**2014 Sec 3 End-of-Year Examination**
**Physics Mark Scheme**

**Paper 1**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | **D** | **6** | **B** | **11** | **C** | **16** | **A** | **21** | **A** | **26** | **C** |
| **2** | **A** | **7** | **C** | **12** | **D** | **17** | **B** | **22** | **D** | **27** | **D** |
| **3** | **C** | **8** | **B** | **13** | **A** | **18** | **B** | **23** | **B** | **28** | **C** |
| **4** | **A** | **9** | **D** | **14** | **B** | **19** | **D** | **24** | **C** | **29** | **D** |
| **5** | **A** | **10** | **D** | **15** | **A** | **20** | **D** | **25** | **C** | **30** | **D** |

**Paper 2**

**Section A**

**1** **(a)** The marbles are not perfectly spherical. Taking the average diameter from more marbles will **reduce the random error** in the diameter of the marble.

**(b)** The diameter of the marble can be determined with an additional significant figure, increasing the precision.
*e.g. If use 10 marbles, diameter = 12.2 cm ÷ 10 = 1.22 cm (3sf)*
*If use 5 marbles, diameter = 6.1 cm ÷ 5 = 1.2 cm (2sf)*

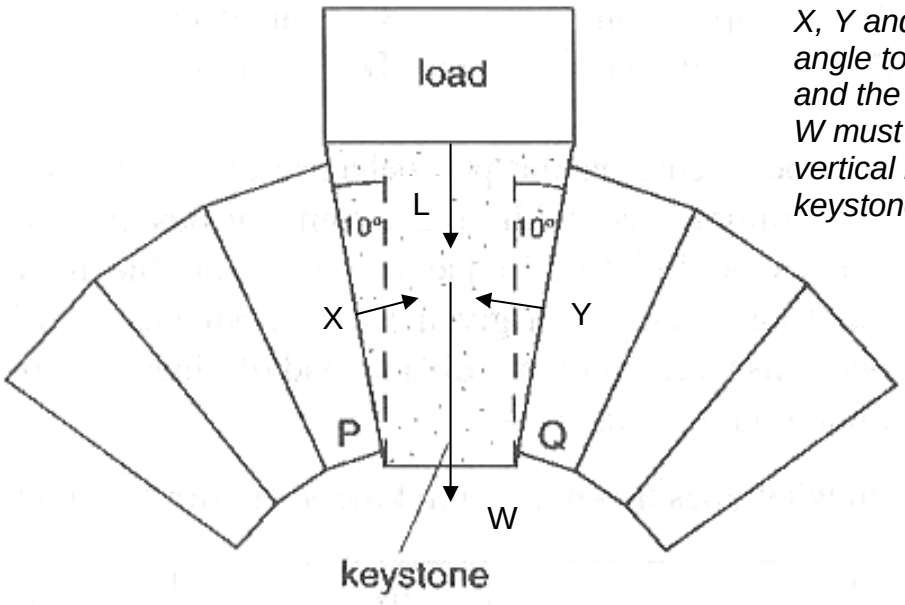
**2** **(a)** a = 30/20 = 1.5 m/s$^2$

**(b)** At t = 30 s

**(c)** Distance travelled by car A **= ½** x 20 x 30 + (30 + 20)/2 x 10 = 550 m
Distance travelled by car B = ½ x 20 x 30 = 300 m
Distance between car A and B = 550 – 300 = 250 m

**(d)** At t = 50 s

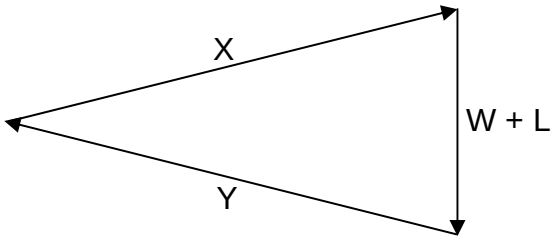
**3** **(a)**




*Note:*
*X, Y and L must act at a right angle to the stone P, stone Q and the load respectively.*
*W must act higher than the vertical mid-point of the keystone.*

**(b)**

Arrows form closed triangle with correct shape and angles.
Y = 8.6 cm x 200 N/cm = 1720 N
*(Only answers between 1680 N and 1800 N are accepted.)*



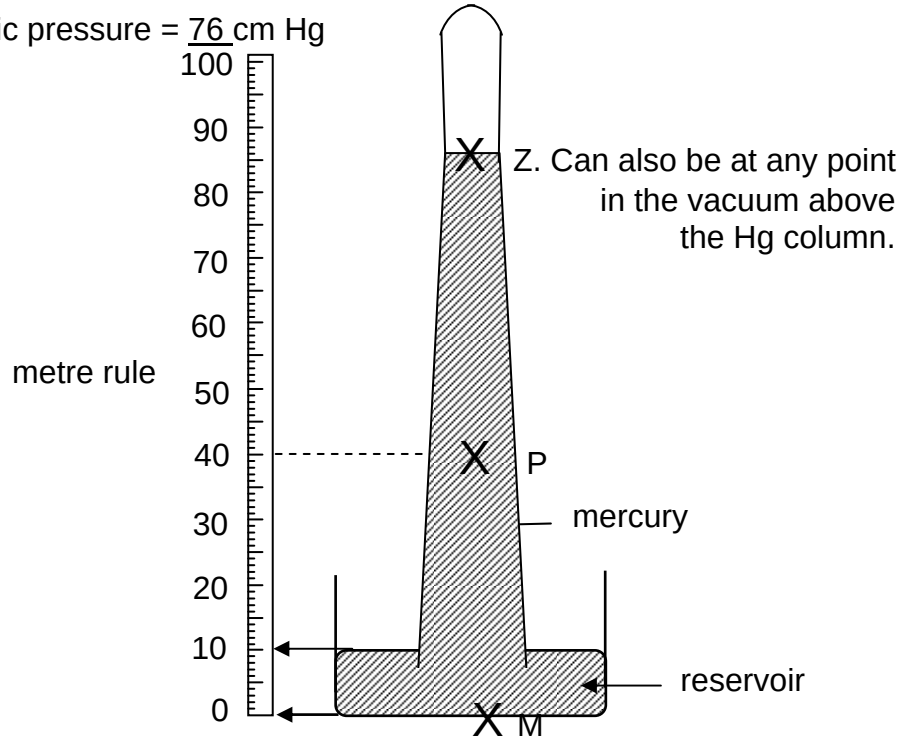

**4** **(a)** It is the **point** through which the **whole** weight of the object **appears** to act.

**(b)** The centre of gravity of the toy is **below** the support (pivot) but not lower than the weights.

**(c)** When displaced to the left, the centre of gravity is shifted to the **right** of the pivot, **the weight creates a clockwise moment** about the pivot, returning the toy to its upright position. *(Note: No full marks awarded even if student stated that the c.g. shift to the right if her answer to (b) is incorrect.)*

**5** **(a)** Atmospheric pressure = 76 cm Hg

**(b)**




or any other points right at the bottom of reservoir

**(c)** (86-70/100) x 13600 x g = h x 1.2 x g; Height of mountain = 1800 m

**6** **(a)** **(i)** mgh = 480 x 10 x 30.0; Work done by motor = 144 kJ

**(ii)** 144 kJ / (2.0 x 60); Power of motor = 1.2 kW
allow for e.c.f.

**(b)** mgh = ½mv$^2$; (30.0 – 12.0) x 10 = ½ v$^2$
Speed of vehicle = 19.0 m s$^{-1}$ (2 or 3 s.f.) **penalty for s.f.**

**7** **(a)** Correct position of image of $P_0$.
Cone from $P_0$ to E. Cone from P to M.
Virtual rays in dotted lines and arrows on real rays to indicate direction; image correctly labelled as $P_0$.

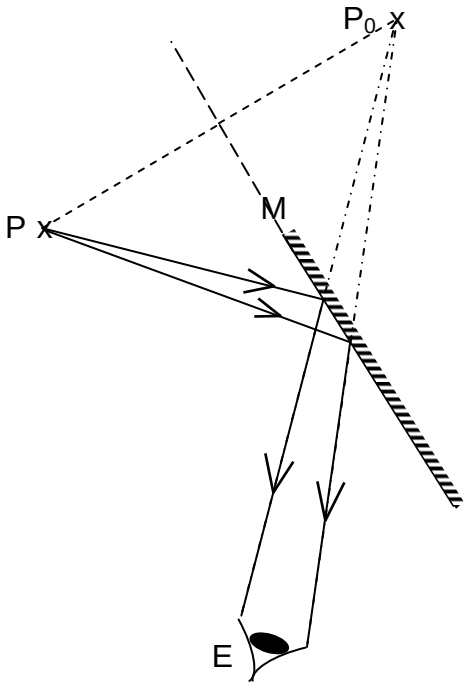



**Fig. 7.1**

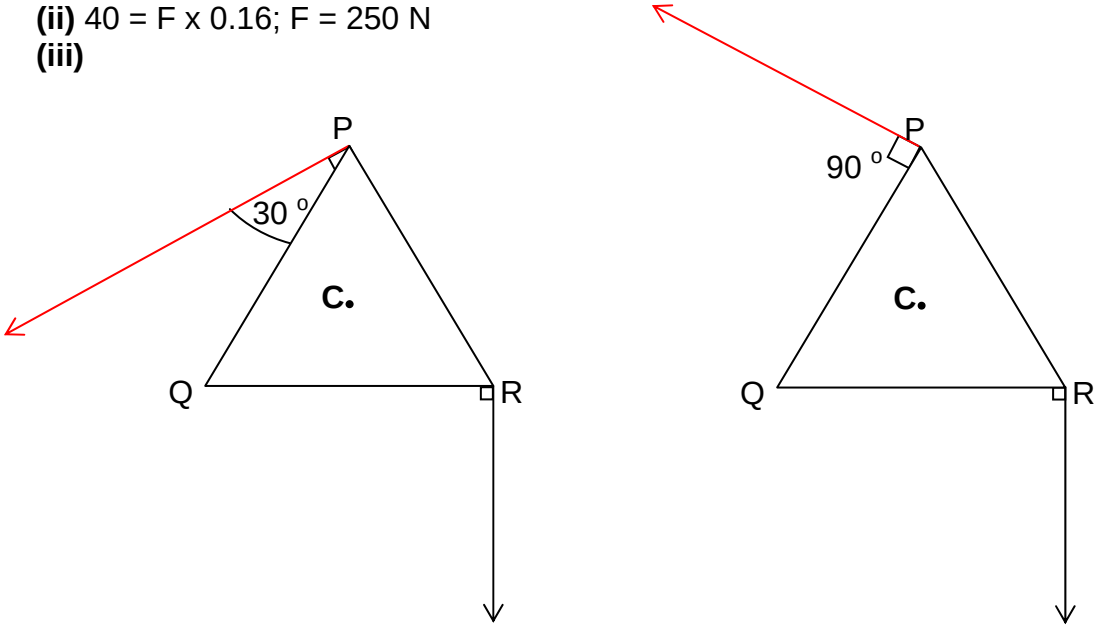
**(b)** **(i)** The angles of incidence and reflection should be equal. The position of the image of the ghost actor should be further away from the sheet of glass.

**(ii)** The image is **virtual**. It is formed by reflection off the sheet of glass and all reflected images are virtual OR the image cannot be captured on a screen.

## Section B

**8** **(a)** The cardboard remains at rest in this position as it has **no net moment** about the pivot. There is also **no net force** acting on the cardboard.

**(b) (i)** Moment = 200 x 0.200 = 40 Nm
**(ii)** 40 = F x 0.16; F = 250 N
**(iii)**




General direction that the force acts
Angle with side PQ = $30^o$ or $90^o$

**(c)** When placed flat on the table, the cardboard has a **lower centre of gravity** and a **broader base**.

**9** **(a)** Atmospheric pressure in pascal = 75.0/100 x 13600 x 10 = 102 kPa

**(b)** P = 102 000 – 60 000 = F/A; 42000 = F/0.00250
Greatest weight that can be lifted = 105 N

**(c)** The rubber rim provides a good air tight seal with the piece of glass since it can be pressed against the glass. This prevents air from entering the suction cup and increasing the pressure inside.

**(d)** Atmospheric pressure at a higher altitude is lower. Pressure difference will be less (decreased) and hence load that can be lifted will be lighter.

**(e)** The suction cup can be made to cover a larger area of the glass.
The resultant force acting on the piece of glass will increase.
OR
The pressure in the suction cup can be further reduced. The pressure difference between atmospheric pressure and suction cup pressure will increase. Hence a larger resultant force will push the glass against the cup.

**10 EITHER**

**(a) (i)** 3000 – 2000 = 2000 a; a = 0.50 m/ $s^2$

**(ii)** a = (v-u)/t; 0.5 = (25 – u)/10; u = 20 m/ s

**(b)** Velocity remains constant. There is <u>no net force</u> acting on the car, thus it does not accelerate.

**(c)** The car is moving with <u>constant deceleration</u> (a = -1.5 m/ $s^2$).

**(d) (i)** <u>Weight</u> of the car and <u>normal contact force</u> by the ground on the car.

**(ii)** They are <u>equal and opposite in direction</u>.

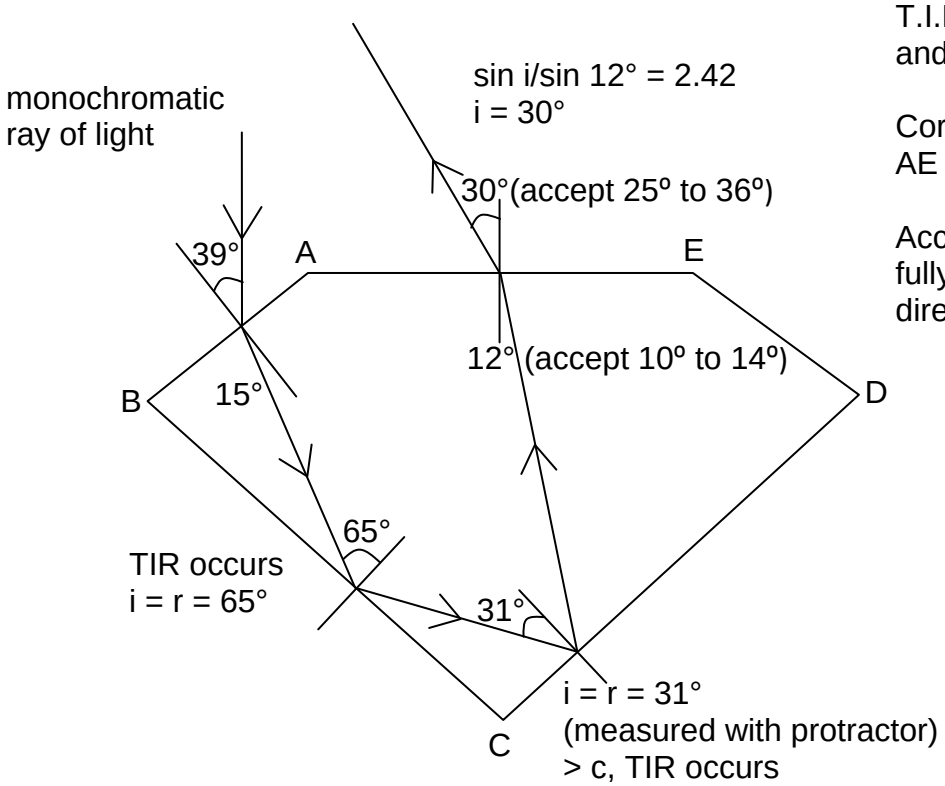
**(iii)** When the car is <u>moving up/down a slope</u>.

**10 OR**

**(a)** The incident angle must be greater than critical angle.
The light must be travelling from <u>an optically denser to an optically less dense medium</u> OR <u>a medium of higher refractive indes to a medium of lower refractive index</u>.

**(b) (i)** 1/sin c = 2.42; Critical angle for diamond = 24.4°

**(ii)**




T.I.R. and i= r at BC and CD

Correct use of sin i/sin r at AE . Allow e.c.f.

Accurately constructed and fully labelled with ray direction

**(iii)** The light that enters the diamond from the top <u>does not emerge from the top</u>.

**(c)** Glass has a much lower refractive index, and hence a <u>larger critical angle</u>. The <u>probability of a ray of light exceeding the critical angle and undergoing TIR is lower</u> and less light leaves from the top surface.