Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Term 3 Class Test
Year 4 (Integrated Programme)

PHYSICS

Chapters 5 to 8, 11 & 19 to 21:
Turning Effect of Forces; Pressure; Energy, Work and Power;
Kinetic Model of Matter; Thermal Properties of Matter;
Practical Electricity; Magnetism; Electromagnetism

13 Aug 2021
40 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work that you hand in.
Write in dark blue or black pen.
Do not use paper clips, glue or correction fluid.
The use of an approved scientific calculator is expected, where appropriate.
At the end of the examination, fasten all your work securely together.

Section A: Multiple Choice
There are **ten** questions in this section. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice **in the table** provided at the end of this section.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

Section B: Structured
You may use an HB pencil for any diagrams or graphs.

Answer **all** questions.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their workings in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

For examiner's use only:

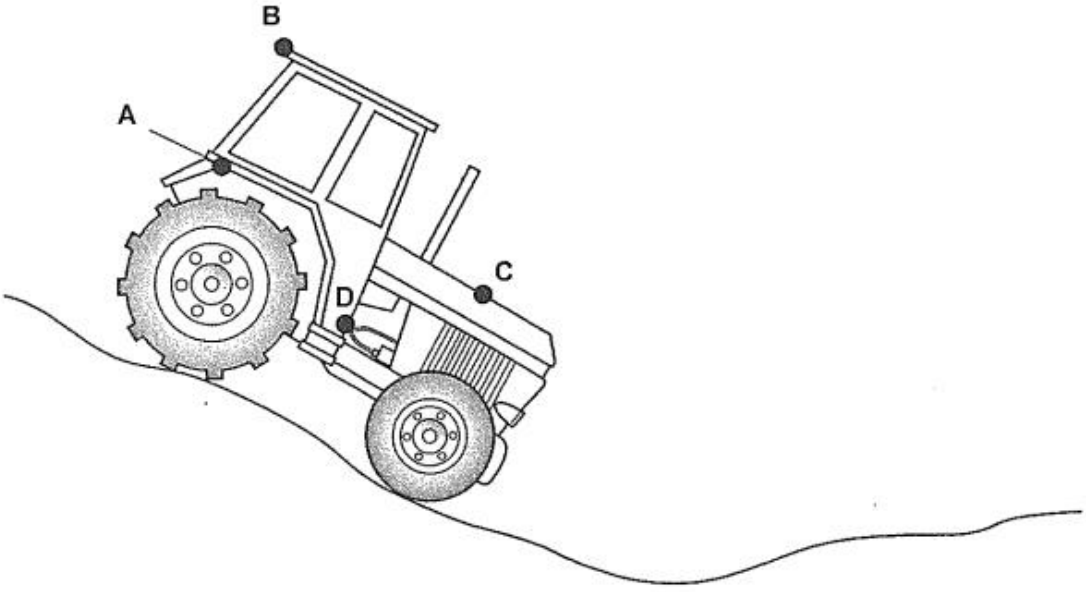
Section A	/ 10
Section B	/ 25
formula s.f.	□ □
Total	**/ 35**

Section A

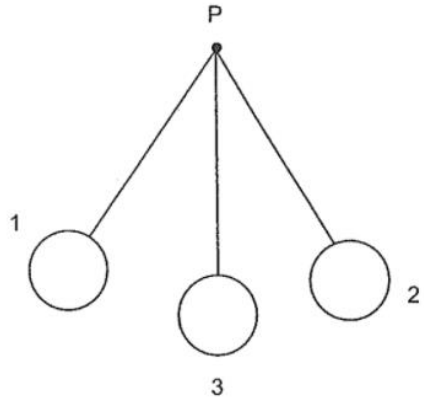
Answer **all** the questions in this section.
Record your choice **in the table** provided at the end of this section.

1 A tractor is being used on rough ground.

What is the safest position for its centre of gravity?



2 A mass hangs on a string fixed at point P. It starts from position 1 and swings to the furthest position on the opposite side, position 2. It then oscillates several times with decreasing amplitude before ending at position 3.



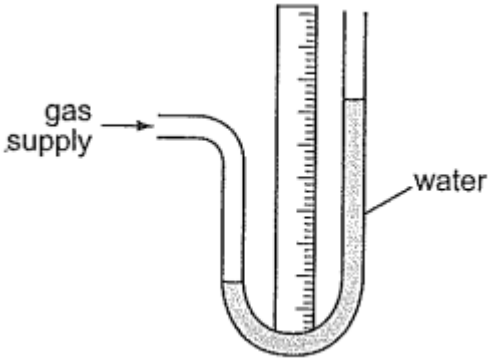
Where does the ball have the most gravitational potential energy?

A at both positions 1 and 2
B at position 1
C at position 2
D at position 3

3 Which of the following does **not** cause the height of the mercury column in a barometer to vary?

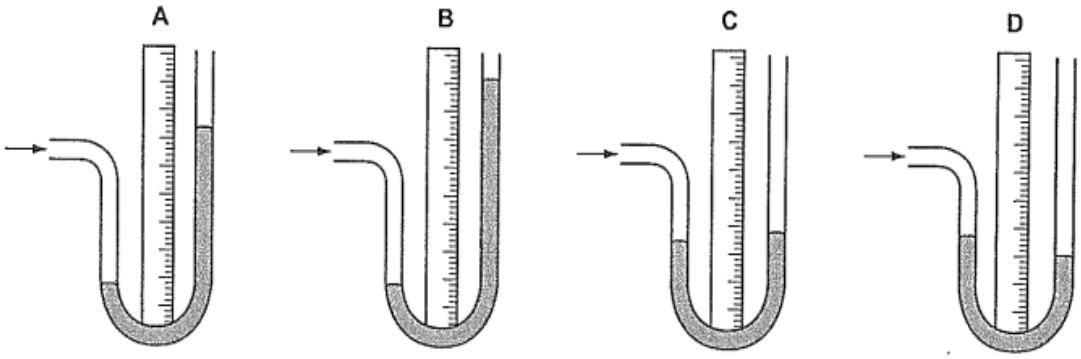
A changes in the atmospheric pressure
B changes in the value of gravitational field strength
C evaporation of mercury from the barometer reservoir
D leakage of air into the tube

4 A water manometer is connected to a gas supply. The diagram shows the water levels.



The water is replaced by mercury, which is denser than water.

Which diagram shows the mercury levels when the manometer is connected to the same gas supply?



5 Which of the following would cost the **least** if operated from the same voltage supply?

A a 5000 W electric cooker used for 1 minute
B a 1000 W electric fire used for 10 minutes
C a 500 W electric iron used for 1 hour
D a 100 W lamp used for 1 day

6 Identical iron and steel cylinders are magnetised by placing them inside a solenoid connected to a d.c. supply.

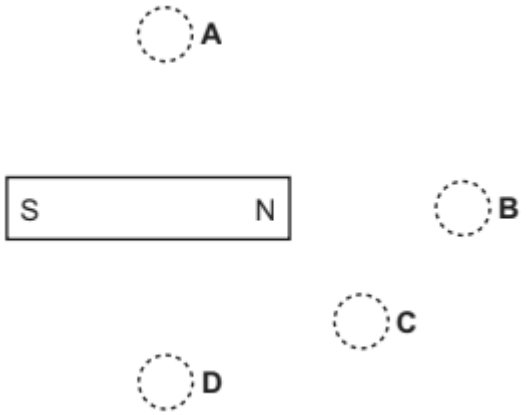
Which pair of statements about the strength of the magnetic field produced by the iron and steel cylinders is correct?

	with supply switched on	after supply is switched off
A	field produced by iron is stronger	field produced by iron is stronger
B	field produced by iron is stronger	field produced by steel is stronger
C	field produced by steel is stronger	field produced by iron is stronger
D	field produced by steel is stronger	field produced by steel is stronger

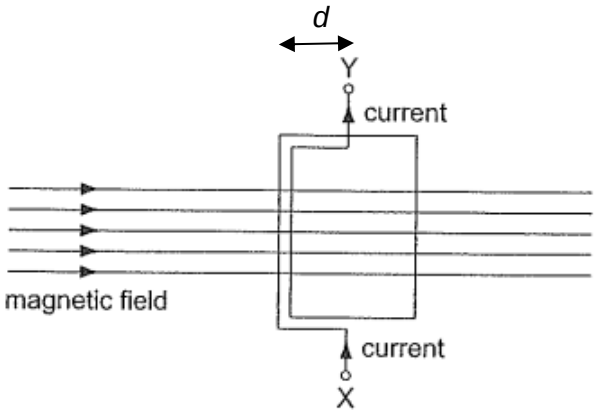
7 Four plotting compasses are placed near a bar magnet. You may ignore any effects of the Earth's magnetic field.

One compass appears as shown below.

What is a possible position for this compass?



8 A coil, carrying a current, is arranged within a magnetic field. The coil experiences forces that can make it move.



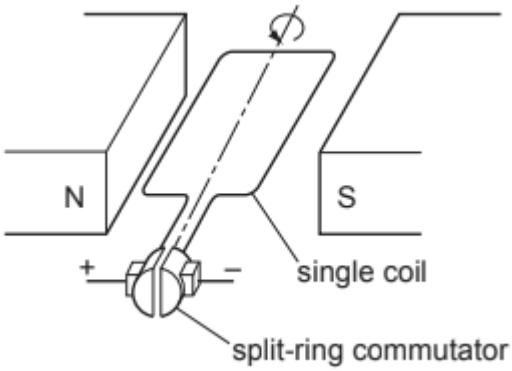
In which direction does the coil move?

A into the paper
B out of the paper
C turns about the axis XY with the left side of the coil coming out of the paper
D turns about the axis XY with the left side of the coil going into the paper

9 With reference to the coil in Question 8, which of the changes below does **not** increase the turning effect of the coil?

A increase the number of turns of the coil
B reduce the distance *d* between the vertical sides of the coil and axis XY
C reduce the resistance of the rheostat connected in series to the coil
D use a stronger magnet

10 The diagram shows a simple electric motor.



The split-ring commutator reverses the current in the coil as the coil rotates.

The coil is rotated 500˚ from the position shown.

How many times is the current in the coil reversed?

A 1 **B** 2 **C** 3 **D** 4

Answers for Section A

1	***D***	**2**	***B***	**3**	***C***	**4**	***C***	**5**	***A***
6	***B***	**7**	***C***	**8**	***D***	**9**	***B***	**10**	***C***

Section B

Answer **all** the questions in this section.

11 A uniform, rectangular concrete block is lying horizontally on flat ground with its largest side in contact with the ground. Fig. 11.1 shows the dimensions of the block.

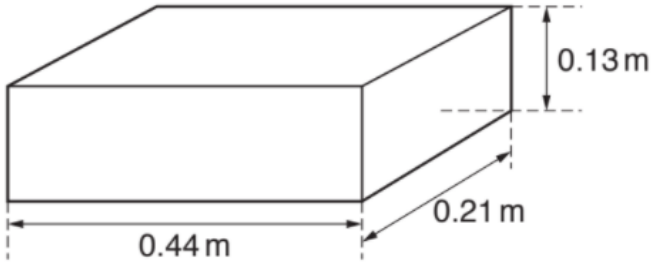


Fig. 11.1

The weight of the block is 240 N.

The block is rotated about its lower, left-hand edge so that it comes to rest on its smallest side, as shown in Fig. 11.2.

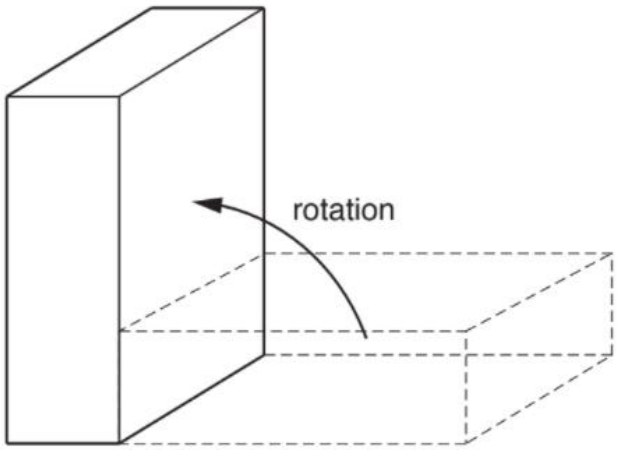


Fig. 11.2

(a) By taking moments about its lower, left-hand edge, calculate the minimum possible upward force F required to start rotating the block.

Upward force is smallest when it is applied at the furthest distance from the pivoting axis (ie. 0.44 m).

By Principle of Moments about the lower, left-hand edge,
Clockwise moments = Anti-clockwise moments

$W \times d_1 = F \times d_2$

$F = 240 \times 0.22 / 0.44$ [M1]

$= 120$ N [A1]

smallest force required = ... [2]

(b) Assuming that the minimum force required for the block to continue rotating remains vertically upwards throughout, state and explain how the magnitude of this minimum force changes.

As the block rotates, the clockwise moment due to its weight decreases due to the smaller perpendicular distance from the pivot to the line of action of weight. [M1]

However, the perpendicular distance from the pivot to the line of action of upward force decreases by the same ratio/proportion, so the magnitude of the minimum force required to provide a smaller anti-clockwise moment remains the same. [A1]

[2]

(c) Explain why work is done as the block is rotated.

EITHER
- The block moves upwards, [B1]
- and the direction of force and direction of motion of the block are the same. [B1]

OR
- The block has weight, [B1]
- and the upward force acts against the weight to move the block in the direction of the force. [B1]

[2]

(d) The rotation occurs over a period of time of 3.0 s.

Show that the average power required for this rotation is 12.4 W.

Average Power = Gain in GPE / Time
= mg(Δh)/t [B1]
= (240)(0.5 x 0.44 – 0.5 x 0.13)/3 [B1]
= 12.4 W [A0]

OR

Average Power = Work Done / Time
= (F x d)/t [B1]
= (120)(0.44 – 0.13)/3 [B1]
= 12.4 W [A0]

[2]

12 Fig. 12.1 shows a freezer.

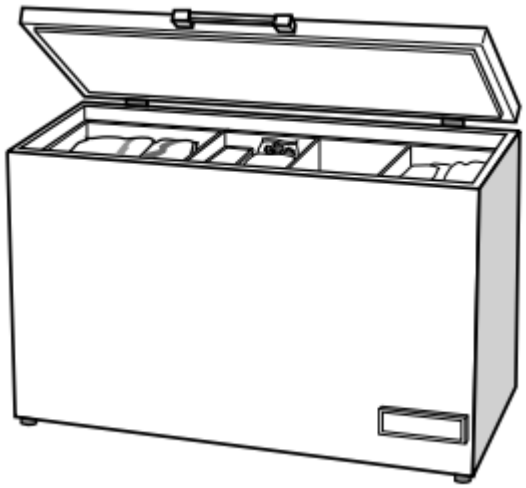


Fig. 12.1

(a) The lid of the freezer is closed and air at room temperature is trapped inside the freezer. The freezer is switched on.

Using ideas about molecules, state and explain what happens to the pressure of the air in the freezer as it cools.

- When temperature decreases, molecules slow down (or have less kinetic energy). [B1]
- Hence, they collide less frequently and with less force with the walls of the freezer. [B1]
- This results in a smaller force per unit area of the air on the walls, or a smaller pressure. [B1]

[3]

(b) When the freezer reaches its operating temperature, it is more difficult to open the lid.

Explain why.

Pressure outside the freezer is higher than the pressure inside, so the pressure difference causes a downward force on the lid. [B1]

[1]

13 Fig. 13.1 shows an electric kettle with a plastic outer casing. The kettle contains 500 g of water at an initial temperature of 25˚C. The kettle is connected to a 230 V power supply and switched on for a period of 10 minutes. During this time, boiling occurs and 80 g of steam is produced.

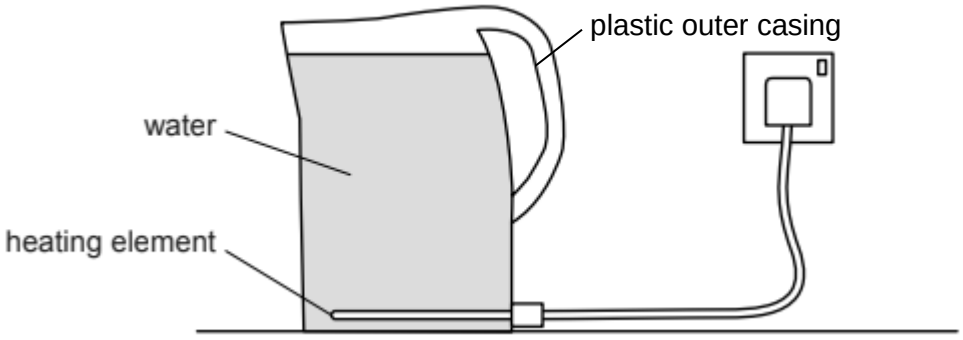


Fig. 13.1

The specific heat capacity of water is 4200 J / (kg ˚C), and the specific latent heat of vaporization of water is 2260 kJ / kg.

(a) Determine the current passing through the heating element.

Electrical energy supplied = Thermal energy to heat up water + Thermal energy to change water to steam

$$IVt = m_w c\Delta T + m_s l_v$$

$$I(230)(10 \times 60) = (0.5)(4200)(100 - 25)\ [B1] + (0.08)(2260 \times 10^3)\ [B1]$$

$$I = 2.45\ A\ (3\ sf)\ [A1]$$

current = ... [3]

(b) Hence, state an appropriate value for the rating of the fuse connected to the heating element.

Accept 3, 4 or 5 A. (whole number) [A1]

rating = ... [1]

(c) In order to explore what he learnt during Physics lessons, a boy removes the earth wire from the three-pin plug connecting the kettle to the mains supply. He then touches the handle of the kettle.

State and explain if there is any danger to the boy when the live wire accidentally touches the internal metal casing of the kettle.

Even though current flows from the live wire to the internal metal casing of the kettle, the external plastic casing provides insulation from the internal components of the kettle, hence preventing electrocution. [M1]

Hence, the boy experiences no danger. [A1]

..... [2]

14 Fig. 14.1 shows a simple relay. Fig. 14.2 shows a reed relay. Both are drawn to the same scale.

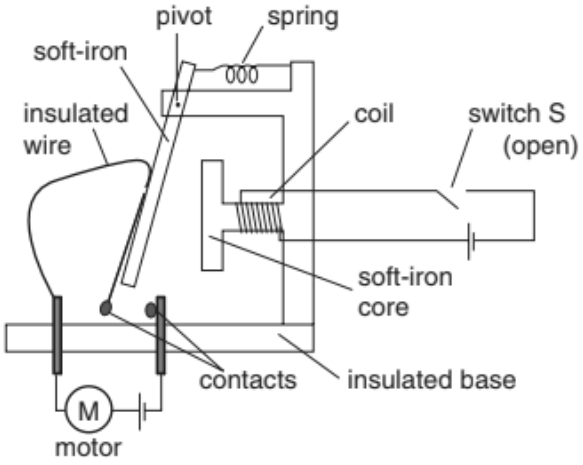


Fig. 14.1

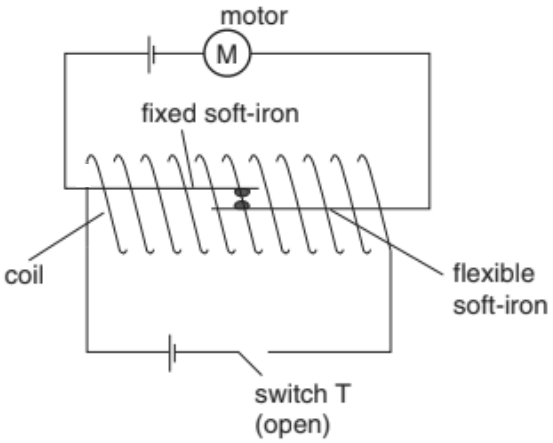


Fig. 14.2

(a) Explain why closing switch S in Fig. 14.1 causes the motor M to start.

- Current flows in the coil, causing iron core (inside coil) to be magnetised. [B1]
- The pivoted soft-iron is magnetised or attracted to the iron core, [B1]
- closing the contacts or completing the circuit (which allows the motor to start). [B1]

[3]

(b) Suggest two reasons why factories may prefer to use the reed relay in Fig. 14.2 compared to the simple relay in Fig. 14.1 when operating high current motors.

- Reed relay requires less space than the simple relay. [B1]
- Reed relay requires less materials compared to the simple relay, which requires a spring, contacts, insulated base and pivot, all subject to wear and tear. [B1]

[2]

(c) Draw the magnetic field lines due to the current flowing in the coil in Fig. 14.2. [2]

- At least three magnetic field lines drawn, not touching each other [B1]
- Arrows of magnetic field lines pointing to the right [B1]