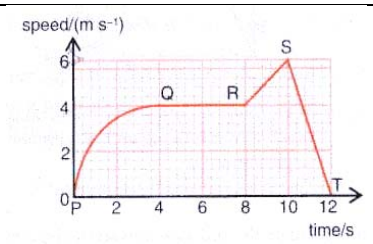
ZHENGHUA SECONDARY SCHOOL
Secondary 4 Express
Preliminary Examinations 2007
SCIENCE (Physics)
Paper 2

5152/2

Marking Scheme

Section A : (45 marks)

Q. No.	Question description / Answer	Marker's Comments
1	Complete the following table to show the property measured by each of the instruments. State the correct unit used. Instrument | Property measured | Unit Vernier calipers | Length | millimetre Spring balance | Weight | newton Voltmeter | Potential difference/voltage | volt [1/2 mark each] total = [2]	
2	 (a) In which section of the graph is the acceleration constant and negative ? [1] Section ST. (b) Calculate the acceleration in part (a) above. Acceleration , a = gradient of the line ST = (0 - 6) / (12 - 10) [1] = - 3 ms^{-2} [1] (c) What is the highest speed of the trolley ? [1] Highest speed of trolley is 6 ms^{-1} (d) What distance has the trolley travelled at uniform speed ? Distance travelled at constant speed = Area under the graph QR = 4 x 4 m [1] = 16 m [1]	

3

A wooden block with a mass of 1.2 kg being pulled with a force of 5 N on a rough surface as shown in Fig 1. The wooden block does not move because of friction.

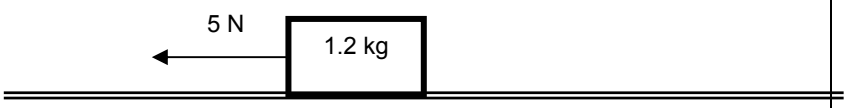


Fig 1

(a) What is the frictional force exerted on the wooden block in this instance ?

5 N [1]

(b) When the wooden block is pulled with a force of 9 N, the block moves with a constant speed.

(i) What is the resultant force acting on the wooden block ?

Zero or No resultant force. (0 N) [1]

(ii) What is the frictional force exerted on the wooden block now ?

9 N [1]

(c) The pull is then increased to 12 N. Calculate the acceleration of the block.

resultant force , F= 12-9 = 3 N [1]

By F = ma

a = F/m = 3 / 1.2 ms^{-2}

= 2.5 ms^{-2} [1]

4

(a) What is meant by moment of a force about a point ? [1]

Moment of a force about a point means the turinig effect produced bythe force about the point.

b)A uniform beam has a weight of 4N and its centre of mass is at 50 cm mark. Fig. 4 shows the beam pivoted at the 60 cm mark, balanced by a mass of weight , W hanging from the 80 cm mark. (Take the value of g = 10 N/kg).

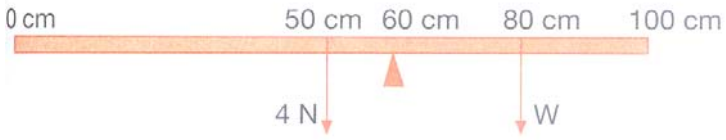


Fig.4

(i) Calculate the mass of the beam.

W = mg

m = W/g = 4 / 10 [1]

= 0.4 kg [1]

(ii) Calculate the value of the weight, W.

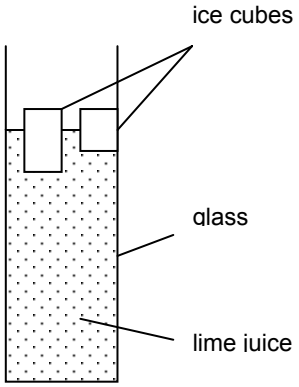
By the Principle of moments,

W x 0.2 m = 4 N x 0.1 m [1]

W = 0.4 Nm/ 0.2 m

= 2 N [1]

5 Ice cubes are added to lower the temperature of lime juice.



(a) Explain how the lime juice just next to the ice cubes cools.

Heat is transferred from the lime juice just next to ice cubes to the ice by conduction. [1] Loss of heat results in cooling or its temperature to fall. [1]

(b) Explain how the lime juice at the bottom of the glass cools.

Cold lime juice at the top being denser and it sinks to the bottom causing the lime juice at the bottom to rise [1]. A convection current is set up which causes the lime juice at the bottom also cools. [1]

(c) Explain why the outside of the glass is wet minutes later. [1]

Water vapour in the air condenses to form water dropplets on the cold glass surface outside minutes later.

6 (a) During a thunderstorm, an observer sees a lightning flash. 6 s later he hears the thunder. The speed of sound is 330 ms^{-1}. Approximately how far away is the observer from the lightning ?

distance = speed x time
= 330 ms^{-1} x 6s [1]
= 1980 m or = 1.98 km [1]

(b) The speed of sound in air is 330 ms^{-1} . What is the wavelength of a note of frequency of 550 Hz?

$v = f \times \lambda$
$\lambda = v / f$ = 330 ms^{-1} / 550 Hz [1]
= 0.6 m [1]

7 In Figure 2, a sound wave is emitted downwards from a ship. The sound wave is reflected from the seabed and is detected as it arrives back at the ship.

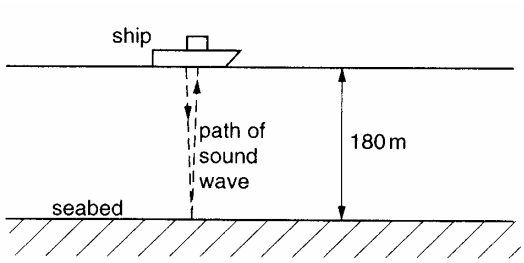


Figure 2

The time between emitting the sound wave and detecting it back at the ship is 0.25 s. The seabed is 180 m below the ship.

(a) Calculate the speed of sound in seawater.

v = 2 d / t

v = (2 x 180) m / 0.25 s [1]
= 1440 ms^{-1} [1]

(b) Suggest why sound waves cannot move from the Earth to the Moon.

The Earth and the Moon is separated by a vacuum. [1] Sound waves cannot travel through a vacuum , it needs a material medium for its travel. [1]

8 Fig. 3 shows the path of a ray of light passing into a glas block. The refractive index of the glass block is 1.5.

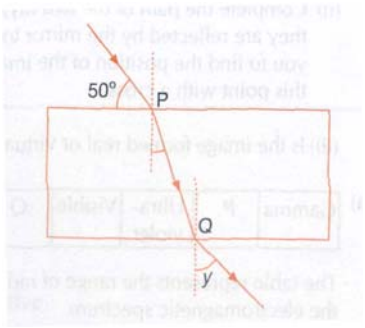


Fig. 3

(a) What is the angle of incidence at point P ? [1]

the angle of incidence at point P is 40^0

(b) Calculate the angle of refraction at point P.

n = sin i / sin r
sin r = sin 40^0 / 1.5 = 0.4285 [1]
r = 25.4^0 [1]

(c) Write down the value of angle y. [1]

the value of angle y is 40^0

9 Figure 4 shows a 4.0 Ω resistor X and a 6.0 Ω resistor Y connected to a 3.0 V battery.

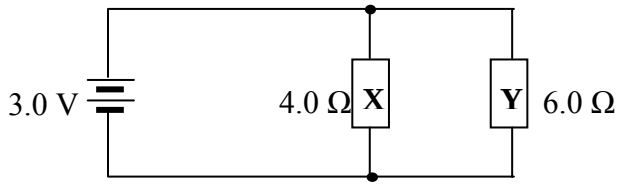


Fig 4

(a) What is the potential difference across resistor X, [1]

p.d. across X = 3.0 V

(b) Calculate

(i) the current in resistor Y, [1]

I = V / R = 3.0 / 6.0 = 0.5 A

(ii) the total resistance of the circuit,

1/ R= 1/ 4 + 1/ 6
= (3 + 2) / 12 = 5/12 [1]
R = 12 / 5 = 2.4 Ω [1]

(iii) the current through the battery,

current through the battery, I = V / R = 3.0 / 2.4
= 1.25 A [1]

(iv) the power supplied by the battery. [1]

P = VI = 3.0 x 1.25 A = 3.75 W

10 The half-life of a radioactive isotope is 20 minutes. The initial mass of the isotope in a sample is 64 g.

(a) What is the mass of the isotope in the sample after 1 hour ?

1 hour = 3 x 20 min = 3 half-life
mass of isotope in sample = ½ x ½ x ½ x 64 g = 8 g [1]

(b) After how long would the mass of the isotope in the sample be 2 g ?

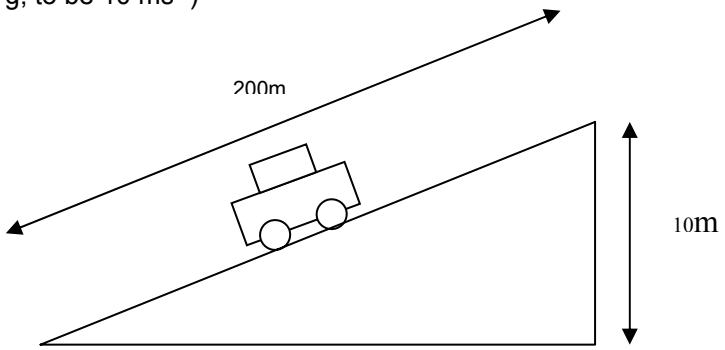
64 g x ½ x ½ x ½ x ½ x ½ = 2 g
1 half-life = 20 min
5 half-life = 5 x 20 mins = 100 mins or 1 hour 40 mins. [1]

(c) In the following nuclear reaction , what are the values of X and Y ?

$$^{X}_{88}Ra \rightarrow {}^{222}_{Y}Rn + {}^{4}_{2}He$$

X is 222 + 4 = 226 [1]
Y is 88 – 2 = 86 [1]

SECTION B : (20 marks)

Q. No.	Question description / Answer	Marker's Comments
B1	(a) Fig. 5 shows a small car of mass 800 kg moving with a constant speed of 15ms^{-1} up the hill. (Take the acceleration due to gravity, g, to be 10 ms^{-2})  Fig. 5 (i) Calculate the gain in gravitational potential energy of the car at the top of the hill. Gain in gravitatational P.E. = mgh = 800 x 10 x 10 J [1] = 80000 J or 80 KJ [1] (ii) Calculate the kinetic energy of the car when it is moving up the hill. K.E. of the car = ½ m v^2 = ½ x 800 x 15^2 [1] = 90000 J or 90 KJ [1] (iii) What is the resultant force acting on the car as it travels uphill ? [1] the resultant force on the car is zero or 0 N. (at constant speed) (iv) Is the total workdone produced by the driving force of the car engine in moving the car up the hill smaller than , equal to or greater than the gain in gravitational potential energy in part (i) ? Explain your answer. Greater . [1] Part of the workdone in doing work against friction and air resistance. [1] (b) If the car of mass 800 kg as shown above is moving on a straight horizontal road with a constant speed of 10 ms^{-1} , find the average force that must be applied to bring the car to rest in 4 s. the deceleration = 10 / 4 ms^{-2} = 2.5 ms^{-2} [1] average force to be applied , F = ma = 800 x 2.5 [1] = 2000 N [1]	

B2

(a) An electric vacuum cleaner is designed to operate from a 240V supply has a power of 1500W.

(i) Calculate the size of current which flows when the vacuum cleaner is being used.

Power P = VI
I = P/V = 1500/ 240 [1]
= 6.25 A [1]

(ii) Suggest a suitable fuse rating to be used with this vacuum cleaner.

(iii)
10 A or 13 A fuse [1]

(b) When the vacuum cleaner is operating normally. What would be the size of the current in

(i) the earth wire, = 0 A [1]
(ii) the live wire = 6.25 A [1]
(iii) the neutral wire = 6.25 A [1]

(c) An electric current of 0.5A passes through a 12V battery for two minutes in a completed circuit.
Calculate

(i) the amount of electric charge that passes through the battery

Electric charge, Q = It
= 0.5 x 2 x 60 C [1]
= 60 C [1]

(ii) the amount of energy that is transferred by the battery during the two minutes.

enegry , E = QV
= 60 x 12 J [1]
= 720 J [1]

B3

(a) Figure 6 below shows high voltage cables used to transmit electrical energy.

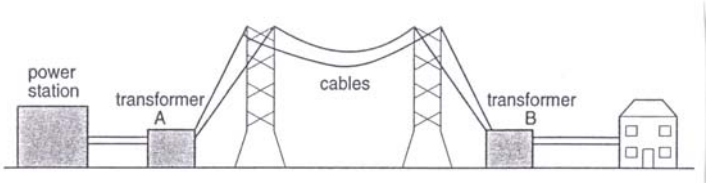


Fig. 6

(i) State the purpose of transformer B. [1]

To step down the voltage to the mains voltage of 240 V

(ii) The cables used are usually thick so that energy loss due to heat is reduced. Explain why this is so?

Thicker wire has lower resistance [1]. Power loss due to heating is $P = I^2 R$, the lower reasistance results in reduced energy loss.[1]

(iii) The power station produces electricity at a voltage of 20 kV. Transformer A is ideal. It has 48000 turns in its secondary coil and produces an output voltage of 400 kV. Calculate the number of turns in the primary coil of transformer A.

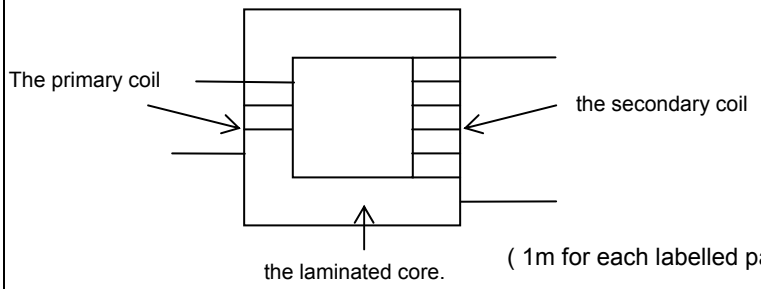
For ideal transformer , $N_s/N_p = V_s/V_p$

$N_p = V_p \times N_s / V_s$

$= 20000 \times 48000 / 400000$ [1]

$= 2400$ turns [1]

(b) Sketch a diagram of a step-up transformer and label the following on your diagram :



(1m for each labelled part)

(iv) If the input voltage in the primary coil is 12V and the output voltage in the secondary coil is 240V, what is the current flowing in the secondary coil if the current flowing in the primary coil is 0.8A ?(Assume 100% efficiency)

For ideal transformer (100% efficient)

Input power = output power

$V_p I_p = V_s I_s$

$I_s = V_p I_p / V_s$

$= 12 \times 0.8 / 240$ [1]

$= 0.04$ A [1]