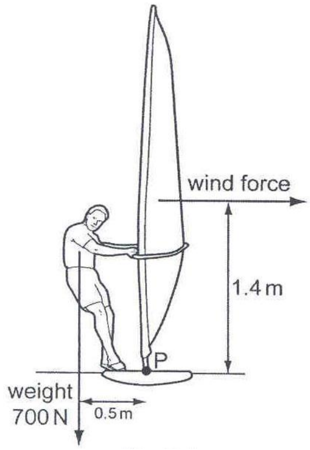
Gravitational acceleration = 10 ms^{-2}
Speed of light in vacuum = 3×10^8 ms^{-1}

For Examiner's Use	
Section A	/50
Section B	/30
TOTAL	

Section A (50 marks)

Answer **all** questions. Write your answers in the spaces provided in the question paper.

1. The figure shows a windsurfer A in equilibrium with a wind force acting on the sail of his board. The weight of the windsurfer is 700 N.



a) State the principle of moments that applies to a body in equilibrium. [1]

When an object is in equilibrium, the sum of clockwise moments about any point is equal to the sum of anticlockwise moments about the same point.

b) Calculate the moment exerted by the weight of the windsurfer about the pivot **P**. [1]

Moment = Force x perpendicular distance
= 700 x 0.5
= 350 Nm [1]

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c) Calculate the force of the wind on the sail. [2]

Taking moment about pivot P,
Clockwise moments = Anti-clockwise moments
Wind Force x 1.4 = 700 x 0.5 [1]
Wind Force = 250 N [1]

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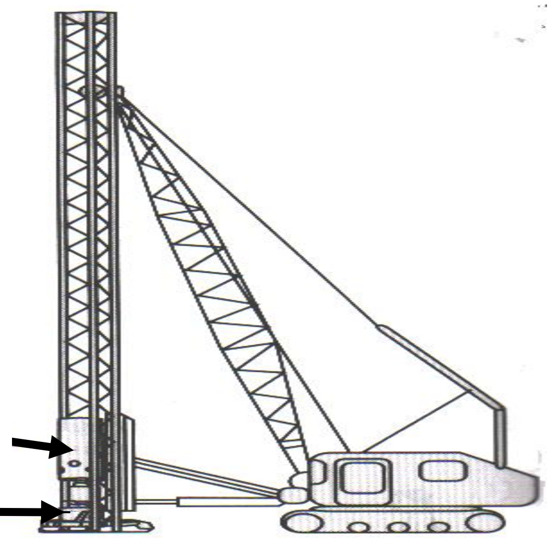
d) Explain why the windsurfer must lean out more if the wind speed increases. [2]

As the wind speed increases, there is a greater force on sail. AND/OR
a greater clockwise moment is generated by the wind. [1]
Hence a greater anticlockwise moment is required.
A greater perpendicular distance of the windsurfer (from pivot) is required to balance the greater clockwise moment from wind. [1]

e) If windsurfer B with a greater mass tries to stay in equilibrium, state how he should change his posture compared to windsurfer A. [1]

(To generate the same moments and stay in equilibrium), he needs to lean outwards less/ lean more towards the sail. [1]

2. When large buildings are being erected, particularly on soft ground, piles are driven into the ground to provide a firm base. The diagram shows a pile hammer in operation. The pile hammer has a mass of 2500 kg.



a) Calculate the loss of gravitational potential energy when the hammer falls 2.0 m to hit the pile. [2]

GPE = mgh
Potential Energy = 2500 x 10 x 2.0 [1]
= 50 000 J [1]

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b) What is the speed of the hammer when it hits the pile, assuming negligible air-resistance? [2]

KE = ½ mv^2
50 000 = ½ x 2500 x v^2
v^2 = 100 000 / 2500 = 40 [1]
v = 6.32 m/s [1]

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c) The total mechanical energy of the pile and the hammer just after impact is 25 000 J. How much energy is lost? [1]

Loss in energy = 50 000 – 25 000 = 25 000 J [1]

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d) What has happened to the lost energy? [1]

The energy is converted to heat and/or sound energy. [1]

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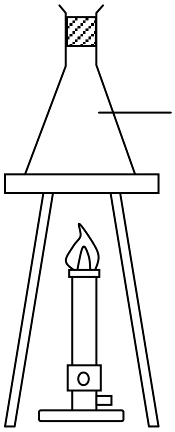
3. The diagram below shows a conical flask with a stopper that is being heated.



Use the kinetic theory of matter to answer the following questions.

a) Describe and explain the motion of the air molecules in the flask as it is heated. [2]

When the temperature increases, air molecules gain kinetic energy [1]
and moves faster. [1]

b) If the outer wall of the flask is painted black before heating, explain how this will affect the air pressure in the flask during heating. [3]

Black is a good absorber of heat and hence the heat transfer will be faster. [1]
Air molecules will gain more energy and collide with the wall of the container with greater force and frequency. [1]
Pressure in the flask will be higher. [1]

c) If the flask is filled with a small amount of water at the bottom before heating, explain how this will affect the gas pressure in the flask during heating. [2]

Due to the vapourisation of the boiled water in the flask during heating, there are now more gas molecules in flask. [1]
Pressure in flask will be higher with water in flask (as there are now more molecules colliding with the wall of the container). [1]

4. An experiment is conducted by placing a tray of ice cubes in an oven. The specific latent heat of fusion of ice is 340 kJ kg^{-1} and specific heat capacity of water is 4.2 kJ kg^{-1} K^{-1}.

a) Explain what is meant by the specific latent heat of fusion. [1]

Specific latent heat of fusion is the amount of energy required to change 1kg of the substance from solid to liquid state without a change in temperature. [1]

b) Calculate the heat required to melt 0.20 kg of ice completely to water. [1]

Heat required to melt ice $= m\ell_f$
$= 0.20 \text{ kg} \times 340\,000 \text{ J kg}^{-1}$
$= 68\,000 \text{ J}$ [1]

c) Calculate the amount of heat required to raise the temperature of the melted ice from 0 °C to 63 °C. [1]

Heat required to raise temperature $= mc\theta$
$= 0.20 \text{ kg} \times 4200 \text{ J kg}^{-1} \,^{o}C^{-1} \times 63 \,^{o}C$
$= 52\,920 \text{ J}$
$= 52\,900 \text{ J}$ [1]

d) Given that the power of the oven is 100 W, calculate how long it takes for the ice to melt and reach a temperature of 63 °C. Assume there is no heat loss to the surroundings. [2]

Total power $= E / t$

100 $= (68\,000 + 52920) / t$ [1] (ecf part b and c)

t $= 1209.2$

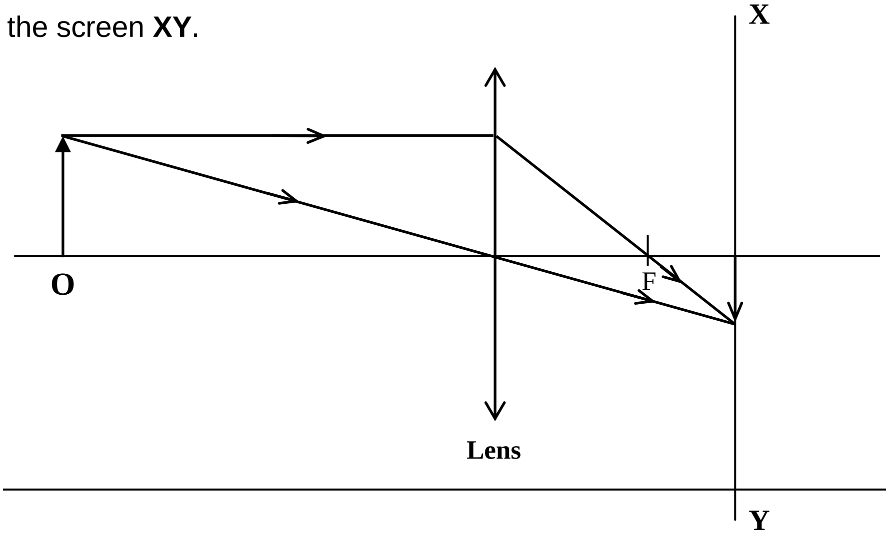
$= 1210$ s [1]

e) Explain how your values in (d) will change if there is heat loss to the surroundings. [2]

Less heat will be transferred to the ice per unit time. [1]

Hence it will take a longer time for the ice to get the required energy. [1]

5. The figure shows an object **O** placed in front of a converging lens. The image is formed on the screen **XY**.



a) Complete the diagram by drawing rays to show how the image is formed on the screen XY. [2]

b) Locate the focal point of the lens and label it **F**. [1]

c) State any changes on the image formed on the screen XY when

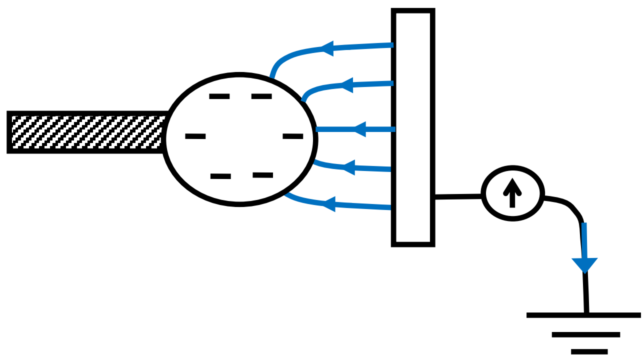
i. the top half of the lens is covered. [1]

The image becomes dimmer / less bright [1]

ii. the lens is moved towards the object. [1]

The image becomes blur / not sharp [1]

6. The diagram below shows a negatively charged metallic sphere held with an insulating handle. The sphere is brought near an earthed metal plate attached to a galvanometer via a copper wire.



a) Draw the electric field set up between the sphere and the metal plate in the diagram above. [2]

b) Indicate in the diagram above the direction of the electron flow in the copper wire. [1]

c) Explain what happens to the charges on the metal plate when the charged sphere is brought near the metal plate. [2]

As like charges repel, [1]

the negative charges of the plate will move away from the charged rod / move to the right and/or flow down the copper wire. [1]

d) Suggest two methods to increase the momentary deflection of the galvanometer. [2]

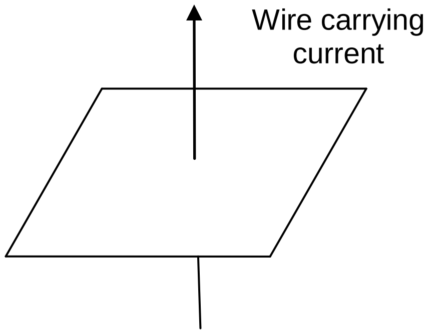
Use a sphere with a greater negative charge [1]

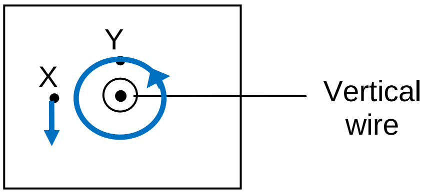
Bring sphere closer to the plate [1]

e) The sphere is now replaced with a positively charged identical metal sphere and brought near the metal plate. State any changes to the deflection on the galvanometer. [1]

The galvanometer will deflect in the opposite direction compared to (c). [1]

7. The two diagrams below show two views of the same vertical wire carrying current through a horizontal card. Points X and Y are marked on the card.





Circular field with anticlockwise direction arrow. [1]
Arrow at X points downwards [1]

a) On figure 2, draw a complete magnetic field line passing through point Y and indicate its direction. [1]

b) A compass is placed on point X. Indicate the direction that the compass will point in figure 2. [1]

c) State the effect on the direction in which compass at point X will point when

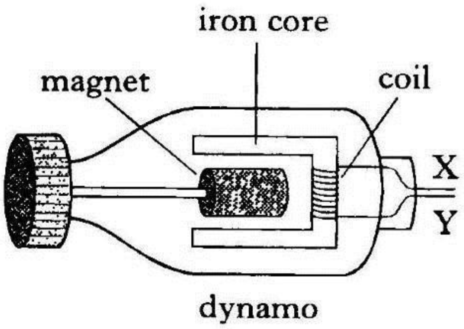
   i. the current in the wire is increased. [1]

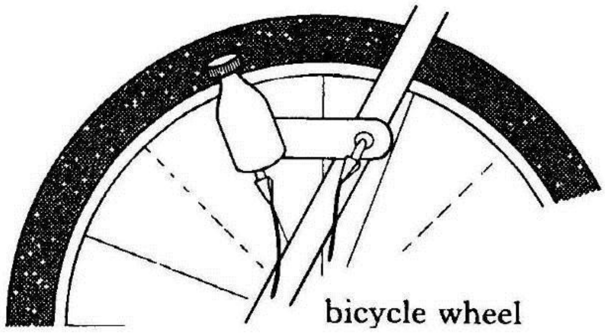
      no change to direction of compass needle [1]

   ii. the direction of the current in the wire is reversed. [1]

      the compass needle will point toward top of page / opposite direction to (i) [1]

8. The diagram below shows a bicycle dynamo. When the front wheel of the bicycle turns, the magnet rotates between the stationary coils of wire and the lamp lights up.





a) Explain how the dynamo produces a current and why the current alternates. [3]

When the bicycle wheel turns, the permanent magnet turns and produces a changing magnetic field. [1]

The magnetic field cuts the coils of wire and / changing magnetic flux linkage induce a emf and hence a current in the coil. [1]

As the magnet rotates, its poles exchange positions / magnetic field direction will reverse and hence the induced current will also reverse its direction. [1]

b) Suggest one way in which the brightness of the lamp could be increased. [1]

Cycle faster / rotate the magnet faster.

Use a stronger magnet

Increase the number of turns in the coil. [any 1, 1m]

c) Give one advantage of using the dynamo for the bicycle lamp instead of a battery. [1]

Environmentally friendly as no chemicals are used.

Will always be available unlike a battery which could run out. [any 1, 1m]

d) Give one disadvantage of using the dynamo to power the bicycle lamp instead of a battery. [1]

Brightness of the bulb depends on the movement of the wheels.

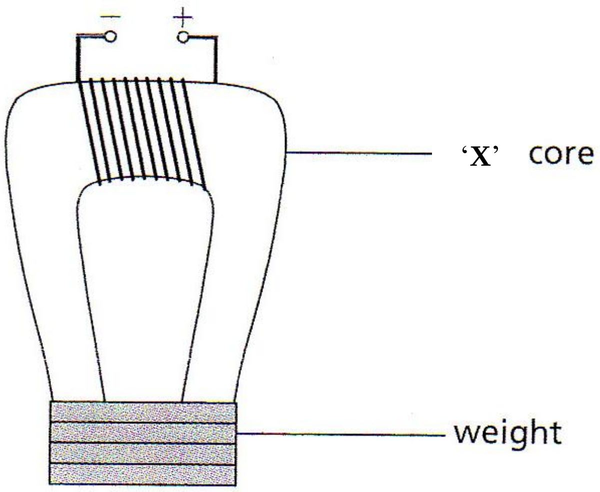
When the bicycle stops, the lamp will not light up. [any 1, 1m]

Section B (30 marks)

Answer **all** the questions in this section in the writing paper provided.

Question 11 has a choice of parts, answer **either one**.

9. The figure shows an electromagnet used to lift some weights



A student is experimenting with the use of several materials to be used as the core of the electromagnet. The table shows the data for four cores made from different materials. The relative permeability of a material is the measure of the degree to which the material can be magnetised or the ease with which magnetism can be induced in the presence of an external magnetic field.

'X' Material	Density/ gcm^{-3}	Relative Permeability	Resistivity/ Ωm
H	7.87	5000	1×10^{-7}
I	7.85	100	2.2×10^{-7}
J	8.90	600	6.84×10^{-8}
K	2.71	1	2.62×10^{-8}

a) State and explain which material is the best for the electromagnet core in order for the electromagnet to lift the maximum number of weights? [2]

Material H. [1]
Its high relative permeability allows the material to be magnetised easily / strongly. [1]

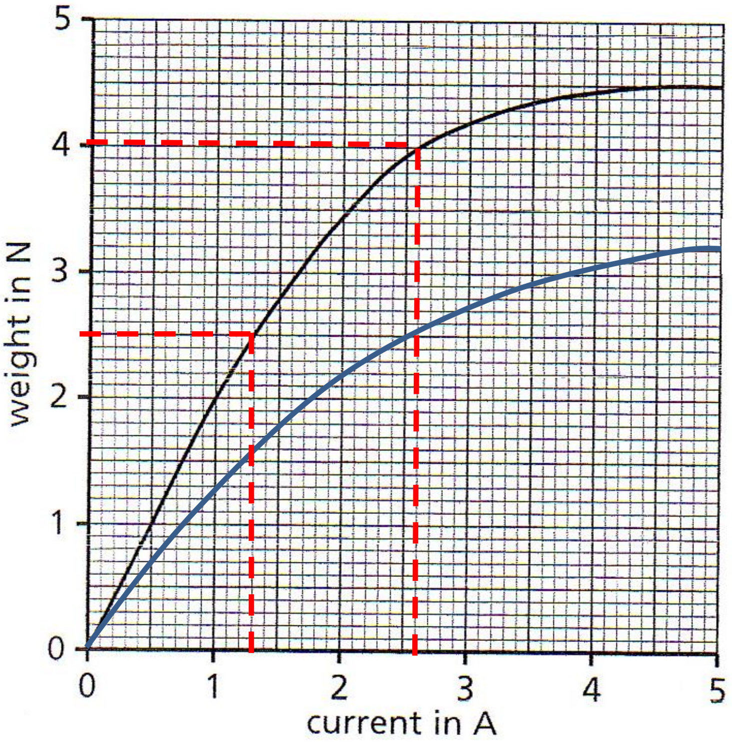
b) If material **K** is used for the manufacture of the weights, explain whether there is an increase or decrease in the number of weights that the electromagnet is able to lift compared to the other materials. [2]

Number of weights are reduced. [1]
Material K is difficult to magnetize / induced with weaker magnetism compared to material H,I and J / the rest. [1]

c) From the table, deduce the relationship between hard magnetic materials and their electrical resistance. [1]

Hard magnetic materials correspond to low resistance. [1]

d) The graph shows how the weight lifted by the electromagnet using a material **H** core is dependent on the current in the coil.



i. Suggest two methods to modify the electromagnet to lift a heavier weight. [2]

Increase current in the coil [1]
Increase the number of turns in coil [1]

ii. Indicate on the graph your prediction of the relationship between weight and current if a material **J** core is used. [1]

A curve that is below curve H as shown above [1]

iii. The current at an instant is set so that the electromagnet can only lift up to maximum weight of one can. One can weighs 2.5 N. When this current is doubled, explain if the electromagnet is able to lift two cans at the same time? [2]

From graph, to lift 2.5 N can, current needed is 1.3 A. When current is doubled to 2.6 A, weight of can to be lifted is 4.0 N. [1]
The electromagnet is not able to lift 2 cans which weigh 5.0 N. [1]

10. A step-up transformer is used to convert an input voltage of 240 V to an output voltage of 600 V.

a) Explain why the input voltage must be an a.c. power source. [2]

A changing magnetic field is produced by the a.c. power source. [1]

This changing magnetic field cuts the secondary coil to induce an emf /current in the secondary coil. [1]

b) Calculate the turns ratio of the transformer. [2]

Turns ratio = $\frac{N_s}{N_p} = \frac{V_s}{V_p}$

= $\frac{600}{240}$ [1]

= 2.5 [1]

c) Given that the input current is 2.0 A, calculate the output current. You may assume that the transformer is 100% efficient. [2]

$I_p V_p = I_s V_s$

240 x 2.0 = I_s x 600 [1]

I_s = 0.80 A [1]

d) Calculate the power input in the primary coil. [2]

$P_p = I_p V_p$

=240 x 2.0

= 480 W

e) Given that the actual output power is 300 W, calculate the efficiency of the transformer. [2]

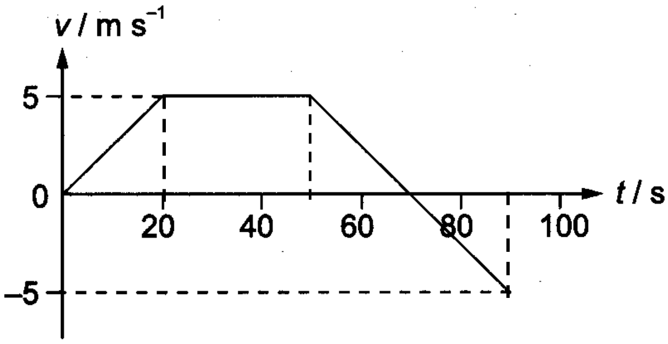
Efficiency = $\frac{\text{Useful power output}}{\text{Total power input}} \times 100\%$

= $\frac{300}{480} \times 100\%$ [1]

= 62.5% [1]

11. Either

A girl starts from rest and travels along a straight line. The diagram below shows the velocity-time graph of the girl from 0 s to 90 s.



a) Define velocity [1]

Velocity is the rate of change of displacement. [1]

b) Describe the motion of the girl from 0 s to 40 s. [2]

From 0 s to 20 s, she is travelling with constant acceleration / velocity increasing at a constant rate. [1]

From 20 s to 40 s, she is travelling at constant velocity. [1]

c) Find the average velocity of the girl in the first 70 s. [2]

Total displacement = 5 x (30 + 70) x 0.5

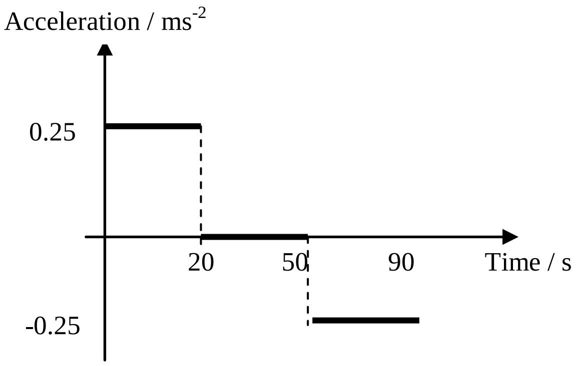
= 250m

Average velocity = total distance / total time

= 250 / 70 [1]

= 3.57 ms^{-1} [1]

d) Draw the acceleration-time graph of the girl from 0 s to 90 s. [3]



e) Find the displacement of the girl from the starting point to the position at 90 s. [2]

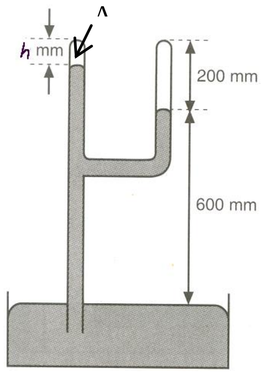
Displacement = (½ x (70 + 30) x 5)) - (½ x 20x5)

= 250 – 50 [1]

= 200 m [1]

11. OR

The diagram below shows a forked tube containing mercury of density 13600 kgm^{-3}. One branch of the tube contains air and the other branch contains vacuum. The length, *h*, is found to be 50 mm.



a) State the atmospheric pressure shown in terms of the length of liquid. [1]

750 mmHg / 75 cmHg [1]

b) Calculate the atmospheric pressure shown by the barometer in Pascal. [2]

Pressure = ρgh

= 13600 x 10 x 0.750 [1]

= 102 000 Pa [1] (ecf from a)

c) Calculate the pressure of the enclosed air in Pascal. [2]

Pressure = ρgh

= 13600 x 10 x 0.150 [1]

= 20400 Pa [1]

d) The apparatus is brought up a tall building and the *h* value changes to 70 mm. What is the height of the building, given that the density of air is 1.25 kg/m^3? [2]

P = $(\rho gh)_{air}$ = $(\rho gh)_{Hg}$

1.25 x 10 x h = 13 600 x 10 x (0.750 – 0.730) [1]

12.5 x h = 13 600 x 10 x 0.020

h = 217.6 m

= 220 m [1]

e) Some adjustments are made to the barometer. State and explain what will happen to the difference in height between the two liquid columns when: [3]

i) more mercury is now added.

Height difference remains the same.
No change in atmospheric pressure, so no change in height difference. [1]

ii) some air is introduced into the barometer at A.

Difference in height will be lesser [1]
The air will result in pressure acting downwards in A. [1]

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