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Exam Preparation and Free Resources

Name of the Student:_____

Max. Marks : 20 Marks   **Time : 20 Minutes**

Mark Schemes

Q1.

   (a)   Total mass of spacecraft = 3050 kg

Change in PE = $\dfrac{6.67 \times 10^{-11} \times 6 \times 10^{24} \times 3050}{6400 \times 10^{3}}$

1.9×10^{11}(J)

2 sf

          condone errors in powers of 10 and incorrect mass for payload
          Allow if some sensible working

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   (b)   Chemical combustion of propellant / fuel or gases produced at high pressure

Gas is expelled / expands through nozzle

Change in momentum of gases escaping

equal and opposite change in momentum of the spacecraft

Thrust = rate of change of change in momentum
          Max 3
          N3 in terms of forces worth 1

3

   (c)   0.031(4) (m s^{-2})

1

   (d)   Use of rocket equation
$v = 1200 \ln \dfrac{3050}{1330}$
996 (m s^{-1})
          Condone 1000 (m s^{-1})

3

   (e)   (i)   Use of correct mass 108 kg

$F = \dfrac{6.67 \times 10^{-11} \times 1.1 \times 10^{13} \times 108}{(2 \times 10^{3})^{2}}$

0.0198 N

(ii)   Use of $v = \sqrt{\dfrac{2GM}{r}}$

Correct substitution $v = \dfrac{2 \times 6.67 \times 10^{-11} \times 1.1 \times 10^{18}}{2 \times 10^{8}}$

0.86 (m s^{-1})

Recognisable mass – condone incorrect power of 10

3

(iii)   Impulse = 25 N × 4.8 = 120 N s

(120 = 108 v so) Velocity = 1.1 m s^{-1}

Clear conclusion

ie explanation/comparison of calculated velocity with escape velocity
from **(e)(ii)**

May use F = ma approach

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[20]