XINMIN SECONDARY SCHOOL

新民中学

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Preliminary Examination 1998

SCIENCE(PHYSICS) 5142 / PAPER 2
SECONDARY 4 EXPRESS / 5 NORMAL
THURSDAY, 3 SEPTEMBER 1998
SETTER: CHIA KH
VETTER: M SHONE

Name: _____ (   )   Class: _____

INSTRUCTIONS TO CANDIDATES

1   Fill in your name, index number and class in the space above.

2   Time allowed: 1 hour 15 minutes.

3   The question paper consists of two sections.

   Section A
   Answer all of the questions in the spaces provided in this booklet.

   Section B
   Answer any TWO of the questions on the writing paper provided.

4   Calculators may be used.

5   This booklet consists of 11 numbered pages.

Where necessary assume the following values:
   Speed of light, c =3 × 10⁸ m/s
   *Acceleration due to gravity, **g** = 10 m/s²*

Section A (Structured Questions)   *45 Marks*
Answer all the questions in the spaces provided.

A1 A substance, initially in the solid state, was heated by a 800 W heater. The temperature was taken at regular intervals and the temperature-time graph plotted as shown in the figure below.
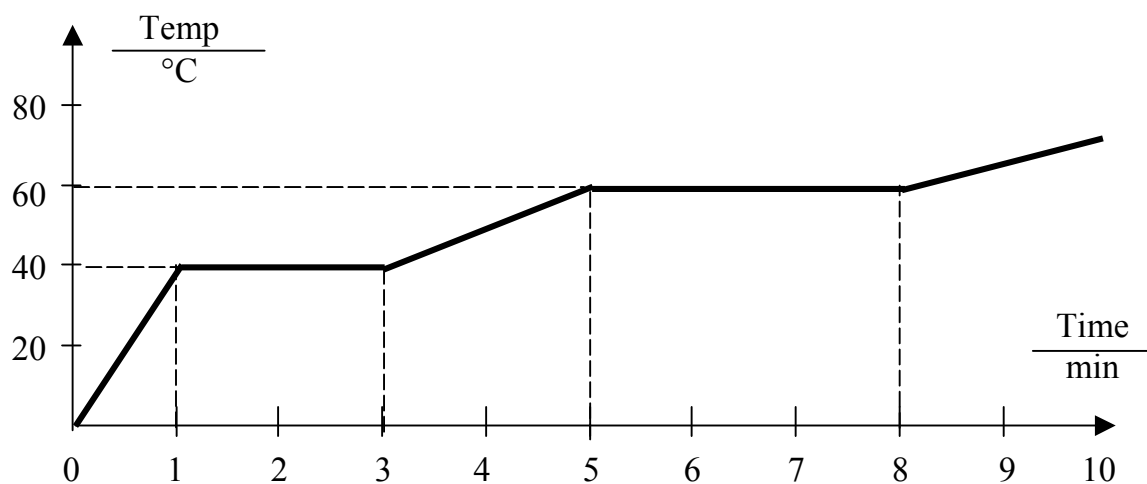

Using the graph above, determine

(a) the melting point of the substance,   [1]

(b) the boiling point of the substance,   [1]

(c) the time taken for the substance to boil.   [1]

Explain why it takes the substance a longer time to increase its temperature by 1 K when it is in the gaseous state as compared to its solid state.   [1]

A2 The figure below shows a truck of mass 2500 kg moving along a straight, level road. The engine enables a forward force of 12000 N to act on the truck. There are also counter forces that total 3200 N acting against the truck.

3200 N ⟵   ⟶ 12000 N
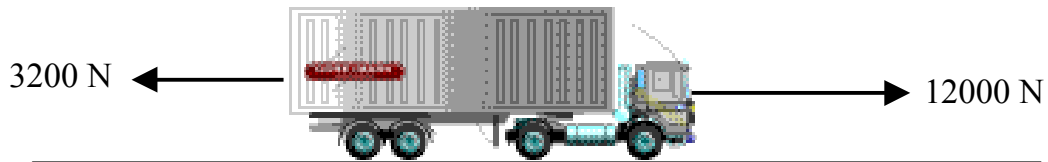
(a) Calculate the acceleration of the truck.   [2]

(b) As the truck goes faster with the same forward force, its acceleration becomes less. Eventually, the truck travels at a constant speed. Explain why this happens.   [3]

A3 A steel rule XY is clamped over the edge of a table. The end Y is pulled down and released. A note is produced as the rule vibrates.

X   Y   steel
                                             rule
                          clamp

table
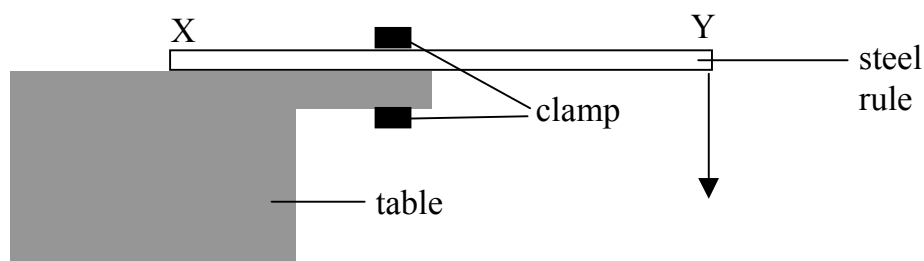
What effect (if any) would be heard

(a) as the vibration of the rule "dies away",   [1]

(b) if Y is pulled further down and then released,   [1]

(c) if the distance between Y and the clamp is increased.   [1]

A4 Three parallel equidistant straight lines are drawn as in the figure below. A plane mirror **FG** is placed on the middle line. Two objects **K** and **L** are positioned on one line in front of the mirror. An observer stands at **J**.
By drawing suitable rays, decide which object(s) (**K** and/or **L**) an observer at **J** can see in the mirror. [3]
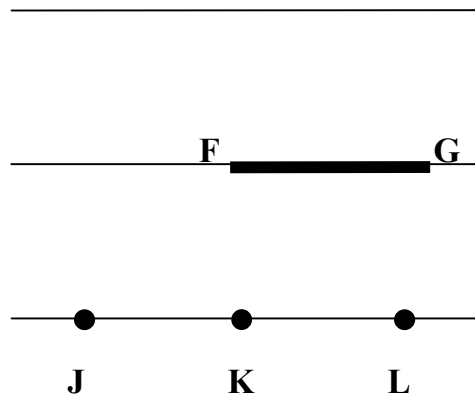
The observer at **J** can see object(s) at _____.

A5 An electric motor is rated 230 V, 150 W.

    (a) What current does the motor draw when it is connected and loaded correctly? [2]

    (b) Calculate the resistance of the motor. [1]

A6 The figure shows some oil in a ripple tank which has shallow and deep sections. The waves are produced in the shallow section and proceeded towards the deep end. There is a distance of 0.6 m between wave crests and their frequency is 35 Hz.
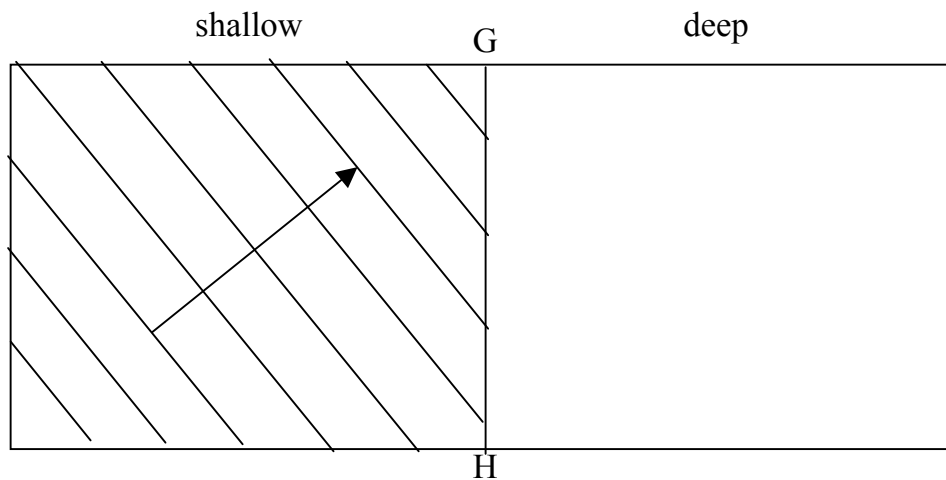
(a) What is the velocity of the waves in the shallow section? [2]

(b) Complete the figure above to show the waves in the deep section. [2]

**A7** The figure shows the path of the light ray through a glass block and into the air again.
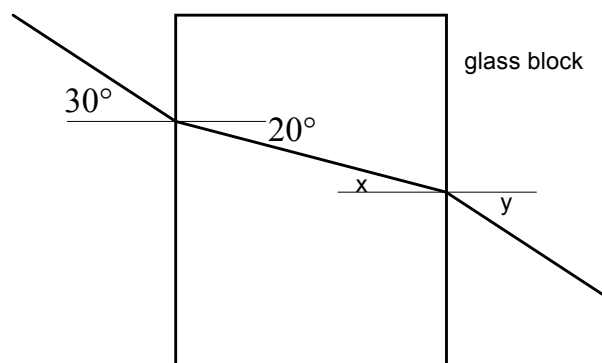
(a) Using the information given in the diagram, determine the refractive index of the glass block. [2]

(b) State the angles x and y. [1]

x = _____;   y = _____.

(c) Given that the speed of light in air is 3.0 x 10^8 m/s, what is the speed of light in glass? [2]

A8 The diagram represents an irregularly shaped flat metal sheet freely pivoted at P on a horizontal pivot so that the plane of the sheet is vertical. The centre of gravity of the sheet is marked C.
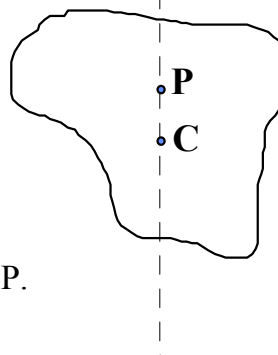
(a) State why C is vertically below P. [1]

(b) Briefly explain how you would attempt to check that C is the centre of gravity of this sheet. [2]

A piece of lead is now fixed to the sheet so that its weight 4 N acts at Y. The distance CY is 0.20 m.
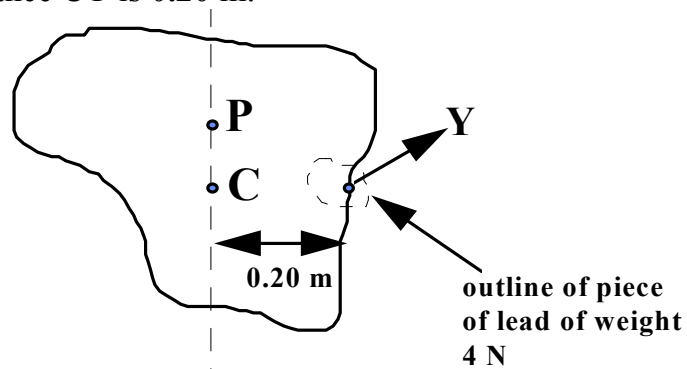
(c) The loaded sheet is held steady in its original position. Calculate the turning effect about P of the weight of the lead. [2]

(d) If the loaded sheet is now released, describe the subsequent motion of the sheet until it finally stops moving. [1]

A9 Draw in the space below a labelled diagram of a transverse wave of amplitude 3 cm and a wavelength of 6 cm. [2]

A10 (a) The diagram below represents a simple experiment used to demonstrate that three forms of radiation are emitted from a particular radioactive source. The experiment is carried out in a region where there is uniform magnetic field.
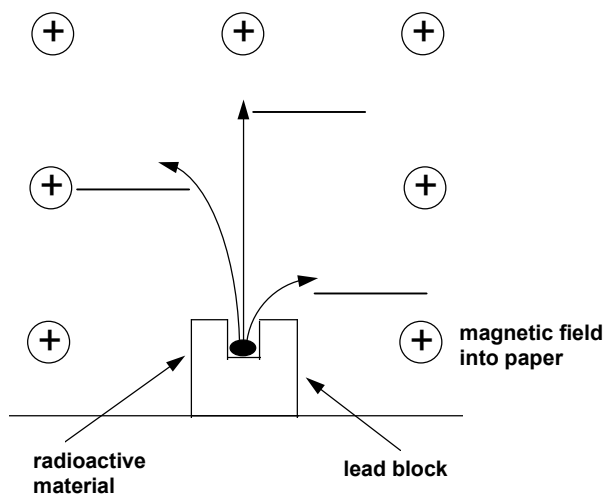
(i) Label the diagram to show which kind of radiation is emitted by each track. [1]

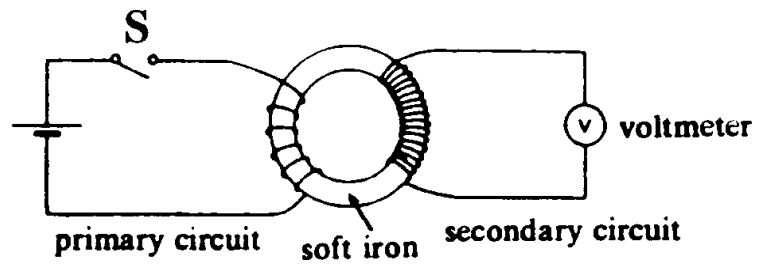(ii) Which form of radiation would be most penetrating? Explain why it is so. [2]

(b) A nucleus of the radioactive isotope $^{24}_{11}\text{Na}$ emits a β-particle when it decays to a nucleus of the element **Mg**.

(i) Complete the equation representing this event : [2]

$$^{24}_{11}\text{Na} \longrightarrow \text{Mg} \ \textbf{+}$$
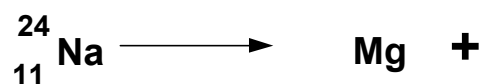
(ii) How many neutrons are there in an atom of **Mg** mentioned above? [1]

A11 The diagram below shows a simple transformer.

Switch S was then closed.

(a) Describe briefly what is seen when the switch **S** is closed. [2]

(b) Describe briefly what is seen when the switch **S** is opened. [2]

**Answer any TWO of the questions on the paper provided.**

B1 (a) State the nature of α-emissions, β-emissions and γ-emissions. Comment on their relative sizes and charges.   [4]

(b) Sodium-24 is a radioactive isotope decaying into a stable magnesium atom by the emission of β- and γ-emissions. The following shows the count rate of a sample of sodium-24 over a 60 hour period.

Time (hours)	0	12	24	36	48	60
Count Rate (counts/second)	200	115	67	38	23	12

    (i)   On graph paper plot a graph of **count-rate** against **time**.
    (ii)   Use the graph to calculate the half-life of sodium-24.   [6]

B2 The figure below shows a battery of e.m.f. 3 V in series with resistors of resistance 2.0 Ω and 4.0 Ω.

                                             3 V

           2.0 Ω   4.0 Ω
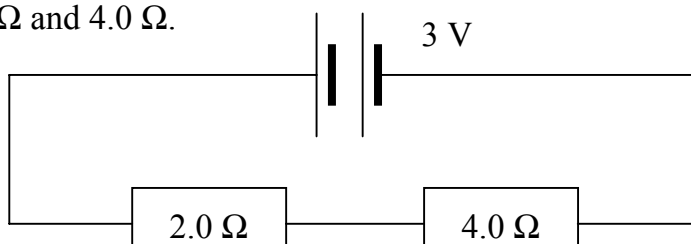
(a) Explain what is meant by "e.m.f. of 3 V".   [1]

(b) State the combined resistance of the 2.0 Ω and 4.0 Ω resistors.   [1]

(c) Calculate the current passing through the 4.0 Ω resistor.   [2]

(d) How much charge passes through the battery in one minute?   [1]

(e) The resistors are now placed in parallel with each other.
    (i)   Redraw the circuit to show the resistors in parallel.
    (ii)   Calculate the current flowing through the 4.0 Ω resistor.
    (iii)   Calculate the power drawn from the battery.   [5]

B3 (a) Draw a labelled diagram to show the essential parts of a transformer that could be used to provide a 24 V supply from the 240 V mains supply.

[5]

(b) The diagram below shows a cross-sectional view of a liquid-in-glass thermometer. The volume of the bulb is V and the bore in the stem has length x and diameter d.

State, with reasons, the effect on the thermometer's range and sensitivity of

(i)   increasing the length of the stem, x,
(ii)   increasing the diameter of the bore, d,
(iii)   making the glass around the bulb thinner.

For such a thermometer suggest a suitable liquid to use stating two reasons for your choice.   [5]