TAMPINES SECONDARY SCHOOL

O

Secondary Four Express
PRELIMINARY EXAMINATION 2023

NAME

CLASS | | | | **REGISTER NUMBER** | | |

PHYSICS **6091/02**

Paper 2 Theory **21 Aug 2023**

1 hour 45 minutes

Candidates answer on the Question Paper

No Additional Materials are required

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 12 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.

Candidates are advised to show all their working 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	
SECTION A (50 marks)	
SECTION B (30 marks)	
significant figure	
units	
TOTAL (80 marks)	

Section A

Answer **all** questions in the spaces provided.

1 Fig. 1.1 shows the velocity-time graph of a car. It was initially travelling to the left.

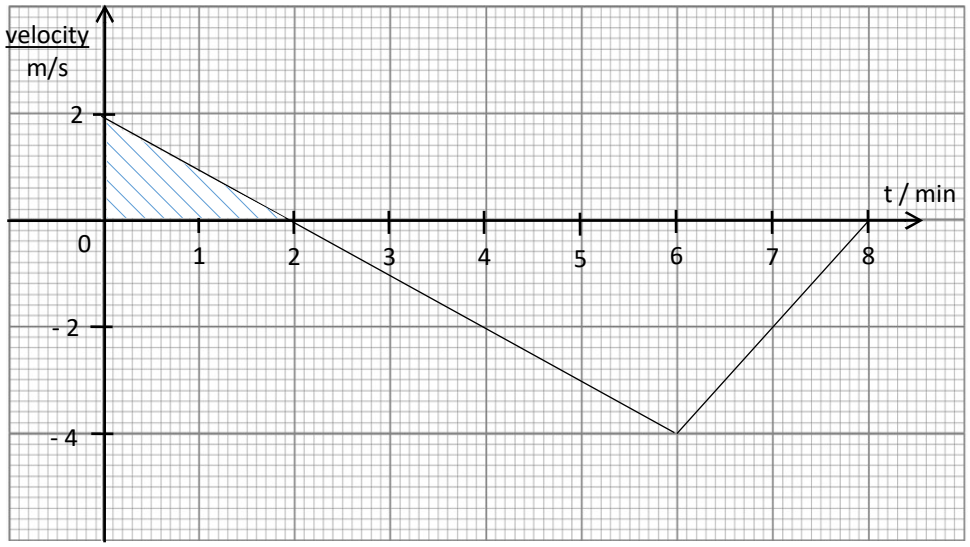

Fig. 1.1

(a) **(i)** State how acceleration of the car can be found from a velocity-time graph.

…..…….... [1]

(ii) Determine the acceleration of the car in the first 4 min.

Leave your answer in S.I. units.

acceleration = …… [2]

(b) State what the shaded area on Fig. 1.1 represents.

..……..... [1]

(c) State the time when the car changed direction.

..……..... [1]

(d) Calculate the displacement of the car after 8 min and state the direction of the displacement.

displacement = ... [2]

direction = ... [1]

2 Fig. 2.1 shows two blocks, initially at rest, being pushed by force F from the left along a rough surface. The mass of block **A** is 3.0 kg while the mass of block **B** is 15 kg. As the blocks are pushed, they accelerate at a constant rate of 2.0 m/s^2. The frictional force acting on block **A** is 1.8 N and the frictional force acting on **B** is 9.0 N.

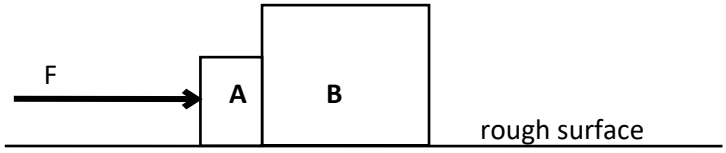

Fig. 2.1

(a) Determine the magnitude of the force F.

magnitude = ... [2]

(b) By considering the forces acting on block **B**, determine the magnitude of the contact force between blocks **A** and **B**.

magnitude = ... [2]

3 In Fig. 3.1, Papa Lim and Crystal stood on a uniform board. The board weighs 40 N and the support is under the centre of gravity of the board. Papa Lim and Crystal weigh 810 N and 400 N respectively. Papa Lim is standing 0.80 m from the support.

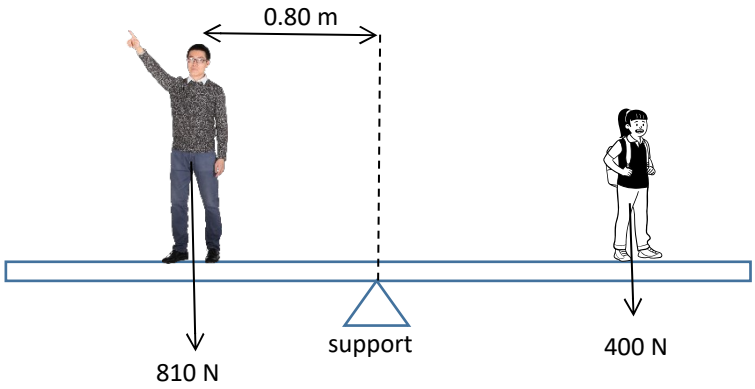

Fig. 3.1

(a) Explain what is meant by "… centre of gravity of the board".

..... [1]

(b) Calculate how far from the support should Crystal stand, to balance the system.

distance = ... [2]

(c) Determine the magnitude of the upward force exerted on the board by the support.

magnitude = ... [1]

4 **(a)** In Fig. 4.1, a ray of light is incident on a right-angled prism of refractive index 1.5.

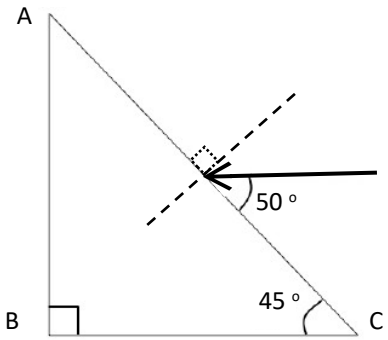

Fig. 4.1

(i) Calculate the angle of refraction of the ray on the face AC.

angle = …… [1]

(ii) Explain whether this ray within the prism will undergo total internal reflection when it hits the face AB. Show any essential working clearly.

…..

…..

….. [3]

(b) Fig. 4.2 shows a thin converging lens used to produce an image **X'** of an object **X**.

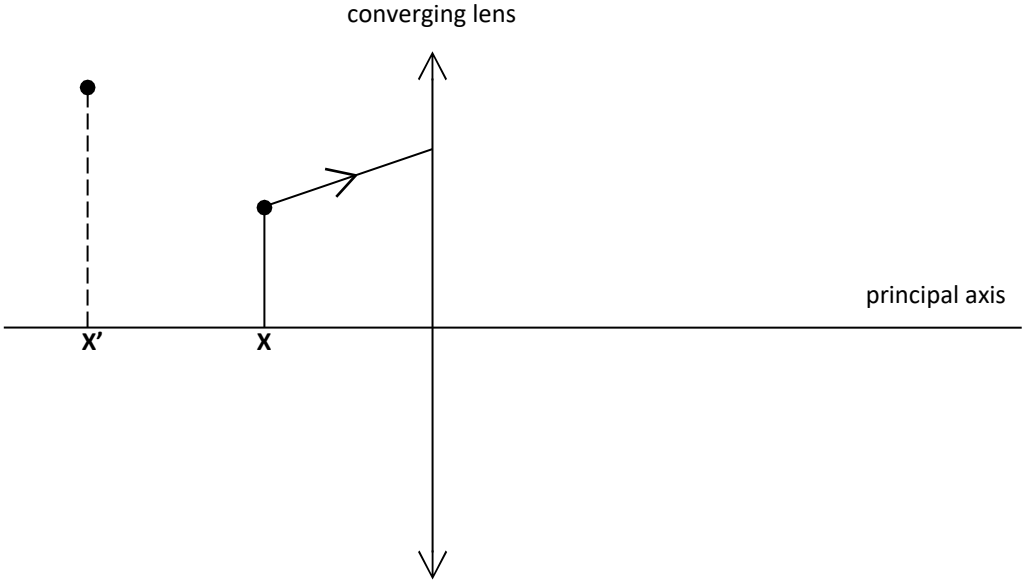

Fig. 4.2

(i) By completing Fig. 4.2 with suitable light rays, locate the position of the lens' principal focus.

Label the principal focus **F**. [3]

(ii) State how the image will change when the half the converging lens is being covered up.

…… [1]

5 Athan standing at a pier noticed wavefronts going towards the seashore. Fig. 5.1 shows the top view of the wavefronts, from when they were far away from shore to the time when they are significantly nearer to shore. **P** and **Q** are two points along the wave.

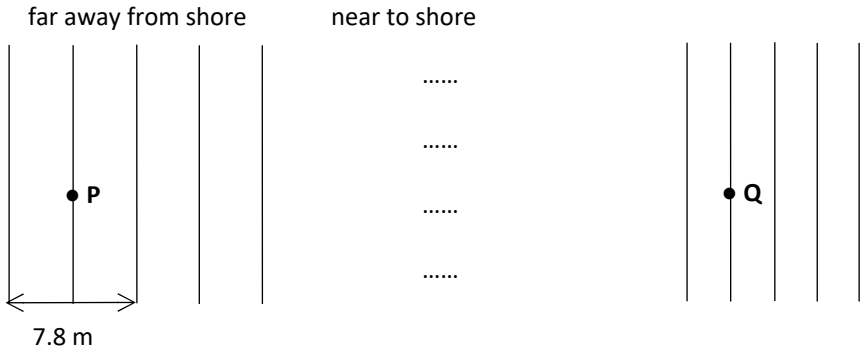

Fig. 5.1

Fig. 5.2 shows the

displacement-time graph of a particle at **P**, starting from the instant shown in Fig. 5.1.

Fig. 5.2

(a) Determine the wavelength of the wave at **P**.

wavelength = …… [1]

(b) Calculate the speed of the wave at **P**.

speed = …… [2]

(c) State the period of the particle at **Q**.

..... [1]

(d) Comment on how the speed of the particle, frequency of wave and the depth of sea at **Q** change as compared to **P**.

speed:.....

.....

frequency:.....

.....

depth:.....

..... [3]

6 In Fig. 6.1, a car becomes electrically charged as it travels along a road.

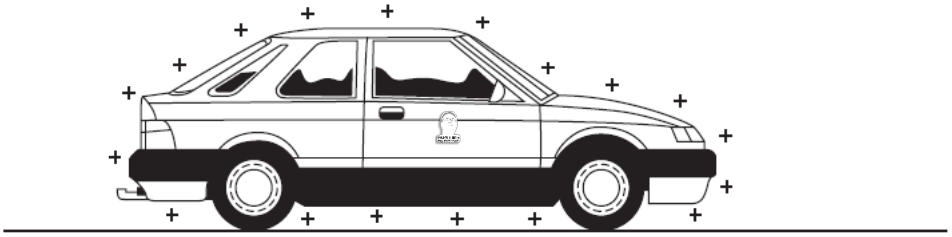

Fig. 6.1

(a) Explain how a moving car becomes positively charged.

.....

..... [1]

(b) Explain why the charges remain on the car after it has stopped moving.

.....

..... [1]

(c) Some car owners fixed a metal strap underneath the car as shown in Fig. 6.2. The metal strap is in contact with the ground as the car moves.

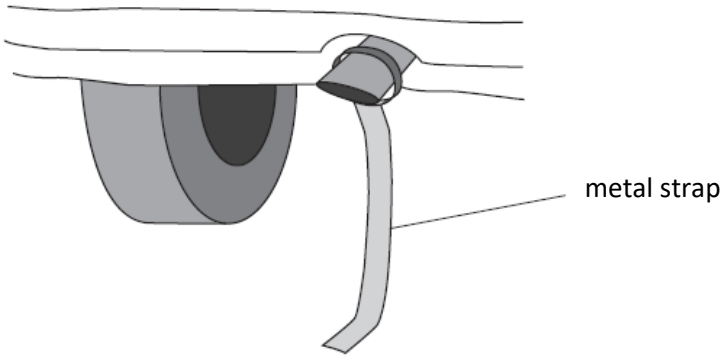

Fig. 6.2

Explain how the metal strap prevents the car in Fig. 6.1 from becoming charged.

.....

.....

..... [2]

7 The circuit set up in Fig. 7.1 has a variable resistor **XY** that varies between 0 Ω to 1000 Ω.

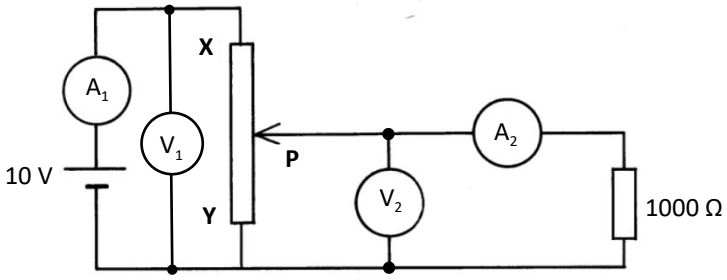

Fig. 7.1

(a) Identify how each meter's reading will change as slider contact **P** moves from **Y** to **X**. Circle the correct answer. [3]

Reading of Ammeter A_1: increases / decreases / no change

Reading of Ammeter A_2: increases / decreases / no change

Reading of Voltmeter V_1: increases / decreases / no change

Reading of Voltmeter V_2: increases / decreases / no change

(b) Determine the reading of ammeter A_1 when slider contact **P** stops midway between **X** and **Y**.

reading = …… [2]

8 Fig. 8.1 shows a wire bent into a U shape frame labelled **ABCD** supported on two knife edges. The knife edges support the wire at **P** and **Q**.

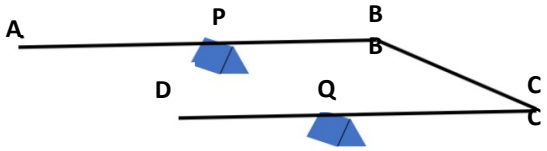

Fig. 8.1

The section **PBCQ** of the wire frame is then placed within a coil of wire. The top view of the set-up is as shown in Fig. 8.2.

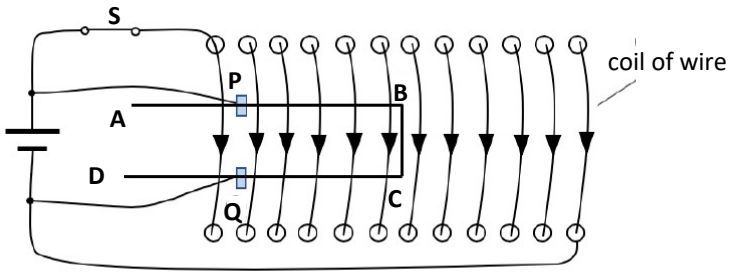

Fig. 8.2

The electrical source is connected in parallel to the coil of wire and the wire frame.

The U shape wire frame is horizontal when the switch **S** is opened.

When the switch **S** is closed, current flows into the wire frame and coil of wire. Current from the source flows into the wire frame at **P** and leaves via **Q**. When the current flows in the frame, the U shape wire frame is observed to rotate about the knife edge.

(a) State which direction will the U shape wire frame rotate.

Explain why this occurred.

……

……

……

…… [3]

(b) It is observed that the turns in the coil of wire move closer when a current is flowing in the coil.

Explain why this occurred.

.....

.....

..... [2]

9 Fig. 9.1 shows a step-down transformer.

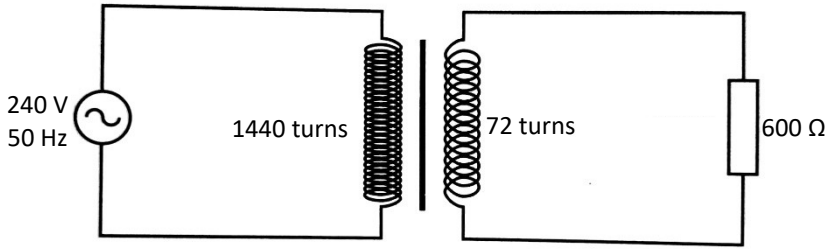

Fig. 9.1

(a) Calculate the potential difference across the 600 Ω resistor.

potential difference = ... [2]

(b) Calculator the power dissipated across the 600 Ω resistor.

power = ... [2]

(c) State the assumption you made in the calculations above.

.....

…… [1]

Section B

Answer **all** questions in the spaces provided.

Answer only one of the two alternative questions in **Question 12**.

10 A temperature activated appliance makes use of an input transducer to switch on the appliance when the temperature falls below a certain level. Table 10.1 shows how the resistance of the input transducer varies with temperature.

temperature / °C	resistance / Ω
14	4900
16	4500
18	4200
20	3900
22	3500
24	3200
26	2900
28	2700
30	2500
32	2300
34	2100
36	1900
38	1800
40	1600
42	1500
44	1400

Table 10.1

(a) Explain what is meant by an input transducer.

.....

..... [1]

(b) Using the data from Table 10.1,

(i) describe the relationship between the resistance of the input transducer and its temperature over the range shown,

…..

…..

….. [1]

(ii) plot the values on Fig. 10.1, [1]

(iii) sketch a best fit line on Fig 10.1 to show how the resistance of the transducer changes with temperature. [1]

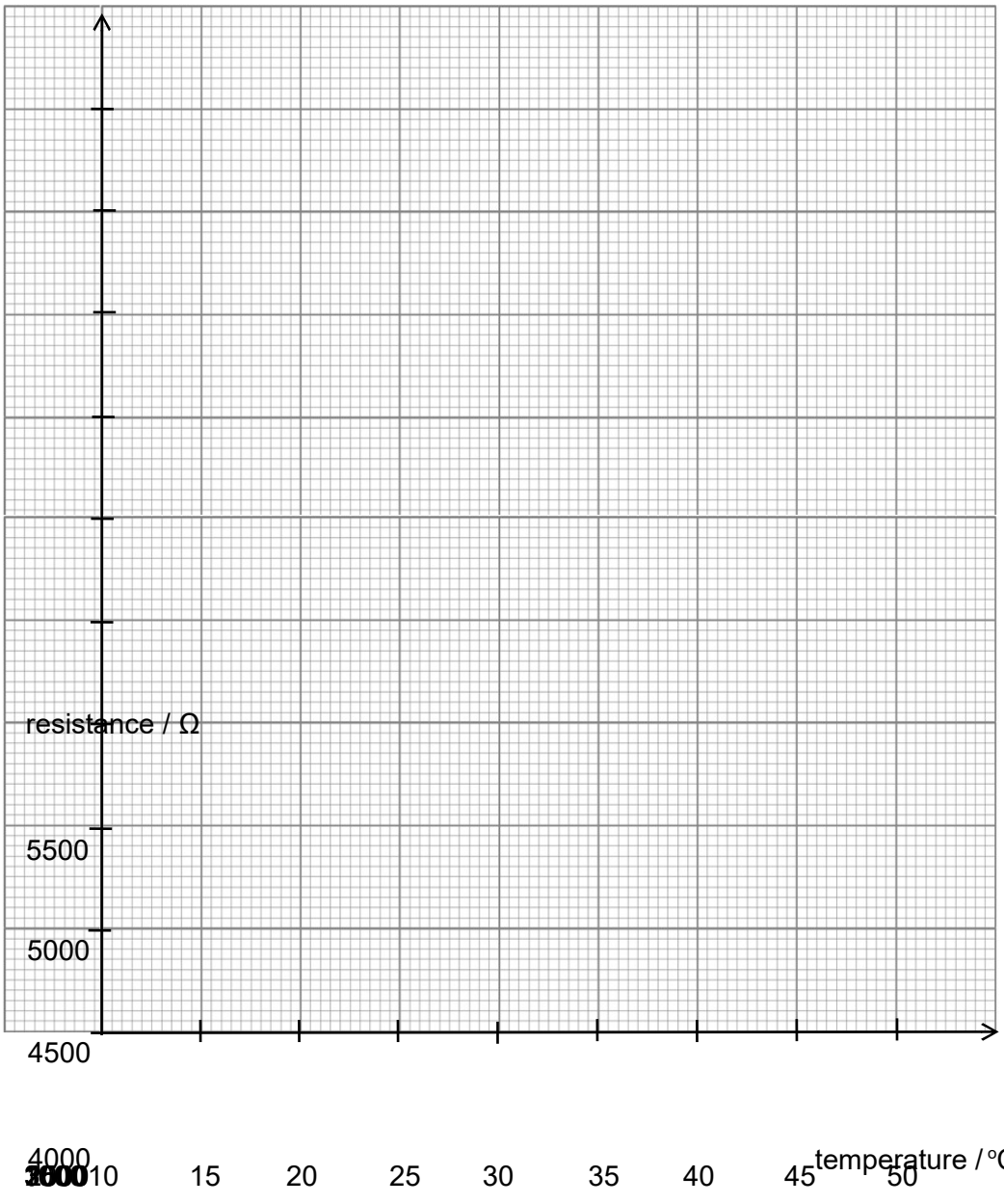

Fig. 10.1

(c) Fig. 10.2 shows how the input transducer is connected to a 4800 Ω resistor and 12 V d.c. supply. The circuit is designed such that when the temperature is above a certain value, a secondary circuit connected to V_{out} will be activated. The minimum voltage needed to activate the secondary circuit is 7.2 V.

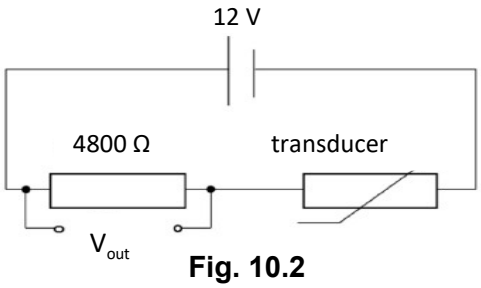

Fig. 10.2

(i) Explain why V_{out} increases when temperature increases

…..…….....

…..…….....

…..……..... [2]

(ii) Determine the minimum temperature of the input transducer when the secondary circuit is activated.

temperature = …… [2]

(iii) When the temperature of the input transducer is equal to the temperature calculated in part **(c)(ii)**, a lamp of rating '7.2 V, 12 W' is connected in parallel with the resistor.

Explain why the lamp will be much dimmer than expected.

…..…….....

…..…….....

…..……..... [2]

11 Fig. 11.1 shows a syringe with a stopper placed over the nozzle so that gas is trapped inside.

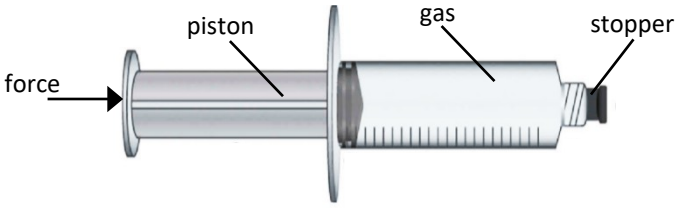

Fig. 11.1

(a) Explain, in terms of molecules, why the piston can be pushed in slowly and the stopper remains in position.

.....

.....

..... [2]

(b) Explain how the gas exerts pressure on the walls of the syringe.

.....

.....

..... [2]

(c) Explain why the pressure is the same at all points on the inside walls of the syringe.

.....

.....

..... [2]

(d) State how the pressure exerted by the gas will change when its volume is reduced by half, at constant temperature.
Explain your answer.

.....

.....

..... [2]

(e) State one assumption for your answer in part **(d)**.

.....

..... [1]

(f) Explain the changes in the motion of the gas molecules when the gas is heated.

.....

.....

..... [1]

12 EITHER

A spherical bob is released from rest in air and strikes a pond below. Fig. 12.1 shows the variation of kinetic energy of the bob with the distance moved during its descent. The bob comes to rest at **C**. The gravitational field strength g is 10 N/kg and the mass of the bob is 0.50 kg.

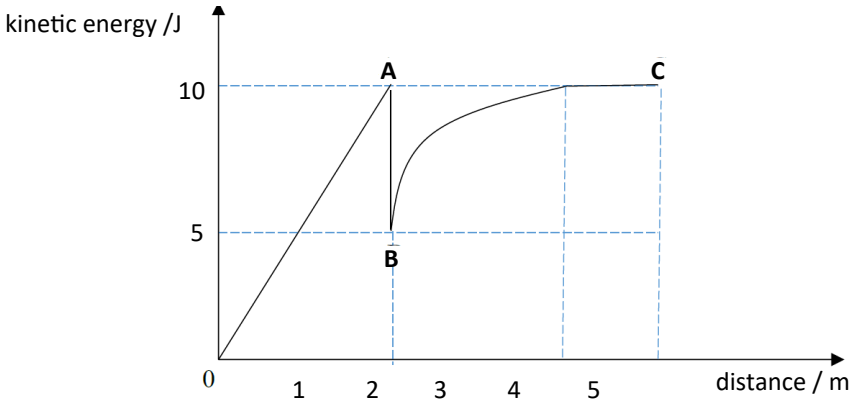

Fig. 12.1

(a) Determine the depth of the pond.

depth = ... [1]

(b) State the gravitational potential energy possessed by the spherical bob just before it is being released in the air.

..... [1]

(c) State the assumption made in your calculation for part **(b)**.

.....

..... [1]

(d) Calculate the velocity at which the spherical bob strikes the surface of the pond.

velocity = …… [2]

(e) Determine the time taken for the bob to reach the surface of the water.

time = …… [1]

(f) Describe and explain what happens to the resultant force acting on the bob at these stages:

(i) between 2 m to 4 m:

…..……....

…..……....

…..…….... [2]

(ii) between 4 m to 5 m:

…..……....

…..……....

…..…….... [2]

OR

The heat capacity of cookware plays a crucial role in determining its ability to distribute and retain heat effectively during cooking. Table. 12.1 shows the properties of three metals **X**, **Y** and **Z**. 800 cm^3 of each of the metal **X**, **Y** and **Z** are used to make three cooking pots of the same shape.

metal	density / (g/cm^3)	mass / g	specific heat capacity /(J/g^oC)
X	2.7		0.90
Y	1.8		0.15
Z	8.0		0.40

Table 12.1

(a) For each of the metal, calculate the mass of metal used for making the cooking pot.

Write your answer in the appropriate row in Table 12.1. [3]

(b) Explain what is meant by "The heat capacity of cookware..."

...

... [1]

(c) Each cooking pot contains equal volume of water and is heated by a hot plate. All the hot plates used are identical.

After the water in each of the pots had boiled, the pots are removed from the hot plates and allowed to cool. After five minutes, the temperature of each pot of water is measured.

(i) State and explain which pot of water will be the first to boil.

.....

.....

..... [2]

(ii) At the end of five minutes, state and explain which pot of water will be at a higher temperature.

…..…….....

…..…….....

…..……..... [2]

(d) State two assumptions made in your answers for part **(c)**.

…..…….....

…..…….....

…..……..... [2]

End of Paper